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Angola: Rice Crop Grow and Food Security Reinforcement

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Abstract

Rice is the staple food of more than three billion people around the world. In Angola it is the most consumed food after maize and cassava. At a time when the country population increases at an approximate annual rate of 3.27% associated to an economic and financial crisis, demand for food is increasing and prices are getting higher. Currently the country lives mainly on imports, spending big sums to import more than 400000 tons of rice per year to meet the internal market needs. This situation is exacerbated by the fact that some countries have banned or restricted their rice exports, leading to a shortage and a rise in prices on the world market. These problems threaten the food security of the Angolan population, increasing hunger and poverty every few years. However, the country has the potential to invest in national rice production, thus replacing imports. This work analyses and discusses how this objective can be achieved, starting from the agroecological potential of the Angolan territory, passing through a summary characterization of the different scales of existing rice production systems in the country and ending with a diagnosis of the main fragilities and constraints that limit the expansion of the area and productivity of the rice crop. The main aim of the suggested strategy is to contribute to increase the quantity and quality of rice production in order to ensure that sufficient quantities of rice are available to meet the needs of the internal market demand. For that, public policies should be able to support rice producers through activities such as providing farmers with new technologies and modern sustainable rice cultivation techniques, promoting local agricultural experimentation and rural extension, as well as helping farmers to reduce post-harvest losses and marketing risks.

Keywords: Angola; Rice production; Agricultural zoning; Food security; Policies and strategies

Introduction

Rice consumption in Angola is only second to those of maize and cassava. Moreover, it is an important component of food security for the majority of households [1]. Although it is steadily increasing, the 7.3 kg annual per capita rice consumption in Angola is still modest when compared with other Sub-Saharan African Countries (SSAC) like Mali and Senegal where the consumption is 60 kg and 70 kg per capita per annum, respectively [2,3] or when confronted with the main world rice consuming countries, as it can be seen in Figure 1 [4].

The leading Angolan regions in rice production are Uige, Zaire, Malanje, Bié, Lunda Norte, Cuanza Norte, Cuanza Sul, Moxico and Cuando Cubango [5,6], in which valleys rice finds a favorable environment for its development [7].

Total harvested rice area in Angola 2016-2017 was 39,412 hectares, producing 61,000 tons corresponding to an average yield of 1.5 tons per hectare, which is very low when compared with other SSA countries productivity. In fact, average rice yields across Africa are 2.5 tons per hectare while world best productivities reach 8.3 tons per hectare (Best practices=average of top 10 countries in the world by yield in the commodity) [8].

Several biophysical and socioeconomic constraints explain the low productivity. The most intense and frequent are: low soil fertility and lack of fertilization; inadequate or inefficient methods of soil preparation; use of low yielding varieties; drought and lack of irrigation; pests and diseases [9]. Last but not the least, about 80% of Angolan rice producers are inefficient small-scale farmers. Economic growth and rapid urbanization of the country in recent years determined a rapid growing demand which could not be satisfied by the stagnant production, immediately translating into rapidly increasing imports.

The growth of imports obviously deteriorates the trade balance, additionally requiring foreign exchange, which became scarcer particularly after the 2014 fall in oil prices. But there is an additional problem.

The world rice market is relatively narrow. Only 5% of the world production is internationally traded, as compared with 25% for soybeans or 20% for wheat. International supply of rice is then residual in relation with world production. This means that variability in production, caused for instance by bad harvest years in the largest producers, is directly passed to world international supply with the consequent implications for price variability.

In presence of such a situation and given the potential for rice production in Angola is it necessary and urgent to implement measures that can overcome it. Namely the increase in yields, the investment in processing plants and, most important, lead the small family farm sector to adopt the technologies necessary for an increasing and sustained rice production.

In the following sections we will address these issues, namely the current bottlenecks and opportunities, the production structure and the possible strategies to success.

Brave Review of the National Economy and Agricultural Sector

In Angola's economic and administrative history, rice began to deserve rulers attention since 1849 [10]. However, it was not until 1925 that the development of its production allowed for the first exports, which in that year amounted to 1,166 tons. From 1938 to 1967, Angola ´s exports for five years ranged from 9,809 to 11,892 tons, which translated into monetary values from 10,084 to 38,808 contos (1 conto is aproximatelly equivalent to 5 euros) [11]. With the outbreak of World War II, Angola's rice had considerable demand, which was met by the precautionary measures of self-sufficiency adopted by the country's administration. Among the incentives granted, the exemption of import duties in 1932 for all the machinery destined to equipping the shelling and polishing rice industry was highlighted [12].

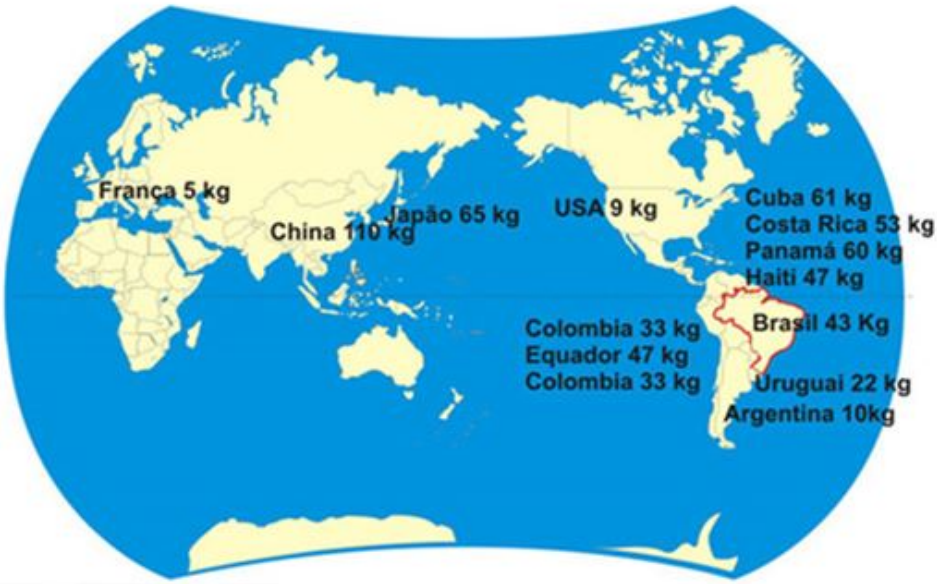

Figure 1: Rice consumption models Source.

In the 1960 and 1970, the country became an active participant in agro-livestock exports, which almost 60% of its consisted of coffee (48%) and sisal (5%), but also including maize, bananas, tobacco, cotton, beans, sugar, palm oil and rice. Agriculture was thus considered to be the main source of employment and wealth generator and the country was positioned as 4th largest exporter of coffee and sisal [12,13].

However, the post-independence war that lasted a little over two decades resulted in the destruction of the main productive fabric, and forced a significant part of the rural population to move to the cities, limiting the agricultural production and consequently the rural commerce. In this way, migration and the dismantling of rural trade transformed an entrepreneurial agriculture that was increasingly market-oriented until the mid 1970s, into a predominantly subsistence farming today [14-16].

Today, according to the USDA GAIN reports [17] Angola is Africa's fifth largest economy where oil production is the main contributor to the economy. According to the Africa Development Bank [18], livestock and forestry contribute about 12% to the GDP and 42% of total employment, with women, providing an estimated 70% of agricultural labour [19].

Although Angola has the resources to become one of the leading agricultural countries in Africa, currently it only cultivates 8% of its 58 million hectares of the available agricultural land, an estimated 90% of farms in Angola are small to medium, the country imports almost 90% of its food needs [15]. Agriculture is the main supplier of the food consumed in the country, although insufficient to meet all needs. The low productivity recorded reflects the low use of technology, and although the country has a reasonable potential for agriculture, the fact that it generally employs ancestral methods of production justifies its poor performance.

Food Import and Food Security

Currently, agriculture production is still predominantly rain-fed, non-market oriented, and based on rudimentary technologies and environmentally unsound practices. The country´s agricultural products are often of low volumes, poor quality and are costly to assemble for sustainable market supply. In addition, the farmers are not organized for the purchase of inputs and marketing of their produce efficiently, thereby incurring in high production and marketing costs that affect the profitability of their enterprises [15].

Over the recent years, Angola has initiated several strategies to boost the agricultural sector. With abundant water resources, and a

favorable climate, the government is committed to use the agricultural sector as a key driver of economic diversification away from oil. However, inadequate rural agricultural infrastructure such as roads, irrigation systems and unreliable electricity supply, as well as low use of yield enhancing inputs and technologies, are strong constraint to achieving that objective. Moreover, lack of skills, limited access to credit, weak research and extension services for support to farmers and inefficient land management systems are also responsible for low agricultural productivity. For example the Angola´s cereal yields increased from 662 kg/hectare in 2001 to 815 kg/ha by 2015, but remain below the Sub-Saharan average of 1,433 kg/ha. In addition, only 5.7% of the arable land is under cultivation nowadays [20].

At present, the country depends on the international market to satisfy about 90% of its food needs, being self-sufficient only in the production of cassava and banana. The main imported food and agricultural products in decreasing order of importance are: sugar, rice, chicken, wheat flour and other cereals, edible oils, followed by beef and pork, legumes and eggs [21].

Figure 2 clearly illustrates this situation in the case of rice [8]. Up to 1975 production was enough to fill domestic demand. From then on, the incapacity of production to cope with the increased demand is evident. This triggered the explosion of imports, particularly after 2003 as Figure 3 clearly shows [8].

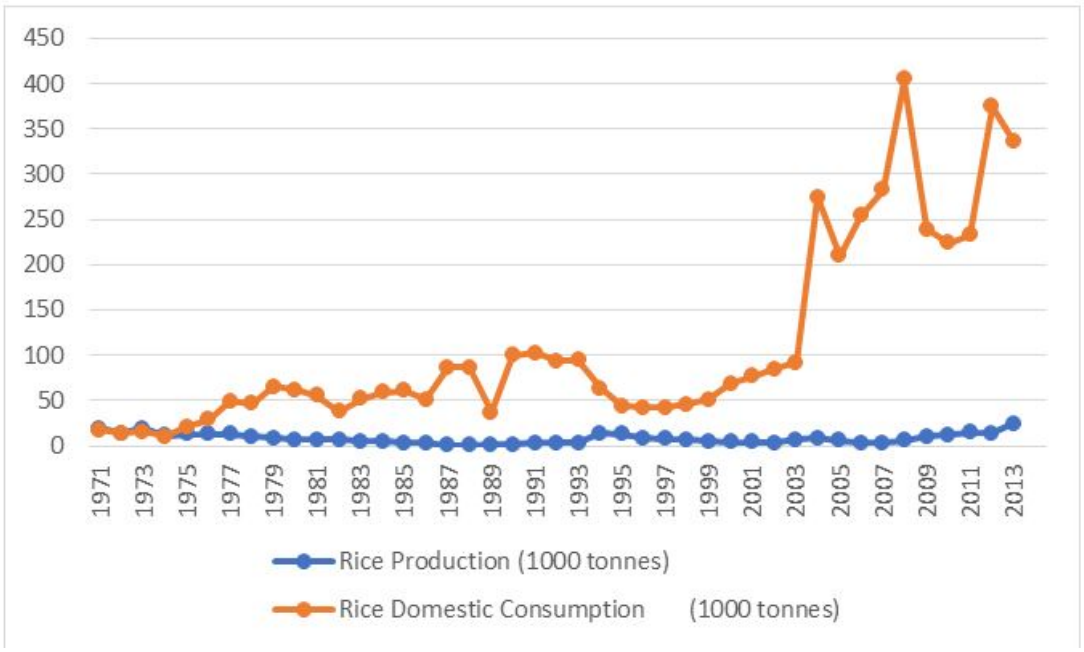

Figure 2: Angola Rice Production and Domestic Consumption (tons of milled equivalents).

In order to overcome the challenges of food production, it is necessary to adopt fiscal incentives to stimulate credit and even direct investments to rebuild the productive structure. It will be then possible to ameliorate the balance of trade through replacing imports and simultaneously foster the diversification of the economy and the generation of job opportunities, thus reducing external dependence.

Within this context, the National Strategy for Food and Nutrition Security (ENSAN) was created, based on the Food and Nutrition Security Action Plan (PASAN). This strategy included in the framework of the Strategic Long-term Development Program (PEDLP-2025) and its Medium Term Development Plan 2009-2013, as well as in the various sub-sectoral policies [22]. The AfDB (African Development Bank) also established a partnership to boost the agriculture value chain.

Thus, rice development strategy is in line with both national policies and international commitments that Angola has ratified aimed at improving the livelihood of the majority of rural communities through enhancing household food security and incomes.

Angola Rice Potential and Resources

Climatic, edaphic and superficial water resources of Angola

Angola is located in the tropical and subtropical zone of the south hemisphere, and its main topographic characteristics and the cold-water current of Benguela are determining factors for the characterization of the two main climatic seasons of the country [23].

In Angola there are two well deferred climatic seasons: the rainy season and the dry season, the latter being popularly known in Angola as the cacimbo season. The rainy season, which is wormer and more humid, runs from October to April, while the dry season runs from May to September [24]. According to Köppen the main types of climate characterized by the intersection of sets of thermal regimes and rainfall regimes are: Aw (rainy tropical climate, dry season in winter), Cwa (mesothermic, humid, dry season in winter), Cwb (temperate climate with dry winter and hot summer), BSh (very hot steppe climate) and BWh (very hot desert dry climate) [25].

According to the geographic location, topography and influx of sea currents, Ngolo 2014 [26] highlights the predominance in Angola of four climatic types described below:

Humid tropical climate, mainly occurring in the north and northeast of the country, including the province of Cabinda and the coastal strip between Benguela and Quelo, characterized by annual precipitations over 1200 mm, most of which occuring between September and May, with maximum monthly rainfall values around 300 mm in April, and a short rainy season between June and August. In this climatic type the average annual air temperature is higher than 22°C.

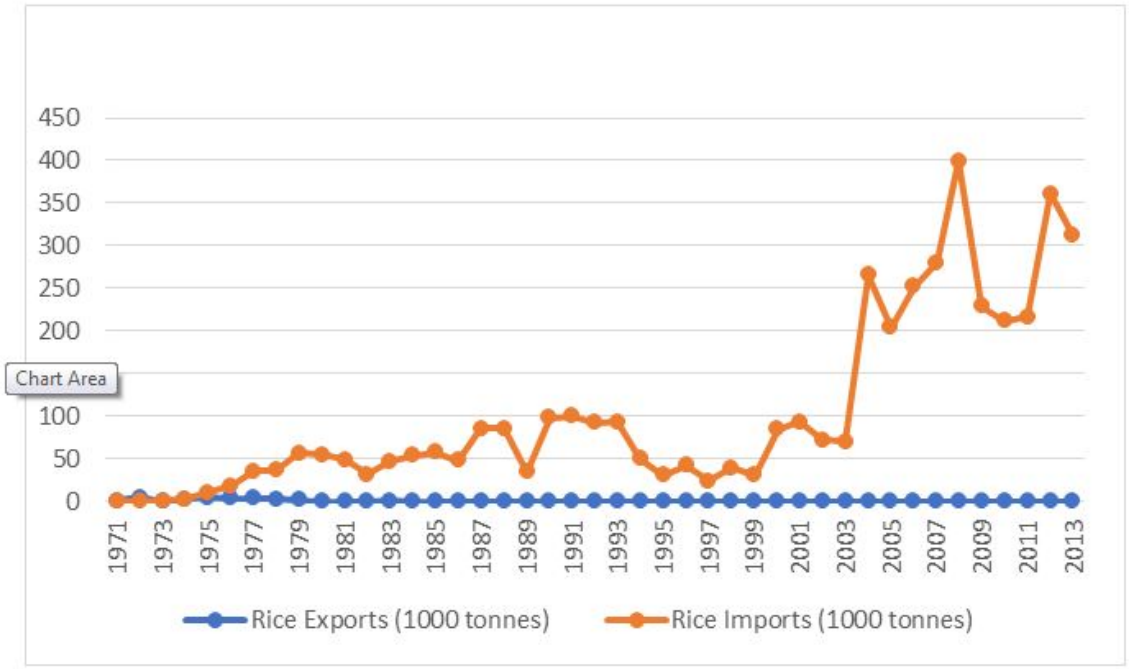

Figure 3: Angola Rice Exports and Imports (tons of milled equivalents).

Semi-humid tropical climate, occurs in the south of the humid tropical climate located in the central south and east of the country, approximately between the localities of Quibala (province of Cwanza Sul)-Sacama (Province of Moxico), Luena (Cuando Cubango Province), Lubango (Province of Huila), with annual rains ranging between 750 mm and 1250 mm, maximum rainfall occurring in the month of March ranging from 200-300 mm. This climatic type presents a very dry period between June and September, with annual thermal averages ranging from 20 to 22°C in the East and 18°C to 20°C in the central zone, requiring irrigation for agricultural exploitation.

Dry tropical climate, occurs along the coast from the north of the municipality of Quelo to the center of the municipality of Lobito. Annual rainfall ranges from 500 mm to 700 mm, with a monthly maximum of 130 mm in April and a minimum in May, with the dry period from May to September. The average annual temperature varies between 24°C and 26°C, decreasing until 20°C towards the south in the provinces of Cunene and Cuando Cubango.

Tropical desert climate occurs in the southwest coast of the country between the northern municipality of Lobito (Benguela) and south of the municipality of Tombua (Cunene). This strip is wider in the south and presents average annual precipitation of less than 250 mm, with a maximum of 100 mm in the month of March and a dry period between May and September. The average annual temperature varies from 20°C to 22°C. The southern end is even drier with average annual rainfall of less than 100 mm from January to April and a long dry period from May to December. Average annual temperatures range from 18 to 20°C.

The described conditions, coupled with the duality of climatic conditions, physiographic conditions and availability of water resources, determine the agricultural potential of two large areas [27]: A rainfed zone complemented by small irrigation systems and large irrigation areas.

The rainfed zone comprises about 70% of the country where abundant rains are observed during a long season, and high temperatures allowing the production of a great variety of crops. This is the great extension of the interior of the country, with the Central Plateau and the Subplanning zones in the north of the country, and the great extension of the east in which the quantitative value of the precipitation varies between 1200 mm and 1800 mm. The relatively short dry season has low temperatures, sometimes with frost, limiting the interest of fresh, horticultural and fruit crops, which, however, may justify complementary irrigation in selected small areas. They are, in general, the conditions of interest for livestock production and rainfed agriculture [5,27,28].

From the south to the west coast, slightly below the 800 mm isohyet, where the dry season is longer and where the precipitation, besides scarce, is irregular, the regions are suitable for the great irrigations. The

great spots of soils with more interest for cultural intensification occur also in these regions: Alluvial, Limestone, Clay, Aridic, Calsialitic, Fersialitic [28]. The South and the western coast region, semi-arid or arid with fertile valleys are well suited to the great schemes of irrigation [27].

Surface water availability is substantial, equivalent to almost 12000 cubic meters per capita and per year [29], but these areas of water resources do not match well with areas of demand for agriculture and domestic use [30]. According to Ferreira and Guimarães [31] only 4 of the 12 SADC countries (Angola, DR Congo, Zambia and Mozambique) do neither have a shortage of water resources nor are they expected to occur in the next 20 years. Angola is the most favoured of all these countries, in terms of availability of water resources, with the potential to provide water to neighboring countries, as it is already the case with Namibia (from Cunene river) and Botswana (from Okavango river). Soils are quite variable and in many cases changing within short distances (Figure 4) [32].

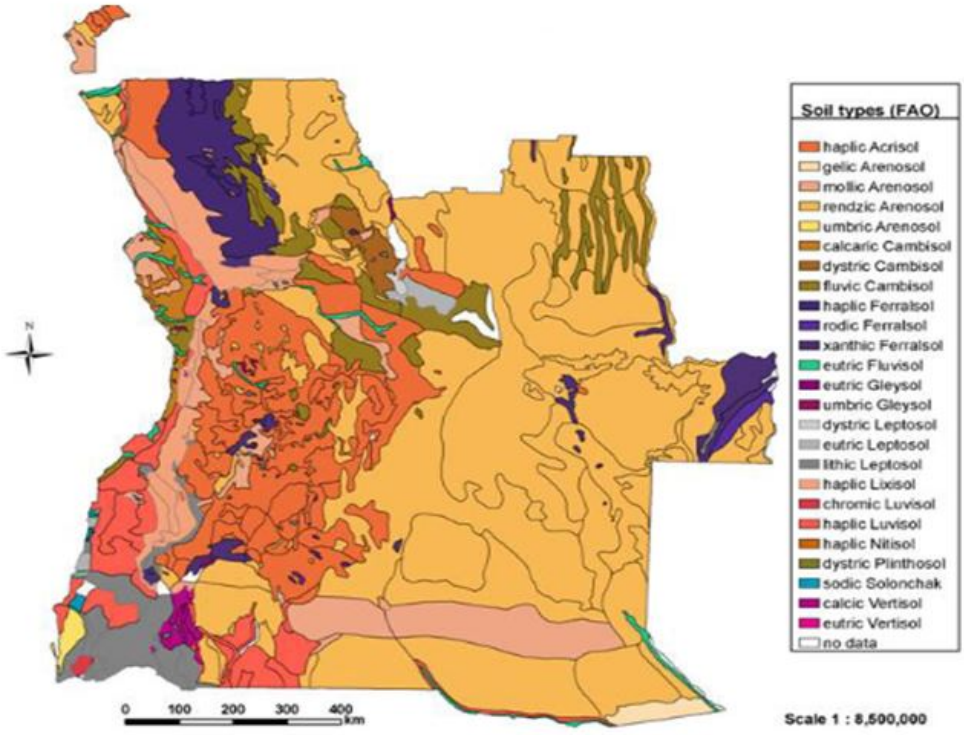

Figure 4: Soils type of Angola Source.

The south eastern part of the country has soils derived from Kalahari sands with very little cropping being carried out. Granitic and gneissic formations predominate in the highlands and plateau where the most productive cropping soils exist. Oxisols, which are of low fertility, acidic, low in organic matter, and commonly affected by aluminum toxicity, predominate. But there are large areas of alfisols and utisols that are reasonably fertile and suitable for crop production [27].

Ferralitic and paraferralitic soils are widespread in central and northern parts of the plateau. The sandy soils of the coastal belt and parts of the foothills have low fertility and low water holding capacity and are prone to salinity problems. There is ample land of reasonable to good potential suitable for cultivation [13,15,27].

Soils of major interest for agricultural activity mainly for the exploitation of rice cropping are the hydromorphic soils (Gley soils and Psamo-hydromorphic soils) characterized by being subject to temporary or permanent flooding, due to ascending water movements, which cause intense reduction phenomena throughout all or part of their profile [33].

Rice can be successfully cultivated as long as it does not lack three important factors: light, heat and water [33]. Rice finds a favorable area for its development in the rivers valleys. It adapts to different types of soils, from sandy, peaty and clayey soils, whose mechanical composition varies according to the nature of alluvial deposits [34]. However, a clay soil is the best to favor good organoleptic qualities to rice [35]. In general, yields are comparatively higher and heavier, on finer textured soils than on thicker textured soils [5,13,36].

Agriculture Zoning

In order to better exploit the country agricultural potential and policies to increase the yield of a certain crop, it is essential to know the factors that allow the adoption of a region as being of good suitability for the crop to be cultivated, using the agricultural zoning method.

The agroclimatic zoning is a variation of agricultural aptitude zoning that aims to delimit in a region, areas with soil and/or climate characteristics suitable for the cultivation of a given crop [26].

Agricultural zoning becomes imperative for granting agricultural credit to producers and at the same time indispensable for the sustainable cultivation of tropical plants, since it favours the production of safer fruits from the food point of view. And zoning allows for the identification of areas that require a lower application of agrochemicals [26]. When well targeted to regional and national agricultural development, it helps to provide technical assistance to producers.

Chagas et al. [37] stated that the agricultural zoning for a given crop is based on the agropedoclimatic variables of a given region which allow defining the aptitude to produce a crop. According to those authors, the fundamental variables to be taken into account are rainfall, sunshine, average maximum and minimum temperatures, soil physical and chemical properties, socioeconomic aspects of the region and the requirements of the crop to be installed.

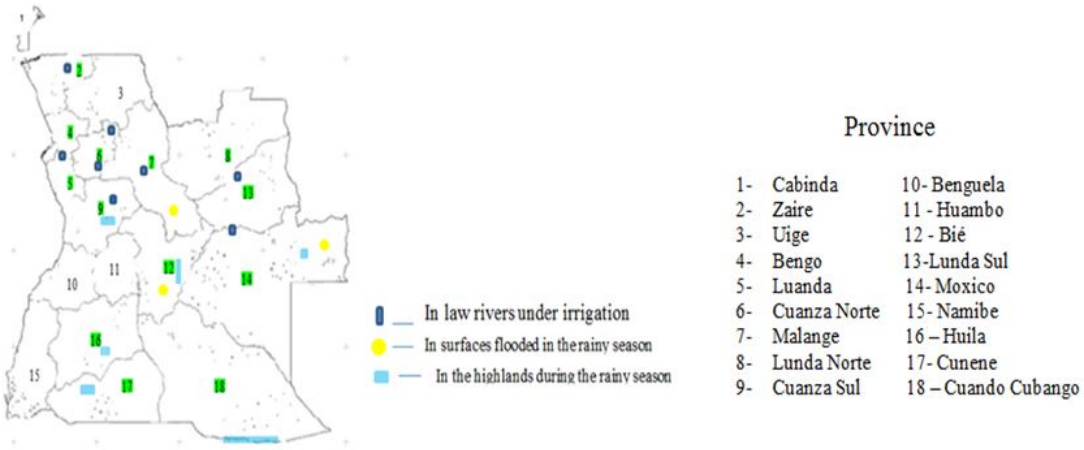

Figure 5: Traditional area and area more favorable to rice cultivation Source.

Based on the potential described on studies made by Diniz [5], there are three types of areas, depending on altitude, climatic factors and crop tradition, for rice cultivation in Angola (Figure 5) [5]. These types are: low rivers under irrigation; surfaces flooded in the rainy season; and highlands during the rainy season.

The most favorable areas to rice cultivation according to Diniz [5] are those located on the flat surface because they bring together a set of climatic, topographic and pedological factors, which are very favorable to the crop, as well as aquifer resources. In these cases, the author takes into consideration three important aspects:

a) Cultivation areas involving poorly drained and periodically floodable plains of Bié and Malanje provinces

b) Plateau areas of Cuanza Sul and Huila provinces, where rice cultivation should preferably focus on alluvial soils with thin textures of river bottoms, easily dominated by irrigation schemes

c) Areas of the Lower Cunene, in relation to the low and fluvial terraces of the respective course and main tributaries and areas of the Low Cubango, in both cases dominated by thin Aluviosols

However, the author points out that in the Lower Cunene zone a marginal strip extending discontinuously from Matala to Calueque is considered as a better zone due to the prevailing excellent climatic conditions (temperature, and daily thermal fluctuations, relative humidity, degree of insolation) and the presence of suitable soils.

Despite the innumerable potentialities, the current rice food situation in the country is quite surprising. Studies made by Schelling et al. [6] have shown that both the proportion of appropriate arable land in use as well as the percentage of potential yield and income achieved (the "income range") are extremely low considering the environmental potential of Angola.

Rice production systems

Rice is a highly versatile crop that can be cultivated in a range of different ecosystems. In Angola most of the rice is cultivated under lowland rainfed conditions, some with the aid of irrigation, and a smaller area of it is still cultivated under the rainfed upland system [9]. Many steps are involved in rice production from seed selection to post-harvest handling [35].

The rainfed lowland system is predominant and largely used by small-scale farmers. The fields are bonded and flooded with rainwater for at least a part of the cropping season. In this system, the small-scale farmers adopt a method of haul direct sowing and in some cases direct seed in line. They rarely use the transplant method because they claim to be very labour-intensive [38].

This system is typically prone to drought, only one crop per year is possible, and fields are subject to flooding in a depth of as much as 50 cm during part of the season. Production is very low and variable, in part because all the work is done manually, and major problems and restrictions include the low quality of the seeds, the water control (both drought and flood) the soil fertility as well as weed management.

With full water control and taking into account all the other production factors, the attainable yields should be around 3 to 6 tons per hectare [39], but actual yields in Angola are much lower (typically 0.35-0.70 ton/ha). The quality of the paddy is low due to poor water

management and delays in harvesting as farmers wait for their fields to dry out. Doing so, the harvested paddy is frequently drier than optimal [38].

In the irrigated lowland system the rice is grown in fields that are flooded during most of the growing cycle with a water depth of 5-20 cm. Average yields of paddy from these fields are between 3 and 6 tons per hectare and per cycle. The paddy quality is generally good and the supply of water can be controlled [40].

The soil preparation consists mainly in a sequence of tillage, harrowing and leveling of the land. Land leveling ensures uniform distribution and depth of irrigation water on the field and saves the amount of irrigation water needed [41]. Farmers usually maintain their rice field flooded with a water layer of 5-10 cm during the cropping cycle until several days before harvesting [42]. This system has the advantage of leading to higher yields per hectare and is practiced mainly by the large-scale farmers, involving large commercial farms and trading companies [11]. A critical issue facing the rice sector is the low productivity [1]. An output of paddy cropping at 1.3 tons/ha is low even by African standards (average of 2.5 tons/ha) and very low by Asian standards (average of 4.4 tons/hactare) [39].

Typology of Rice Farmers and Processors

Mbomba et al. [43], based on a study by Primo et al. [44] stated: "Angolan agricultural sector is dominated by family farms which represent almost all production units, since the business units represent only 0.2% of the total. In terms of area occupied, the situation is slightly different, the business units occupying about 40.7% of the area. As a result of this duality between number and area, the average area of family units is quite small, about 1.37 hectares that contrasts with the 515.1 hectares of the business sector".

As in other Sub-Saharan African countries, (Uganda, Tanzania, Nigeria, Mozambique and Ghana) most of the rice produced in Angola is under the control of small farmers [45]. These small farmers, maneged by women, men and young people, produce rice mainly for domestic consumption and the surplus, if it exists, is sold at local markets or directly to the final consumer. Some of them exchange their surplus rice production with the seed for the next agricultural season.

Kilimo [46] classifies rice farmers into three categories:

1) Small-scale farmers who constitute about 80% of all the rice farmers and cultivates less than 2 hectares of land using rudimental technology

2) Medium-scale farmers who constitute about 15% of all rice farmers and cultivate between 2 and 6 hectares of land using variable technology

3) Large-scale farmers who constitute about 5% of all the rice farmers and cultivates over 6 hectares of land normally included in rice irrigation schemes using more advanced technology

In spite of this typology, most rice farmers cultivate less than 1 hectare of land according to the author.

Although the total number of farmers engaged in rice cultivation is unknown, official sources from the Institute for Agrarian Development (IAD) estimate that in the agricultural campaign of 2015/2016 about 1,269,159 families were involved in Family Farms Holdings (FFH), cultivating maize, rice, beans, massambala (*Sorghum vulgare*) and potatoes. The same report highlighted the numbers of Entrepreneurial Agricultural Holdings (EAH) which were about 12,892 [38]. The productivity reached for rice cultivation in the same year was 1.23 tons/hectare in FFH and 2 tons/hectare in EAH [47].

Table 1 describes the six large-scale farms existing today in Angola with rice production areas ranging from 2,000 to 10,000 hectares. All the farms are state property, except Rice Kamacupa Society that is private [48].

Designation	Total available area (ha)	Total cultivated area (ha)	Location
Sociedade Arrozal de Kamacupa	2000	500	Kamacupa-Bié
Fazenda Longa	3000	1500	Cuando-Cubango
Fazenda Agro-Industrial de Sanza-Pombo	10, 000	5000	Uige
Fazenda de Ombandja	5000	2000	Cunene
Capanda Polo Development Society	300	100	Malange
Fazenda Agro-pecuária	10000	6000	Moxico

Table 1: Presentation of large-scale rice farms existing in Angola.

Most of these farmers are sponsored by GESTERRA (Arable Land Management is a public limited company incorporated in 2004 by public funds and protected by the Angolan Ministry of Agriculture) and CAMCE (a subsidiary of the China National Machinery Industry Corporation, proposed to Construct mills) [48].

In the years 1960-1970, before the armed conflict, the country had 26 rice processing factories in full operation with production capacities varying from 1 to 12 tons in 8 hours [11]. Table 2 shows the existing rice mills factories in Angola that, are still inoperative as result of the conflict.

Currently paddy (what has been harvested from the field and threshed but not yet milled) is hulled manually, using a mortar and pestle. Each rice-producing family has one of these artifacts, which process almost 90% of the rice produced. Normally rice processed in this way is only for own consumption, because the quality of the final product is not attractive in the market. Most consumers prefer imported rice [38].

In some regions, such as Moxico and Lunda Norte, paddy rice is sold to local or regional traders who use small local mills to process it. Some paddy production is also sold directly to mill owners, who in turn sell their processed products to merchants and rural families.

There is a very limited value addition, particularly in the hulling stage, because most small factories have antique and low quality processing machines generating a high percentage of broken grains (The price of hulled rice is more or less:

Price of hulled rice=(price of paddy) × (1/hulling ratio) + hulling costs) [38].

Province	Number	Production capacity (tons/8 hrs)	Location
Benguela	1	1	Lobito
Bié	7	1-12	Kuito, Catabola, Kamacupa
Cuanza-Sul	3	1-3	Gabela, Seles
Lunda	2	2-10	Minungo, Saurimo
Malanje	4	2-10	Malange, Capunda, Songo, Katepa
Moxico	3	4-12	Cavungo, Vila Luso, Lumeje
Huila	2	3-8	Lubango, Dongo
Zaire	4	2-3.6	Damba, Negaje, Sanza-Pombo, São Salvador

Table 2: Rice mills inoperative factories existing today in Angola.

At the level of the Angolan agribusiness sector, there are 4 units of rice mills in operation. One in Sanza Pombo (Uíge) with a capacity of 1,200 tons/month, two in Malanje and in Cuando Cubango with processing capacity of 40 tons of rice per day each, and one in Bié with a capacity of 3,800 tons/month [47].

The rice produced in these units is packed in 50 kg to 100 kg bags and most of it is supplied to the armed forces in the provinces of Benguela, Luanda and Moxico. In addition, they provide seeds to local farmers through the Agrarian Development Station (ADS). The idea of the entrepreneur is to buy rice from small farmers as a way to encourage them to increase the area of cultivation. Some medium and large processors pack and sell their rice, practicing prices that vary according to the needs and the purchasing power of local markets [38].

Respective roles of women, men and youth

Men and women farmers have different responsibilities in the rice production systems. Their tasks vary from region to region. According to FAO [49], women play an important role in the food security process, as they form the majority of the workforce in agriculture [50]. Women are also involved in all aspects of the rice value chain, particularly planting, weeding, bird scaring, harvesting, processing and trading. On the other hand men are mostly involved in the land preparation works. Both, men and women are engaged in rice harvesting and threshing [51]. Although women are the key factor in the value chain process, their contribution is often neglected in terms of salary, access to credit, and decision-making compared with men. So, an effective strategy could be the promotion the role of women in decision making, awarding them dignity and esteem [50,52].

Rural life is becoming increasingly less attractive to young people who are less involved in rice production. Most of the youth prefer to seek jobs in urban areas. Low profitability, poor security of land tenure and high risks are just some of the reasons why youngsters are leaving rural areas to seek jobs in cities. This causes a danger to future production and food security [53]. Growing youth unemployment, ageing farmers and declining crop yields under traditional farming systems requires engaging youth in agriculture a high priority [53,54].

A study conducted by Lewis and Wilson [39] in Tanzania, Ghana, Mali and Nigeria showed that small farmers have limited access to market-focused value chains. Their main selling points are the small traders, and many of them are farmers who buy paddy for the purpose of seed (which, frequently, is sold below the fair price). Poor road access and long distances from major urban markets are further barriers that impede not only small farmers becoming larger, but also the development of more trade-focused companies with stronger linkages to markets. Overcoming these obstacles would further facilitate the adoption of technology, which in turn would increase productivity.

Map of farm types with rice production systems and agricultural zones

The sections; Rice production systems and Typology of rice farmers and processors describe the agents of the solution and the constraints they face

Limiting Factors

a) Climate, land, soils, water

b) Legacy of insecurity-thin infrastructure development in areas formerly held by UNITA

c) Farm structure

d) Farm location with respect to markets and role of transport costs in inflating input costs and deflating output prices on farm

e) Macro policy-what has been the behavior of the real exchange rate?

f) Are there input price distortions-seed, fertilizer, water, machines?

The problem of rice production in Angola is already well studied; therefore it is only necessary to enter the phase of practical realizations. From the colonial past when the country was producing for export, the seed problem was already considered to be one of the most pressing, with high percentages of cracks outside world standards, lack of purity of variety, presence of foreign seeds in lots that caused the occurrence

of many red berries, which commercially devalues the product. Presence of savage forms of rice that stay on the ground and also contribute to adulterate the cultural variety. Today the official services do not have an organism for seed certification, so it has been the responsibility of the producer to obtain his own seed [11].

In other hand the thin infrastructure development as a legacy of insecurity in areas formerly held by UNITA; the farm location with respect to markets, the transport costs, the behavior of the real exchange rate causing input price distortions, namely in seed, fertilizer, and machines, the fragmented rice value chain, lack of adequate rice milling facilities; high production costs; poor infrastructure; lack of adequate human resources in the value chain and inadequate policy environment. These and others are some of the main factors limiting the increase in rice production in Angola. Despite these challenges, it is possible to transform the Angolan rice sector into a competitive, income and employment generating sector.

Strategies for Rice Development in Angola

a) Eliminating macro bias (e.g., the real exchange rate)

b) Closing the yield gap on small farms

c) Closing the land use gap on large farms

It is essential to conduct studies on rice production, industry and trade, and there are several models that can be taken as references. Some such as those from FAO [55] were used in many sub-Saharan African countries and the results were promising.

Considering the situations of rice cultivation in Asia, and in African countries such as Tanzania, Ghana, Uganda, Mali, Nigeria and Kenya in terms of production, industry and trade [46,56,57] it is useful to try to identify the analogies and differences that result if we compare the rice activity of Angola and those countries.

When we look at the situation of rice in these countries, we can see that the lines of action that currently are widely adopted are:

a) Adaptation to Irrigation

b) Increase in the use of fertilizers

c) Study of varieties adapted to the environment

d) Establishment of the most rational pricing policies

Regarding these items, we have already tried to give a detailed account of the way in which they have been tried to solve them. So it seems to us of great interest to compare such solutions with the rice policy of Angola, in what concerns promotion and commercialization.

In Ghana, the model used to promote sustainable rice production consisted in using a combination of strategies including different times of planting, water management control practice, use of fertilizers, choice of rice variety to plant, and use of herbicides [58]. Mali created a Participatory Modelling Applied to Seed Systems involving different stakeholders (farmers, FOs, NGOs, research groups, seed growers, etc.). The model allows, to simulate favorable mechanisms for conservation, maintenance and use of varietal diversity in family farming systems [59].

In Uganda the increase in production of rice is attributed to a combination of factors such as: appropriate government policy, intensive promotion of the commodity, availability of improved rice varieties and other relevant technologies and the increased consumption of rice driven mostly by rapid urbanization as well as the relatively high rate of population growth [46].

Based on those positive political will and interventions that produced outstanding achievements we understand that to realize the potential and capitalize on the current demand-driven production momentum for Angola, there is a need to inject adequate technological and financial investments into the rice sector. Such investment in innovation platforms would galvanize the whole value chain and the resulting scaling-out of relevant technologies would ensure sustainable rice production.

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