

Research Article

Investing in the Pioneering Varieties as an Agreement to Attaining Economic Take-off on Smallholder Seed Firms in West Africa

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Abstract

Farmers everywhere depend on access to good quality seed, which is fundamental to their crop production systems. Most governments have made significant investments in strengthening national agricultural production capacities, yet farmers in developing countries still face difficulties in accessing the quality seed of the varieties that they require. Guaranteeing farmers' access to quality seed can only be achieved through a viable seed supply system that can multiply and distribute seeds, which have been produced or preserved. This is better achieved by the private sector, but medium- to large-scale international seed companies concentrate on high-value crops and avoid dealing in the self-pollinating, open-pollinating and vegetative-propagated varieties on which most smallholder farmers depend for their food security as the biology of these crops makes it easy for farmers to keep their seeds for several seasons. However, smallholders are often seen as the driving force of economic growth, poverty reduction and food security. This is also true for smallholder seed enterprises, which, in the absence of large companies, provide a valid alternative for the production and distribution of food security crops. This paper reviews case studies on smallholder seed enterprise in Côte d'Ivoire, as well as relevant world literature in order to identify key issues that facilitate or constrain the development of the seed sector. The final section provides some guidelines on policy design and implementation to promote the development of sustainable seed enterprises at different stages in the evolution of national seed sectors. It provides examples of good practices and hence seeks to assist governments in identifying ways in which they can support the development of smallholder seed enterprises that will provide the most appropriate varieties to smallholder farmers in their efforts to boost food production.

Keywords

Innovative Varieties, Food Security, Economic Take-off, West Africa

1. Introduction

Smallholder-based farming is a major source of livelihood for the rural population in Africa. Farm households in this region derive their food and income mainly through crop production, livestock rearing, and fish farming. Notwith-

standing, in most West African countries, food and nutrition insecurity has remained a severe problem, with a high prevalence in rural areas. Still, there is little insight into the structure of farming systems at the regional level, which is a

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Received: 24 November 2023; **Accepted:** 27 December 2023; **Published:** 2 April 2024



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prerequisite for informed decision-making on food production. Though rice makes an important contribution to peoples' diets, self-sufficiency in rice production in African countries is not yet achieved. The key to increasing productivity is adoption of high-yielding varieties, fertilizers, and other inputs. Thus of all the inputs, high-quality seed is perhaps the most important, as it determines the upper limit of what farmers can achieve, improving access to new high yielding and climate- smart hybrid varieties requires increasing seed production and expanding distribution through increased competition in the seed system. Therefore, the main questionnaire appears in following:

How can the Investment in the original varieties help in reaching food security and achieving economic take-off?

2. Seed Strategy, Food Security & Economic Take-off

Over the past few years, the International Development Association has supported successful reforms that have both increased the competitiveness of the agriculture sector and enabled smallholder farmers to improve their incomes, food security and well-being.

2.1. Seed Sector

2.1.1. Key Factors Influencing Development of Small-scale Seed Enterprises

The following elements highlights some of the literature dealing with small-scale seed enterprise development, reinforcing the key lessons learned from the three country case studies as following: [6]

A. Conducive policy environment: SCOWCROFT and POLAK provide in 1998 a clear description of the key elements of a national seed policy to guide the development of a country's seed sector, stressing the role of this national policy in providing a framework for the rational development of the seed sector. These include:

1. Plant improvement and variety development;
2. Variety evaluation, registration and release;
3. Plant variety rights;
4. Seed certification;
5. Production, storage and marketing;
6. Strengthening seed supply systems;
7. Farm and community seed production;
8. Developing capacity in seed multiplication;
9. Establish sensible seed quality protocols;
10. Promotion of production and marketing of high-quality seed.

These are discussed in more detail below.

B. Demand: First issue for development of seed enterprises - is there a demand that will ensure the long-term Commercial survival of the enterprise? This will occur only where farmers are selling a significant proportion of their output, and hence

generating the cash income needed to purchase inputs on a formal market.

1. Seed quality;
2. Price;
3. Markets and market information.

C. Availability of Improved Varieties and Seed: Many authors have referred to demand and availability of seed as 'chicken and egg' – demand will not grow in the absence of available improved seed, but efforts to develop improved varieties depend on demand for the finished product.

D. Entrepreneurship and technical skills: Producing quality seed requires a range of skills at various levels, from planning and management of seed production through skilled farm operations.

E. Access to credit: Availability of credit, particularly at government-subsidized rates of interest, was mentioned as a key success factor.

F. Enterprise ownership and profitability: Seed enterprises must be based on local ownership and profitability (in either monetary terms or by other socio-economic measure) if they are to develop and grow sustainably.

G. Infrastructure: Infrastructure storage facilities are a crucial element of any seed enterprise.

H. Linkages between formal and informal seed sectors: The functional linkages between the formal and informal seed sectors improve the functioning of both and promote evolution of the seed sector.

2.1.2. Key Lessons for Development of a Seed Sector

The stage of development of a seed sector is a primary consideration for any planned interventions, as the following point of view: [6]

A. Pre-Industrial Stage: at the very earliest stages, government efforts must be two-pronged:

1. Create awareness of improved agricultural practices, including the benefits of using quality seed and improved cultivars;
2. Produce and supply quality seed of the best local landraces or improved varieties that are available elsewhere and are suited to local agro climatic conditions.

B. Emergence Stage: during the emergence phase, the focus is on building on the foundations established during the pre-industrial phase:

1. Efforts to promote the demand for improved seed should include multi location variety testing and demonstration trials, combined with continuing efforts to popularize new high yielding varieties.
2. Extension services should be strengthened to ensure that farmers are aware of new varieties and their characteristics. Providing seed in small packets may be used to encourage farmers to test new varieties under their own conditions.
3. Participatory plant breeding and selection should be strengthened to improve existing local varieties.

C. Expansion Stage: the major focus of the expansion phase

is to continue to build demand for seed, and to provide a policy environment that encourages private-sector involvement in seed production and marketing.

D. Maturity Stage: at the maturity stage, the focus should be on providing a policy environment that encourages a balance of public and private investments in the seed sector, and the Governments should continue their investment in fundamental research and education, but training in technical skills for seed production and processing can be taken on increasingly by the private sector.

2.2. Development of New Varieties

It is important to distinguish variety from seed. A variety is a specific example of plant germ plasma that is devoured through an input, seed. Once the farmer has acquired the germ plasma, it may be quite feasible to maintain the genetic integrity indefinitely, through seed saving, without recourse to further purchase. (The principal exceptions are hybrids, and certain open-pollinated varieties, discussed below.) The failure to distinguish between seed and variety (and the use of the meaningless term 'seed varieties') is a cause of much confusion in seed policy. Demand for a variety is not the same as demand for seed.

True, the variety is embodied in the seed, but once the farmer obtains a small quantity, he or she is able to test and at times modify it, and can often multiply and maintain it. It is not sufficiently recognized that a considerable portion of the spread of the wheat and rice varieties of Asia's Green Revolution was carried out by farmer-to-farmer seed movement rather than by formal seed provision channels. [14]

The development of new varieties is a fundamental function of the seed sector and these new varieties need to be better than what farmers currently have in terms of yield, tolerance to pests and disease and environmental stresses, and suited to farmers and consumer preferences. For major food crops, this function is undertaken by national agricultural research institutes (NARIs), often in collaboration with international agricultural research institutes, including the Consultative Group on International Agricultural Research (CGIAR) centers. International and sometimes national seed companies perform this function mainly for export crops and hybrid varieties of food crops and vegetables. The first step in the development of new crop varieties is the conservation of plant genetic resources for food and agriculture (PGRFA) in national and international gene banks. Gene banks conserve genetic material from wild relatives of domesticated crops, landraces or improved varieties and act as a source of genetic material for breeders. In recent years, breeding strategies have become more participatory, with breeders working closely with farmers under local field conditions rather than in research stations to jointly developing varieties or mixtures of varieties that are highly adapted to local conditions. These strategies also enhance the adoption rate of new varieties or mixtures of varieties by farmers: [2]

2.3. Explanations for Inadequate Seed System

There has been a demand for seed ever since the beginning of agriculture, but the formal organization of seed provision is a relatively recent phenomenon. Organized efforts at plant breeding only began in the late eighteenth century, and it was not until the late nineteenth century that commercial plant breeding began to emerge. This was further stimulated by the rediscovery of Mendel's work on plant genetics in 1900. Farmers began to purchase seed because not only it embodied the output of scientific plant breeding, but also because seed enterprises could at times offer advantages of cleanliness, purity or convenience that were difficult with farm-saved seed. As the seed industry developed in Europe and North America, most seed production was done by commercial or co-operative entities. Nevertheless, both government and private commercial enterprises managed plant breeding. In the US, the American Seed Trade Association was formed in 1883, but it was not until the advent of hybrid maize in the 1930s that private plant breeding began to challenge the predominance of the state experimental stations. Today, most large seed companies do their own plant breeding, although crops they are still partially or wholly dependent on public research. [14]

3. Food Security

In the 1970s, the definition of food security was developed from the perspective of food supply to ensure that all people everywhere have enough food to eat. The importance of consumption and access was put forward in the 1980s through the concept of entitlement (Sen 1981). The term of nutrition security emerged with the recognition of the necessity to include nutritional aspects into food security. Four dimensions of food and nutrition security as follow: [13]

3.1. Food Security Characteristic

There are many characteristics attached with food security such as: [13]

A. Food availability: the availability of sufficient quantities of food of appropriate quality, supplied through domestic Production or imports (including food aid).

B. Food access: Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources).

C. Utilization: utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs. This brings out the importance of non-food inputs in food security.

D. Stability: to be food secure, a population, household or individual must have access to adequate food at all times. They should

not risk losing access to food because of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of Stability can therefore refer to both the availability and access dimensions of food security.

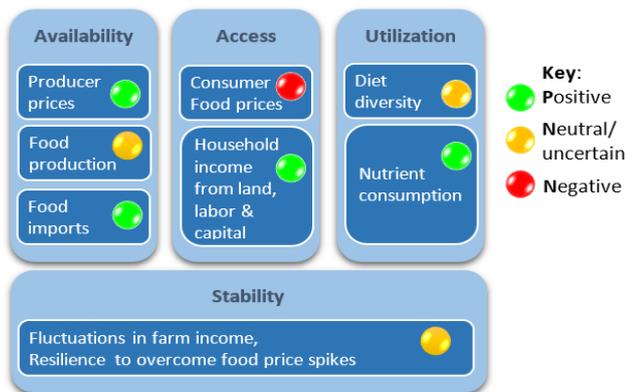


Figure 1. Channels of impact of cash crop income on the four dimensions of food security.

The current food system (production, transport, processing, packaging, storage, retail, consumption, loss and waste) feeds the great majority of world population and supports the livelihoods of 2003 million people. Agriculture as an economic activity generates between 1% and 60% of national GDP in many countries, with a world average of about 4% in 2017. Given the current food system, the FAO 10 estimates that there is a need to produce about 50% more food by 2050 to feed the increasing world population. [3]

3.2. Food Security and Insecurity, the Food System

Food systems encompasses all the activities and actors in the production, transport, manufacturing, 30 retailing, consumption, and waste of food, and their impacts on nutrition, health and well-being, 31 the environment [3]

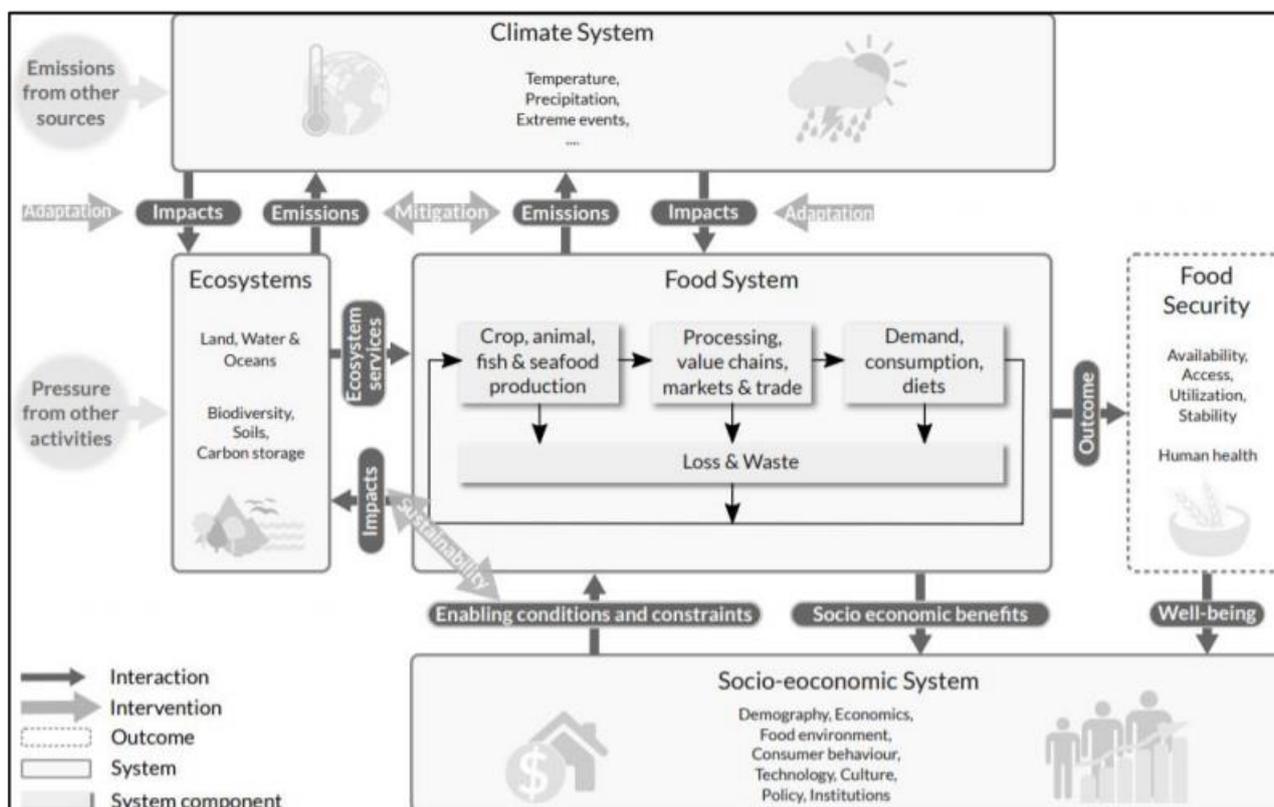


Figure 2. Interlink between the climate system, food system, and ecosystem.

Following the figure above founded that, these systems operate at multiple scales, both global and regional. Food security is an outcome of the food system leading to human well-being, which is also indirectly linked with climate and ecosystems through the socio-economic system. Grey arrows

represent response options for sustainable practices, mainly in terms of climate change mitigation (M) and adaptation (A). Adaptation measures can help to reduce negative impacts of climate change on the food system and ecosystems. Mitigation measures can reduce greenhouse gas emissions coming

from the food system and ecosystems [3]

3.3. Effects of Climate Change on Food Security

Climate change is projected to negatively affect the four pillars of food security availability, 30 access, utilization and stability – and their interactions. [3]

A. impacts on livestock production systems: Livestock systems are impacted by climate change mainly through increasing temperatures and 35 precipitation variation, as well as atmospheric carbon dioxide (CO₂) concentration and a combination 36 of these factors. [3]

Among livestock systems, pastoral systems are particularly vulnerable to climate change Industrial systems will suffer most from indirect impacts leading to rises in the costs of water, feeding, housing, transport and the destruction of infrastructure due to extreme events, as well as an increasing volatility of the price of feedstuff which increases the level of uncertainty in production. Mixed systems and industrial or landless livestock systems could encounter several risk factors mainly due to the variability of grain availability and cost, and low adaptability of animal genotypes. [3]

B. Impacts on pests and diseases: Climate change is changing the dynamics of pests and diseases of both crops and livestock. The 34 nature and magnitude of future changes is likely to depend on local agro-ecological and management 35 context. This is because of the many biological and ecological mechanisms by which climate change 36 can affect the distribution, population size, and impacts of pests and diseases

on food production. These mechanisms include changes in host susceptibility due to CO₂ concentration effects. On crop 40 composition and climate stresses, changes in the biology of pests and diseases or their vectors, mismatches in timing 42 between pests or vectors and their ‘natural enemies’, changes in survival or persistence of pests or 43 disease pathogens, and 45 changes in pest distributions as there. Such processes may affect pathogens, 46 and their vectors, as well as plant, invertebrate and vertebrate pests. [3]

C. Smallholder farming system Impacts: New work has developed farming system approaches that take into account both biophysical and five economic processes affected by climate change and multiple activities. Farm households in the six developing world often rely on a complex mix of crops, livestock, aquaculture, and non-agricultural seven activities for their livelihoods. Across the world, eight smallholder farmers are considered disproportionately vulnerable to climate change because nine changes in temperature, rainfall and the frequency or intensity of extreme weather events directly 10 affect their crop and animal productivity as well as their household’s food security, income and well eleven being. For example, smallholder farmers in the Philippines, twelve whose survival and livelihood largely depend on the environment, constantly face risks and bear the thirteen impacts of the changing climate. Smallholder farming systems have been recognized as highly vulnerable to climate change because they are highly dependent on agriculture and livestock for their livelihood. [3]

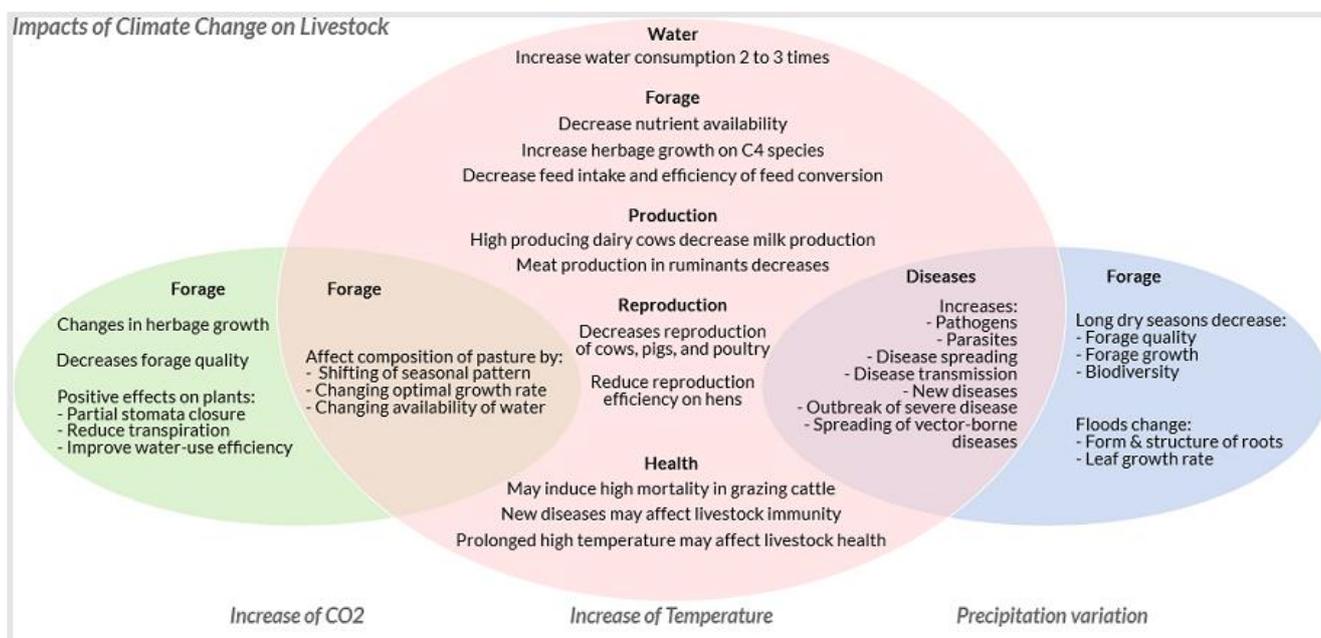


Figure 3. Impacts of climate change on livestock.

3.4. AGRA Strategy for Consolidating Recent Gains in Africa's Seed Systems

Throughout history and around the world, sustained increases in agricultural productivity have been catalyzed by the introduction of seed from improved, locally adapted crop varieties.

Broad experience and comparative analysis show that few other attempts to increase farmers' yields have been proven as successful or sustainable. For farmers to achieve adequate returns on investment and sustain agricultural intensification they must adopt seed with improved genetics, coupled with fertilizer and good crop management practices. Historically, smallholder farmers in sub-Saharan Africa have had limited access to seed of high yielding, responsive, locally adapted varieties of their staple food crops. As a result, crop yields on most smallholder farmers' fields in Africa have remained far below their potential. Crop yields in most of Africa have remained at approximately one-third of those produced by farmers in other developing regions of the world. This is doubly regrettable given the many recent advances in breeding of stress-tolerant, disease-resistant crop varieties adapted to African conditions. Meanwhile, Africa's population continues to increase 50% faster than increases in farmer productivity, causing the continent's projected annual food deficit to rise to 60 million MT by 2020, costing US\$14 billion. Previous attempts at achieving agricultural transformation in Africa regularly underestimated the central role of higher-yielding seed as a catalyst for incentivizing farmers to intensify crop production and produce surpluses for local and national markets. However, recently introduced models that link the breeding of a wide range of high yielding, locally-adapted crop varieties with seed production and marketing campaigns led by private, independent seed companies and agro-dealers have made impressive inroads in the creation of a viable seed system for African agriculture. The Seed Systems strategy, builds on a tested and strong foundation of the Program for Africa's Seed System (PASS) initiative (2007- 2017), funded by the Bill and Melinda Gates Foundation and Rockefeller Foundation, whose driving belief was that Africa's farmers already wanted and were ready for improved technologies. The PASS investments focused on four main themes: educating a new generation of African crop breeders, the breeding and official release of new crop varieties, helping local seed entrepreneurs establish companies, and building agro-dealer networks to sell improved seed and other inputs to local, smallholder farmers. [12]

3.5. Improved Seed Policies at National and Regional Levels

As improved seed assumes a more central role in agricultural development priorities and farmer demand continues to expand, Africa's seed policies are in need of urgent review through a process of consultation and dialogue. In particular,

how policies either support or restrict the growth of private seed companies and seed retailers should be interrogated. The validation of regional seed harmonization agreements at national level is a top priority, especially for countries with weak domestic seed sectors. With strong support from USAID, The Rockefeller Foundation, and BMGF, AGRA has established a record of accomplishment of successfully advocating for seed policy reform, having worked effectively with the governments of Mali, Ghana, Tanzania, Burkina Faso, and Mozambique to liberalize foundation seed supply policies, among others. Other areas requiring policy review include seed inspection and certification; royalty charges for public varieties; restricted seed marketing by private seed companies in some countries; and variety testing and release. Despite the release of numerous new varieties, many old varieties are still being promoted thus the need to deliberately promote new releases and phase out old varieties to enable farmers benefit from the novel traits in modern varieties. These and other policy reforms will form the focus of the dialogue undertaken by AGRA with the relevant ministries in the 11 country program areas. AGRA will advocate broadly in favor of increasing seed supply among smallholder farmers, especially in areas where new, higher yielding, and climate smart varieties have been developed. AGRA will encourage governments to take a systematic approach to monitoring seed supply through the creation and use of seed dashboards by relevant public agencies. [12]

4. Economic Take-off

Take-off is generally described as a stage where growth becomes the normal condition of an economy (i.e. sustained and steady growth rate). Specifically, take-off is achieved when three conditions are primarily met: [11]

First, when the rate of productive investment rises to about 10% of the economy's national income this implies that the economy must be highly suitable for investments (e.g. political stability, low-risk etc.) thus attracting numerous investors. Second, presence of one or more highly productive manufacturing sectors that exhibit sustainably high level of growth. Third, the existence, if not quick emergence, of political, social and institutional structures that would enable the economy to continuously exhaust possible means of expansion. This condition also involves the presence of a political leader or group that is highly prepared to regard the modernization of the economy as a serious "high-order political business". Therefore, these radical changes in the agricultural sector are deemed as essentials for enabling a successful take-off. [11]

4.1. Importance of Take-Off for Underdeveloped Countries

Now we will discuss how the take-off stage helps industrialization in the underdeveloped countries. The concept of

take-off carries some important messages for these countries attempting to accelerate their economic growth. They are first; the underdeveloped countries should make all possible endeavors to raise savings and capital formation for accelerating economic development.

Secondly, the underdeveloped economies should concentrate on the growth of one or more leading sectors, which could stimulate development activities. Thirdly, most of the underdeveloped countries are caught in the web of traditional values, patterns and attitudes. The traditional social system tends to minimize the importance of economic incentives, material rewards and rational calculations. In such a situation, the take-off stage stresses on the institutional changes in social structures for removal of inhibiting institutions and values. [10]

4.2. Rostow's Stages of Economic Growth

Professor W. Rostow, an eminent economic historian and a specialist on economic development has analyzed the process of economic growth and advocated the stages through which an economy passes to become developed. Prior to Rostow, approaches to development had been based on the assumption that 'modernization' was characterized by the western world, which were able to advance from the initial stages of underdevelopment. Accordingly, other countries aspiring for a modern state, Rostow penned his classic 'Stages of Economic Growth' in 1960. Rostow relates social and institutional factors with economic forces of growth through a number of observable propensities of the community such as Propensity to develop fundamental science, Propensity to apply science to economic needs, Propensity to accept innovations, Propensity to seek material advance, Propensity to consume, and Propensity to have children. Rostow's model asserted that all countries exist somewhere on this linear spectrum and climb upward through five stages in the development process. They are: [10]

A. the Traditional Society: The structure of the traditional society was based on the primitive technology and the facilities of modern science and technology were altogether absent. All economic activities in such societies were carried on with simple tools and implements, and were confined only to meet the domestic needs. All the pre-industrial revolution societies can be termed as traditional societies. Agricultural production was the main occupation and this was done mostly to suit the needs of the household with available primitive tools.

B. the Pre-Conditions for Take-Off: According to Rostow, pre-conditions for take-off is an era, when society 'prepares itself for sustained growth'. He further suggests that the pre-condition for take-off requires radical changes in three non-industrial sectors. First, there should be expansion of social overhead capital i.e., development of transport, communication, roads, etc. Secondly, radical changes should take place in agriculture to increase its productivity. Thirdly, there should be an expansion of foreign trade. Foreign capital and

technical knowledge should be imported to sustain industrialization in the initial stages of development.

The pre-condition for take-off require evolution of modern science, development of technology, expansion of social overhead capital particularly transport, increasing agricultural productivity, widening the extent of the market and expansion of internal and external trade.

C. The Take-off: Self-sustaining growth, according to Rostow, happens in the take-off stage. He defines this stage as "an interval during which the rate of investment increases in such a way that real output per capita rises, and this initial increase carries with itself radical changes in production techniques and the disposition of income flows, which perpetuates the new scale of investment and perpetuates thereby the rising trend in per capital output". Prof. Rostow calls this a great watershed in the life of modern societies. Growth, in fact, becomes automatic during the stages of take-off. Modern writers call it by different names such as "big push", "initial push", "critical minimum effort", "great leap forward", etc. Rostow has suggested the following three related conditions for making the growth process self-sustained: First, rise in the rate of productive investment from about 5 or less to over 10 percent of the national income or net national product. Secondly, the development of one or more substantial manufacturing sectors, with a high rate of growth. Thirdly, existence or quick emergence of political, social and institutional framework, which exploits the impulse to expansion in the modern sector. The potential external economy affects the take-off and gives to growth an on-going character.

D. The Drive to Maturity: Rostow defines this stage as "the period when a society has effectively applied a range of modern technology to the bulk of its resources". During this period, many technical changes take place and society reaches technical maturity. The process of industrial development is differentiated when the new leading sectors gather momentum to supplant the old leading sectors. Here, economic maturity is reached when regular growth becomes the habit of every sector of the economy.

E. The Age of High Mass Consumption: After attaining maturity, the economy moves to the age of high mass consumption. According to Rostow, being fed up with the fruits of industrial maturity; people try to seek more leisure, increased, welfare, social security, etc. In other words, this is the period of consumer's sovereignty. According to the dynamic theory of production, the level of income rises in each stage of growth of the economy.

5. Investing in the Original Varieties Seeds in Cote d'Ivoire

With all of its natural advantages in the area of agriculture (central location in West Africa, strong research capacity, long history of private sector involvement, and very favorable agro-ecologies for the production of a wide range of crops),

one might expect Côte d'Ivoire to be well-advanced in the development of its seed systems.

Côte d'Ivoire is also the country where World Food Prize Laureate, Dr. Monty Jones, developed the Nerica rice varieties in the 1990's and early 2000's.

5.1. General Context

Côte d'Ivoire's economy has experienced a strong economic revival over the last decade. With the return of political stability and peace after a period of civil conflict that lasted from 2000 to 2011, the country has shown an impressive economic performance. From 2012 to 2017, average real annual GDP growth was about 8 percent, in sharp contrast with the performance registered during the 2002–2011 period. With population increasing at about 2.5% per annum, while the real GDP per-capita growth decreased by 23% between 1998 and 2011, it increased by 34% between 2012 and 2017. With GDP growth estimated at 7.4% in 2018, Côte d'Ivoire continues to be one of the fastest growing economies in Sub-Saharan Africa. Four main factors have been identified as drivers to sustained high economic growth: macroeconomic stability (exchange rate, inflation, debt management); good business environment promoting private investments; export orientation; and income growth and equality. On all these factors, Côte d'Ivoire's performance has been improving but needs to make sustained progress. [15]

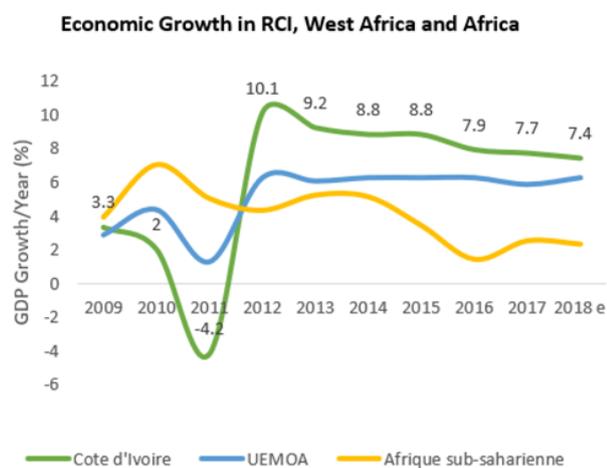


Figure 4. Economic growth in RCI, West Africa and Africa.

5.2. Côte d'Ivoire has Built Its Economic Development on Agriculture

Its exceptional performance in cocoa, for which the country is the world's largest producer with 40% of the world supply, is well known.

Côte d'Ivoire has also become the largest world producer of raw cashew nuts. It remains the largest exporter of rubber, palm oil, bananas, pineapples and copra in Africa, and the

second producer of Robusta in Africa (ranking 7th in the world). The country is also self-sufficient in a variety of foods maize, sorghum, millet, yam, cassava, plantain banana – with growing exports to the sub-region. The only exception is rice for which total imports represent 50% of the country's domestic demand. Rice is the staple food of the Ivorian population. It is the main cereal consumed by all social classes in the country, with a ratio of 70kg/year/capita. The rice-growing area in 2019 was estimated at 823,411 ha for a milled rice production of 1,304,468 tones and a consumption requirement of 1,830,385 tones. To reduce the gap between supply and demand, the government imports € 450 million worth of rice each year. The country is the fifth-largest importer of rice in the world and the second largest in the continent after Nigeria. To achieve rice self-sufficiency, the Ivorian government adopted a national rice strategy in 2012, which was subsequently reviewed in 2020. One of the options of this strategy is to improve access to quality seed of varieties adapted to climate change with good grain quality. Indeed, the seed is the primary production factor for farmers. It contributes to at least 40% of crop yields in West and Central Africa. West and Central African countries and development partners are increasingly aware of the strategic importance of seeds. This awareness has increased since the food price crisis of 2008 and is reflected in several local, national or regional policies and initiatives to improve producers' access to certified seeds. In several countries, seed subsidy programs targeting smallholders are implemented since several years now. Efforts have been made to harmonize national regulations and facilitate the emergence of a regional seed market. However, the access of the majority of WCA smallholders to certified seed remains problematic.

5.2.1. Policy and Regulatory Aspects of the Seed Sector

The rice seed strategy is based on various plans and programs developed within the framework of agricultural development policies. First, there was the Agricultural Development Plan from 1992 to 2015, adopted in 1993, which recommends, concerns rice, the search for food security and self-sufficiency through the national coverage of rice needs and the competitiveness of the national sectors. Then there was the Poverty Reduction Strategy Document, adopted in January 2009. Which identifies rice as a pillar of food security and self-sufficiency, and which opts to promote food crop production by ensuring financing conditions and improving marketing channels. There is also the National Agricultural Investment Program (PNIA) from 2010 to 2015 and from 2018 to 2025, which reflect the country's vision, ambitions and priorities in the agricultural sector.

The most recent is the National Rice Development Strategy, which was adopted in 2012 and revised for the period 2020-2030. This strategy is based on the implementation of integrated rice projects that take into account irrigated rice cultivation, the development and rational use of plots, the

production of high-yielding varieties and the total mechanization of the rice value chain [1].

5.2.2. Overview of System of Rice Intensification (SRI) in Côte d'Ivoire

System of Rice Intensification (SRI) activities were first documented in Côte d'Ivoire during 2014 following the onset of the West Africa Agriculture Productivity Program's (WAAPP) regional Improving and Scaling up SRI in West Africa (SRI-WAAPP) project. Following initial trials overseen by the SRI-WAAPP National Facilitator for Côte d'Ivoire, the project focus zoned in on peri-urban areas across the country. The map at right lists SRI trial sites as of 2016. The second regional workshop, attended by 60 participants from the 13 West African countries involved in the SRI-WAAPP project, took place in Abidjan, Cote d'Ivoire, February 16-19, 2015. Various additional SRI-WAAPP trainings are outlined in the progress/activities section below. In a 2021 article the National Center for Agronomic Research (CNRA) reports that SRI methods used in irrigated rice plots of Gabon, in the Savannas district in northern Côte d'Ivoire, have resulted in a 25% increase in production. (This site is part of a SRI project was implemented in 2013 in Côte d'Ivoire and Gabon was one of the 13 departments selected for its extension phase.) In October 2021, the Adaptation Fund approved the "Scaling up Climate Resilient Rice Production in West Africa" (RICOWAS) project which includes Côte d'Ivoire and 12 other countries in the region. The RICOWAS project emphasizes SRI methods and other climate resilient rice production practices.

5.3. Seed Sector Improvement Strategy

The strategy for improving the seed sector is based on the national seed sector development program designed by ADERIZ [8]. This program is fully linked to regional strategies and especially to the national rice development strategy which takes into account the period 2020 to 2030 [1]. The overview of this program is to build a professional and efficient rice seed sector to support the achievement of rice self-sufficiency. Its overall goal is to contribute to the sustainable meeting of the needs for quality seeds through:

1. The strengthening of the institutional and operational capacities of the seed sector actors (to organize and professionalize the rice seed sector);
2. The perpetuation and securing of breeder, foundation and certified seeds productions;
3. The quality control and certification of produced and commercialized seeds;
4. The creation of an incentive setting for private sector involvement in the seed sector;
5. Promote the use of quality seeds to rice farmers.

The outcome of this strategy is to increase the use of quality seed up to 70% in 2030, including 30% of certified seed and 40% of the seed of good quality obtained through the Com-

munity-Based Seed System (CBSS), an intermediate system between the formal and informal systems. To achieve this, all actors involved in the promotion of rice seed should be combined through a common strategy. This strategy should stimulate the professionalization and empowerment of private sector actors, especially in terms of the sustainability of production, conditioning, packaging, storage and marketing activities for quality seeds, particularly certified seeds. State intervention will be restricted to its sovereign task (control, monitoring, collection, certification, improvement of the business environment, etc.) and the establishment of a more responsible and efficient seed administration [5]. Rice in Côte d'Ivoire is Big Business That Depends on Small Firms When it comes to agricultural value chain development, including for staple crops like rice, big, (multi)national firms are often considered the entry point to catalyze the chain. There is another way of course: Domestic small and medium enterprises (SMEs) in smaller towns and cities. They are much closer to smallholder and remote farmers and thus better placed to interact with and source from them a key component of inclusive value chain development. Their ubiquity is a huge benefit. However, their smaller size could also represent a major weakness depending on the answer to one question: do these SMEs have enough capacity? As part of the Côte d'Ivoire Economic Inclusion into Value Chain pilot, supported by the World Bank, we assessed several smaller rice mills to find out.

What we discovered was that identifying rice mills that could catalyze value chains proved even more difficult than we expected. We interviewed mill owners in the intervention areas of the pilot project and found that most of them did not have the ambition and/or capability to play this role. Nonetheless, a few of them proved to be surprisingly dynamic. Clearly, the potential is there. [4]

A. Big on numbers, low on quality: Currently, 80 percent of Côte d'Ivoire's paddy rice is processed by small mills that operate largely in the villages as a service to farmers and traders. The processing quality is usually poor, leaving many impurities and even small stones in the processed rice. In order to sell in urban markets and compete with imported rice, the quality of processing would have to go way up. A technology allows rice mills to improve their processing quality. About 300 of Côte d'Ivoire's slightly larger rice mills, with a processing capacity of at least one ton of paddy rice per hour, are already employing it. However, there are only about 20 mills of this size in the three intervention regions of the pilot project.

B. Value chain with little structure and competitiveness: To select the three mills the pilot project could work with (one in each region), we had in-depth conversations with 14 of the 20 mill owners and their employees about different aspects of their business, from governance structure and management strategy to accounting, marketing, and human resource and business management. To our surprise, only three mills demonstrated sufficient potential to catalyze a value chain

once provided with technical assistance through the pilot project. Only a few others seemed to have the potential to do so in a couple of years.

Côte d'Ivoire's rice value chain is clearly underperforming, and for good reason. Most of Côte d'Ivoire's rice traders, who procure for the local markets, do not face quality requirements. As a result, they do not have the means or willingness to provide the inputs farmers would need to boost quality: agronomic advice, quality seeds and fertilizers on credit, and reliable purchasing power that would smooth out mill utilization. The country's rice mills mostly operate well below capacity and at low and decreasing profit margins. But we know that with technical support, farmers could raise their productivity and create a larger and more reliable supply of quality rice. That could enable rice mills to supply distributors serving more demanding urban markets like that of Abidjan, thereby fetching higher prices and running their mills at full capacity.

Eventually, perhaps it could allow Côte d'Ivoire to stop importing rice.

C. a new type of entrepreneur: The three entrepreneurial mills we identified to join the pilot project are getting technical assistance to make big changes. For one, they're building durable partnerships with farmers, incentivizing them to produce rice for urban markets and not just personal consumption by providing agronomic advice and quality inputs on credit, provided by a microfinance institution. The pilot project will further assist them in the next step: finding working capital from financial institutions to procure rice from the contracted farmers. Future blogs will elaborate on the challenge of engaging the other partners, from unorganized smallholder farmers to reluctant financiers.

5.4. Rising with Rice in Côte d'Ivoire: The Contours of a Pilot Project

The potential for poverty reduction through value chain development (VCD) in Africa is an approach that Côte d'Ivoire hopes will work for its rice farmers. During the 2008 world food crisis, rice prices tripled in a matter of months, and the Government of Côte d'Ivoire got to work on a National Rice Development Strategy. With more than half of the country's rising demand for rice being met by imports, which could in principle be produced locally, the strategy aims to create self-sufficiency when it comes to rice production. The strategy lays out a VCD approach driven by the private sector, with the rice mills as entry points.

It focuses on strengthening market development while at the same time improving the productivity of rice farmers and the quality of rice processing. This should allow the domestic rice value chain to produce higher volumes of quality white rice to meet the unmet urban demand. [9]

A. Rice as food and cash crop: The rice value chain has a high potential for inclusive employment and income generation. Rice is grown across the country, including by the poorest

households. Rice cultivation is labor-intensive, and large differences in net returns per hectare in similar agro-ecological conditions across Côte d'Ivoire suggest substantial room for productivity gains. Also, developing the rice value chain can create new off-farm jobs, including in input provision, machinery services, at the rice mills, in marketing and in distribution. But VCD is more difficult for staple crops. In the case of rice, smallholder farmers are unlikely to uphold a contract they have signed with millers if farmers are not directly paid at harvest or if other buyers pay higher prices at harvest. Similarly, mills may opt not to honor the prices stipulated in the contract when the market price drops. pilot project in Côte d'Ivoire hopes to tackle the question of what an effective VCD intervention could look like for rice, especially when trying to link poorer farmers to expanding markets. The pilot, which will begin this spring, simultaneously supports rice mills and smallholder rice farmers.

Mills will be granted access to working capital on a commercial basis by a bank to provide farmers with credit to buy inputs, and to buy their paddy rice in cash at harvest. Mill owners, managers and employees receive management training to improve their operating procedures, commercialization practices and financial management and strengthen their market linkages.

The combination of these interventions will allow the mills not only to meet local demand for white or processed rice, but also to serve the more demanding, larger urban markets. To reach these higher value markets, however, the mills require a steady supply of quality paddy rice from farmers. So to boost productivity, the pilot also provides extension services to farmers to help them apply modern agronomic practices. With their productivity increasing, farmers will see their food security and incomes grow.

B. Reaching the poorest: Value chain development (VCD) is not just uncommon for staple crops. This pilot is also novel in the way that it is explicitly targeting the poorest rice farmers. Research shows that cash transfers to poor households increase their expenditures for food, education and other basic items. Nevertheless, cash transfers alone are not enough. Smallholders also need support measures that increase their productivity and access to markets that are developed enough to buy their products. The pilot anticipates helping these farmers jumpstart a process out of poverty by combining cash transfers and VCD.

So, Future blog posts will keep you posted on how the intervention unfolds in practice, how it affects smallholder rice farmers' earnings, and what this means for poverty reduction strategies in Africa.

5.5. Levers for the Development of the Seed Sector

The process of consultation with stakeholders shown that the seed sector in West and Central Africa in its present state is not compatible with the objective of a sustainable increase of

agricultural productivity. While it is important to recognize the value of recent and past interventions, it should also be noted that results achieved so far are far from the expected and that efforts that are more appropriate need to be made. However, it should be pointed out, that future public policies and investments could effectively contribute to the sustainable development of the seed sector only if they are directed mainly towards the following six areas:

1. Implementing more coherent seed policies;
2. Improving the governance of seed sector;
3. Strengthening seed demand and supply;
4. Improving the performance and responsiveness of the research-development scheme;
5. Strengthening actors "capacities and facilitating involvement of youth and women;
6. Establishing appropriate and sustainable funding mechanisms.

It is the accumulation of strategic outcomes of the six areas will lead to the improvement of the accessibility and use of certified seeds to meet demand. The six levers proposed are complementary and may have different priority levels.

Côte d'Ivoire's experiences show the importance of engaging different stakeholders to grow and deliver quality seeds needed for boosting agricultural productivity and making more food available. [7]

Throughout West Africa, WAAPP is supporting governments' efforts to prepare and implement seed system strategies, improve regional seed regulations and strengthen seed certification systems. A project of this scale requires collaboration so WAAPP is working with scientists, farmers, the private sector and others to make improved seeds for rice, plantain and other staple crops available to more people. In Côte d'Ivoire, the National Rice Development Office's (NRDO) seed improvement initiatives are positively impacting rice supply. The NRDO is laying the groundwork for six seed centers around the country. It engages with farmers and seed entrepreneurs, collecting seeds, cleaning them, and then storing them in WAAPP-funded cocoon storage facilities, which preserve their quality for longer periods. It also builds up distribution networks through farmer co-ops.

The national seed system, which was disrupted in 1994 with the closing of the National Office for Seeds and Plants (NOSP), has been resurrected and is almost fully operational with the support of WAAPP. Since that crash, the cumulative production of quality and certified rice seeds financed by WAAPP has reached 6600 tons from 2012 to 2015.

Around 50,000 beneficiary producers farming on 100,000 hectares of land have improved their yields by 30 to 150 percent.

Credit for the huge jump in productivity goes to seed producers like louhiri. Bilhof farm currently produces four varieties of rain-fed rice seeds on 100 hectares. But the Ivorian entrepreneur has big plans for the future, and hopes to eventually grow enough rice seeds to meet half of his country's demand. He encourages citizens in other West African coun-

tries to find their own ways to contribute to their seed systems.

The use of quality seed remains one of the important levers to boost the development of the agricultural sector. Given the importance of the seed sector in the agricultural development process, the Government of Côte d'Ivoire, through the ADERIZ, has fully committed itself to develop a strategy for the development of the rice seed sector. The issue of the rice seed sector is as follows low availability, such as seed poor quality, high price of seed, the lack of a well-functioning and structured network in terms of marketing and distribution of rice seed. The difficulty for actors to have access to credit or a fund for the development of the seed sector, the poor functioning of the institutional framework, the lack of material to reduce the difficult working conditions and increase the

efficiency of activities. literature, not a short summary or conclusion. Any future research directions could also be stated in the discussion.

6. Conclusions

The use of quality seed remains one of the important levers to boost the development of the agricultural sector. Seeds from seed multiplication farms are better in quality, more resistant to pests, and can yield up to 50% more than traditional varieties. Meanwhile, traditional seeds that are grown locally by farmers can be vulnerable to pests and moisture, sometimes causing farmers to lose their crops." Low quality seeds can yield harvest shortfalls, which can leave a dent in farmers' incomes as well as in the availability of staple foods in markets. Future agricultural growth will require considerable private investments, from producers and larger investors to modernize production systems and create more value added. The National Plan of Development (PND 2016-2020) aims at making private investment a motor of the country's economic growth. Côte d'Ivoire has considerable potential in agriculture and agro-business, a reasonable infrastructure in the process of modernization, a strategic coastal location. Because of this situation, the Ivorian State must take measures to:

1. Establish a real seed industry in Côte d'Ivoire;
2. To ensure continuously, the production of breeder and foundation seed;
3. To ensure a better supply of foundation seed to multipliers and seed companies and certified seed to rice farmers in sufficient quantity and quality;
4. Ensure quality control and certification of all classes of seed produced and marketed;
5. Create favorable conditions for a strong private sector for the development of a successful seed sector;
6. Promote the use of quality seed among rice farmers;
7. Create conditions for the professionalization of the actors in the seed sector;
8. Maintaining a sustained growth in agriculture will require considerable investments in technology generation/innovation and a much better access to inputs, advisory services;

9. Finally Côte d'Ivoire must continue to adopt and implement medium and long-term reforms that will contribute to improve the agricultural business environment.

Conflicts of Interest

The authors declare no conflicts of interest.

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