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CHALLENGES IN THE SUSTAINABLE ECONOMY OF NORTHERN GHANA– IMPACTS OF SOYBEAN TRADE ON BAMBARA GROUNDNUT: A CASE STUDY

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Abstract

The global seed trade has reached and conquered Northern Ghana, squeezing out local suppliers. Considering ongoing population growth, rapidly urbanizing communities, changing diets, and vast quantities of imported food products, the endeavours of enterprises that try to reduce the local food production deficit should be more appreciated. Rice, maize, and soybeans are three types of grain that dominate the global seed trade. Furthermore, the natural conditions and vegetation of the sub-tropical region are close to optimal. While rice and maize have been cultivated for a long time, soybeans are a new crop in the semi-arid climate zone of the Guinea-Savannah.

The motivations and ambitions are clear: pushing improved soybean seeds into the traditional farming system of Northern Ghana to meet the zero hunger sustainable development goal while widening the market for western seed producers. In the Ghanaian context, microfinance is built on making customers dependent on services. On the bone hand, it is a tool to extend farm sizes through mechanization, fertilizers, and modern cultivation technologies to increase yield; on the other hand, microfinance could cause financial difficulties within society and farmer associations, and it has negative effects on unsupported and unfinanced activities such as cultivating indigenous crops.

Keywords

Ghana, agriculture, local farmers, soybean, Bambara Groudnut

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1. Introduction

Developing countries face increasing challenges. After the hardest period of the Covid-19 pandemic, the disruption of global supply chains, the soaring energy and food prices, and skyrocketing inflation resulting from the Russia-Ukraine conflict, the shortage of staple food products – especially cereal – has become a serious problem in many African countries. Moreover, the sharp rise of food prices is exacerbated by the rise of agricultural inputs like fuel and fertilizers as well. Local producers face many difficulties and also the dilemma of whether to pay increasing costs of inputs or accept that yields will decrease in the short term. But they faced this issue in the past as well. They needed to cope with the increasing market pressure of large multinational agrarian companies, especially in the soybean industry. As a result of deregulations and international agreements, national governments cannot directly interfere in global competition (Erdeiné Késmárki-Gally et al., 2015). Transportation as a factor also plays a significant role in competitiveness models (Nagy et al, 2023), and especially it plays in Africa where the modern and efficient transportation infrastructure means the bottleneck in many cases. Additionally, the environmental impacts caused by economic activities and climate change have increasingly necessitated green investments, financed in several countries by green bonds created by financial markets (Sági, 2020). There is no doubt about the role of soybeans as a food and feed product (i.e., sources of protein and oil); however, this means that the local farmers must take risk. The relatively cheap import prices and the appearance and domestic activity of foreign soybean producers in Northern Ghana create stiff competition. The rise of soybean production is a trend globally (see Tables 1-2 and Figure 1) and also in Ghana (Figure 2).

Country	Domestic Production (MMT) (2016)	Percent of World (2016)	Percent Growth (1990-2016)	Average Annual Growth Rate (1990-2016)
United States	117	33%	124%	3.1%
Brazil	114	32%	624%	7.9%
Argentina	58	16%	403%	6.4%
China	13	4%	17%	0.6%
India	12	3%	342%	5.9%
Paraguay	11	3%	720%	8.4%
Canada	7	2%	419%	6.5%
Ukraine	4	1%	4,223%	15.6%
Uruguay	3	1%	8,400%	18.6%
Russia	3	1%	337%	5.8%
World total	**352**		237%	4.8%

Table 1: Total Domestic Soybean Production and Growth of Production from 1990 to 2016, in the Ten Largest Soybean Production Countries as of 2016.
Source: USDA FAS, Production, Supply, and Distribution Database (2017)

Country	Area of Soybeans Harvested (Millions of Acres)	Percent of World (2016)	Percent Growth (1990-2016)	Average Annual Growth Rate (1990-2016)
Brazil	84	24%	248%	4.9%
United States	83	24%	46%	1.5%
Argentina	45	13%	286%	5.3%
India	28	8%	345%	5.9
China	18	5%	-5%	-0.2%
Paraguay	8	2%	281%	5.3%
Canada	5	2%	359%	6.0%
Russia	5	1%	214%	4.5%
Ukraine	5	1%	2,007%	12.4%
Uruguay	3	1%	3,474%	14.7%
World total	**298**		121%	3.1%

Table 2: Total Acres of Soybeans Harvested and Changes in Acres Harvested in the Ten Largest Soybean Producing Countries as of 2016.
Source: USDA FAS, Production, Supply, and Distribution Database (2017)

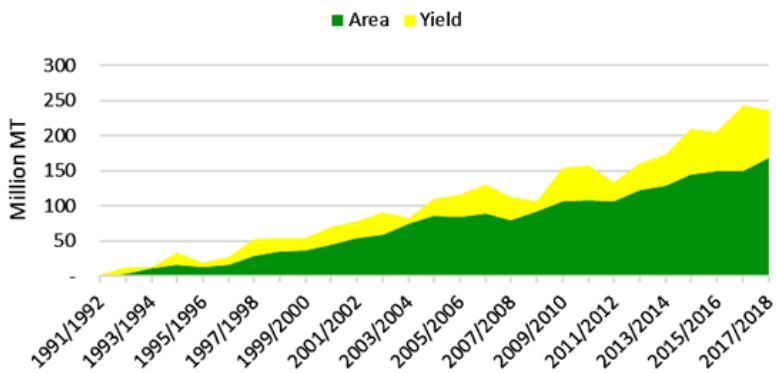

Figure 1: Increase in World Soybean Production Due to Changes in Yield and Harvested Area, 1990-2016.
Source: USDA FAS, Production, Supply, and Distribution Database (2017)

In such a complex and difficult situation, Ghanaian farmers need to choose new alternatives for land cultivation and plant production. Agricultural reforms would serve not only the development of the rural society, but also be a valuable contribution to peace and security in the West Africa (Neszmélyi, 2014). Our study focused on indigenous plant species that local farmers have many years of experience and tradition in producing. These plants may help Ghanaian producers regain their competitiveness and contribute to more environmentally sound, sustainable production compared to soybeans that have a more significant carbon footprint.

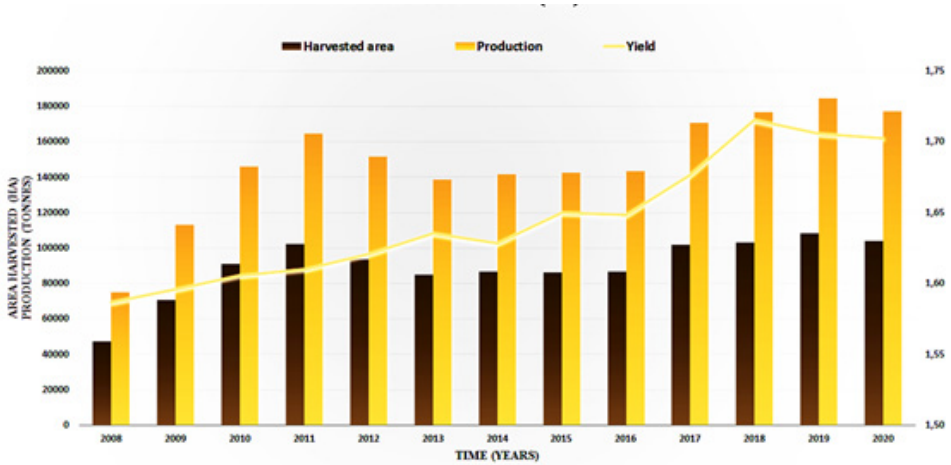

Figure 2: Growing Indicators of Soybean Production in Ghana between 2008 – 2020 (ha).
Source: FAOSTAT (2017), self-edition

Bambara Groundnut

Bambara groundnut (Vigna subterranea (L.) Verdc.) is one of the most underutilized and less studied indigenous crop species in West Africa. However, Bambara is a legume that is still a small part of the traditional African diet. Unfortunately, other crops are more common compared to this conventional one. Due to the increasingly high price of meat, this low-cost legume could serve as a supplemental, affordable, and pure source of protein. In addition to its high protein content of 19%, is also has essential amino acids, trace elements, and an optimal amount of saturated and unsaturated fatty acids (Hlanga et al., 2021; Tan et al., 2020)

Figure 3: Groundnut harvest in Tongo, Upper East Region, Ghana. Bambara was not found in the sortiment.
Source: Taken by the authors

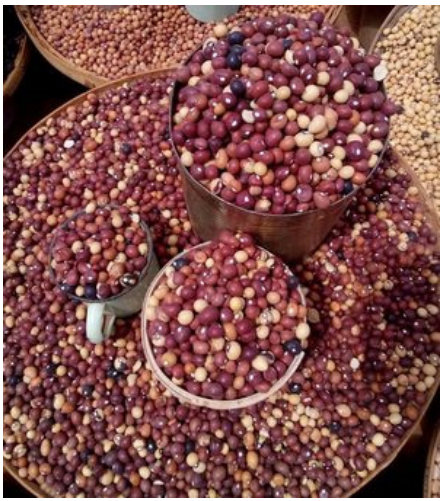

Figure 4: Bambaranut for sale.
Source: African Products Australia

Since the first Eastern Nigerian botanical description of Bambara Groundnut (Hepper 1963) and into the 21st century, pod- and biomass production potential, nitrogen-fixing capacity, and drought- and insufficient-nutrition tolerance have been topics discussed in scholarly articles (Azam-Ali et al., 2001). Research interest and public knowledge on Bambara nut have been increasing on many continents (Khan et al., 2021) becoming specified and detailed according to geographical sites and research areas (Konate et al., 2020; Yahaya et al., 2022).

2. The Objectives of the Research

In the frames of the present study the authors set the following research goals to be achieved.

(1) To understand the distribution system for seeds and other agricultural inputs within the target communities.
(2) Identify primary stakeholders and influential actors in the system.
(3) Explore and describe the current farming model (i.e., farm biodiversity) utilized by the surveyed population.

This article serves as a foundation for future studies. It does not dealing with special areas of agriculture like soil science or cropping system nor with economic indicators like productivity or return rates. This paper will not make an argument about the advantages of Bambara beans compared to soybeans. The main goal of the research was to explore and accurately describe the microfinance system for seed production and agriculture in this region of Africa.

3. Data Collection and Methodology

Agricultural service models including microfinance and credit lending, mechanization services (Vida & Vasa, 2020; Vasa et al., 2021), and theoretical and technological

skills in the labour force are available in Northern Ghana. While a few non-profit and for-profit organizations compete in this service market, trying to cover communities, districts, and regions results in more bankrupted and abandoned organizations compared to operating ventures.

This farmer survey that we carried out in two different regions of Ghana (i.e., the Upper East Region and the North East Region) between 9 August and 12 in 2021 was an efficient instrument to measure yields, loan taking willingness, and the financial needs of farmers as well as to observe the relationships between service industries, governments, and customers.

We hired three enumerators (census-taker persons) with tertiary education background during the study period and interviewed 79 farmers individually. Leaders of the farmer associations included the following categories:

- heads of associations (7 persons)
- secretaries of associations (7 persons)
- treasurers of associations (7 persons)

These stakeholders have the biggest influence on their group and the most complex knowledge about the association and trends in the agro-market.

We have trained the enumerators on the questionnaire, but they already had previous knowledge about the topic being studied; furthermore, personal relationships with the surveyed communities helped researchers to conduct the study efficiently. In this report, we are using a 5% significance interval as the most preferred probability for agroeconomic analysis.

4. Stage 1: Community Observation

We targeted seven communities: six small communities in the Upper East Region (Korania, Bondunia, Kapania, Upper Gaani, Lower Gaani, New Gaani) and one larger community in the North East Region (Kukua). Because of the homogeneity of the first six communities, we handled them as only one group of farmers under the name of Navrongo. The 49 respondents from Kukua and 30 from Navrongo comprise our surveyed population.

Average age of the whole population is 41.1, ranging between 19 and 71. Aggregation of this highly deviating (standard deviation: 13,6) data set has created four age groups: youth (19-30), younger middle age (31-40), older middle age (41-50), and elders (51 and above). With this aggregation, we have four similar size groups, providing a basis for additional separation and analysis procedures.

Communities	Counts	% of Total	Cumulative %
Kukua	49	62.0%	62.0%
Navrongo	30	38.0%	100.0%

Table 3: Respondents, self-collection

Agg. age groups	Counts	% of Total	Cumulative %
19-30 years (Group 1)	20	25.3 %	25.3 %
31-40 years (Group 2)	19	24.1 %	49.4 %
41-50 years (Group 3)	22	27.8 %	77.2 %
51 years =< (Group 4)	18	22.8 %	100.0 %

Table 4: Whole population aggregated by age groups, self-collection. Source: The authors' data collection

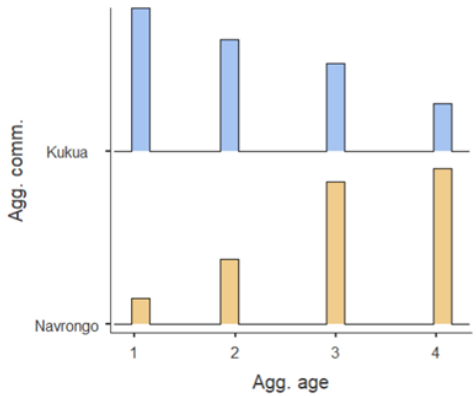

Figure 5 - Aggregated age density of the two main farmer groups. Source: The authors' compilation

As Figure 5 shows, there is a significant difference between Kukua and Navrongo: while Kukua is a relatively young community, Navrongo's female population is getting older. Therefore, in Kukua we conducted research with the individuals considered young and younger middle-aged, while in Navrongo we focused on aging women groups, where 23.3% of the women were widows.

If we combine conclusions in Figure 5 with data in Figure 6, we can determine that our population is highly reproductive. With the aggregation of responses given for the question related to *number of children*, we have created different three *children* groups, respectively: group 1 (0-2 children), group 2 (3-5 children), and group 3 (6 or more children).

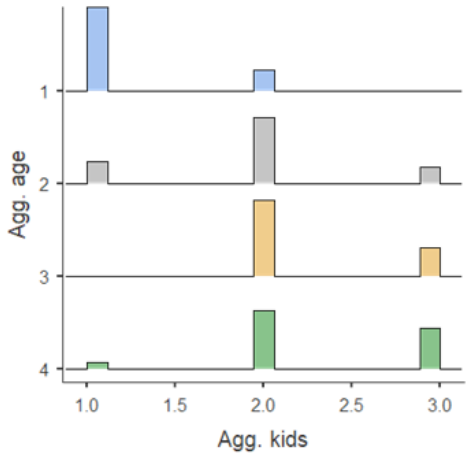

Figure 6: Number of children groups divided by age groups, whole population.
Source: The authors' compilation

To determine significance, we can run a basic ANOVA-test on children groups to compare them with age groups.

	Sum of Squares	df	Mean Square	F	p
Agg. age	16.2	3	5.391	19.7	<.001
Residuals	20.5	75	0.273		

Table 5: ANOVA – Number of children differentiate by age, whole population.
Source: The authors' compilation

The test above shows a significant difference (p<0,001) between age groups in terms of their numbers of children, moreover providing a deeper understanding of farmers' family dynamism. The Tukey post-hoc test illustrated that age groups show differences in terms of family size.

Comparison							
Agg. age		Agg. age	Mean Difference	SE	df	t	p_{tukey}
19-30years	-	31-40 years	-0.7474	0.168	75.0	-4.461	<.001
	-	41-50 years	-1.0727	0.162	75.0	-6.639	<.001
	-	51 years=<	-1.1333	0.170	75.0	-6.670	<.001
31-40 years	-	41-50 years	-0.3254	0.164	75.0	-1.987	0.202
	-	51 years=<	-0.3860	0.172	75.0	-2.244	0.121
41-50 years	-	51 years=<	-0.0606	0.166	75.0	-0.365	0.983

Note. Comparisons are based on estimated marginal means

Table 6: Significant differences between age groups by number of children, whole population.
Source: The authors' calculation

Significant differences (p<0,001) are showing up between the 1st and other age groups (2nd, 3rd, 4th). There are negative differences from the perspective of the 1st group. This means the farmers between the age of 19-30 have fewer children than their older colleagues. Because of the tendencies we see in Figure 5 and Figure 6, as our young farmers become older they are going to have more children than three. This not only generates more people to feed in the communities but also produces potential customers in the market.

Comparison							
Agg. age		**Agg. age**	**Mean Difference**	**SE**	**df**	**t**	**p_{tukey}**
19-30 years	-	31-40 years	-0.833	0.168	45.0	-4.96	<.001
	-	41-50 years	-1.106	0.181	45.0	-6.13	<.001
	-	51 years=<	-1.500	0.222	45.0	-6.74	<.001
31-40 years	-	41-50 years	-0.273	0.190	45.0	-1.43	0.485
	-	51 years=<	-0.667	0.230	45.0	-2.90	0.029
41-50 years	-	51 years=<	-0.394	0.239	45.0	-1.65	0.364
Note. Comparisons are based on estimated marginal means							

Table 7: Significant differences occur in number of children between age groups, Kukua. Source: The authors' calculation

This was the whole population, but if we only focus on Kukua, where most of our partners are under 41, we are able to state the same: our community is regenerating itself, providing a solid ground to plan and create a market for our current and future services.

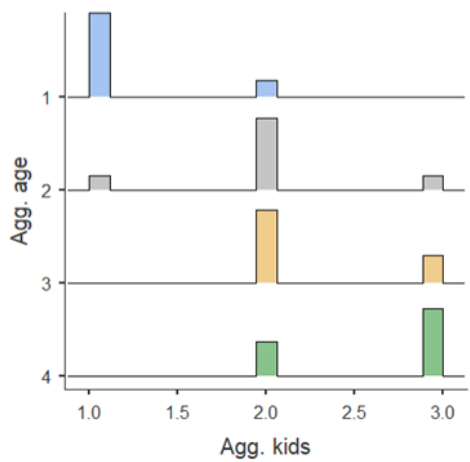

Figure 7: Number of children groups divided by age groups, Kukua. Source: The authors' compilation

Not only the age distribution, but the gender and religious background highlight differences between the two main groups of our clients. While 93.3% of farmers in Navrongo are women who believe in a Christian god (100%), farmers in Kukua are mainly males (85.7%) and Muslim (100%).

Figure 8: Household survey, Kukua, 2021.
Source: Taken by the authors

As it is usual in Northern Ghana, more than 50% of our farmers are uneducated formally, lacking basic writing and reading skills. In our surveyed population, illiteracy is similar to the Upper East Region (51,9%) but lower than in the North East Region (64,1%) according to the 2021 Population and Housing Census in Ghana (Government of Ghana, 2021).

Only one person (1.2%) indicated tertiary education at a higher level, and we aggregated him to the secondary high school group.

Educational level	Counts	% of Total	Cumulative %
Non formal	47	59.5 %	59.5 %
Primary	16	20.3 %	79.7 %
JHS	9	11.4 %	91.1 %
SHS, Tertiary	7	8.9 %	100.0 %

Table 8: Educational level frequencies, whole population.
Source: The authors' own data collection and calculation

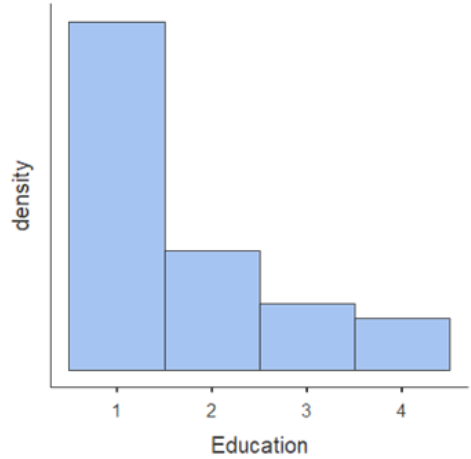

Figure 9: Density of highest reached educational level within the whole population.
Source: The authors' own calculation

In Ghana, public school system from primary to high school became tuition free in 2017 (Government of Ghana, 2017). This regulation will surely increase the current literacy level and support younger generations to gain basic knowledge. We used the ANOVA test again to identify significant differences of educational levels between age groups.

	Sum of Squares	df	Mean Square	F	p
Agg. age	16.5	3	5.493	6.84	<.001
Residuals	60.2	75	0.803		

Table 9: ANOVA – Educational level difference by age, whole population.
Source: The authors' own calculation

Comparison							
Agg. age		**Agg. age**	**Mean Difference**	**SE**	**df**	**t**	**p_{tukey}**
19-30years	-	31-40 years	-0.111	0.287	75.0	-0.385	0.980
	-	41-50 years	0.782	0.277	75.0	2.824	0.030
	-	51 years=<	0.933	0.291	75.0	3.206	0.010
31-40 years	-	41-50 years	0.892	0.281	75.0	3.179	0.011
	-	51 years=<	1.044	0.295	75.0	3.541	0.004
41-50 years	-	51 years=<	0.152	0.285	75.0	0.532	0.951
Note. Comparisons are based on estimated marginal means							

Table 10: Significant differences of educational level between age groups, whole population.
Source: The authors' own calculation

There is no difference between age group 1 (19-30 years) and age group 2 (31-40 years). For educational level, these two age groups function as one. Their educational level is the same, just like age group 3 (41-50 years) and age group 4 (51 years and above), between which we could not identify a difference. However, there is a significant difference between the younger (19-40 years) and the older groups (41 years and above), the younger group is more educated than the older one. With the regulation discussed above, this trend looks to be continued.

This discussion is important from the perspective of stakeholders. With increasing educational levels, literacy, command of the English language, and basic economic skills are improving, which make rural populations more professional and skilled when planning for the future, calculating loans, and giving them confidence to understand contracts and business situation. If farmers connected to global value chains they are supposed to be formally educated with basic economics, mathematics and language skills, therefore they will be more efficient and successful in the market.

Figure 10: One-on-one discussions with farmers under the shelter, Kukua, 2021. Source: Taken by the authors

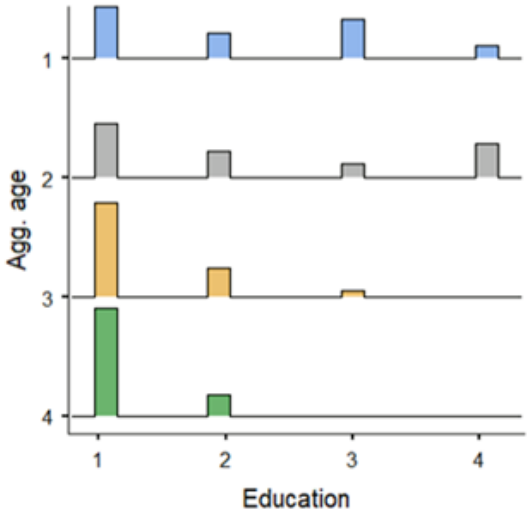

Figure 11: Educational level varies between age groups, whole population.
Source: The authors' compilation

5. Stage 2: Farmland Observation

Our two main communities, Navrongo and Kukua, operate different farm models (e.g., communities of Navrongo are located within the Tono irrigation scheme, while farmlands of Kukua are rainfed); furthermore, the available arable land and human capacity of families also vary. We have separated them to provide a realistic and reliable picture about the clients and the business operation of the service provider. In the following section, we provide data in the form of value/person, which are then multiplied by the number of farmers we cooperated with so by this we calculated a reliable estimation.

2019 average numbers, before the provider						
	acres*		bags		yield [bags/a]	
	Navrongo	Kukua	Navrongo	Kukua	Navrongo	Kukua
maize	1.3	4.0	4.7	11.1	3.6	2.8
rice	2.4	0.7	18.5	2.3	7.7	3.3
soybean	0.0	0.6	0.0	2.0	0.0	3.2
cowpea	0.2	1.8	0.3	2.2	1.6	1.2
*1 acre = 0.4047 hectares - 1 hectare = 2.4711 acre.						

Table 11: Yields of different species of crops in 2019.
Source: The authors' calculation

5.1. Rice

The main difference between the communities is their specialization: while a farmer in Kukua cultivates four acres of maize, in Navrongo it is only 1.3 acres per farmers. However, size of rice lands is 2.4 acres in Navrongo, while Kukua has 0.7 acres per farmer.

	Navrongo [acre/ farmer]		**Size changes in percentages [%]**
	2019	2021	
maize	1.3	1.4	+7.5
rice	2.4	3.1	+27.1
soybean	0.0	0.0	0.0
cowpea	0.2	0.3	+57.1

Table 12: Increasing number of cultivated acres, Navrongo. Source: The authors' calculation

Tono irrigation scheme provides constantly available fresh water throughout the year, creating opportunity for farmers in Navrongo to plant and harvest twice a year. The harvested 7.7 bags per acre of rice paddy in 2019 shows similarities with the UN FAOStat database with its published Ghanaian yield of 7.67 bags per acre (calculated with 150kg per bag of rice paddy). Kukua's rainfed technology cannot compete with artificial irrigation and does reach 50% of the country's average.

Figure 12: Rice fields close to Navrongo, Tono irrigation scheme, 2021. Source: Taken by the authors

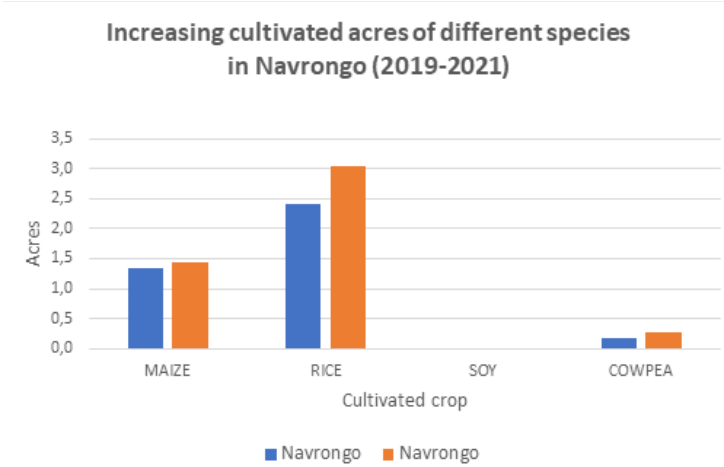

Figure 13 - Increasing cultivated acres in Navrongo.
Source: The authors' own compilation

Figure 14: Picture Open air desiccation of rice, Tono irrigation scheme, 2021.
Source: Taken by the authors

Figure 15: Picture Rice in bags, Tono irrigation scheme, 2021.
Source: Taken by the authors

5.2. Maize

In Kukua in 2019, the planted area of maize was relatively high (i.e., four acres per farmer), but the yield (2.8 bags per acre) was unbelievable low. UN FAOStat shows 9.75 bags per acre yield in 2019 (calculated with 80kg per bag of maize), but in the interviews farmers stated they will never admit the real quantity of harvested crops. If we multiply the admitted yield by three to get closer to the official data of FAO, it still remains 8.4 bags per acre, and we cannot be certain of the validity of these calculations. Poor quality sandy soil with low nutrient content does not hold water and supply enough quantities of nitrogen, phosphor and potassium (kalium) to boost yields. To have deeper understanding of production and collect more accurate data, we need to organize interviews with the most reliable farmers.

Despite of the quality issues of production that we intend to solve, farmers do invest in production, apply to purchase for land, and believe it is worth it to produce crops. Average maize yield in Kukua in 2019 was around 6.28 bags per acre because of the limiting factors discussed above.

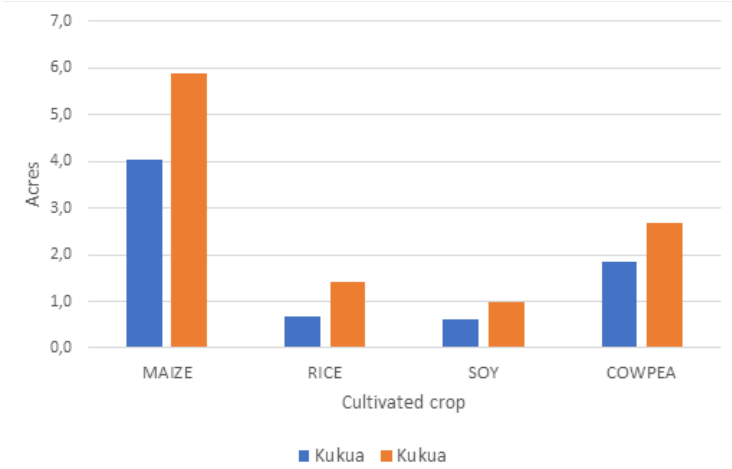

Figure 16: Increasing cultivated acres of different species in Kukua (2019-2021). Source: The authors' own compilation

	Kukua [acre/farmer]		Size changes in percentages [%]
	2019	2021	
maize	4.0	5.9	+46.2
rice	0.7	1.4	+107.5
soybean	0.6	1.0	+59.0
cowpea	1.8	2.7	+44.2

Table 13: Increasing number of cultivated acres, Kukua, self-calculation. Source: The authors' own calculation

5.3. Legumes (Bambara Groundnut, Soybean, Cowpea)

Legume production capability in Navrongo is limited because of the wet ground of the Tono irrigation system. Rice in monoculture is gaining ground, leaving less space for indigenous plants and only room for subsistence farming. In Kukua, however, lands receive more rainfall are ideal for bean and groundnut production. Cowpea is gaining ground because the Southern Ghanaian diet includes this crop instead of the Bambara Groundnut, which is consumed by Northerners. Soybeans have been recently introduced into the market. The planted area for soybeans has increased by 59% within two years. The new wave of large-scale layer and broiler breeding, and the practices of Western- and South-American producers influenced the Ghanaian farmers to plant this important element into the premix (Martey et al., 2019).

The 57.1% (Navrongo) and 44.4% (Kukua) increases in planted cowpea areas illustrate emerging interest in this legume, and farmers (especially in Kukua) have pointed out the growing demand for and prices of this crop. Another traditional, indigenous legume is the Bambara groundnut with an average 18% protein, high

starch, and moderate oil content. With high resistance against drought and poor soil quality, it seems like an ideal choice for agricultural production within the Savanna climate zone. It may not provide a high oil and protein quantity like soybeans, but other natural benefits including its water holding capacity and extreme resistance make this legume unique and an ideal raw crop for the West African food industry. Bambara cultivation also helps to sustain biodiversity and conserve tradition. Unfortunately, there are no state-led support or regulations and little commercial interest to cultivate these indigenous crops in a long run.

6. Stage 3: Agro-service Observation

Maximizing productivity with the least amount of input possible is what farmers and the service provider want to achieve in collaboration. Providing agricultural services to farmers is a complex, difficult process due to logistical and organizational challenges; furthermore, deep and comprehensive theoretical knowledge is essential for efficient operation. In Northern Ghana, the government operated extension officer system is weak and unreliable; subsidised inputs like fertilizers and chemicals are not available in time nor spatially; microfinance offered by commercial banks is difficult for famers to apply for due to factors like illiteracy, weak economic conditions, and the nature of agriculture. Additionally,, the price of tractors and harvesters are too high for individuals. Official and registered farmer associations would be eligible entities to act on these matters, but real improvement has not yet appeared. Referring to the current survey, the service provider has made microcredits, mechanization, and inputs available and affordable to individuals and associations.

> **Definition of microfinance**: a system of providing services such as lending money to individuals who are too economically disadvantaged to use banks (Oxford Dictionary, 2022).

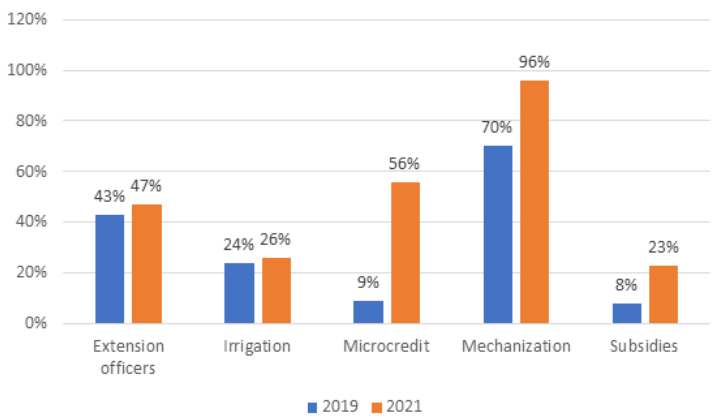

Figure 17: Increasing service availability before and after the provider, whole population. Source: The authors' compilation

Availability of microcredits (in the form of cash, ploughing, or inputs) has grown by 47%. The system was able to increase mechanization of ploughing by 26%, which has created not only income for the organization, but free time for those households with children under 20. Seventy five percent of the whole population has at least one child under twenty, and 88% of them said that their children had more time for studying as mechanized ploughing saves time. All participants in the survey (100%) who use tractor services indicated the time and energy saved as a benefit; furthermore, 94% started to plan on expanding their farms.

In Kukua, the availability of subsidised fertilizers and mechanization service increased rapidly. Farmers in Navrongo mostly applied for microcredits and ploughing.

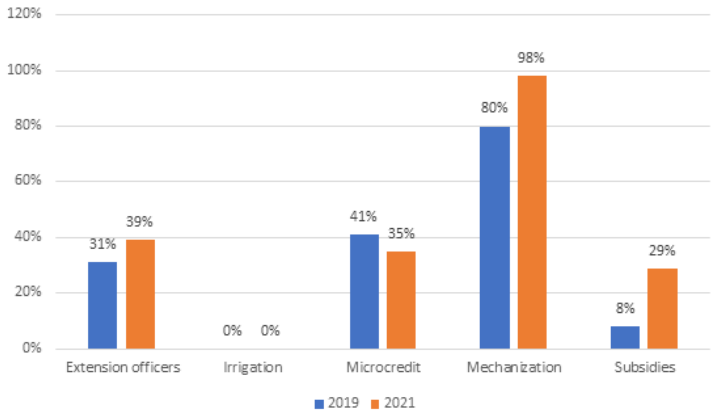

Figure 18: Increasing service availabilty, before and after the microfinance introduction Kukua. Source: The authors' compilation

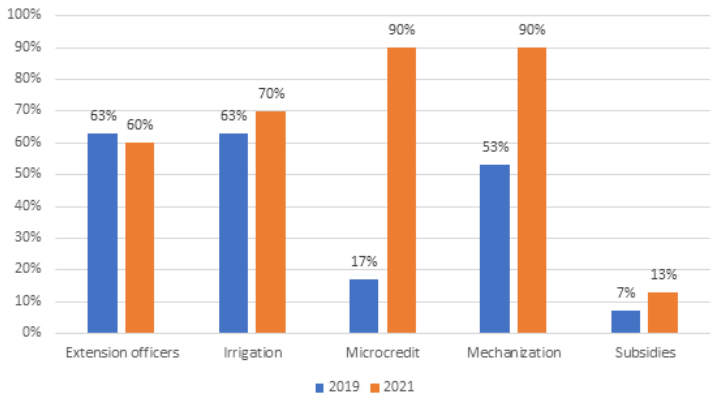

Figure 19: Increasing service availability, before and after the microfinance introduction., Navrongo. Source: The authors' compilation

Microfinance System

Microcredit in May 2021 was available in three different forms: tractor service, input materials, and capital. The relatively high demand for mechanization service along with the bankrupted subsidised fertilizer and seed market have both created challenging situations for the company. Several surveys and published articles illustrate that women are more reliable in fiscal situations (Blanco-Oliver et al., 2021; D'Espallier et al., 2011). The take-payback loans rate of women are higher, while the share of profit and socio-economic growth are more widespread if they are controlled by females. Another study mentions that gender is one of the major factors influencing micro crediting and success when taking loans (Anang et al, 2015).

In Navrongo, farmers ploughed an average of 0.9 acre per farm on credit, while average total farm size was 5.3 acres. Eighty three percent of the population applied for credit in the form of capital, taking 282 GHS individually. This money was free to spend on anything, but our suggestion was to purchase fertilizers. Only seven percent of female clients mentioned using a small portion of money on personal needs, but they did not provide specifics. The majority of them (73%) prefer paying back the loan in cash, and only 17% pay after one month has passed.

In Kukua, tractors ploughed 32% of the total farmland on credit. There was also a big portion of cash to make payments. This survey was not able to measure the lack of pre-information about the business operation model of the organization. We know that 12% of our farmers chose credit, 17% paid in cash, and 71% paid with both cash and credit.

Individuals who were not members of the Farmer Association were not allowed to take a credit-based loan even if they wanted to do so. This regulation helped the association itself to be more stabilized. In the region the average farm size is 9.4 acres, while the members of the Farmer Association cultivate 13 acres in average. For the whole population, assuming variances between "only credit", "only cash" and the "mixed" group, there are disappointments. The average farm size ranges between 9.4 (cash), 12.8 (mixed), and 14.0 (credit), and there are also slight differences in the educational levels too. However, these results were not sufficient to identify groups with different behaviours. Our main limiting factor was the size of the surveyed population. Further separation would create incomprehensible small groups, so the information to be drawn could not be reliable and representative.

To maximize the credit that farmers can apply for, more efficient regulation is necessary to protect the provider. Unfortunately, from this survey we do not know the exact number of ploughed acres paid by cash.

One hundred percent of the Kukua Farmer Association indicated that they will pay back their credit loans with crops (The authors, 2021), even if backlogs are generated from subsidised fertilizers or mechanization. According to their survey responses, 57% of credits will be paid back within a month, and it is going to reach 97% of repayment within two months. Farmers are aware of credit obligations.

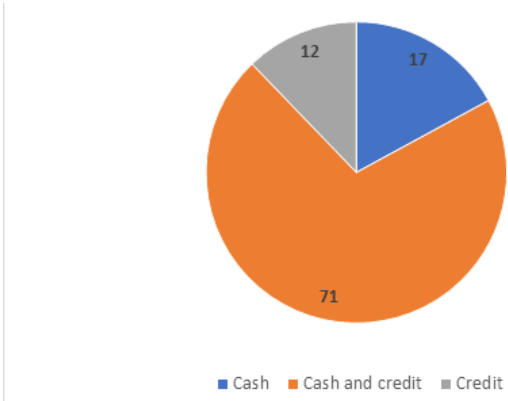

Figure 20: Share of payment methods for ploughing (%), Kukua.
Source: The authors' compilation

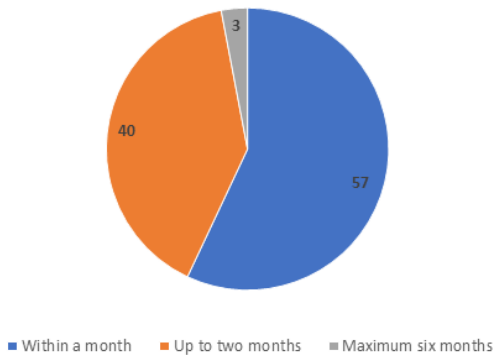

Figure 21: Payment intervals credits after harvest, Kukua.
Source: The authors' compilation

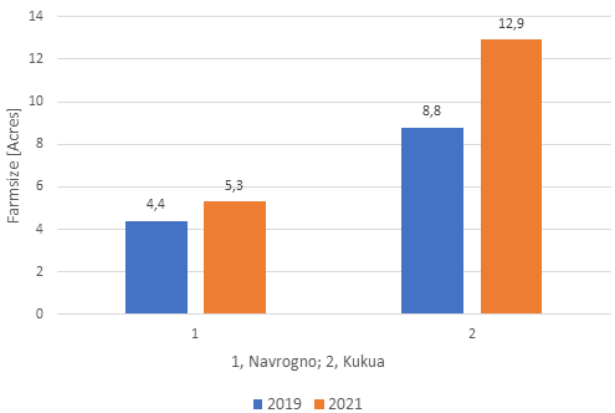

Figure 22: Average farm size in acres in 2019 and 2021.
Source: The authors' compilation

People invest in lands. Farmers in Navrongo indicated that available farmland is decreasing, especially if it is irrigated. Farmlands are getting further away from households because of the limitations of land use. While most farmers would be interested in expanding their farms, without mechanization of harvesting or hiring more workers, growth is impossible. Some of them mentioned their age as another limiting factor for growth. The basis of stable operation and development is the financial independency and stability (Tóth & Káposzta, 2021). Kukua is growing. The significant difference between the 2019 and 2021 explains the current situation in West Africa's food market, as well the strengthening role of micro creditors functioning as umbrella organizations for local communities and associations. The 47% growth of cultivated land is just a piece of the whole tendency during the last decade.

7. Summary and Conclusions

While our exploratory research points to increasing indicators related to cultivated land, microcredit and agro-service availability in the examined communities, the phenomena of changing land-use, declining biodiversity and urbanization are also occurring in global value chains (Hoekstra & Chapagain 2008; Richards, 2013; Jedwab et al., 2015). Northern Ghana has to increase its own production to meet the emerging demand in food products (e.g., livestock keeping and direct human consumption), but it should not forget about its natural heritage.

Soybeans are a relatively new player in the examined seed market with wide acceptance and internationally well-known standards adopted in cultivation and other uses (Debnath & Babu , 2020; Specht et al., 2015) As a legume, it shares similar values with the indigenous legumes of Northern Ghana such as the Bambara Groundnut, which has been the subject of an increasing number of research articles focusing on agronomy, food processing and market opportunities despite negligible economic interest (Gan, 2020).

In the recent years primary agro-production in Northern Ghana started to get integrated into global agricultural value chains through improved seeds cultivation, purchasing NPK fertilizers and ploughing by second-hand tractors. But the COVID-19 crisis, the Russia-Ukraine War, and the globally high inflation all contributed to a slowdown of growth which turned the focus again towards the domestic production and consumption.

State-led regulation of the seed market, cooperation with international research institutes that prioritize the selection of Bambara varieties, and development of food-processing technologies would serve the well-being of the region and support sustainable opportunities for protein production under semi-arid conditions (Vaskó et al., 2022).

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