



AN INSIGHT INTO THE CHALLENGES OF IRISH POTATO CULTIVATION IN BOKKOS

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Abstract

Bokkos is found on the Jos plateau at an elevation of 4,400 feet it is characterized by extensive plain lands shares the same weather. Before the advent of colonialism, agricultural activities within the societies in Bokkos was generally small scaled, overwhelming emphasis was on subsistence production, the people cultivated crops ranging from cereals, root crops and vegetable.. Irish potato (solanum tuberosum) is cultivated in 140 countries and more than 100 of those countries are located in the tropical and Sub – Sahara Zones. Annual world production stands at 314.75 million tones and covers 19.55 million hectares. More than a billion people worldwide eat potato. In Africa, Nigeria occupies the seventh position in terms of total potato production (840 tonnes was produced in 2007 with an average price of ₦70, 000 per tonne. Over ₦5 Billion Naira circulated in Nigerian economy from potato production, potato is cultivated in Plateau state with the highest production from Bokkos and Mangu Local Governments. Bokkos is the major producer of Irish Potato due to the existence of vast land for rainy season and mining ponds/dams and valleys for the dry season; Irish potato was introduced on the Jos plateau and Bokkos in particular by Europeans mostly the miners in the later part of the 19thc and the early part of the 20thc. Since then Irish potato is being cultivated in a commercial quantity in most parts of Bokkos. This study found out that Irish potato cultivation in Bokkos has been faced with numerous challenges such as climate change, storage, diseases etc. ways of mitigating these challenges includes; adapting potato production to climate change, improving water capture and irrigation etc.. The study suggests that since Bokkos has the prospect of producing and supplying Nigeria and the entire west-African sub-region with potato and potato products because it enjoys the best climate favourable for potato cultivation efforts must be made by the Government in restructuring the market, improving the infrastructures such as roads, storage facilities, introducing early maturing potato varieties etc.

Keywords: Challenges, Irish Potato, Cultivation

Introduction

Bokkos is situated at an elevation of 4,400 feet, or 1330 meters, on the Jos plateau¹. The Ron villages are characterized by an intense plain region with sporadic hills, but the Kulere and mushere areas are primarily mountainous ² Bokkos is bordered by Barkin-Ladi to the north, Wamba in Nassarawa state to the west, Qunpan to the south, and the Mwaghavul people (Mangu) to the east. Bokkos is 1,682 kilometers in total area.³

Like the rest of the Jos Plateau, Bokkos experiences similar temperatures, precipitation patterns, and flora. February through April is the hottest month, and December through January is the coldest.⁴ The average annual rainfall is 58 inches, with the majority of the rain falling between June and September. The temperature is 21 degrees Celsius, with winds of 13 km/h and 8% humidity. The soil rarely stays wet for longer than a few hours, making it ideal

for growing temperate crops like maize and potatoes.⁵

The economic systems of the Bokkos were historically small-scale and relatively homogeneous, meaning that economic functions were neither specialized nor distinct from other societal functions. Despite this, there was a great deal of variation in the kinds of economic organizations, the degree of technology, the dependability of production, and almost every aspect of life. Similar to neighboring communities,⁶ there was a strong focus on subsistence production, a lack of machine technology, and no larger-scale resources or manufacturing for the market beyond the local level.⁷

In Bokkos, where agriculture was the predominant occupation, agricultural activity was mostly determined by natural phenomena like rainfall, temperature, and climate, as well as shifting cultivation.⁸ The crops that the Bokkos people grew were vegetables, cocoa, yam, sweet potato, and risga;

among the cereal crops were acha (hungry rice), millet, guinea corn, and Tamba.⁹

Introduction of Irish Potato as a Cash Crop in Bokkos.

The Irish potato (*solanum tuberosum*), which was discovered in Chile 1300 years ago, is thought to have originated in South America, according to records from archaeological sources. It was discovered in Peru and Bolivia 900 years ago.¹⁰ Irish potatoes were a mainstay of common people's meals across Europe. After rice, wheat, and maize, potatoes are the crop with the fourth highest yield in the world.¹¹ Approximately 126 countries farm the crop, with over 705 of the world's potato acreage being in Europe and the former Soviet Union.¹² The nutritional value of potatoes is strong in vitamin C and carbohydrates.¹³

In the late 19th and early 20th centuries, Europeans most notably the Germans in Cameroon and the tin miners in Jos began bringing Irish potatoes to Nigeria.¹⁴ Following the conquest and establishment of colonial rule in Bokkos societies, the colonial government realized in 1938 that temperate crops, like potatoes, could thrive on the Jos plateau. Therefore, they began a systematic introduction of the crop by giving farmers seedlings, which the majority of farmers

rejected.¹⁵ A few years later, the farmers realized the crop's economic value and developed an interest in cultivating it; however, the amount of seedlings they received was woefully insufficient.¹⁶ Its production increased from 180 tons in 1940 to 1,732 tons in 1944 through variety testing and adaptation, which included crop multiplication. In 1954, production reliant on rain-fed agriculture yielded 1,440 tons, with an additional 360 tons coming from dry season farming.¹⁷

During the interwar period, the colonial political and military personnel in the west African sub-region produced demand for potatoes, which led to an increase in the Jos plateau's yield of potatoes.¹⁸ The post-independence era saw a sharp rise in potato production, primarily due to the expansion of the middle class and advancements in transportation. Following Nigeria's independence, the colonial government's pre-independence increase in potato production persisted until 1970, when the northern region's ministry of agriculture helped the Jos and Pankshin native authority import fresh seedlings from the United Kingdom for direct distribution to farmers in specific areas, including Ron land (Bokkos).¹⁹ Since then, Irish potatoes have been grown commercially in every region of Bokkos with the exception of Mushere and Kulere land, and they have become the main source of income for the local population.²⁰

Table 1 below shows the increase in potato production in Nigeria from 1940 to 2006.

Year	Tuber Yields (Tonnes per hectare)	Total Land under Productions	Total Production (Tonnes)
1940	6.0	30	180
1944	6.0	290	1,732
1954	6.0	300	1,800
1964	6.0	405	2,430
1973 – 77	5.0	9,600	48,000
1977 – 83	5.2	10,000	52,000
1983 – 84	5.0	14,000	70,000
1985 – 87	10.0	20,000	200,000
1991	10.0	40,000	400,000
2001	12.0	50,000	600,000
2006	13.6	55,000	750,000

Source: National Root Crops Research Institute Umudike 2009.

Potato Production in Nigeria

Statistical Data on Nigerian agriculture and especially Irish potatoes is scarce, sometimes contradictory and not always reliable. This fact makes it difficult to present a serious estimate on harvested and marketed

potatoes. The table below draws on data published by FAO, by the National Root Crop Research Institute (NRCRI) and by a Nigerian consulting firm Smal-Konsult.

Table 2: Nigerian potato production and consumption:

Parameters	FAO Official Data ³ (2008)	NRCRI Estimate (2010)	Smal-Konsult Estimate (2012)
Land area cultivated	263,000 ha	295,000 ha	300,000 ha
Annual Production	1,105,000 tons	1,475,000 metric tons	1,500,000 tons
Average yield per ha	4.2 tons	5 tons	5 tons
Potato consumption in Nigeria	502,000 tons	1,030,000 tons	1,175,000 tons
Annual consumption per capita	3.3 kg	6.5 kg	7kg
Total import (ware, seeds and processed potatoes)	40,000 tons	60,000 tons	No data available
Total export	No data available	30,000	No data available

Source: Economic Development for Peace and stability in Plateau state-Promotion of Potato value chain in Nigeria Abuja Nigeria September, 2014

For 2008 the FAO counted an annual production of 1.1 million tons on an area of roughly 260,600 ha resulting in an average yield of 4.2 tons. Then within 4 years' time this modest yield increased slightly to reach 5 tons per hectare in 2012 which remains one of lowest yields on Irish potato plantation worldwide. The major reason for such a low output is the scarcity of certified seeds. Because clean seeds are not available most of the potato plants under smallholder production potentially carry diseases.²¹ The result is lower yields averaging only 5 tons per hectare instead of 20 tons that could be achieved by progressive farmers. The table also reveals that annual consumption per capita of Irish potatoes has more than doubled between 2008 and 2012. Today, most of the potatoes marketed are consumed as fresh potatoes by end-consumers. However, in Nigeria like in many other developing countries, a change in demand patterns can be observed. Consumer demand is shifting from fresh tubers to processed products and ever greater quantities of potatoes are being processed to meet rising demand for convenience food and snacks. The major drivers behind this trend include expanding urban populations (Nigeria is one of the most heavily urbanized countries in the West-African region), rising incomes, diversification of diets, and lifestyles that leave less time for preparing the fresh product for consumption.²² The local fresh potato markets including retail shops are the main destination of the production. Only a minor part of the production goes into potato processing, although future trends show an increased demand for processed products.

Compared to the major crops cassava, yam and sweet potatoes the cultivation of Irish potatoes only

plays a tangential role in Nigerian national food and nutritional security. In 2012 the annual production of Irish potatoes represented 1.15 % of the total output of root and tuber crops in Nigeria (FAOSTAT). To date, Irish potatoes are grown by some 400,000 farmers on about 300,000ha. Around 90% of the production is done by small scale farmers that own less than 1 ha of land and carry out their operations manually with traditional farms tools like hoses and machetes. Main reasons for this low mechanization rate are the high costs of renting coupled with the fact that the machines are not readily available.²³

Average yield for smallholder potato farmers is very low and ranges from 4 to 6 tons/ha. Even though yields have slightly increased in recent years, through training of famers and the import of improved seeds, they represent only 20% of what could potentially be achieved on the cultivated areas in Plateau state. In general the application of good agricultural practices remains suboptimal. Especially the use of tractors for soil preparation, planting, ridging and harvesting is very limited among the majority of the farmers which leads to reduced efficiency and lower yields. Farmers barely keep written records of production and marketing practices and tend to ignore market signals for better quality potatoes. As a result, good crop management, involving the appropriate and efficient use of inputs, such as good-quality seed, is seldom practiced.²⁴

Cultivating Potato in Bokkos.

Land preparation, planting, cultivation, and harvesting are generally done manually. Lifting is done manually between March and July in preparation for the (rain fed) rainy farming season while manual lifting of the land

usually takes place between September December in preparation for dry season farming before temperatures rise too high. In cultivating potato, land preparation begin by ploughing the land and forming ridges (i.e. for rain fed farming) while the dry season farming does not require ridges.²⁵ after ploughing and ridging small hoe is used to open holes/trenches of 3 inches deep and 10-12 inches apart, fertilizer is then applied inside the trenches dug before or after planting the seedlings depending on the method the farmer is familiar with, the seedlings contains buds that are usually planted facing the sun which eventually sprouts into plants.²⁶

The planting period of rain fed potato spans between the month of march through the end of the month of July and the harvest takes place three or four months later i.e. between May and September depending on the variety, while the irrigation fed planting starts from late September to early January and the harvest spans between December to April depending on the variety and the availability of water²⁷ Potato grows well in deep arable fertile soil that have good water retention capacity as compact soil reduces root and tuber development and may cause tuber deformation, It is best suited in to a sandy loam or a soil that is well drained, very sandy soil may require extra watering to maintain adequate soil moisture.²⁸

After planting and watering, potato is weeded to reduce competition with weeds and also to get rid of weeds that act as alternate host of insects and pest like aphids , weeding is done when the crop is between 10-25 cm high and within 4-5 weeks of planting , potato crop requires cold climatic condition , it grows well in temperature between 150-250⁰c, well drain soil rich in organic matter, loam and sandy soil are most suitable for tuber development, it prefers slightly acidic soil having 5.2 -6.0 PH and does not tolerate alkaline depending on the weather and variety.²⁹ it takes potato between eight to twelve weeks to mature and ready for harvest.³⁰

fertilizer application for irrigated fed potato is usually done after cultivation and planting of the potato seedlings, the fertilizer is then spread on the entire farmland, similarly, fertilizer application for the rain fed potato is done in two ways, firstly fertilizers can be spread in between the ridges before cultivation takes place, afterwards potato seedlings are planted on it, the advantage of this kind of application is that the potato is planted on top of the fertilizer and it serve as a great

energizer to the crop which enables it to germinate immediately when it come in contact with rainfall, the second method takes place only when the potato seeds have been planted and the fertilizer is applied on top or it can be delayed until during the process of weeding. The fertilizer that best suites potato and gives higher yields is the NPK 20:10:10. Fertilizer trials have revealed very limited response to potassium, a fertilizer recommendation for most potato areas of 22.6 kg. Superphosphate and 125 kg. Ammonium sulfate. (ASTC recommendations: 192kg Nitrogen, 50kg phosphorus and 50kg potasium per Ha). Organic manure is widely used when available. Potato is normally intercropped with maize which suppresses yield. Crop rotation is hardly practiced, Best agronomic practices are hardly followed, Crop rotation does not follow any set pattern as farmers adapt to their specific conditions.³¹, as well as other states including.

Marketing

Farmers bring their potatoes to village markets and sell them either to local merchants or to dealers who in turn transport the produce to urban markets. The five leading local markets in plateau state in order of importance are Maikatako, Bokkos, Ampang West, Mangu and Daffo. Other important transit markets within the state include Building Materials Vegetables market and Farin Gada vegetables Market, all in Jos. Potatoes are sold in urban centers in the north, near the production zones, and in more distant northern and southern cities. The major ones being Lagos, Abuja, Porthacourt and Maiduguri (potato is marketed in almost all major cities especially the various state capitals). The absence of effective storage facilities for ware potatoes is an important constraint on their distribution.³²

Peak supply is from June – August for Bokkos, August -December for Mangu and January – April again for Bokkos. Potatoes can be found in the market at other times of the year, considered as off season (April – June) but normarlly at higher prices³³

Wholesale Markets

Nigerian potato wholesalers are mostly merchants/dealers who normally come from the major cities or use their agents to organize bulk procurements for onward distribution through supplies/export or sale to retailers for onward retail marketing. Primary wholesale markets are found near the main harvesting

areas in Plateau state and major secondary collection markets are located in the large urban areas such as Abuja, Lagos, Port Harcourt, Ibadan, Kano, Sokoto, Maiduguri and Jos. The two major primary collection markets in Plateau state are Maikatako and Bokkos

together are handling over 50% of total potatoes traded on wholesale level. The table below compares the turnover (estimated figures) of the major primary collection markets in Plateau state for the years 2012 and 2014.³⁴

Table 3: Estimated turnover of Plateau state collection markets for 2012 and 2014

Markets in Plateau State	Turnover in tons		2012 turnover	2014 turnover projected	Change in %
Peak season	Off-season		Total	Total	
Maikatako, Bokkos LGA	33,600	11,400	45,000	19,540	- 57%
Bokkos, Bokkos LGA	27,720	12,600	40,320	17,943	- 55%
Daffo, Bokkos LGA	15,960	2,700	18,660	11,970	- 36%
Mangu, Mangu LGA	16,200	5,760	21,960	13,725	- 37%
Ampang – West, Mangu LGA	19,440	10,080	29,520	18,150	- 38%
Total	112,920	42,450	155,460	70,263	- 48%

Source Economic Development for Peace and stability in Plateau state-Promotion of Potato value chain in Nigeria Abuja Nigeria September, 2014

Projections for 2014 were made after about 75% of the peak season harvest had been brought in. Findings show that the turnover in 2014 was likely to drop significantly by almost 50%. This was mainly due to the outbreak of the “potato late blight diseases” in almost all the potato producing LGAs especially Bokkos and Mangu (the two leading potato producing LGAs in Nigeria).

Many primary as well as secondary collection markets require physical improvements. Often market places handle far more tons of produce per year than their capacity would allow for. This situation has resulted in high congestion and an overflow into surrounding areas causing very poor hygienic conditions. In addition the poor maintenance of many markets and improper handling of produce has resulted in high marketing losses. Pictures below show Maikatako market located in Plateau state³⁵

Retail Market

Urban Retail sector

In the 1980s and 1990s Nigeria decided to attract foreign direct investments into the country. Attractive investment incentives such as full capital mobility/repatriation were provided and enabling

policies like foreign exchange liberalization and independent monetary policy have been established. As a result more and more foreign retail chains have penetrated into major Nigerian cities over the past years. Their penetration enabled the formal retails sector to expand very rapidly with strong growth in value sales. Leaders of this expansion drive include Shoprite, Africa’s biggest retailer, Spar, Europe’s largest retail network, and Massmart, South Africa’s second –largest retailer. Shoprite opened its tenths shop by the end of January 2014 with many more underway. According to Whitey Basson, Shoprite’s CEO, the retail chain plans to increase the number of stores in the country by 25 by the end of 2015.

The entrance of international players in the formal retails sector is gradually creating a new business paradigm in Nigeria. Prior to now, informal markets were predominant in the country, with a bargaining culture determining prices. Nowadays these new retail outlets are changing the face of retailing.³⁶

Factors responsible for the expansion of Irish Potato production in Bokkos
Availability of Fertile Land

Bokkos's large, plain, and fertile land is a major factor in the growth of Irish potato production. The Bokkos people can cultivate as much land as possible because of the large expanse of land. Irish potatoes are cultivated three times a year: in April and May for the first planting, in July and August for the second, and in October and January for the dry season. If there is a shortage of land, however, all of those plantings may not be possible.

Second, dry season cropping can be done in mining ponds that were left over from colonial mining operations. In a similar vein, Amalgamated Tin Mines Nigeria (ATMN)'s earth dams have made a significant contribution to Irish potato output. The areas surrounding the dams and mining ponds are now crucial irrigation locations for the cultivation of potatoes in Ireland. As a result, farmers who are close to the ponds are now comparatively wealthier. However, those whose farms are a bit further away occasionally had to settle for purchasing several meters of pipes in order to be able to pump water from a distance to their irrigated potato farms; the high cost of pumping water has little bearing on their harvesting profits.³⁷

More significantly, the presence of valleys and streams has greatly impacted the production of Irish potatoes. These features cut through all of the villages in Bokkos, and the locals use sacks filled with sand to block the waterways along the valleys and streams in order to trap the water used to irrigate the Irish potato farms and ensure a steady supply of water for them throughout the irrigation season.

Improved Seedlings:

As has already been mentioned, the first Irish potato seedlings sent to Bokkos during the colonial era were from Britain. Before 1960, planting of foreign types that were deteriorated and ill-adapted contributed to the low yields of potatoes in Ireland³⁸. The government carried out the colonial government's potato multiplication program until 1970 after gaining independence. The early success of Nigeria's potato crop was largely due to the seed multiplication project.³⁹

The market for potato seedlings grew along with the demand for potatoes. In response, the Pankshin Native Authority and the Ministry of Agriculture Jos created two seed multiplication programs: one at Ta-hoss for the dry season variant and one at Riyom for the rain-fed version.⁴⁰

Four rounds of seed multiplication were carried

out. The first stage entailed importing grade "A" potato seed from the United Kingdom. Every year between March and April, two to three tonnes of seed were imported and kept in storage until it sprouted. The imported seeds were multiplied in government farms in Riyom during the second stage, which ran from May to September. The government farm's second round of seed multiplication under irrigation was the focus of the third stage. In charge of Ta Hoss irrigation program was the Ministry of Agriculture. Distributing the mutated seeds to farmers under irrigation was the last step. The plan was successful and aided in the early growth of Nigerian and Bokkos plateau states' potato output.⁴¹ In 1976 a potato research station was established at Kuru, in Jos South Local Government Area. The station was established to address the problem of climate adaptation of the crop, low tuber yields and inadequacy in the supply of the crop in the country.⁴² A number of European varieties were introduced into the country through different sources; some of these varieties include **Pinpernel, Ackersegem, Dekema and Ros in Eburu**⁴³. In the 70s another set of potato varieties were introduced from Europe by the Benue –Plateau Ministry of Agriculture, these varieties include **Ajax, Morka, Spunta Nicola, Desiree, Damant, Dan – Cameroon, Alpha Br 63 – 18, Br 63 – 15, Cardinal and Baraka**. Some new varieties were also developed between 1973 –1976 through breeding by Mister. D.R. Suchomel which includes **RC767 – 4, RC767 – 2, RC777 – 2, RC777 – 3, RC776 – 3**.⁴⁴

These varieties were popular among farmers because of their high yields, from that year no further importation of potato varieties were made until 1986 when the following set of potato varieties were imported by Plateau State Ministry of Agriculture: **Kondor, Bertita, Delcora, vento, Famosa and Romano**⁴⁵ The research station also conducted collaborative studies with the International Potato Research Center and the Netherlands Potato Research Institute. As a result of these collaborations, farmers were able to choose new high-yielding varieties on a regular basis by selecting adapted genotypes that were selected, multiplied, and sent to them. One kind that was recently chosen is called "Okwonkwo." Similar to this, the most recent selection called as "Yellow" because to its leaves is producing a high yield.⁴⁶

Improved Farming Techniques

The production of potatoes in Bokkos has significantly increased due to advancements in growing practices. A semi-mechanized farming system has taken the place of the previous one, which used traditional implements. This approach has been improved by utilizing a mechanized method that includes a ridge that is 75 meters apart for production during the dry season, a plough, and a harrow. Over 90% of the farmers in Barkin Ladi, Bokkos, and Mangu use tractors in addition to huge hoes to augment ground preparation, allowing them to cultivate additional hectares of land.⁴⁷

Farm inputs are widely available, which has greatly improved Irish potato production in Bokkos. Currently, farmers can choose which high-yielding potato varieties to plant; for example, they can choose between Kondor, Rashin Ruaka Bertita, and Nicola for dry season farming, or they can choose between Nicola and Diamant for all-season production.

Farmers are advised to utilize several fertilizers for farm maintenance. These include NPK 15:15:15, which comes in 400 kg or 8 bags per hectare, or 100 kg N, 100 kg P, and 40 kg K, which is generally advised for Butura and the Jos Plateau.⁴⁸

Between the fourth and eighth weeks of planting, weed management can also be done chemically or manually. The fourth week of weeding is done manually by pulling the weed to prevent damage.⁴⁹ Chemical control: Several pesticides are used for pre-emergence, including Lasso/Atrazine and Galex. In potato farms, however, basagram is sprayed on controlled weeds after they emerge.⁵⁰ Using the manual approach has become much less stressful as a result of this. Among the fungicides utilized are Ridomil MZ, Bestan, Cone Capravit, and Bresta.⁵¹

Marketing;

Over 80% of the potato produced in Bokkos is transported out of Plateau State to other states most especially Borno, Yobe, Lagos, Port Harcourt, Abuja and Kaduna, neighbouring countries like Tchad, Niger, Cameroon also benefit from Bokkos potatoes. The famous Maikatako, Bokkos and Daffo markets have been serving the purpose of providing an avenue for Bokkos farmers to sell their Irish potato after harvest. Because of the existence of these markets, the local assemblers who hitherto buy the product directly from the farm are dislodged; they are no more relevant as every farmer prefers to take his product direct to the

market. This has made it possible for the farmers to sell their products at a very good and reasonable prize.

The Impact of Irish Potato Cultivation on the Economy of Bokkos

Irish potato production has had a significant impact, particularly on Bokkos land's economy. This may be seen from the following angles:

1. Creation of Employment:

Irish potato production has assisted in generating employment to the generality of Bokkos people in the following ways;

- a. **Farmers:** Potato farmers are among the wealthiest people in Bokkos; they grow and sell potatoes at least three times a year⁵². As farming techniques and inputs have improved, farming has become easier, which has significantly decreased unemployment. However, some farmers had lost interest in the profession and were on the verge of giving up the farm in search of more lucrative endeavors.⁵³ Given that every week, an average of 50 trucks, each carrying an average of 600 bags of potatoes, leave Maikatako market to travel to other regions of Nigeria and several West African countries, an average of 90 million naira passes into the hands of the Bokkos people.⁵⁴
- b. **Retailers** – Often referred to as commission agents, or yan chuwa-chuwa, these individuals purchase goods in small quantities and resell them at the market. Acting as a middleman between producers and large, distant buyers, they are neither producers nor buyers, but every market day they return home smiling with a respectable sum of money.
- c. **Transporters--** Transporters are essential to the Irish potato industry because they move the product from the farm to the local market and beyond. Since this is how they support their families and make a living, truck and long haul owners also profit from this transportation of the product.
- d. **Other Businesses--** It's crucial to remember that the production of potatoes in Ireland has spawned other industries. For instance, the sale of agricultural inputs like fertilizers, insecticides, herbicides, and fungicides has

grown to be a very successful industry in Bokkos.

2. Effective Utilization of land:

Some Bokkos people lost their lands due to tin mining, but with the introduction of Irish potato production, these ponds and lands—which were once thought to be unimportant—became the most valuable because of their proximity to water, which makes it easy to cultivate irrigated lands. This has turned out to be a blessing in disguise, as the previous calls for the lands' reclamation have significantly decreased. Similar to this, Bokkos has effectively used its valleys, streams, and water; no terrain, no matter where it is located, is "waste" or useless.

3. Food Security

Food security has resulted from the production of Irish potatoes, which are a staple food for the Bokkos. Eighty to ninety percent of the crop is sold to fund the purchase of other food items not grown in the region, and the remaining proceeds are used to pay for other necessities for the household. As a result, the average Bokkos person is now secure in terms of their access to food. Similarly, Buturaland has not had a documented occurrence of hunger in the previous 35 to 40 years.⁵⁵

4. Labour Migration

Irish potato production has brought about the lowest possible level of labor migration in Bokkos. Young, healthy, and physically fit individuals who would have otherwise relocated to the township in search of work have instead chosen to remain in Bokkos when they consider the higher wages associated with Irish potato cultivation. Owing to the advantages, high-ranking government employees have also entered the Irish potato industry, hoping to augment their family's income.⁵⁶

5. Women Empowerment

Irish potato has also played a vital role in the economic empowerment of Bokkos women. During the pre-colonial and colonial era, women were not allowed to own property as, all she own belongs to her husband, that is why even at the point of divorce the woman must surrender everything she has laboured for in favour of the husband.⁵⁷ but that is not the case now because after colonialism things began to change, that is why Bokkos women are deeply involved in farming especially Irish potato where they make their fortune. They are also involved in marketing the crop, a survey in the Maikatako market reveals that 70 – 80% of Irish potato

retail marketers are women, the retail business has in no small measure contributed to the economic emancipation of the women. Between the early 80s and early 90s most of the pick-up vans found in Buturaland that were used in conveying Irish potato to the local markets and Jos were owned by women⁵⁸. The Bokkos women are empowered that their market tentacles are not restricted to Bokkos alone, but spread all over the local government, such as Mangor, Manguna, Kwatas, Tangur, Daffo, and Mbar. They are also the major retailers that buy the crop from Mangun, Ampang and Kerang towns in the neighbouring Mangu Local Government Area⁵⁹

Problems/Challenges of Potato Cultivation in Bokkos.

Climate change

Due to changes in temperature and water regimes, potato yields have declined and are expected to decline even further in sub-Saharan Africa. Global climate change has had a significant impact on variations in the availability of water resources. Due to climate change, water supplies are becoming scarcer in many places. Potatoes, more than other crops like wheat, are sensitive to soil water deficits and require regular irrigation, particularly when the tubers are growing.⁶⁰ The necessity for irrigation of potato crops increased in Bokkos due to shorter or less frequent rainfall, for instance, there are less arable lands available for rain-fed potato farming, and there has also been a decline in total rainfall. The changing seasonal rainfall pattern has presented challenges for potato cultivation as well. During the farming season in 2016, rainy seasons began by the end of March, while in 2017 they started towards the end of April. This resulted in shorter growing seasons for potatoes under irrigation and rain-fed conditions, which in turn caused shifts in the areas where the crop can be produced profitably.⁶¹

Challenge of storage

After harvesting, Storage of potato is one of the major challenges faced by farmers in Bokkos, the ultimate goal of storage is

- i. To ensure the potato retains the natural water in the tuber.
- ii. To ensure that the potato hold the respiration rate to a minimum level.
- iii. To hold reducing sugar level in the potato to zero.

- iv. To maintain external appearance of the potato tuber.

Rainfed farmers sometimes sell their products below cost, resulting in significant losses. This is caused by inadequate or nonexistent storage facilities, which forces farmers to sell their crops at any prevailing price after harvest.⁶² A small percentage of farmers are fortunate to have constructed a few modest additional rooms that are used and designated as local storage facilities by spreading out throughout a space and ignoring other elements that must be taken into account, such humidity and temperature.⁶³ Because this does not provide the desired outcome, the bulk of farmers who are unable to continue farming and do not have a place to store their goods are left with little choice but to compel sales at any price. For most farmers, this has been a huge setback; those who suffer significant losses are often forced out of the industry.

Farmers that grow rain-fed potatoes are particularly impacted because these potatoes are more sensitive and are typically harvested during the rainy season. For farmers without storage facilities, the best course of action is to sell their produce at any price.⁶⁴ At the time this report was produced, the European Union had supported the construction of 12 potato storage facilities in the Plateau state to address the shortage of sufficient storage space. Up to 20 metric tons of seed or ware potatoes can be stored in a single "diffused-light storage (DLS)" structure for a maximum of six months. Because of this, farmers may now sell a portion of their crop at a greater price in the off-season, when there is the most demand for seed and ware potatoes.⁶⁵

Poor packaging and measurements

Currently, a variety of packaging styles are used in both wholesale and retail settings, particularly bags that come in different sizes and materials. It is extremely uncommon to measure in kg. Markets utilize a range of sizes of baskets for retail purposes. Tubers are offered in bulk and in nets weighing up to 5 kg in supermarkets and retail stores. Potatoes are frequently packaged at the wholesale level using polypropylene bags with maximum filling quantities of 50 and 100 kg. Nevertheless, many bags are overfilled and maximum filling levels are frequently ignored. It is challenging to locate and obtain comparable pricing in the absence of conventional bag sizes.

Lack of financial resources for short and long-term investment

Financial institutions, including Microfinance Banks, Microfinance institutions as well as commercial banks are generally reluctant to lend to the potato sector. This is mainly due to declining productivity, highly fragmented market, poor record keeping, inadequate storage, absence of tangible guarantees and meager value addition infrastructure. Adding to this the sector is poorly linked and lowly integrated,

Challenge of Diseases

Any interaction between a pathogen—a bacteria, virus, fungus, mycoplasma, nematodes, or unfavorable environment—and the host—the potato—that reduces the potato's ability to produce or be useful is known as a potato disease.⁶⁶ For a very long time, illnesses have been the bane of potato growers in Bokkos and other plateau state potato growing regions. Over the years, diseases that seemed incurable have caused potato farmers to suffer significant losses. Diseases have also significantly decreased potato yields and cultivation overall, and farmers who have invested large sums of money in farming have typically seen a significant reduction in their capacity to cultivate potatoes or, in extreme cases, have chosen to quit the industry. Early and late blight, black heart, black sports, black leg, bacterial soft rot, silver scurf, farum rot, farum wilt, and vaticulum wilt are a few diseases that are preventing potatoes from being produced in Bokkos.⁶⁷ The late blight disease has had a significant impact on potato agriculture, resulting in negative consequences for farmers.

Challenge of Marketing

Potato markets are poorly organized elsewhere in the globe, and Bokkos potato markets are not an exception. In certain nations, the state controls potato markets, while in others, supply and demand dictate their operations. The large bulkiness and high water content of potato tubers, along with their susceptibility to infections or physical harm, do not make them unsuitable for long-distance transportation, particularly when they are rain-fed.⁶⁸ Similar to this, farmers are compelled to sell their goods as soon as they are harvested due to inadequate or nonexistent storage facilities; yet, they also encounter a plethora of issues and difficulties there.

First, farmers bring their goods to market

knowing nothing about the price; instead, they are at the whim of the going rate, which is occasionally set by the purchasers.⁶⁹ It is customary for the prices of potatoes obtained on Mondays at the Maikatako market to range greatly from those obtained at the Daffo and Bokkos markets on Tuesdays and Thursdays, respectively.⁷⁰ This is mostly because Maikatako Market enjoys higher price stability due to its closeness and other considerations; this has been ascribed to the enormous flood of buyers who frequent the market more than any other market in Bokkos. Due to the massive influx of buyers who frequent this market more than any other in Bokkos,⁷¹ prices can occasionally increase or decrease by 10–100% depending on the factors at play. These factors primarily include the availability and scarcity of the commodity, the availability or lack of potential buyers, who are typically present or absent due to other factors like holidays like Christmas, Easter, and Salah, as well as potential ethnic and religious conflicts that may be occurring in the area where the markets are located and which inevitably impede the flow of people and goods.

Another issue that farmers encounter when marketing potatoes is the issue of intermediary men and women, also referred to as "yan chuwa-chuwa. The way the market is set up disadvantages potato farmers because they typically don't have direct access to buyers.⁷² Once at the markets, farmers sell their produce to middlemen at a predetermined price, and the middlemen then resell the produce to buyers before paying the farmers the predetermined price. This frequently leads to problems because the middlemen occasionally fail to pay farmers at the agreed-upon price, sometimes citing circumstances such as an oversupply of produce or having to sell it for less than the agreed-upon price.⁷³

The second significant issue that middlemen/women present to farmers is that, on occasion, they work with market buyers to irritate farmers by delaying purchases or resale until the afternoon, when the market is fully saturated. By that time, farmers will have become restless and eager to leave, at which point low prices will be offered, and farmers will be compelled to take whatever price is given.⁷⁴

Challenge of Depending on Natural Rainfall.

A significant obstacle to African agriculture as a whole has been the continent's long-standing heavy reliance

on rainfall. Bokos potato growers and potato production have likewise faced significant difficulties due to weather, climate, and rainfall variations. In rain-fed agriculture, potatoes are expected to be planted in early April and continue until the end of July. However, this is only feasible if the rains begin precisely by the end of March. Any delays in the rains until the end of April have an impact on the entire planting season because Bokkos consistently experiences heavy rains in June and July, which damages the potato and results in total.⁷⁵

Regarding irrigation farming, while there are several ponds and earth dams that were mostly built during the mining era by the amalgamated tin mining Nigeria limited (ATMN), these water sources are limited to specific areas in Maikatako, Kuba, Mazat, Tenti Maiyanga, etc. The bulk of Bokkos' potato-growing regions lack access to these kinds of water sources, and in the cases that they do, the dams and ponds that they build are woefully insufficient because potato growers must compete with other farmers for the same water supply that they use for growing other vegetables and crops like carrots, spinach, cabbage, peppers, tomatoes, cucumbers, onions, and so forth.⁷⁶ In the past two years, the bulk of farmers in these areas have suffered significant losses as a result of the extreme pressure placed on the dams and ponds. Many of them were unable to handle the pressure and dried up just when the potatoes were not ready for harvest and most needed water. But most of the places from Kwatas to Tangur, Mbar, Mangor, Manguna, and Daffo aren't lucky enough to have dams and ponds surrounding them.⁷⁷

Challenge of farm inputs.

While there are considerable farm inputs available, such as improved varieties, fertilizers, and improved farming techniques with tractors and herbicides, among other things, one would think that this would have greatly improved potato cultivation and production. However, this isn't the case because, for instance, the tractor services are incredibly inadequate and can't keep up with farmer demand; during farming season, farmers are seen waiting in line at the agricultural services and training centers (ASTC) in Butura to book tractor services; at times, it can take up to four weeks for a farmer to receive a tractor because the services are so inadequate. As a result, the majority of farmers still till the land manually with hoes and small hoes, which has

a significant impact on potato cultivation and production.⁷⁸ Similarly, the price of fertilizer is still not affordable, a bag of NPK 20:10:10 Golden fertilizer which is the most reliable cost between N45,000-N46,⁷⁹ other inputs such as water pumps are beyond the reach of the farmers, for farmers whose farmlands are far from the areas where water flows naturally, they need water pumps to irrigate their farmlands and small scaled potato farmers cannot afford buying such inputs. Farmers are challenged by lack of resistant varieties, almost all potato improved varieties are infected with one disease or the other most especially blight⁸⁰

Challenge of bad rural roads.

Transporting potatoes to markets is a major challenge for potato farmers; for farmers that grow in dry seasons, the challenge is lessened, but for cultivators that grow potatoes under rain, it is a constant nightmare because potatoes are typically harvested during the wettest part of the season, when vehicles are unable to get to the farms and the harvested potatoes may spend three or four days either on the farm or traveling to the markets.⁸¹

Challenge of inaccessible farmlands

While farming is still practiced in some of the towns, it is done on a small basis. The majority of the communities in Bokkos are having trouble getting to their farmlands, and the wave of attacks that have caused the insecurity in the affected areas has presented numerous challenges for the farmers. The security challenge that farmers in Bokkos and Plateau State are facing is severely taxing them as they fight land grabbers and still struggle to protect their cultivated crops from the herdsmen. For example, farmers in Yelwa Nono community in Bokkos LGA who were previously forced to flee their homes due to the bandits' persistent attacks are finding it more and more difficult to get to their homes and farmlands. Prior to being driven away by terrorists, the residents of these communities had sizable Irish potato and maize farms; however, they are currently unable to farm. The majority of them wish to return to their hometowns, but they are unable to do so due to uncertainty about the future and concerns about safeguarding their crops and lands. Because of the threat posed by Fulani herdsmen, many farmers have chosen not to plant or harvest. Many have moved away from their primary source of income—farming—and taken up new endeavors.⁸²

Challenge of strained relationships

Another major challenge of Irish potato production in Bokkos is the strained relationship currently existing between the herdsmen and the farmers. Before now most of the Irish potato farmers and the Fulani herdsmen used to have a cordial relationship this is evident from the fact that Irish potato farmers whenever they want to expand their potato farmlands they only need to notify the Fulani herdsmen on their desires to fetch from their cow dung and at no cost, this made it possible for the farmers to expand their farmland to areas that hitherto may have been considered not fertile for the cultivation of Irish potato. This in no small measure greatly contributed to the expansion of Irish potato production in Bokkos. Currently, the situation is the opposite. The pastoralists view the farmers as possible foes who pose a threat to their survival and future, hence they are unwilling to sell their cow manure to them for any price. But, the farmers saw the herdsmen as outsiders coming onto their land with the intention of destroying their crops. This undermines the possibility of peaceful cohabitation in these communities by fostering a climate of mistrust and hostility.⁸³

Challenge of loss of farming Population

One of the challenges in potato growing is the loss of farming populations as a result of illness, accident, and disability. These primarily afflict young males, leaving women and the elderly to tend to the land. Frequently, farming may cease entirely, at least momentarily, as rural communities escape violence and seek safety elsewhere. When people run, the land might be occupied by others, which would make it more difficult for them to return when peace finally prevails.⁸⁴

Way forward for potato cultivation in Bokkos.

From a distance, Irish potato farming in Bokkos appears to be a profitable venture free of difficulties, but closer inspection reveals that the industry is marked by significant dangers and difficulties. Like many farmers operating in sub-Saharan Africa, potato producers in Bokkos encounter several difficulties. These difficulties appear daunting but are not insurmountable. The following could be viewed as a path forward for enhancing Bokkos' potato output and farming.

Adapting Potato Production to Climate Change.

Reduction in yields caused by increased temperature and decreased water availability could be avoided to a

great extent by shifting potato producing areas, though competition for land between potato crop and other users could pose a challenge. Potato yields in Bokkos, Nigeria, and sub-Saharan Africa are declining primarily due to temperature and changes in water.⁸⁵

Improving Water Capture and Irrigation.

Potato requires frequent watering while tubers are growing to maintain yields, due to decreasing water availability in Bokkos, improving irrigation techniques and water capture is necessary to maintain potato crop yield without putting too much stress on the water supply, an example of an irrigation technique aimed at reducing water use which has been tried on potato is sub-surface irrigation. The overdependence on rainfall and rain water which affected potato production and yields must be re-examined, dam and ponds can be constructed especially in areas where non exist.⁸⁶ Government can also consider privatizing the constructions on the basis of public private partnership(PPP) where investors are licenced to construct dams and ponds and manage it, farmers will in return be paying a token for the water used, the ownership can later be transferred to the government, this will help both the rain fed and the dry season farmers to plant their crop at any time of the year without the fear of either the rains coming lately or ceasing earlier than expected.⁸⁷

Creating New Potato Cultivars.

To do this, standard plant breeding methods and genetic modification will be the two main strategies used to develop new potato types. These methods could be crucial in developing new cultivars that can sustain yields in the face of climate change-induced stress. A few traits that could be useful in lessening the detrimental effects of climate change on potato output are:⁸⁸

Developing Heat stress tolerance varieties

The ability to develop and maintain tuber growth and initiation under high temperature is very key. Developing cultivars with great heat stress tolerance is critical for maintaining yields especially in countries with potato production areas that are near or even exceed maximum temperature limits e.g. sub-Saharan Africa.

Developing Drought tolerance Strategy

This includes better water use efficiency (amount of food produced per amount of water) as well as potatoes that can be exposed to short drought periods and recover and produce acceptable yields, deeper root system could also be beneficial as most commercial potato cultivars needs frequent irrigation due to their shallow roots.⁸⁹

Developing Fast growth and early maturity varieties:

Potatoes that grow faster could help adjust to shorter growing season in Bokkos and also reduce the number of life cycle pest such as potato tuber moth can compete in a single growing season.

Developing/ adopting Disease resistant varieties:

Numerous viruses and insects, including nematodes and aphids, pose a significant threat to potato production regions. Additionally, a number of diseases and disorders pose significant challenges to farmers. Potatoes that are resistant to local pests and illnesses may be useful in adjusting to the spread of diseases into new regions. The several species that are closely related to potatoes (*Solanum*), many of which can be crossed with potatoes, are an important source of genetic material for developing new potato cultivars. Additionally, there are numerous *Solanum Tuberosum* types that are native to the commercially significant original habitat of potatoes and may include valuable genetic material. In order to address issues of this magnitude, the government should, through appropriate agencies and institutions, such as the National Root Crops Research Institute Umudike (potato program in Jos), be given special grants to conduct thorough research into the various diseases and provide a sustainable solution. Several hundred pests and pathogens are also known to be responsible for potato disease and yield declines. In a similar vein, the government, acting through the ministry of agriculture, ought to think about providing farmers with access to chemicals like pesticides, fungicides, and insecticides at no cost.⁹⁰

Marketing restructuring

Restructuring the market is essential to enhancing potato farming; the current state of the potato market has deterred many farmers and would-be farmers, necessitating a change in the structure of the market to maximize profits for farmers. It is necessary to

reorganize the market so that farmers can participate in negotiations and/or set the price for their goods. This can only be accomplished by redefining the middlemen's role as merely acting as commission agents with no real power to affect commodity prices.⁹¹ comparable, similar the market should take the following direction.

i. **Reorganized and refocused:** in this context, it is important to continually reorganize producers' areas of expertise, introduce processor capacity expansion, and foster the growth of the consumption of both fresh and processed potatoes.

ii. A progression and expansion from the cultivation of staple foods for sustenance, with surpluses going into the market through barter and commerce.

iii. Expansion of developed markets where high value after-farm and easily consumable food components will be essential attributes.⁹²

Develop an improved storage system/facilities:

There needs to be an attempt to alter or enhance the current storage system in use because it has been one of the biggest problems potato producers confront. In order for farmers to contemplate a more proactive and systematic strategy that is more effective and efficient in potato storage, deliberate efforts must be made by the government, farmer's cooperative associations, and investors to raise cash and credit facilities to farmers. If that is accomplished, farmers should be instructed on how to store freshly dug potatoes at a low temperature (about 95 degrees Celsius) with high humidity in a well-ventilated area to prevent rot and the growth of microorganisms. The temperature should be kept at 600 degrees Fahrenheit during storage. In addition, investors and private citizens may want to think about constructing commercial storage facilities where farmers can store their potatoes.⁹³

In order to maximize potato yields, the government should also think about providing subsidies and making agricultural inputs like fertilizer and tractors available. This will increase the productivity of farmers. In order to add to the value chain, the government must also start thinking about enlisting the help of investors in the potato processing industry. Processing potatoes raises their price and is done so in order to

- i. Increase the value and enhance its worth.

- ii. To develop new products both in types and styles.
- iii. Eliminate waste and prevent spoilage.
- iv. Make them more readily available and convenient for use.
- v. To creates its usefulness, extends its shelf life improve its quality and preserve its nutrients
Potato can be processed by drying, canning, chipping and freezing.⁹⁴

Improve the conditions of Rural Roads

Since Irish potato is a perishable crop, the road is very vital in realising its maximum benefits, Road construction is capital intensive in nature which cannot be undertaken by the farmer, therefore there must be a deliberate effort by the government to embark on construction of critical roads that are key to linking the farmers in conveying the potato products to the various markets in good time most especially after harvest.

Allowing farmers access to their farmland.

In order to boost Irish potato production in Bokkos, Government must take deliberate actions to ensure that farmers are given adequate protection for them to access their abandoned farmlands

Prospects of Irish potato cultivation in Bokkos

Given the right circumstances, Bokkos can produce and supply potatoes and potato products for both local consumption and export to the entire west African sub-region. Currently, potatoes from Bokkos are exported to Niger, Chad, Cameroon, and the Benin Republic; this situation can be expanded to cover the entire sub-region⁹⁵. Bokkos enjoys the best climate, weather conditions, and soil properties for potato cultivation. The government can reallocate appropriate resources to the potato business in order to achieve its lofty goal of creating hundreds of thousands of new job possibilities; after all, it has created a great deal of employment and is worth a try.⁹⁶

Conclusion

The government, investors, potato farmers, and all other stakeholders in the potato industry must work to address all the issues affecting the sector because Bokkos has the potential and capacity to cultivate and produce potatoes and potato products that can meet the demand of the entire nation. Potato farming and marketing also has the potential to create jobs and improve the financial standing of farmers and marketers.

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