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Seven propositions to support and finance the agricultural sector in sub-Saharan Africa in the context of climate change

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Abstract

Poor rural households in vulnerable sub-Saharan Africa (SSA) countries have suffered - and will increasingly suffer - losses and damages due to climate change. These losses and damages put at risk the international commitment to meeting the Sustainable Development Goals. The international community is currently discussing a large scale increase in the financing of development assistance to meet this challenge. This note advances a set of propositions to guide international aid in addressing losses and damages due to climate change. The basic principle is that rather than focusing on targeted transfers to compensate for losses and damages - that will only increase over time and become prohibitively expensive -, the international community and SSA governments should seek to create income opportunities for affected rural households through a renewal of the role of agriculture for development, where under-investment relative to potential remains massive.

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We identify for this a sequence of steps that include Asset Building (land and human capital), Green Revolution (staple crops), Agricultural Transformation (high value crops and animal products), and Rural Transformation (rural-based Small and Medium Enterprises in agroindustry and agricultural services), ultimately converging to Structural Transformation (urban-based manufacturing and services). Successful implementation of this sequence is guided by seven propositions as to how to invest in agriculture for development in the context of climate change. Given the challenge of climate change, more than ever addressing the issue of risk reduction is a key component (on the demand side) of expected success in attracting private investment in agriculture. This can be achieved through irrigation, adoption of climate resilient crops and animals, index insurance, and parametric pre-committed lines of credit. We also review (on the supply side) results from experimental studies as to how to mobilize private funds for investment in agriculture through microfinance and commercial banks.

Logic of the argument

The theory of change to reduce under-investment in agriculture and the losses and damages due to climate change for smallholder farmers in SSA is presented in Figure 1. It starts from two observations on current conditions regarding investment and climate, identifies the determinants of the supply of and demand for public and private investment funds in agriculture, proposes a conceptual framework for the role of agriculture for development, and derives seven propositions for investment to reduce under-investment in agriculture and the losses and damages for the rural poor due to climate change.

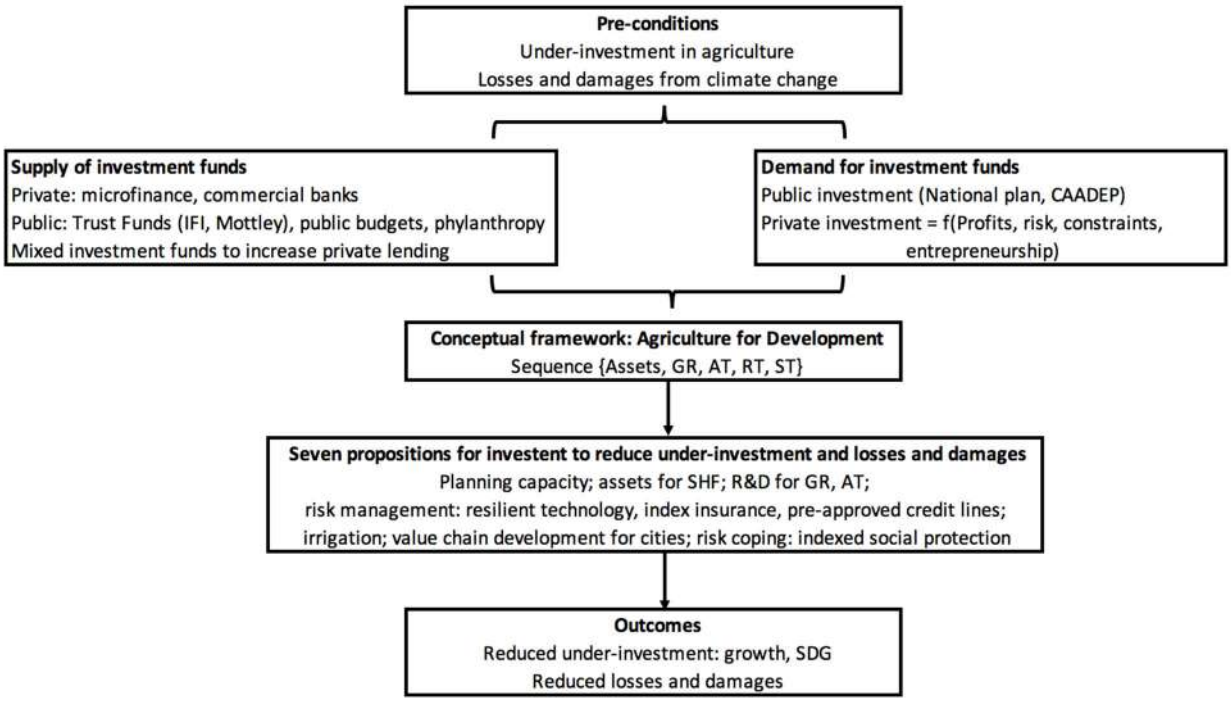

Figure 1. Theory of Change for Investment in Agriculture and Climate Change

The first observation is that there is a strong underinvestment of public resources in sub-Saharan Africa agriculture in general (compared to the 10% of public budget recommended by CAADEP) and in particular in Research and Development (R&D, compared to the 1 % of agricultural GDP recommended by NEPAD). This public underinvestment limits private investment and adoption of technologies to increase resource productivity in agribusinesses and smallholder agriculture. Investing in public and private goods in agriculture can therefore create opportunities for growth, employment, poverty reduction, food security, and adaptation to climate change. It is an important factor in the success of the Sustainable Development Goals (SDGs).

The second observation is that climate change in SSA is causing, and will increasingly cause, losses and damages to farmers with potentially devastating consequences for welfare, social stability, and international emigration. Faced with these threats, the international community proposes to mobilize significant additional resources (from billions to trillions) to deal with these losses and damages, following the initiative of Prime Minister Mia Mottley of Barbados at COP27, endorsed by Presidents Macron and Trudeau.

There are two complementary approaches to reducing losses and damages due to climate change in smallholder agriculture:

a. One is to make targeted ex-post compensatory transfers to small farmers. The needs for such transfers will increase over time to quickly reach unaffordable levels.

b. The other is to create ex-ante income opportunities by adapting agriculture to climate change and increasing investment in the sector. Given the current massive underinvestment in agriculture and the availability of new methodologies to deal with climate change, this is the approach we develop in this note. The emphasis on creating opportunities rather than transfers to address climate change losses and damages is similar to Severino's (2023) approach to public support for small and medium enterprises through entrepreneurship.

The conceptual framework to guide investment in agriculture follows the approach proposed in a semi-coordinated way (Rome working group) by IFAD, FAO, the World Bank, DFID/UKAid, the Gates Foundation, BRAC, and other international institutions that finance development. This approach must internalize the challenge and difficulties of climate change. This conceptual framework consists of a sequence of complementary investments directed to:

(1) Consolidate the Assets of smallholder farmers (land, water, human capital),
(2) Complete the success of the Green Revolution (staple food crops),
(3) Carry out an Agricultural Transformation (high value-added crops and animal speculations to feed the cities and export),
(4) Invest in a Rural Transformation (non-agricultural rural activities, in particular small and medium enterprises in agroindustry and rural services),
(5) Achieve a Structural Transformation where agriculture decreases its share of employment and GDP to the benefit of industry and urban-based services.

Given the current situation of robotization and repatriation of industry, Structural Transformation is most often delayed in favor of Rural Transformation in secondary cities and their regions.

Diagnosis of the performance of agriculture in SSA from the perspective of this conceptual framework leads to seven propositions for public investment that could guide international development financing with the resources anticipated from the Mottley Initiative:

1. Develop planning capacity at national and local level.
2. Consolidate property rights to secure the investment.
3. Invest in agricultural R&D in SSA with its local heterogeneity.
4. Provide better climate risk management through resilient technology, index insurance, and pre-approved contingent credit.
5. Invest in water control, especially irrigation.
6. Build inclusive value chains for urban food.
7. Link social protection to losses and damages due to climate change through parametric indexation.

The financing of private agricultural investment made possible and profitable by these public investments can follow two approaches (on the supply side of investment funds):

a. The modernization of rural microfinance (without collateral and therefore based on joint liability and dynamic incentives) to offer larger loan volumes to support non-divisible investment (and not only current expenses), a reduction in the cost access to capital, more flexible disbursement and reimbursement rules adapted to the conditions of use of credit, and complementarity with risk management instruments. Significant progress has already been made towards these reforms in the context of experimentation and impact analysis.

b. Risk reduction for commercial credit loans to agriculture as in the Gravellini (2023) proposal for mixed public-private investment funds with risk sharing for the benefit of the private sector (senior partner in repayments). Public participation includes government, international aid, and philanthropy which subsidizes the sharing of risk and profit in favor of the private lender, thus creating an investment fund supply multiplier.

On the demand side, three major constraints need to be lifted to increase private investment:
a. Increase the demand for credit for investment: there is weak demand for current expenses (seeds, fertilizers) but strong demand for the indivisible expenses of investment goods.
b. Increase demand for ways to manage risk (resilient technology, index insurance, pre-approved contingent lines of credit).
c. Develop inclusive value chains that link domestic agriculture to urban consumption (AT for high added value products, RT for processed products).

In conclusion, these public and private investments in agriculture (opportunities) should make it possible to reduce the losses and damages associated with climate change, in addition to direct compensatory transfers.
These massive investments in African agriculture in the difficult context of climate change will require a profound restructuring of the architecture of development financing. Particularly important is to avoid the fragmentation of efforts and to put in place expertise in the IFIs and other donors for an efficient and coordinated approach in the dimensions of growth, poverty, and sustainability (Le Houérou and Lankes, 2023).

Objective

The objective of this note is to put forward a number of proposals on how to support and finance agricultural enterprises in sub-Saharan Africa (SSA) in order to improve their performance and the role of agriculture for development. These enterprises are private, either individually owned or collectively owned, but also often with incomplete property rights that approximate open access resources. The business structure is generally dominated by peasant agriculture. This agriculture, however, increasingly coexists with a sector of medium-sized and agro-industrial companies with vertical integration and strong insertion in value chains. The challenge is to insert peasant agriculture into local markets and value chains that cater not only to the international market (cotton, coffee, green beans, cut flowers) but also to rapidly growing urban consumption (fruits and vegetables, animal production, processed products). This note puts forward seven propositions to capitalize on encouraging experiences of effective solutions and generalize their implementation.

These propositions are put forward in the context of the upcoming discussions of the Mottley Initiative. This initiative aims at obtaining an increase "from billions to trillions" of financial resources to be spent in the form of transfers to compensate (ex-post) the losses and damages of the poorest individuals and the most vulnerable countries due to climate change. However, such resources, as is the case of the Global Shield Against Climate Risks (2023) presented at COP27, could also be used to invest in the (ex-ante) adaptation to climate change of the most vulnerable countries and producers. The two approaches are complementary. However, in this note, the emphasis is on adaptation, where we seek a renewal of the role of agriculture for development, adapted to climate change. The note describes an approach to generate new opportunities for public and private investment in agriculture that is more resilient to climate change (technological innovations) and with agents less exposed to climate risks (institutional innovations such as index insurance, parametric credit lines, and social protection indexed to climatic hazards).

Context

Agriculture in SSA continues to play a fundamental role in employment, GDP growth, food security, poverty reduction, healthy food quality, and structural transformation. Despite this widely recognized importance and despite many local successes, overall there has been weak growth in the productivity of agricultural resources, persistence and even a recent increase in rural poverty, and a lag in structural transformation. This suboptimal performance of agriculture is due to public

underinvestment compared to international standards, lack of adoption of new technologies, delay in the transition to crops with higher added value, lack of competitiveness with imports, and adverse effects of climate change. Although performance of the sector has generally been modest, there is a strong latent potential at the aggregate level linked to the continent's abundance of land with agricultural potential and energy resources still available and the technological gap that can be recovered (Odusola, 2021). Africa is dotted with notable successes of technological and institutional innovations from which lessons can be learned to catch up on the global backlog.

In short, the main dimensions of the context for agriculture that condition current performance and guide the formulation of alternative proposals are:
1. Strong **demographic pressure** involving a young population seeking employment, particularly in rural areas. This young and abundant labor force is both a unique source of growth and market creation, and a threat to social stability if its demands are not met.
2. Accelerating **urbanization**, with a vibrant small and medium-sized enterprise (SME) sector, but also too frequently an accumulation of workers in the informal sector and slums. The transfer of labor from peasant agriculture to the urban informal sector is therefore not necessarily a source of productivity gains, compromising the expected benefit of Structural Transformation.
3. A rise in **absolute poverty** which contradicts SDGs 1 and 2 on poverty and malnutrition. The rural population remains by far the main source of global poverty.
4. **Structural transformation**--with the expected shift from rural labor to labour-intensive urban industry--delayed by robotization, repatriation of firms, and premature deindustrialization (Rodrik, 2015).
5. An acceleration of **climate change** which penalizes tropical and semi-arid agriculture and induces migratory flows of refugees from climatic hazards towards cities and international borders.
6. A rise in insecurity and armed **conflicts** that undermine the stability of governance institutions and investment in agriculture. In a classification of African countries into four categories (lower-middle-income, low-income, resource-rich, and fragile states), it is these last two categories that have the most negative performances of their agricultural trade balance (Jayne, Fox, Fuglie, and Adelaja, 2021).
7. A rise in **public debt** which limits the already insufficient public investment in agriculture according to international criteria.
8. On the positive side, the emergence of a dynamic and innovative information technology sector, the bubbling of **entrepreneurship** in SMEs (Severino, 2023), and the strength of community **solidarity**. Africa is rich in traditional institutions that can be the foundation of modern institutions in finance, insurance, and commercial contracts (Platteau, 2000).

Conceptual framework in using agriculture for development

The conceptual framework that we use in this note, both to guide a diagnosis of the way in which agriculture contributes to economic and social development, and to draw from it a number of normative propositions for investment in agriculture, derives from IFAD's work (Rural Development Report 2016, edited by Hans Binswanger) conducted in collaboration with the FAO, the CGIAR, the World Bank, the Gates Foundation, DIFID, and the ATAI program (Agricultural Technology Adoption Initiative, 2018). It consists of a series of cumulative steps to support structural transformation, a fundamental product of agriculture's contribution to development. These stages are: Control of Productive Assets, Green Revolution (GR), Agricultural Transformation (AT), Rural Transformation (RT), and Structural Transformation (ST) (defined in Table 1). Implementation of this approach requires capacity for planning, coordination, and analysis at the local and national levels which acts as a precondition for implementation of the conceptual framework. This participatory planning effort must integrate the economic, social, and environmental dimensions of the role of agriculture for development. It is therefore demanding in terms of resources and human capital. Significant advances in this planning capacity have been made with the ATAs (Agricultural Transformation

Agency) in Ethiopia and Rwanda. After the Mexican debt crisis and dominance of the Washington Consensus, it is an exercise in governance that has too often fallen into disuse and which must be intensely rebuilt. Given the current delays in Structural Transformation (Rodrik, 2015), Rural Transformation (RT) in secondary cities is the main outcome of agriculture in support of development (Christiaensen and Todo, 2014).

Steps	Processes
Asset building	Access to land and human capital for the landless and SHF
Green Revolution	Adoption/diffusion of new seeds and fertilizers for staple crops
Agricultural Transformation	Access to water for irrigation Ag diversification toward high value crops Development of value chains and contracting
Rural Transformation	Mechanization and land concentration Development of land and labor markets Growth of the rural non-farm economy
Structural Transformation	Rural-urban migration Urban-based industrialization and services

Table 1. The sequence {Assets, GR, AT, RT, ST}
Note : SHF = smallholder farmers

This conceptual framework is in particular derived from the Chinese experience (Jinkun Huang in the IFAD team). China is indeed a successful case of using agriculture for development, starting from cereal production in the context of the communes, to development of an intensive horticultural sector (the Household Responsibility System), and proliferation of township enterprises before concentration of large enterprises in the urban context. In this sequence (Table 2), step 1 corresponds to Assets and GR, step 2 to AT, steps 3.1, 3.2, 3.3 to RT, and step 4 to ST.

Pathway and speed of rural transformation

Stage	Paths of Transformation	Major IPIs
1	Primary on staple food production	Institutions (e.g., land) + infrastructure + technology and extension
2	Agri. Diversification	Plus Mkt reform + improve mkt/ irrigation/road infrastructure
3.1	Farming + part time non-farm employment	Plus Local SMEs policy in rural
3.2	Increasing specialization on farm or non-farm job	Plus urbanization; labor & land rental mkt
3.3	Agri. mechanization and more off-farm job	Plus mechanization, human capital, etc.
4	Rural urbanization and integrated urban-rural development	Plus eliminating discrimination between rural and urban, and among regions

Table 2. The sequence {Assets, GR, AT, RT, ST} applied to China
Source : Huang, 2013

If we think of using this conceptual framework, carefully adapted, to analyze and forecast the African experience, can we identify certain specificities of sub-Saharan agriculture which condition its application? Referring to Brooks and Byerlee (2021), the most important dimensions would be:
1. High **population** growth and the importance of agriculture in national employment pose the problem of youth in the agricultural sector and the importance of creating jobs that are satisfactory to them. For these young people, access to a plot of land to survive on, as in the past for their parents, is less and less sufficient to satisfy their ambitions (Suri and Udry, 2022). We must now add technological dynamism, innovative agricultural activities (AT), and non-agricultural complementary sources of income (RT).
2. Strong geo-spatial **heterogeneity** implying the need to search for locally defined {Active, …, ST} sequences.
3. The prevalence of **peasant** agriculture where production for family consumption is important in addition to a marketable surplus (limited by the size of the farm) and participation in the labor market (constrained by seasonality of employment and conflict with the use of time on the family plot). Women have a fundamental role to play in this agriculture, particularly in food production.
4. High vulnerability to **climate change**, especially in rain-fed agriculture without water control.
5. A rapid growth in food **imports** that compete with domestic production, especially in the dimension of nutritional and phytosanitary quality, to meet the demand of cities.
6. Existence of **continental** organizations such as NEPAD (New Partnership for Africa's Development) of the African Union which help guide and coordinate domestic policies.
7. Strong public **under-investment** in agriculture and in particular in research and development for agriculture (R&D).

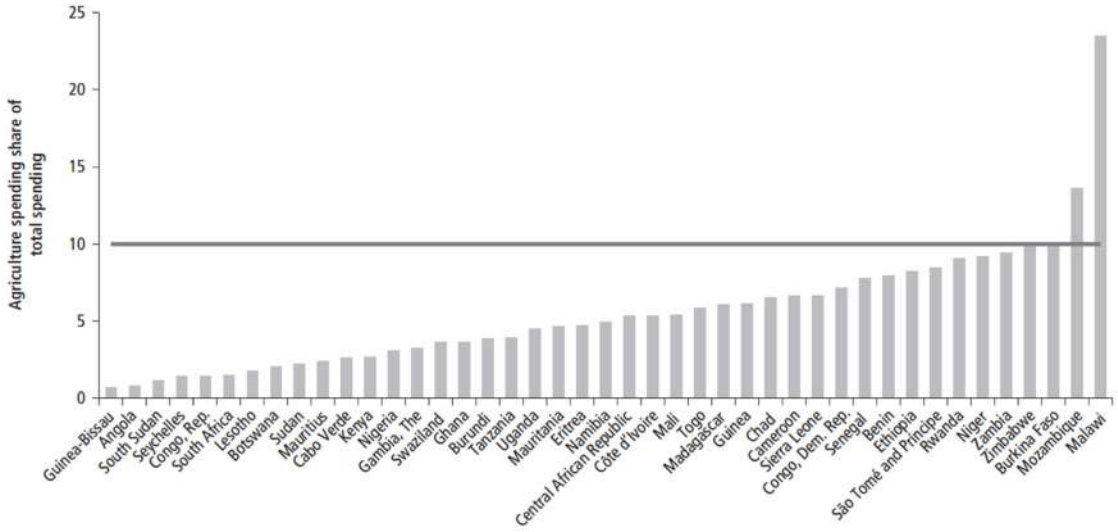

Figure 2. Public investment in agriculture in percentage of the public budget and CAADP 10% recommendation by country in SSA

Source : Goyal and Nash, 2017

As shown in Figure 2, only 4 of the 43 countries in SSA meet the CAADP (Comprehensive Africa Agricultural Development Program) recommendation to invest no less than 10% of the public budget in agriculture. For research and development in agriculture, NEPAD's recommendation is to spend at least 1% of agricultural GDP on it. As Figure 3 shows, only 6 countries fulfill this condition. The vast majority of this research is public (the CGIAR (Consultative Group on International Agricultural Research) and the NARS (National Agricultural Research Systems)) and not private as in industrialized countries (Fuglie et al., 2019).

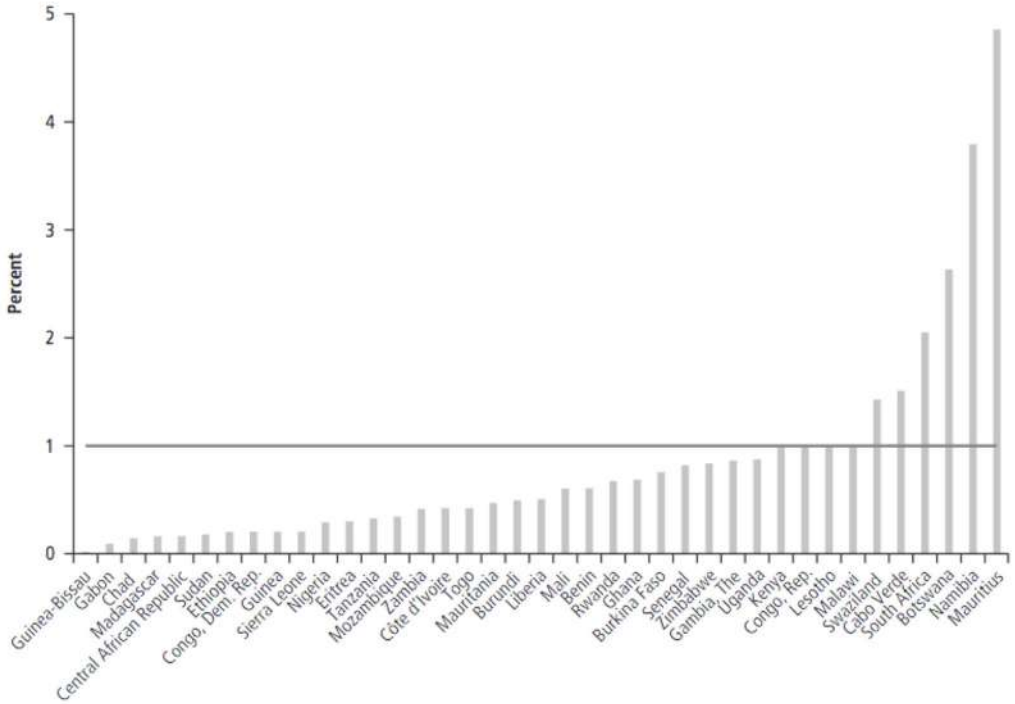

Figure 3. R&D public expenditures for agriculture in percentage of agricultural GDP and NEPAD 1% recommendation by country in SSA

Source : Goyal et Nash, 2017

Evidence

We now use the five stages of the conceptual framework to make a diagnosis of the current situation in SSA. The objective will be to derive a set of recommendations for investment in agriculture to reduce losses and damage.

1. Ownership rights over assets that are too often incomplete (Assets)
Well-defined property rights over natural resources (land, water) are an essential condition for secure access to productive resources, investment, and conservation. Significant progress has been made towards certification (which limits land transfers by sale or lease to community members) for example in Ethiopia and Benin. The certificates can then be transformed into titles without limits on transactions and thus allow access to commercial bank credit. But these individualistic institutions are often ill-suited to African conditions where farmers and herders must share access to the same land according to the seasons. Collectively owned land, studied in particular by Elinor Ostrom, has therefore been seen as a viable alternative for Africa (Nubukpo, 2023). Effective management with this form of property rights, however, requires cooperation between users, which can be difficult when population pressure and climate change disrupt ancestral systems, as is often the case in the Sahel. New modes of local governance are therefore necessary. This is an area where participatory experimentation is particularly important. In BRAC's "graduation" approach, implemented in seven African countries, productive assets are complemented by health and training in the use of assets. Despite the difficulty and cost of these experiments, it is an essential starting point for a successful sequence {Assets, …, ST}.

2. An unfinished green revolution (GR)
Despite considerable efforts to promote the production of staple grains and an increase in yields (the AGRA (A Green Revolution for Africa) program supported by the United Nations and the Rockefeller and Gates Foundations), yields (Figure 4) and the use of chemical fertilizers in SSA (Figure 5) continues to diverge from that in other regions of the world.

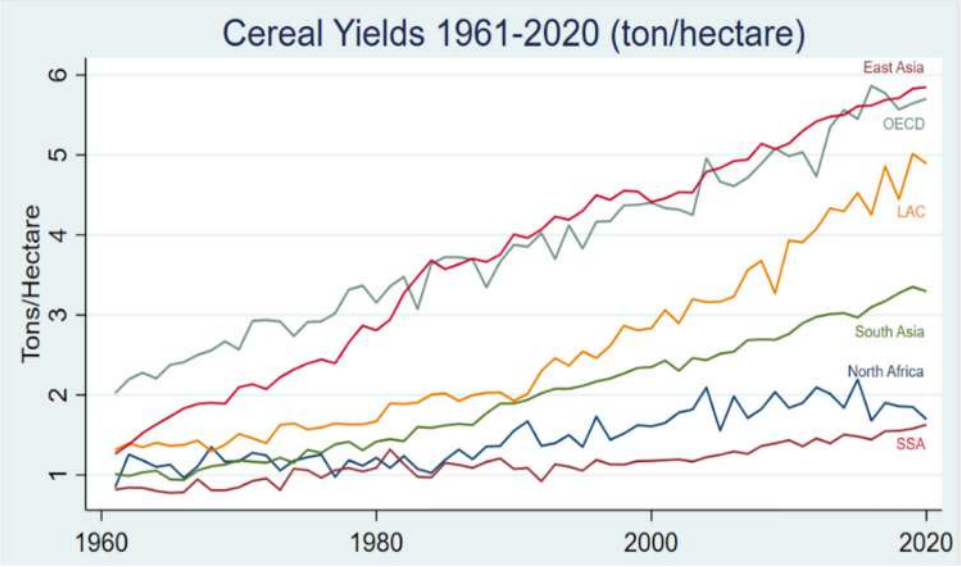

Figure 4. Cereal yields by region
Data source: World Development Indicators, The World Bank, online

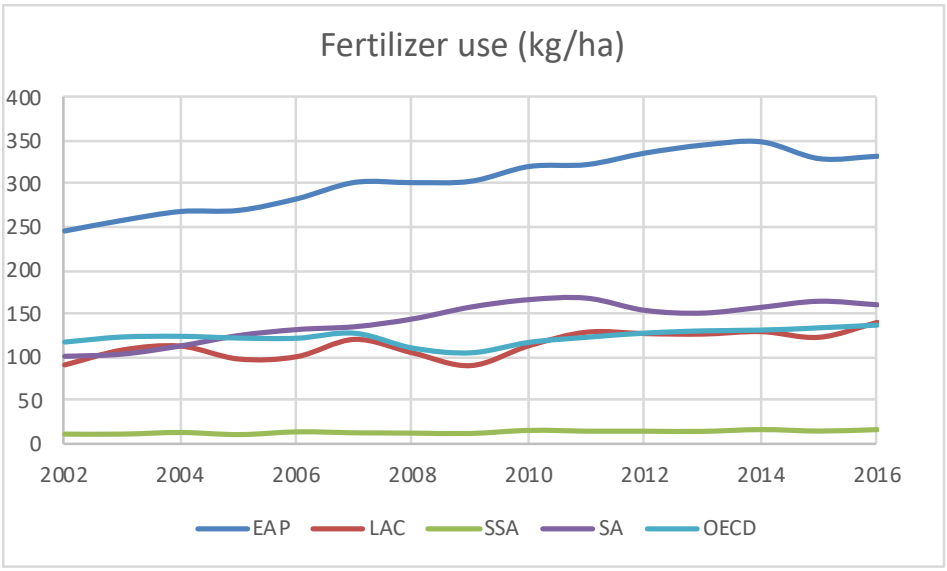

Figure 5. Fertilizer use by region
Data source: World Development Indicators, The World Bank, online

The growth of agricultural production in SSA has caught up with that of other regions in 1991-2018 (Figure 6), but this growth is obtained mainly on the basis of the expansion of cultivated areas and not of the increase in yields (Figures 6 and 7).

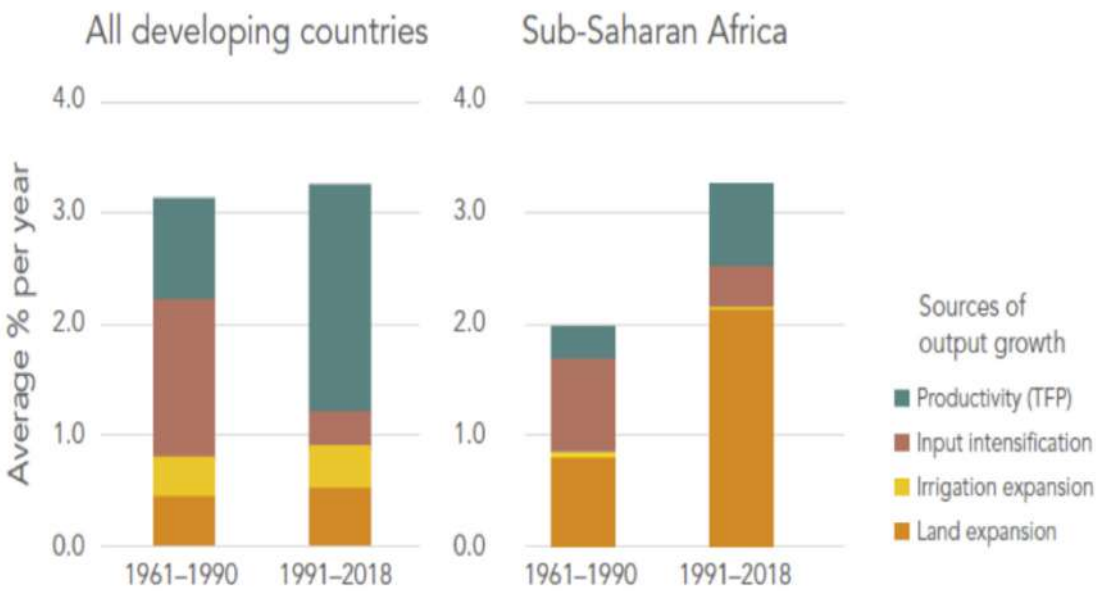

Figure 6. Sources of agricultural growth by region
Source: Goyal and Nash, 2017

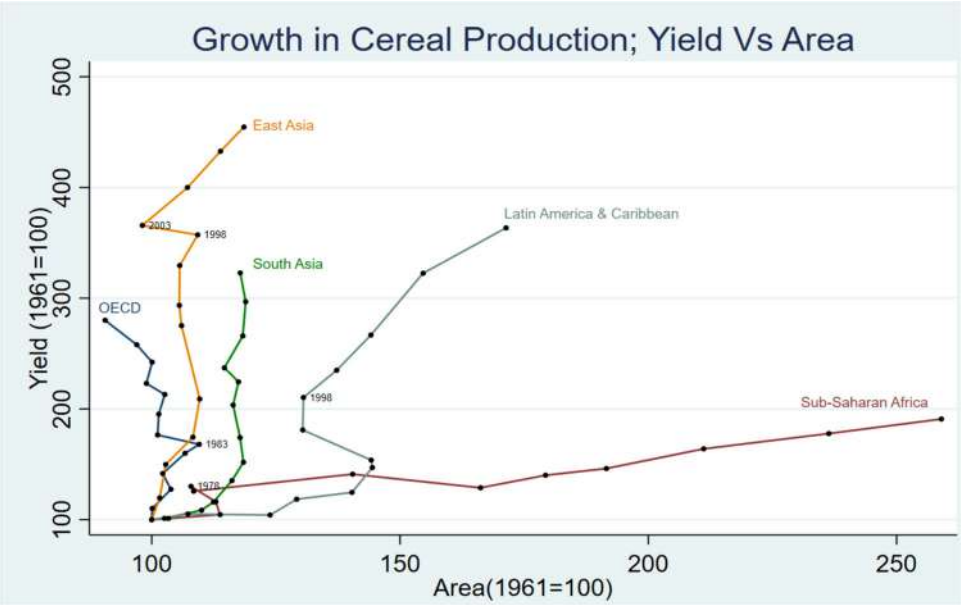

Figure 7. Roles of area expansion and yield in cereal production by region
Sources: World Bank, 2007, and Winters, 2023

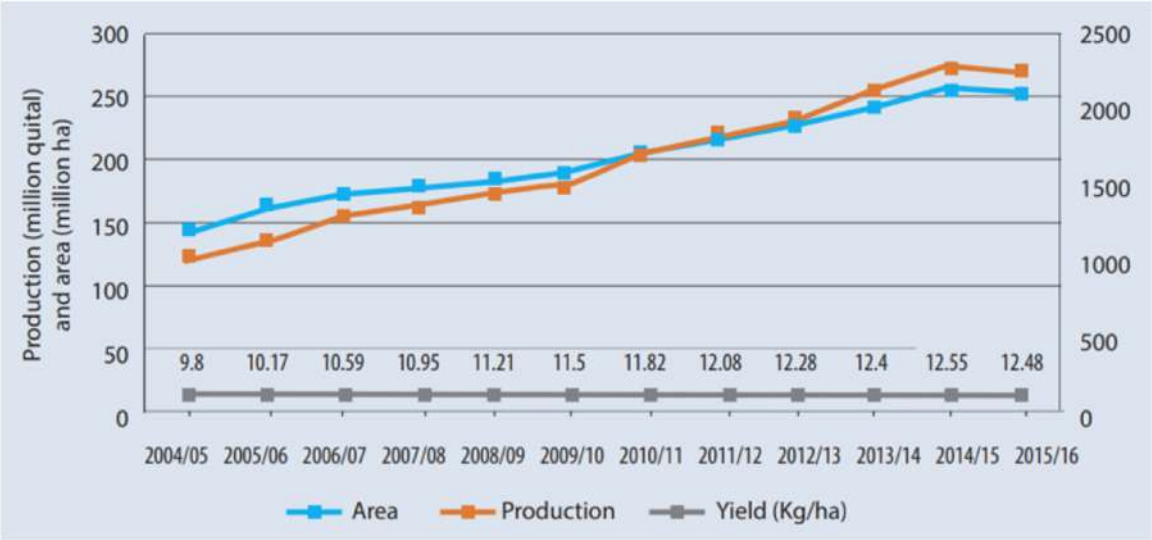

Figure 8. Roles of area expansion and yields in crop production in Ethiopia
Source: Brooks and Byerlee, 2021

Even in Ethiopia (Figure 8) where the GDP growth rate has been 8%/year for the past ten years, increased yields have not been the source of agricultural growth.

This lack of productivity gains results in strong pressure on the environment and deforestation to support horizontal expansion (Figure 9).

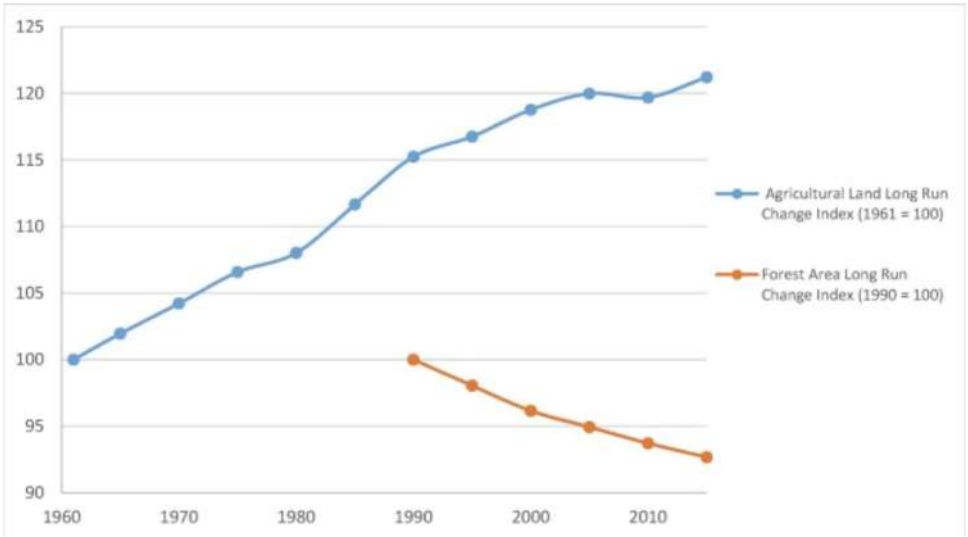

Figure 9. Horizontal expansion horizontale and deforestation
Source : Barbier, 2020

Constraints to the adoption of Green Revolution technologies have been studied in detail through experimentation (randomized controlled trials) for impact analysis in the ATAI project (Magruder, 2018). They mainly consist of:

Liquidity constraint: access to credit and savings facilities.

Risk constraint: access to index insurance, risk-sharing contracts, parametric lines of credit, and shock-contingent social protection.

Information constraint: Access to extension system or information from agro-dealers and social networks.

Market access constraint: deficient infrastructure and lack of storage capacity; non-competitive and shallow local markets.

Creative institutional innovations have been proposed to overcome these constraints. However, a fundamental constraint remains largely effective: the too frequent low profitability of investment in available technologies. This is related to the local specificity of agriculture and the lack of public and private investment in research for local agroecological conditions. Given significant economies of scale in R&D, this problem of the geographical heterogeneity of African agriculture (linked in particular to the verticality of the continent according to geographer Jarred Diamond and the lack of water control) remains an immense problem difficult to solve.

3. Insufficient agricultural transformation (AT) to feed the cities

The urban population is growing rapidly in SSA, reaching 42% of the total population in 2021. With increasing incomes, adaptation of behaviors to urban habitat, and time constraints, eating habits are changing. Rural consumption dominated by maize, cassava and millet gives way to urban consumption dominated by wheat, rice, fruits and vegetables, animal products (milk, meat, fish), and sugar. Without sufficient transformation of agricultural production, cities are increasingly turning to imports for food. As a result, imports of food products have increased as rapidly (Figure 10) as exports of agricultural products (cotton, coffee, peanuts). We are therefore witnessing a growing separation between the dynamism of agricultural production (focused on rural consumption and exports) and the dynamism of urban consumption (dependent on imports of high value-added foods and processed products).

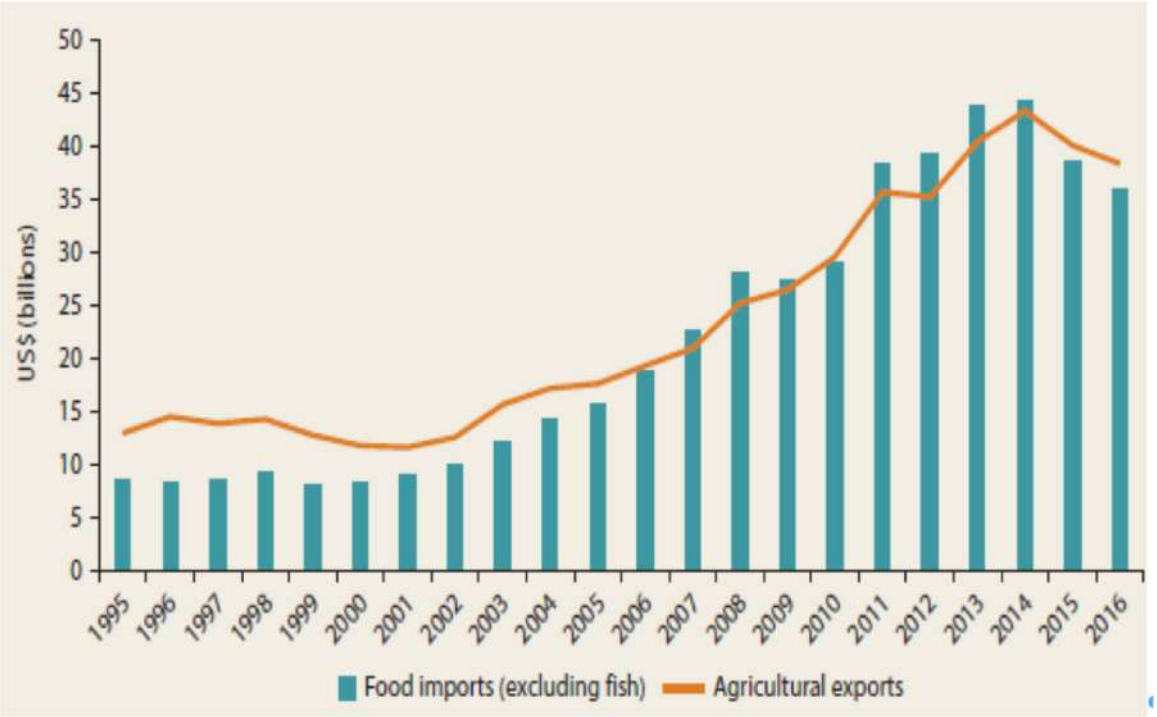

Figure 10. Food imports and agricultural exports in Africa
Source: FAOSTAT database, 2018, online

In addition, markets for foodstuffs that have their origin in peasant production have a significant failure for quality recognition (Bernard et al., 2017). Peasant production is difficult to certify and trace because it is typically lumped together by intermediaries. This is one more incentive for agro-industries (wheat mills in Ethiopia) and consumers (onions in Senegal) to secure quality through imports. Peasant agriculture is thus partially cut off from access to expanding and remunerative urban markets. This weakens the role of the dynamics of agricultural production as a driver of Structural Transformation through the low cost of urban food and hence low nominal wages in the cities.

4. Delays in rural transformation (RT)

Rural transformation is marked by the diversification of rural household incomes, in particular their increasing participation in rural non-farm activities and the labor market. This diversification of income is an important asset for reducing rural poverty without emigration to the cities or international borders. The delay in Agricultural Transformation is reflected in a delay in Rural Transformation, i.e. the emergence of agriculture-related SMEs in rural areas. As seen in Figure 11, the share of agricultural income for rural households is higher in African countries than in countries in other regions of the world at equal levels of per capita income. In Figure 12, there is a corresponding lag in participation in off-farm activities.

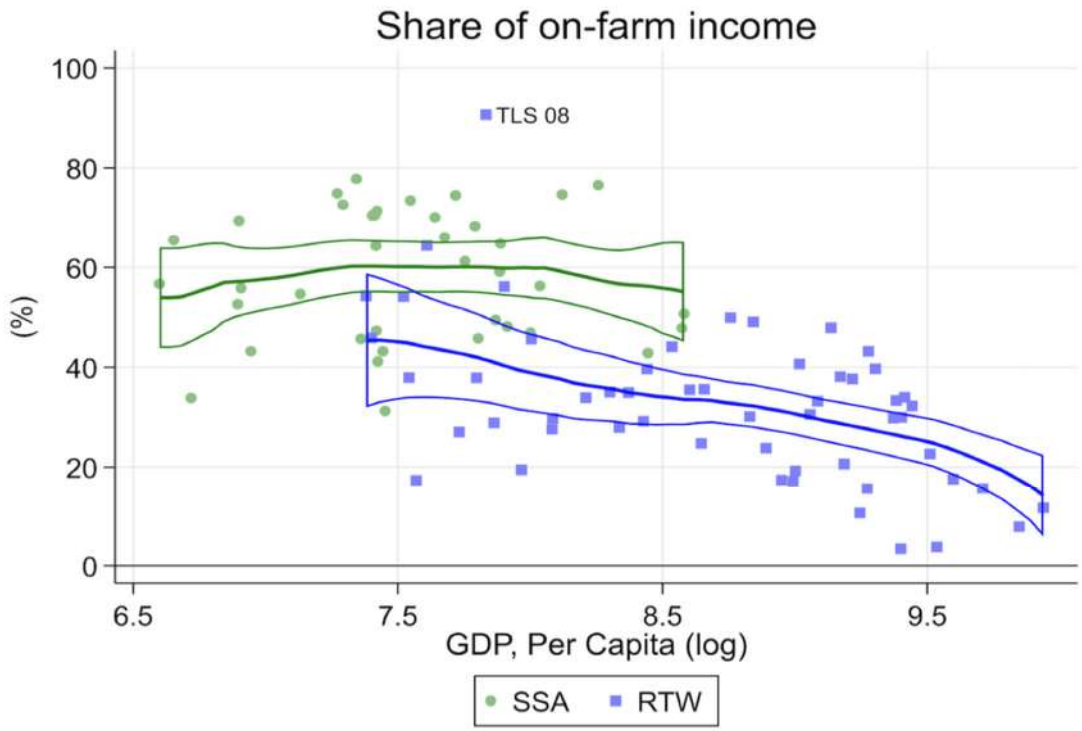

Figure 11. Share of on-farm income in rural households' total income, by level of per capita income and regions
Source : Winters et al. (2023)

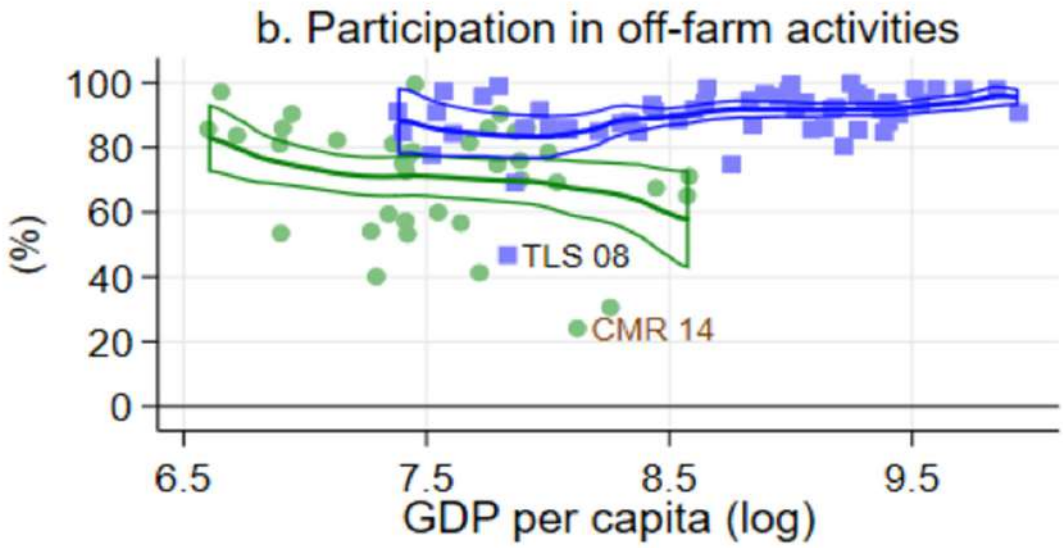

Figure 12. Participation in off-farm activities by rural households, by level of per capita income and region
Source : Winters et al. (2023)

5. A truncated urban Structural Transformation (ST)
With premature deindustrialization (Rodrik, 2015) and low labor productivity in the urban informal sector, Structural Transformation (ST) is delayed in SSA (Figure 13) compared to its classical form observed in Asia (Figure 14).

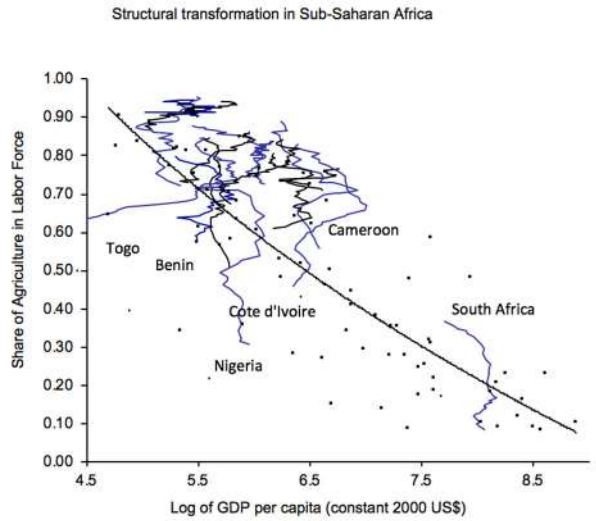

Figure 13. Structural transformation in SSA
Data source : World Bank

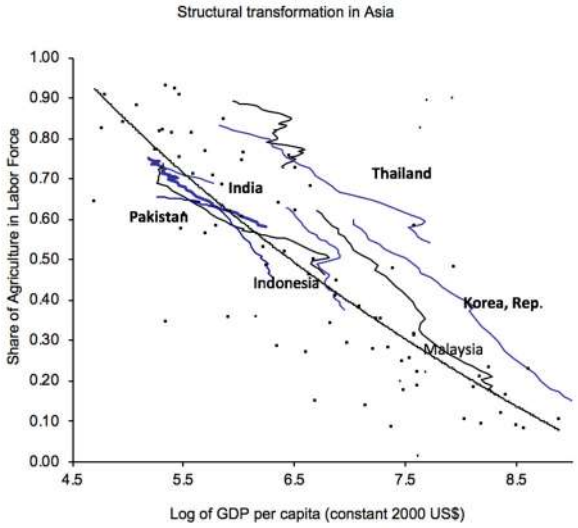

Figure 14. Structural transformation in Asia
Data source : World Bank

An important substitute may therefore be Rural Transformation where ST finds a temporary realization. Secondary cities become the source of the emergence of non-agricultural rural activities linked to agriculture and local consumption (Christiaensen and Todo, 2014). The dynamics of these local non-agricultural activities strongly depends on the dynamics of agriculture, in particular success of an Agricultural Transformation.

Financing private investment in smallholder agriculture and managing risk

The financing of peasant agriculture that interests us here is to invest in the Green Revolution and Agricultural Transformation. We have seen that two important constraints at these stages, and the corresponding adoption of technologies, are access to credit and risk management. These constraints have been extensively studied through impact analysis using experimentation (ATAI, 2018). The results reveal two paradoxes regarding the possible lifting of these constraints.

Access to credit. The availability of liquidity to finance investment in smallholder agriculture is severely constrained by the lack of access to credit offered by commercial banks and the conditions of access to credit accessible through microfinance. Commercial credit is constrained by the lack of financial guarantees due to incomplete or non-usable land property rights as collateral (certificates, collective property). Even when property rights allow land to be used as bank collateral (titles), smallholder farmers are most often reluctant to use their assets to access credit so as not to put at risk their access to land. They are therefore "risk constrained" (Boucher et al., 2008). The increase in the supply of commercial credit is therefore not sufficient to increase investment in smallholder agriculture without changing demand.

Credit accessible through microfinance remains ill-suited to investment in agriculture because of insufficient amounts to buy indivisible goods, financial costs that are too high, repayment conditions that are too rigid, and loans that are too short-term for seasonality in agriculture. The paradox, however, is that access to credit, even when possible and at subsidized prices, generally has little effect on the use of chemical fertilizers. This suggests that the constraint of access to credit is not the only limit to current expenditure (for the use of fertilizers that are essential for the Green Revolution) in peasant agriculture (Suri and Udry, 2022). Many studies indeed show that lifting the credit access constraint, including with high subsidy rates, has only modest effects on fertilizer use (Beaman et al, 2014, in Mali; Carter et al, 2013, in Mozambique). More important are insufficient profitability (lack of complementary inputs such as soil organic matter (Marenya and Barrett (2009) in Kenya) and transaction costs in markets that are too high) and risk of the expected returns from these expenditures that is too high. On the other hand, credit has an important role in the acquisition of indivisible investment goods (Cai et al., 2022).

Significant progress has been made to improve the value of microfinance credit for current expenditures and investment in agriculture. Experiments reveal that the borrowing and repayment rate increase when: (1) repayment terms are more flexible (availability of a grace period, adjustment to seasonality) and better suited to credit usage conditions (e.g. for harvest storage provided by the One Acre Fund in Kenya (Burke et al., 2019)); (2) the asset acquired can be used as collateral on loans (animal, mobile water tank, portable pump); (3) customers have more prior business experience; (4) a menu of loan contract options is available, allowing better tailoring of loan terms to personal circumstances; (5) dynamic incentives are available, despite increasing competition between sources of microfinance supply; and (6) earned reputation as a borrower can be used as collateral to access other sources of loans through credit bureaus.

The supply of microfinance products has therefore improved considerably through institutional innovations, partly based on experimentation and impact analysis (Cai et al., 2022). Innovative financial products such as Risk Contingent Credit (Shee et al., 2018)-where repayment of the loan is secured by index insurance, the insurance serves as collateral for the loan, and the insurance premium is paid with repayment of the loan at the end of the campaign--can address the problem of risk. Precision agriculture, with soil quality testing, satellite weather observations, and the possible use of artificial intelligence to define technical assistance, is used to customize loans, reduce risk, and increase the profitability of investment (Cole and Fernando, 2017; Apollo Agriculture in Kenya, 2023). The proposal for a mixed public-private investment fund for agriculture by Gravellini (2023), with unequal risk sharing between public and philanthropic partners (juniors in relation to repayment risk) and private (seniors in relation to repayment risk) goes in the direction of reducing risk for private capital in loans to agriculture (including peasants without collateral), agro-industry, and livestock to increase the supply of private loans to the sector. To result in increased investment, it leaves to solve the problem of motivating the demand for investment funds including profitability, risk management, constraints, and management, as we saw in the Theory of Change for Investment in Agriculture and Climate Change in Figure 1.

Risk management. While a credit constraint may therefore not be a major limiting factor of current expenditures in smallholder agriculture until other constraints have been lifted, uninsured risk seems to be a major cause of under-investment, particularly in the context of climate change. Faced with risk, farmers manage the consequences of shocks (ex-post) through the liquidation of savings, emergency borrowing, the sale of productive assets, migration to cities and international borders, use of child labor taken out of school, and delay in consumption expenditure, including food with possibly irreversible consequences on the physical and mental development of children. They also manage risk (ex-ante) through less risky but also less productive technological choices, the accumulation of precautionary savings which compete with investment, choices of productive assets biased towards liquidity (e.g., animals instead of fixed investments), and the diversification of sources of income with an opportunity cost in relation to comparative advantages and specialization. Risk management is therefore crucial for investment, and remains very deficient. There are basically four approaches to this management of risk:

(1) **Technological innovation** with production systems that are more resilient to climatic hazards. The risk-reducing benefits of new varieties of flood-tolerant rice and drought-tolerant maize have been measured in experimental impact evaluations. This approach to risk management, however, suffers from massive underinvestment in R&D for local conditions in Africa.
(2) **Index insurance** linked to climate shocks. Despite the logic of this financial product for peasant agriculture, demand without significant subsidies remains limited, not exceeding 6-18% of farmers across experiments (Shickele, 2016). The causes of low adoption are high uninsured residual risk (basis risk), lack of understanding of the logic of insurance with prepayments in relation to shocks, and reluctance to group insurance which would allow for better compensation of uneven losses across individuals based on direct observation of losses by group members. However, cases of transitory subsidies to establish credibility of the approach (demonstration effect of payments after an insured shock), combined with simple training in the principles of the financial logic of insurance, have demonstrated the potential success of the approach (Cai et al, 2019);
(3) **Pre-approved credit lines indexed to climate shocks**. This credit makes it possible both to compensate the farmer for losses and damages after a shock, but also to secure investments in agriculture and increase income (BRAC experience in Bangladesh; Lane, 2022). The advantage of this financial product for adoption is that it has no ex-ante cost comparable to the payment of insurance premiums, only ex-post costs for loan repayment. Significant progress has therefore been made in risk management for investing in smallholder agriculture. The paradox, however, remains the low rate of adoption of the available products;
(4) **Irrigation**, which smoothens water shocks. This is a major deficit of agricultural infrastructure in SSA. It is becoming increasingly important in the context of adaptation to climate change. It should therefore be an essential candidate for the increased supply of investment funds for agriculture to reduce losses and damages.

Risk management is therefore an important condition for investing in agriculture. We now have better instruments for this, making it possible to catch up with underinvestment in the context of climate change.

From positive diagnosis to normative proposals

Implementation of the conceptual framework of the sequence {Assets, GR, AT, RT, ST} offers us an opportunity to relaunch public investment in agriculture and the possibility of creating a new attraction for private investment in this sector in the context of climate change. The political economy of its implementation requires understanding the causes of current underinvestment. It would be hard to say that public underinvestment stems from ignorance by governments and international agencies of the potential benefit of agriculture for development. This benefit has been amply demonstrated by the history of industrialized and emerging countries which have found in

the agricultural revolution (the increase in the productivity of labor and land through technological and institutional innovations) the foundations for a Structural Transformation and the Industrial Revolution. We must instead turn to disappointment with the returns to public investment in agriculture that have led governments and donors to alternative investments. We can say that the main causes of failure that will have to be remedied are the following:

a. A management of public investment in agriculture that is too complex to be implemented successfully without the necessary information, coordination, and evaluation instruments.
b. Public expenditures appropriated by private interests under the form of direct subsidies and transfers (and therefore transformed into private consumer goods) rather than spent on public goods, sources of private investment and productivity gains.
c. A long-term economic dimension of investment that exceeds political time.
d. A bias towards meeting the clientelist demands of the urban electorate which is more demanding and accessible than the rural electorate (Lipton, 1985).
e. A level of risk that is too high for private investment without sufficient risk-sharing with public institutions that have greater risk absorption capacity. This dimension becomes crucial in the context of climate change.
f. A role of peasant agriculture that makes the sector not only a potentially lucrative economic activity, but also a culture and a lifestyle.
g. Serious market failures (land, food, labor, capital, risk) that confuse economic behavior and rules of survival (de Janvry, Fafchamps, and Sadoulet, 1991).

Implementation of the sequence {Assets, …, ST} must therefore start from easy-to-achieve successes that demonstrate and convince of the feasibility and benefits of the approach. These successes are necessary to create political support for long-term public investments that exceed the length of the electoral cycle. Available successes must be analyzed and publicized to serve as a basis for popular support. For this, therefore, it is necessary to start from the geographical areas best endowed with resources, closest to markets, and with an agriculture that is already most commercialized. The approach will then be generalized to less favored regions and less prepared farmers. Multilateral development banks can use this conceptual framework to strengthen their support for agriculture. This is part of what is possible to do to achieve a real revival of the use of agriculture for development within the complex framework of climate change. This recovery should provide opportunities to lower the losses and damages associated with climate change compared to those in the current context of under-investment in agriculture.

Seven propositions to support and finance the role of agriculture for development in the context of climate change

The use of the conceptual framework {Assets, GR, AT, RT, ST} applied to sub-Saharan Africa leads us to make seven propositions for public investment to support private agricultural enterprises and strengthen the role of agriculture for development in the context of climate change.

1. **Develop planning capacity at the national and local level** to put in place investment strategies in the sequence {Assets, GR, AT, RT, ST}. This planning coordinates the economic, social, and environmental dimensions in the formulation of **investment projects** in a context of strong geographical heterogeneity. It must be based on information and therefore impact assessments of past and proposed policies and investments. It must also be participatory to create credibility and continuity of public investment in agriculture. The experiences of Ethiopia and Rwanda, with the support of the Gates Foundation, are informative starting points in this direction.
2. **Consolidate ownership rights to secure investment (Assets)**. Ownership of land includes both individual and collective certification and titling. As in Mexico for communal lands

(PROCEDE certification program), this formalization of property rights must be participatory and transparent to avoid unjust expropriations and illegitimate land grabbing.

3. **Invest in agricultural R&D in SSA** to develop technologies better adapted to local agro-ecological conditions and therefore more profitable to adopt. Better profitability is a sine-qua-non condition for the ultimate success of a Green Revolution (GR) for SSA, in addition to removal of the usual constraints to adoption: liquidity, risk, information, and market access. Increasing the yields of field crops is also necessary to curb deforestation. Public investment in R&D can attract private investment in R&D that will gradually replace public investment.
4. **Provide better climate risk management** with public support for innovative instruments such as resilient technology (experiences of flood resistant SwarnaSub1 rice in India and drought resistant hybrid maize in Kenya), index insurance (experiment of PICC (People's Insurance Company of China) with temporary adoption subsidies and simple training of farmers in financial concepts), and pre-approved credit lines indexed to climate shocks (BRAC's experience in Bangladesh for clients with an established borrower reputation) (GR). It is important to reduce risk not only ex-post (compensation for losses and damages indexed to climate shocks) but also, and above all, ex-ante (resilience, index insurance, pre-approved credit line indexed to climate) to increase the investment and income in normal years. As demonstrated by experimental research (randomized controlled trials), the total of gains in normal years due to risk reduction can exceed the total of avoided losses in years of climate shocks (Emerick et al., 2016). Given the challenge of reviving agriculture in the context of climate change (when there was still underinvestment under normal climatic conditions), increasing resilience and better managing risks for the smallholder sector become more essential than ever.
5. **Invest in water control, especially through irrigation**. Agricultural Transformation (AT) towards high value-added crops to feed the cities requires water control, especially in the context of climate change where irrigation not only serves to increase yields and introduce high added value crops, but also to reduce risks. Large-scale water control (such as the experience of the Senegal River Valley) remains one of the big absents in SSA where 7% of the cultivated area is irrigated compared to 63% in South East Asia.
6. **Build inclusive value chains for urban food** with resource-bearing contracts (price guarantees, technical assistance, credit, insurance) and quality recognition (AT). This construction requires investment in rural infrastructure such as roads and storage capacity. These investments are also the basis for a Rural Transformation (RT) (e.g. experiences of agro-industrial tomato cultivation and dairy in Senegal). Contracts can be made with producer organizations as in the case of productive alliances supported by the World Bank in Latin America and West Africa (World Bank, 2016).
7. **Link through parametric indexing social protection to losses and damages due to climate change** in smallholder agriculture. These transfers are quick complements to the creation of opportunities through agricultural recovery.

These investment expenditures each have a different degree of international public good, national or local public good, and private value. They therefore call for different combinations of international aid, public expenditure, and private expenditure. These investments are complementary, and therefore public investment is essential to enable private investment. In the case of the poorest countries, budgetary constraints require additional contributions from international aid. In the case of adaptation to climate change and compensation for losses and damages due to climate change, the historical responsibility of industrialized countries also requires an additional contribution from international aid. And the trade-off with the SDGs requires special attention in the context of climate destabilization. This is the spirit of the upcoming conference on Financing Development Assistance and Reducing Loss and Damage from Climate Change. The proposed conceptual framework and the seven propositions for supporting and financing the

agricultural sector in sub-Saharan Africa in the context of climate change can be used to prioritize investments that require international assistance.

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"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

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