Market Survey on Willingness to Adopt Resilient Seeds

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GCIC offers financing and capacity building services that address challenges to starting and growing business in the green economy, including renewable energy, energy efficiency, waste management, climate smart agriculture and water management and purification. The Centre also incubates promising start-ups and seed capital funding to entrepreneurs. In addition, GCIC provides business advisory and market development services, access to product testing facilities and government engagement on policy.
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List of Abbreviations

ACDI/VOCA Agricultural Cooperative Development International/
ADVANCE Agricultural Development and Value Chain Enhancement program of ACDI-VOCA
AGRA Alliance for Green Revolution in Africa APSP Agriculture Policy Support Project
ATTP Agricultural Technology Transfer Project
BMGF Bill & Melinda Gates Foundation
CRI Crop Research Institute
CS Certified Seed
CSIR Centre for Scientific and Industrial Research
ECOSIB Entrepreneurs for Commercial Seed Incubation
EGS Early Generation Seeds
FAO Food and Agriculture Organization
FinGAP Financing Ghanaian Agriculture Program
GLDB Grains and Legumes Development Board
ICRISAT International Crop Research Institute for the Semi-Arid Tropics
IFAD Institute for Food and Agricultural Development
IITA International Institute for Tropical Agriculture
ISSD Integrated Seed Sector Development in Africa
KNUST Kwame Nkrumah University of Science and Technology
M&B M&B Seeds and Agricultural Services Limited METASIP Medium-term Agriculture Sector Investment Plan
MNCs Multi-National Corporations
MoFA Ministry of Food and Agriculture
NARI National Agricultural Research Institute
NASTAG National Seed Trade Association of Ghana
NGO Non-Governmental Organization
NSC National Seed Council
NSTL National Seed Testing Laboratory
NSP National Seed Policy
NVRC National Variety Release Committee.
NVRRC National Variety Release and Registration Committee
OPV Open Pollinated Variety
PASS Program for Africa's Seed Systems
PPRSD Plant Protection and Regulatory Services Directorate
QDS Quality Declared Seeds
RMG Regional Market Group Concept Limited
SARI Savannah Agricultural Research Institute
SEEDPAG Seed Producers Association of Ghana
SSTP Scaling Seeds and Technologies Partnership
TVRC Technical and Variety Release Committee
USAID United States Agency for International Development
UCC University of Cape Coast
WACCI West Africa Centre for Crop Improvement
WAPP West African Agricultural Productivity Program
WASP West Africa Seed Program

Definition of Key Terms

Climate Resilient seeds: Seeds that can withstand the effects of climate changes such as drought and flooding. Examples of resilient seeds in Ghana are CSIR-Omankwa, CSIR- Abontem and Wang-dataa.

Certified Seed: Certified seed refers to seeds obtained from the first or second multiplication of foundation seed. Certified seeds are produced under conditions that ensure maintenance of genetic purity and varietal identity. They must meet minimum standards for purity ascribed by law before they are certified by an appropriate regulatory agency.

Certified seed vs. Resilient seeds: Certified seeds are basically seeds that have passed through the certification process and have met PPRSD's requirements to be deemed certified. They may or may not be climate resilient. Certified seeds are bred to exhibit several desirable factors such as higher yields, disease tolerance, drought tolerance, lodging tolerance etc. Certified seeds that exhibit climate resilient characteristics such as drought tolerance would, under the scope of this research, be deemed climate resilient.

Breeder Seed: Breeder seeds are produced from nucleus seed under the supervision of a qualified plant breeder in a research institute. Breeder seed are produced under the highest level of genetic control to ensure the seeds are genetically pure and accurately represents the varietal characteristics identified during variety selection.

Foundation Seed: Foundation seed refers to any seed obtained from pre-basic or breeder seed produced under generally accepted breeding rules for that variety and intended for the production of certified seeds. Foundation seeds are produced under conditions that ensure maintenance of genetic purity and identity.

Formal seed system: This comprises a series of interlinked activities, from genetic resource management; variety breeding research and crop improvement; variety testing and release; conditioning and storage; marketing and distribution; to the final use of the seeds by farmers with quality control performed at each stage.

Informal seed system: This describes the local seed system that relies heavily on farmer saved seeds. In Ghana, the informal sector is primarily served by farmer saved seeds obtained from own fields, through exchange or purchase from local market.The informal system tends to generate and maintain less than uniform planting materials adapted to local requirements and thus such seeds are fraught with challenges of contamination, high disease incidence and low yields. More often than not, they are also not climate resilient.

Executive Summary

One of the fundamental metrics of the Climate-smart agriculture sub sector is safeguarding food security, and critical to this, is the development, promotion and adoption of resilient seeds for crop production. Thus, as part of steps to provide relevant market-centered support to its incubatees and other stakeholders in the seed sector, GCIC via SNV commissioned Growth Mosaic to conduct research into the resilient seeds sector in Ghana. In line with GCIC's thematic area of climate smart agriculture, we defined resilient seeds as seeds that can withstand the effects of climate changes such as drought and flooding (i.e. the more common effects of climate change in the West African geographical region).

The formal seed system in Ghana is headed by the Ministry of Food and Agriculture which hosts the National Seed Council and National Variety Release Committee. The National Agricultural Research Institutes (CRI and SARI) are responsible for varietal research and breeder seed development whilst the Grains and Legumes Development Board (GLDB) has the mandate to produce foundation seeds. The formal seed system was initially heavily public sector driven but is increasingly opening up to private sector participation. This opens up several opportunities within the value change for seed processors to expand into, such as the production of breeder and foundation seeds, seed processing, etc.

The total size of the market in Ghana for rice, hybrid maize, OPV Maize and soybean was approximately US$ 57 million as at 2015. Demand for specific types of seeds typically comes from farmers and agro-input dealers but NGOs, projects and the Government of Ghana are key drivers of demand in the domestic market. Under the Planting for Food and Jobs (PFJ) program, government facilitates the adoption of resilient seeds through the provision of subsidized seeds and inputs, as well as sensitizing farmers on the benefits of resilient seeds. It also facilitates access to equipment and machinery for seed producers through the provision of loans and subsidized inputs. Although these government interventions have significantly increased adoption of resilient seeds, it has also distorted the market to an extent because private seed producers are not able to sell at competitive prices to farmers outside the PFJ program. Seed producers have now been forced to join the Planting for Food and Jobs program to sell their seeds because the farmers are aware of the subsidized prices and prefer to buy seeds at those lower prices.

Donor agencies such as USAID have also facilitated an increase in the production, supply and demand of resilient seeds through the provision of technical support (mechanized machinery, seed distribution vans, irrigation facilities etc.) to seed producers and other value chain actors. These donor interventions have contributed to making the operations of seed producers more sophisticated. Even though these interventions have contributed to an increase in production of climate resilient seeds over the last decade, the expected yields of seeds have not been as high as anticipated. Even though seed quality is critical, it is not the only factor influencing the outcome of production when resilient seeds are planted. Improved soil fertility, application of fertilizer at the right time and in the right quantities, infrastructure for irrigation systems to reduce over-reliance on rainfall are also critical. All these complement and enable the use of resilient seeds to generate the desired results of improved yields and food security.

Key Findings of the Study

Both demand and supply of resilient seeds have been on the increase due to interventions in the form of programs by both government and donor agencies. However, these programs give a distorted view of the resilient seeds value chain in that they absorb the costs (such as subsidized seeds or inputs) of generating and sustaining high adoption. It is yet to be seen whether these increases in demand and supply of seeds would be sustained after these programs end. However, the initiative of some input dealers and extension officers in setting up demonstration sites to create exposure for farmers to learn more about resilient seeds and its benefits is helping to build a strong foundation for demand among farmers for resilient seeds with or without the PFJ program.

Even though several interventions have been orchestrated by government, donor agencies and other actors in the seed value chain to address challenges in the sector there are still some challenges remaining to be addressed. These include inadequate infrastructure, inadequately resourced certification bodies resulting in delays in the process of certifying seeds, lack of demand forecasting and market information, seed producer challenges with cash flow due to delayed payment of subsidies on seeds supplied to users.

Factors that have been found to influence adoption of resilient seeds by farmers are availability of labor, exposure to demonstration fields planted with resilient seed, experience in crop production, exposure to resilient seed varieties through conferences and workshops organized by international development programs and NGOs, access to agriculture extension officers, membership of an FBO, farm size.

Results from surveys administered to commercial farmers, aggregators and smallholder farmers indicate that yield is the most important factor that influences them to use resilient seeds. Although factors such as price of seeds and availability of seeds influence adoption of seeds (considering the current situation where the PFJ program is providing seeds at a subsidized price) survey results indicate that other factors such as quality of seeds and accessibility of seeds play a more important role. Commercial farmers and aggregators also indicated the out growers they work with are influenced by the quality of seeds, time to maturity and yield. Their out growers are thus more willing to try out resilient seeds when there are demonstration farms that show these attributes.

Findings from foundation seed breeders, certified seed producers and input dealers show that there is more room for farmers to increase their usage and adoption of resilient seeds.

Recommendations

Across the seeds value chain, resilient seeds need to be recognized as only one, yet critical component of improving food security through climate smart interventions. Effective collaboration with other vale chain actors is critical to the growth and success of interventions to improve food security. Any interventions introduced to increase adoption of resilient seeds within the seeds market need to be worked out at commercial scale through effective collaboration with other actors such as Integrated Water & Agricultural Development Ghana Limited (IWAD)-irrigation, Ghana Agri-Input Dealers Association (GAIDA)-inputs such as fertilizer and other chemicals. Some factors that will improve adoption of resilient seeds are:

- Access to loan facilities to buy machines that make production mechanized.
- Investments into infrastructure such as Irrigation facilities
- Cash-flow improvement through better repayment of buyers.

Recommendations for NASTAG/Government

To keep the private businesses incentivized to produce potent quality resilient seeds when supplying farmers in government projects, there needs to be a structure in place to repay/reimburse private seed companies promptly, compared to the current lag time of 6-8 months which is not feasible in the long term for small and growing seed companies. NASTAG/Government can therefore liaise with financial institutions to extend credit lines to seed producers supplying seeds under the PFJ program with government serving as a guarantor.

Recommendations for Seed Producers

Resilient seed producers stand to make more sales if they concentrate on maize resilient seeds as compared to rice seeds as maize has had a higher adoption rate than rice. This is attributed to interventions by stakeholders such as input dealers and the government to expose farmers to resilient maize seeds. However recent initiatives by government to promote made in Ghana rice might affect this dynamic.

Local seed producers can take advantage of government and donor programs to increase their production and supply of resilient seeds by:

- Partnering with NASTAG to bid for contracts under PFJ to supply fixed quotas of seeds (guaranteed offtake) up until the end of the project in year 2020.
- Applying for loans from government under the PFJ program to purchase subsidized inputs such as tractors and planters which they can continue to use even after the program ends.

Seed producers can also take advantage of other opportunities such as building their technical capacities by training their staff at the West Africa Centre for Crop Improvement (WACCI) or by attending capacity building workshops organized by donors or government. Seed producers can also expand into the production of breeder and foundation seeds if the plant breeders bill is passed.

Recommendations for Seed Producers post PFJ
After these programs end, certain roles or activities being carried out by these programs would need to be taken up by other players in the sector in order to maintain or increase the adoption of resilient seeds. These include:

Guaranteed offtake - Seed producers need to enter into contracts or MOUS with commercial farmers and aggregators detailing the volumes of seeds they should supply them with on an annual or periodic base. This would enable seed producers to forecast demand for seeds and produce the right varieties and quantities of seeds.

Marketing and sensitization - Seed producers could also partner with input dealers and seed distributors to share costs in marketing (through radio advertisements, demonstration farms , distribution of free starter packs of resilient seeds for farmers to test etc.) the seeds they produce.

Creation of market linkages between value chain actors to provide reliable and readily available output market for agricultural produce- NASTAG is best positioned to play this role as it is made up of different players within the resilient seed value chain. However, it currently has only 45 members meanwhile there are over 300 seed producers in Ghana. Seed producers therefore need to join NASTAG to take advantage of market linkages, strengthen their collective voice as well as to form partnerships to market and distribute the seeds they produce.

Increased provision of agricultural extension services -Seed producers could partner with Agric extension officers to hold workshops and set up demonstration farms to train farmers in their target markets/ communities on the benefits of resilient seeds as well as agronomic best practices to farm them.

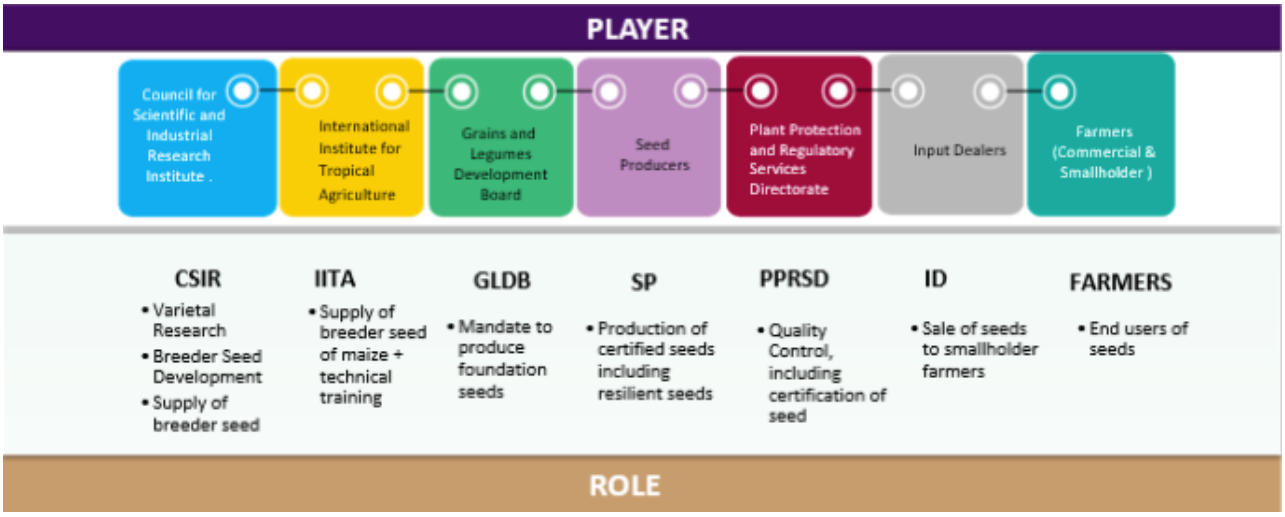
Overview of the Resilient Seeds Value Chain in Ghana
This section of the report seeks to:

- Provide an overview of the resilient seeds value chain, including diagrammatic presentation/block diagram of the chain, and profiles of key actors and stakeholders
- Identify and map out the various stages involved in the production of resilient seeds in Ghana, indicating clearly the institution or groups involved and the various roles they play along the chain
- Establish the current situation with regards to the interdependencies of the roles undertaken by the various actors and stakeholders, and challenges that need addressing in order to enhance effective coordination and general output.

Stakeholders in the seed value chain and the roles they play

The formal seed system in Ghana is headed by the Ministry of Food and Agriculture which hosts the National Seed Council and National Variety Release Committee. The National Agricultural Research Institutes (CRI and SARI) were initially responsible for varietal research and breeder seed development whilst the Grains and Legumes Development Board (GLDB) had the mandate to produce foundation seeds for all crops. The formal seed system was initially heavily public-sector driven but is now increasingly opening up to private sector participation. For example, some universities such as KNUST are currently engaging in varietal research and other private sector producers are currently producing foundation seeds. Demand for seeds comes from farmers and agro-input dealers but NGOs, projects and the Government of Ghana are key drivers of demand in the domestic market.

Map of major players in the resilient seeds value chain

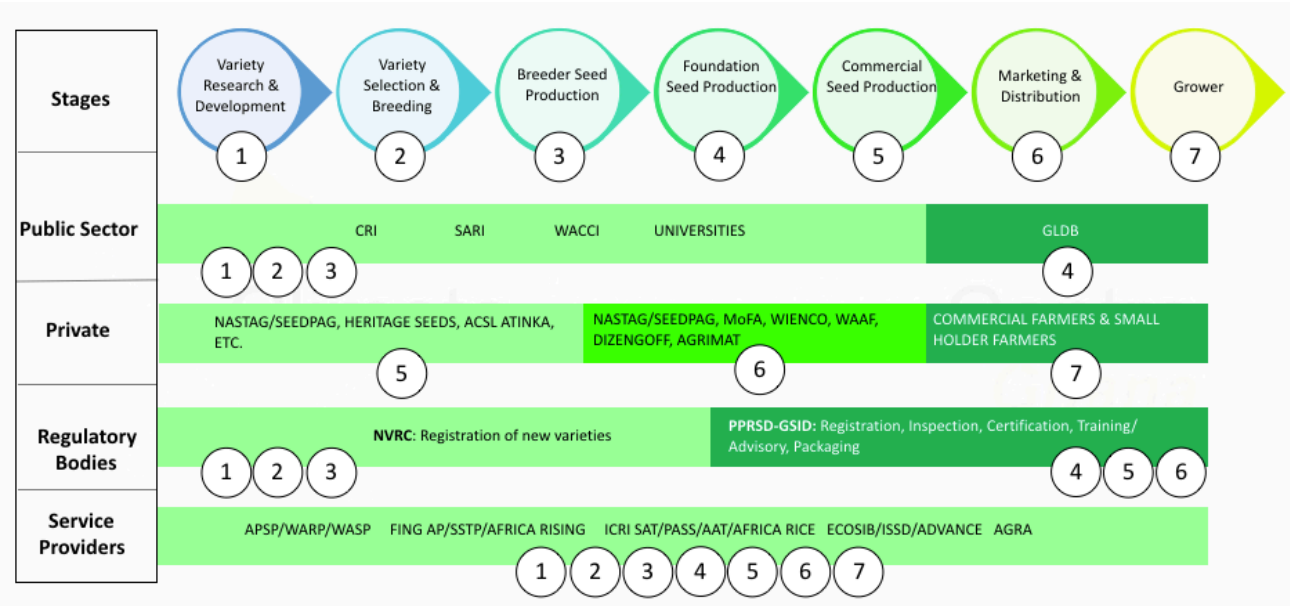


The map above shows the main stages involved, institutions and their roles in resilient seed production

Stages Involved in Resilient Seed Production

Breeder seeds are developed by CRI and SARI using germplast from International Agricultural Research Centers. CRI and SARI then produce these seeds through their breeders and outgrowers. GLDB and recently other private sector producers then produce foundation seeds from these breeder seeds. Seed producers then grow "certified" seeds from these foundation seeds, however the seeds can only be labelled certified after testing and certification by PPRSD. A stakeholder mentioned that this process can sometimes take several years due to some challenges which are explained under "Challenges in the seed sector". When the seeds are finally certified they are supplied to input dealers who then sell the certified seeds to commercial and small holder farmers for planting.

Below is a map showing the stages involved in the production of resilient seeds and stakeholders involved at each stage.



Profile of Major Stakeholders

Ministry of Food and Agriculture (MOFA)
The Ministry of Food and Agriculture has primary regulatory mandate over the seed sector including the resilient seed sector. MOFA has different directorates, institutions and boards regulating the seeds industry in Ghana. These include the Directorate for Crop Services under which PPRSD and Agricultural Extension are nested. Under the PFJs program the ministry has expanded the regulatory role it plays in the seeds value chain to include:

- Facilitation of the provision of subsidized and improved seeds to farmers in partnership with seed producers.
- Facilitation of the provision of subsidized fertilizer to farmers in partnership with distributors
- Increased provision of agricultural extension services
- Creation of market linkages between value chain actors to provide reliable and readily available output market for agricultural produce

As a result, MoFA has since the implementation of the PFJs program in 2017 played a major role in increasing the demand for resilient seeds.

Research Institutions and Universities
Research Institutions operating in the resilient seeds value chain include CRI, SARI and WACCI. The two leading institutions for production of breeder seeds in the country are CRI and SARI. The former focuses on crops grown in the Coastal, Forest and Transitional zones whilst the latter concentrates on crops produced in the Guinea and Sudan Savannah. They both operate under CSIR. The public breeding system draws on germplasm from International Agricultural Research Centres (such as CIMMYT, IITA, ICRISAT, etc.) and is funded by government with some support from donor agencies through projects. Universities including Kwame Nkrumah University of Science and Technology (KNUST) and University of Cape Coast (UCC) are also involved in the breeding of seeds in Ghana.
The West Africa Centre for Crop Improvement (WACCI) is a partnership between the University of Ghana and Cornell University, USA that was established in June 2007 with funding from the Alliance for a Green Revolution in Africa (AGRA) to train local plant breeders working on improving crops factoring in local environments for farmers in Africa.
Grains and Legumes Development Board (GLDB)
Historically, GLDB was the only body allowed by law to undertake the production of foundation seed in Ghana . It has produced foundation seeds for maize, rice, sorghum, cowpea, soybean and groundnut. However, since 2018 this has been opened to the private sector.

National Variety Release and Registration Committee and Technical and Variety Release Committee (NVRRC and TVRC)
The Plants and Fertilizers Act of 2010 also established the National Seed Council (NSC) as well as two committees, namely the National Variety Release and Registration Committee (NVRRC), which is the standing committee, and the Technical and Variety Release Committee (TVRC) that provides technical advisory support. NVRRC is mandated to create and maintain the national variety list and to give recommendations regarding release of varieties, removal of varieties from the register, or the inclusion of crop species. TVRC is required to advise the NSC regarding registration and certification procedures and fees, publish a list of crop varieties grown in Ghana (and by extension the ECOWAS catalogue) annually and conduct technical reviews as needed.
Ghana Seed Inspection Directorate (GSID) and Plant Protection and Regulatory Services Directorate (PPRSD)

The GSID, under PPRSD, operates through regional offices from where its inspectors visit fields to train, supervise and approve commercial seed production. Its officers are also present at conditioning sites to conduct seed tests. GSID has exclusive supervisory role over the production of breeder seeds through to the sale of certified seeds to grain producers or

farmers. It plays a role in producer training and the provision of standard packaging materials in which nearly all certified seeds are sold. GSID operates the National Seed Testing Laboratory (NSTL), which carries out seed sampling and laboratory quality tests to verify moisture content, purity, germination and health of the seeds before the seeds are certified for distribution and sale.

National Seed Trade Association of Ghana (NASTAG) The National Seed Trade Association of Ghana (NASTAG) is an amalgamation of all the value chain actors in the seed industry. NASTAG's currently has 45 fully registered members and membership is open to all seed value chain stakeholders including registered companies of producers, processors, traders, distributors and other auxiliary registered companies and government institutions. NASTAG facilitates linkages between farmers and seed produces.

Programs and NGOs

Ghana's seed sector has received a lot of support from donors through programs over the years. These include, USAID and AGRA-Scaling Seeds and Technology Partnership (SSTP), USAID-Agriculture Technology Transfer Project (ATTP). An overview of these programs can be found here. These projects have been instrumental in several of the key successes recorded in the industry, particularly in the area of policy improvements, variety research and release, promotion and awareness creation, private sector participation, resourcing of public research institutions and capacity development. Also, they have impacted significantly on demand by facilitating access and adoption of resilient seeds.

Challenges in the Seeds Sector

Several interventions have been orchestrated by government, donor agencies and other actors in the seed value chain to address challenges in the sector, however there are still some remaining to be addressed. These include:

Inadequate infrastructure:

- There is currently a lack of processing facilities for seeds (only 5 government owned seed processors providing services to the whole country). This results in long wait times for the processing of seed prior to their being presented for testing and certification. This proves a major challenge to seed producers trying to get seeds certified before the next planting season. However, some private seed processors are trying to establish seed processing centers in Ghana.

- Ghana Seed Inspection Directorate (GSID) is chronically under-resourced, (seed producers sometimes have to pay for field officers to come to their facilities) and this thus delays the process of certifying seeds. This is especially cumbersome for the over 300 seed producers as every production batch of seeds has to be vetted and tested by GSID before the seeds are certified. However, GSID has not yet attempted a less resource-intensive solution to this problem such as accreditation/authorization.

- Seed breeders (nucleus and breeder seeds) and seed producers (certified seeds) also complain of lower than expected/advertised yields especially from their outgrowers due to the lack of irrigation infrastructure to mitigate the effects of erratic and unreliable rainfall patterns. Further support from government and aid agencies is thus needed to build irrigation infrastructure for seed breeders and producers.

- Lack of demand forecasting and market information on specific varieties of seeds also makes it difficult for breeders to forecast demand in order to plan production and thus supply the right varieties and quantities of seeds. This often results in poor business linkages among seed growers and agro-input dealers .

Low cash flow due to delayed payment of subsidies on seeds supplied to users

Delays in the payment of subsidies on seeds supplied by seed producers under the PFJs program is having a negative impact on the cash flow of seeds producers. Some seed producers interviewed indicated that Government can take about 6 to 8 months to reimburse the seed producers.

Assessment of Adoption Rate of Resilient Seeds in Selected Farming Zone

This section assesses the rate of adoption of resilient seeds (rice, maize and soybean) in selected farming zones. The research was carried out in farming zones in the following regions: Ashanti, Bono, Ahafo, Bono East, Northern, Savanna and North East regions. The research also indicates the parameters or factors contributing to adoption, including the level of impact of these parameters. 246 smallholder farmers, 28 commercial farmers/aggregators and 28 input dealers as well as other value chain stakeholders were interviewed.

Prevailing rate of adoption of resilient seeds by farmers in selected farming zones
There is basic knowledge on the ground of climate resilient seeds among smallholder farmers surveyed, i.e. those with an average of 2 hectares of farming land, as 89% of them had heard of climate resilient seeds . Smallholder farmers who were aware of resilient seeds were exposed to them through input dealers, agricultural extension officers, government subsidized programs such as the Planting for Food and Jobs (PFJ), colleague farmers, aggregators as well as radio advertisements. Majority of those interviewed however heard about the resilient seeds through agriculture extension officers from MoFA as well as through input dealers.

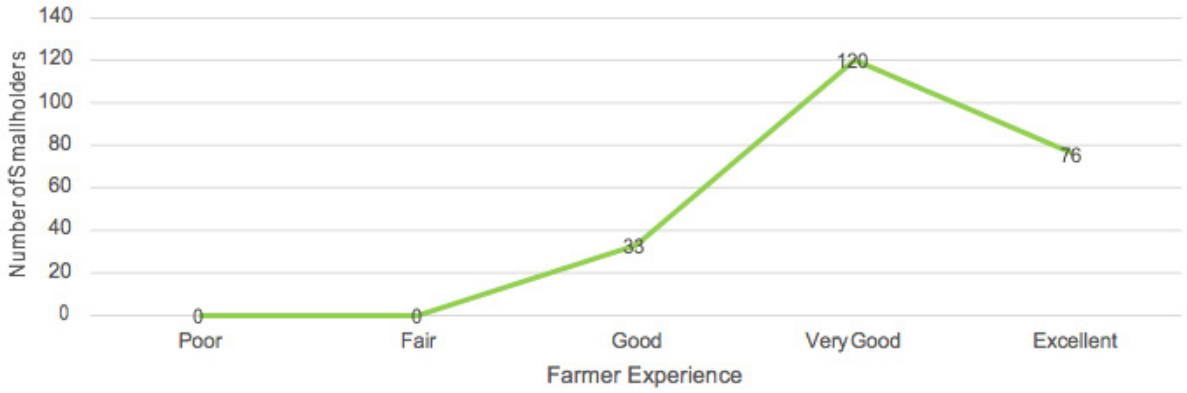
13 aggregators representing almost 50% of the aggregators interviewed mentioned that the smallholder farmers they provide seeds to are willing to try the climate resilient seeds. 54% of commercial farmers and aggregators indicated that they provide resilient seeds to the out growers they work with. Commercial farmers and aggregators thus have a major influence on smallholder farmer/outgrower willingness to use climate resilient seeds and Majority (87%) of smallholder farmers indicated that they had used resilient seeds before. Of those who had used the seeds before, they gave reasons such as “High Yield”, “It reduces the cost of irrigation” and “It’s tolerant to diseases and pest as well as high productivity” as to why they had used resilient seeds . 44% of farmers indicated that they had used resilient seeds for 6-10 farming seasons indicating that they had adopted resilient seeds. Of the smallholder farmers interviewed, 74% of them identified as family heads and 71% of the smallholder farmers owned the farmland they farmed on.

This goes to show that majority of respondents were decision-makers when it comes to their farms and this had a large influence on their use of resilient seeds .

Number of farming seasons resilient seeds have been used	Number of farmers
0 – 5	79
6—10	109
11—15	32
16+	12

Smallholder farmers interviewed generally had a good experience with resilient seeds. Below is a pictorial representation of the positive feedback received from the smallholder farmers.

Smallholder farmers experience with resilient seeds



The graph above is consistent with 91% of the smallholder farmers indicating they will recommend resilient seeds to their colleague farmers. For commercial farmers and aggregators 100%, mentioned they would recommend resilient seeds to their colleague farmers.

There is a high prevailing rate of adoption of resilient seeds among the farmers interviewed. From interviews with key stakeholders, this is mainly due to the Planting for Food and Jobs government program where seeds are sold to farmers at subsidized prices. From the data gathered, good experiences that the farmers have had with the seeds is also a contributory factor to adoption.

Parameters contributing to willingness to adopt resilient seeds and Importance of these factors in scaling up adoption

Across the research findings , yield is a major factor that influences the choice of seeds for smallholder farmers and

commercial farmers/aggregators. It is also one of the major attributes identified by the smallholder farmers which they look out for when selecting resilient seeds.

- While concentrating on seeds in general, commercial farmers and aggregators mentioned yield as the most important factor when considering attributes of seeds. Refer to Table 1 for further analysis.
- When asked to rank in order of priority different factors which could contribute to willingness to adopt resilient seeds, 65% of the commercial farmers and aggregators ranked yield as the most influential factor. The influence of yield in adopting resilient seeds is further emphasized with zero commercial farmers and aggregators ranking it as the least influential factor. Refer to Table 2 for further analysis
- Commercial famers and aggregators also indicated the outgrowers they work with are influenced by the quality of seeds, time to maturity and yield. They also mentioned that their outgrowers are more willing to try resilient seeds when there are demonstration farms that show the above attributes .
- For smallholder farmers, the ranking showed results consistent with the analysis above. Refer to Table 3 for further analysis.

Respondents were also interviewed on the special attributes they want resilient seeds to have which would make them more likely to use resilient seeds. They mentioned quality and yield. Lodging, disease and pest resistance were other special attributes mentioned.

Based on these analyses, it shows that yield is a very important factor when choosing seeds for farmers of

all groupings considered under this research. As such resilient seeds that have other desirable attributes would need to also be high yielding in order to be considered by farmers.

Main Takeaway from Assessment of Adoption Rate

From the data analyses, it shows that yield is the most important factor that influences smallholder, commercial and aggregators to use resilient seeds. Although factors such as price of seeds and availability of seeds influence adoption of seeds (considering the current situation where the PFJ program is providing seeds at a subsidized price) survey results indicate that other factors such as quality of seeds and accessibility of seeds play a more important role.

Market trends, bottlenecks and opportunities influencing high adoption of resilient seeds

The total size of the market in Ghana for rice, hybrid maize, OPV Maize and soybean was approximately US$ 57 Million as at 2015. According to research, about 35% of land under cultivation in Africa is allocated to improved crop varieties. Across various farming communities such as the Savanna zones especially, there is a challenge of drought and yield among others that affects production and supply to farmers.

Undoubtedly, there is an urgency to supporting community based and farmer managed seed systems in order to protect and enhance seed diversity. It is important that seed varieties that can withstand drought are available to enable farmers in those areas to still produce to meet demand volumes. In Ghana, drought-tolerant rice, maize and soybean foundation seeds are increasingly being developed by CSIR-SARI to improve food security and climate challenges in farming communities. The Ministry of Food and Agriculture (MoFA) Planting for Food and Jobs program (PFJ) has been playing an increasing role in influencing market trends including production, pricing, distribution of resilient seeds nationwide. Nonetheless, findings from foundation seed breeders, certified seed producers and input dealers show that there is more room for farmers to increase their usage and adoption of resilient seeds.

To understand adoption of resilient seeds, it is important to look at not only “buyers’ such as farmers/input dealers, but at seed producers as well. In any given market, the supply and demand need to be looked at to understand what will influence high adoption, since availability of the product being demanded is critical for the market.

Historic Trends of Factors Affecting Resilient Seed Adoption

Various researches have been conducted over the past decade to understand the level of adoption of various resilient seeds across maize, rice and soybean. Some research found that, significant determinants of the level of improved maize seed adoption of farmers include:

Level of education of farmer increases their level of adoption, given their ability to recognize the value in the improved variety, and be more prone/have a higher probability of adopting the resilient seeds. All these factors affect farmers' level of adoption of climate resilient/improved variety of seeds, compared to local variety of seeds. In addition, factors that have been found to influence high adoption of resilient seeds by farmers are:

Labour	Significant availability of labor
Demonstration	Exposure to demonstration fields planted with resilient seed
Experience	Long length of experience in crop production
Exposure	High level of exposure to resilient seed varieties through conferences and workshops organized by international development programs and NGOs.
Access	Ability to access agriculture extension officers
Membership	Being a member of an FBO
Large Farm Size	Farmers with larger farms appear to have a higher level of adoption, given climate resilient seeds will ultimately enable them maximize profits and be more efficient.

There have also been influencers of low adoption such as:

- Living farther away from farm
- Earning significant amount of income in the previous planting season without using resilient seeds.

Market Trends, Major Influencers and their influence on Market Dynamics

In order to identify the relevant bottlenecks that would potentially hinder and opportunities that would contribute to high adoption rate of resilient seeds across farming communities in Ghana, we need to understand market trends and their major influencers, as well as how they affect market dynamics. In this research, we look at market trends in production, pricing, distribution of resilient seeds, demand as well as incentives affecting the adoption of resilient seeds.

Production Trends

There has been an increase in production of climate resilient seeds over the past decade

The most commonly promoted resilient seeds have been varieties of maize seeds, such as Opeaburoo.

Market Trends

Among private seed producers and government foundation seed breeders, there has been an increase in production of climate resilient seeds over the last decade. However, the expected yields of seeds have not been as high as anticipated. Seed quality is critical , yet not the only factor influencing the outcome of production when resilient seeds are planted. Improved soil fertility, adoption of agronomic best practices, infrastructure for irrigation systems to reduce over-reliance on rainfall are also critical. All these complement and enable the use of resilient seed to generate the desired results of improved yields and food security.

To date, resilient seeds are sourced from foundation seed breeders in Ghana and Nigeria including: GLRDB, CRI, IITA Ibadan, and CSIR-SARI. Although resilient seeds are being produced across maize, rice and soybean, the most commonly promoted resilient seeds have been varieties of maize seeds , such as Opeaburoo (a maize hybrid).

Major Influencer of Production

Implementation of Government Policies and Subsidies in Seeds Sector

Major Influencers

The creation and implementation of government policies and subsidies has played a significant role in the production of resilient seeds in recent years, especially when the Planting for Food and Jobs program was initiated. (Source: Interviews with Producers). Other influencers of production have been:

- Demand of farmers
- Training of seed producers by GIZ, KNUST and CRI and MOFA
- Government loans, to purchase mechanized machines or for working capital, offered to seed producers with flexible payment terms. Typically, they repay with their produce to MoFA's PFJ program.

Pricing Trends

The PFJ program has changed the market dynamics for the price of seeds sold to farmers.

There have been delays with the reimbursement of seeds to seed producers

Current Market Trends

Since the inception of the Planting for Food and Jobs program, the dynamics for the pricing of seeds have changed. Government contracts with seed producers to produce seeds at an agreed upon price of e.g. GHC 8 per kg for maize seeds and then sell them to input dealers for GHC2 per kg. The GHC6 subsidy is then reimbursed to the seed producer by government on submission of required documentation. Due to these and other government subsidies, farmers are incentivized to purchase some resilient seeds at significantly lower prices. A side effect of this is that, when seed producers attempt to sell resilient seeds at their true cost outside the PFJ program, input dealers may not be willing to take them on because farmers will be reluctant to purchase them. They would rather

pay the price offered through the PFJ program.

Unfortunately, under the PFJ, there have been a trend of delay with the reimbursement of subsidies to seed producers.

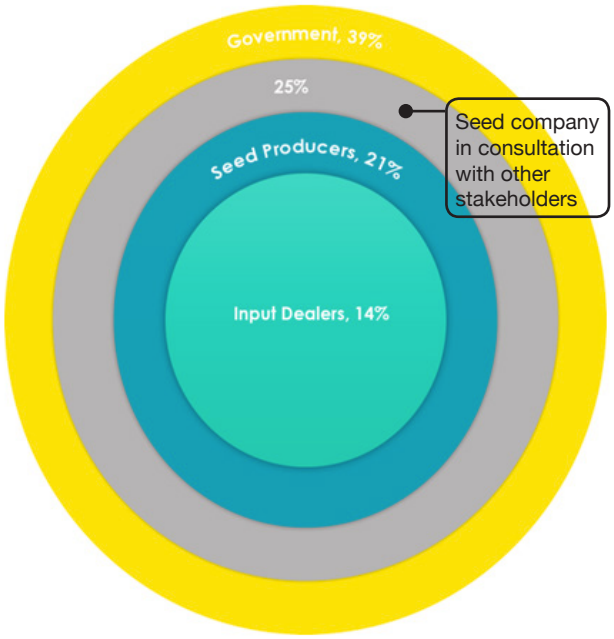
Major Influencers of Price

The most significant influencer of price setting is the government.

Government sets price along with other stakeholders such as NASPAG and SEEDPAG

Major Influencers

- In a recent survey conducted, it was found that the most significant influencer of price setting is the government.



Influencers of Seed Prices (%)

Government's is currently playing the role of providing subsidies and moderate pricing. However, the question remains as to whether it should be playing this role. Reimbursements to seed producers takes a long time, raising questions on whether government has capacity to fund these subsidies. Government is furthermore playing an increasing role in setting prices with the introduction of the PFJ program.

Planting for Food and Jobs appears to have influenced not only price of resilient seeds but receptiveness of farmers to buy at a given price. Given that the PFJ program is involving private seed producers who have a production cost and selling price, there is a price at which they would need to sell to farmers to be profitable. Now, aside going through the usual channel of selling to input dealers or farmers directly, where they then bear the full cost of producing the seeds, the PFJ program pays a subsidy to make the seeds cheaper for the end users i.e. farmers. Although this has significantly increased adoption of resilient seeds, it has also distorted the market to an extent because private seed producers are not able to sell at competitive prices to farmers outside the PFJ program. Seed producers are forced to join the planting for food and jobs program to sell their seeds because the farmers are aware of the subsidized prices and prefer to pay at that lower price.

Historically, it was mainly SEEDPAG, NASPAG that played a role in price setting. Now however, their power to rule on pricing is mainly in collaboration with the government of Ghana through the PFJ program. According to input dealers, seed prices are mainly set by the government now. In cases where seed producers have some control over price setting, this is mainly in consultation with other stakeholders such as the government. Although farmers are not price makers but rather price takers, their decision to purchase seeds, rather than using farmer saved seeds, and frequency of purchase depends on their purchasing power.

Distribution

Distribution Trends

Over the past 3-5 years, there has been a gradual improvement in seed distribution to various communities

Seed producers bear transport costs and use company vans to transport seeds to their buyers

Current Market Trends
Seed distribution has improved gradually over the last 3-5 years. Seed producers bear transport costs and use company vans to transport to their buyers – typically their retail outlets and input dealers. Also, input dealers distribute to farmers through their retail shops.

Major Influencers
According to some seed producers under the PFJ program, government is reimbursing transportation costs to seed producers. However, it takes about 6-8 months for producers to receive their repayment, thus affecting the cash flow of these private companies who may be keeping in business mainly through this program.

Incentives
Current Market Trends
The major incentives have been price subsidies for farmers. The lower prices of seeds through government programs such as the PFJ has been a major incentive for adopting resilient seeds. Also, it was found that the use of resilient seeds is also a precondition for accessing subsidized farm inputs. As such, farmers are incentivized to use resilient seeds.

For some seed producers who receive reimbursement for their transportation costs, this might be an incentive to continue producing to meet demand, while keeping the business of seed production and distribution viable for private seed producers.

Demand

Demand Trends

The main target market of seed producers are: Input dealers, Farmers, Smallholders and Commercial Farmers.

54% of input dealers interviewed mentioned that demand for resilient maize seeds has been very high.

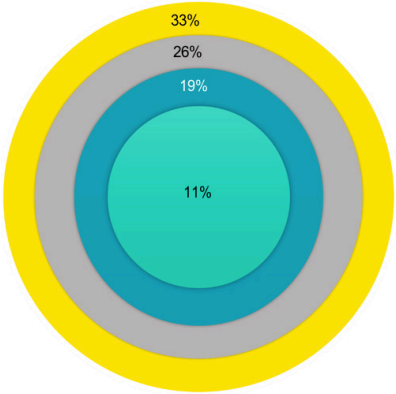
Sales from previous seasons are used to calculate estimated demand

Major Influencers

Several factors influence farmer demand of seeds including yield, type of seed available/introduced to the area, farming season (major or minor). Farmers demand for seeds is also dependent on there being a ready market for those varieties of seeds.

Demand for seed was previously influenced by other farmers. However now, according to a recent survey, farmers' demand is mostly influenced by government policies and subsidies as well as their level of exposure to resilient seeds at conferences and on demonstration sites. See table below:

Government policies	**33%**
Level of exposure to resilient seeds at conferences and on demonstration sites	**26%**
Farm size	**19%**
Level of education of farmers	**11%**
Availability of labor	**11%**



Advertisements/marketing of resilient seeds by seed producers and input dealers also play a role, although not as significant as government policies. Advertisements may play a better role as a complement to giving farmers exposure to seeds through demonstration sites.

Input dealers play a role in promoting the adoption/increased usage of high yielding, drought and disease tolerant varieties through:

- Partnerships with the Ministry of Food and Agriculture (MoFA)
- Advertisements on Radio
- Educating and Encouraging Farmers Directly
- Through Workshops or Demonstration Farms.
- Majority of These Activities Are Internally Funded by the Input dealers

SWOT of Market Trends

STRENGTHS	WEAKNESS	OPPORTUNITIES	THREATS
• Strong collaboration where seed producers serve as suppliers to farmers in the PFJs program • Government loans to seed producers plays a significant role in improving seed availability. • The setup of demonstration sites by seed producers is increasing farmers' exposure • Development projects are providing interventions to that quality/ potent seeds are produced. • Input dealers can use their internally generated funds to market resilient seeds	• Insufficient production and distribution, inadequate support and the absence of a good structural framework for improved seed development • Lack of demand and forecasting systems • Low level of certified seed uptake • Mismatch between varieties of breeder and foundational seeds produced and demand for these varieties leading to overproduction or underproduction of certain varieties • PFJ price subsidies are distorting market prices for private seed producers	• Seed producers can take advantage of the PFJ to sell their resilient seeds and grow their businesses. • They can also apply for loans from government under the PFJ program to purchase subsidised inputs such as tractors and planters which they can continue to use even after the program ends. • They can also build their technical capacities by training their staff at the West Africa Centre for Crop Improvement (WACCI) or by attending capacity building workshops organized by donors or government. • They can also expand into the production of breeder and foundation seeds if the plant breeders bill is passed.	• Importers or larger foreign private seed producers too can enter the market with higher yielding seeds at cheaper prices and compete with local seed producers without being dependent on the PFJ program.

Strengths

- The collaboration between private seed producers and government through the PFJ program is creating an enabling environment for resilient seed adoption by farmers. Private seed producers serve as suppliers to farmers in the PFJs program.
- Government's provision of loans to seed producers to improve their production, thereby facilitating quality and increase in seed production, has played a significant role in creating availability for resilient seeds.
- The initiative of input dealers and extension officers in setting up demonstration sites to create exposure for farmers to learn more about resilient seeds and its benefits is helping to build a strong foundation for demand for resilient seeds with or without the PFJ program among farmers.
- Interventions through development projects such as USAID and GIZ has played a role in ensuring that quality/potent seeds are produced in the most efficient manner, and farmers are better educated about what resilient seeds are through workshops organized for various farming communities.
- Input dealers can use their internally generated funds to market resilient seeds to more farmers through local radio stations.

Weaknesses

- Although a few interventions have come from development projects, there is insufficient production and distribution, inadequate support and the absence of a good structural framework for improved seed development.
- Compared to the market size of seeds, there is still a low level of certified seed uptake although the level of adoption of resilient seeds by farmers is slowly growing because of some interventions. There are still several farmers that reuse seeds or produce their own seeds. This segment of farmers also needs to be won over to constantly patronize certified seeds.
- Resource wastage: Mismatch between varieties of breeder and foundational seeds produced and demand for these varieties leading to overproduction or underproduction of certain varieties
- Aside going through the usual channel of selling to input dealers or farmers directly, the PFJ program becomes the buyer who pays a subsidy to make the seeds cheaper for the end users, farmers. Although this has significantly increased adoption of resilient seeds, it has also distorted the market to an extent because private seed producers are not able to sell at competitive prices to farmers outside the PFJ program.

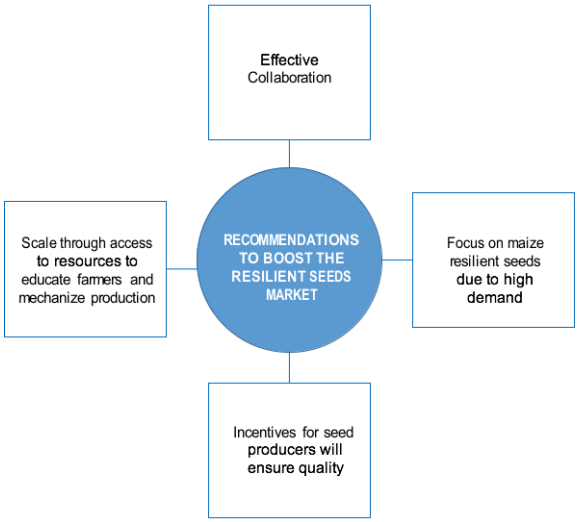
Opportunities

- Serious private seed producers can take advantage of the PFJ to sell their resilient seeds and grow their businesses.
- They can also apply for loans from government under the PFJ program to purchase subsidized inputs such as tractors and planters which they can continue to use even after the program ends.
- They can also build their technical capacities by training their staff at the West Africa Centre for Crop Improvement (WACCI) or by attending capacity building workshops organized by donors or government.
- They can expand into the production of breeder and foundation seeds if the plant breeders bill is passed

Threats

- The challenges of insufficient production and distribution, inadequate support and the absence of a structural framework for improved seed development of the local market leaves room for importers or larger foreign private seed producers to play a leading role in the market.
- Although the PFJ is contributing to improved level of adoption, the program has distorted the pricing of resilient seeds, which can significantly affect how private seed producers and input dealers sell to farmers.

Recommendations to boost the market for resilient seeds in Ghana to improve adoption rate



Effective collaboration with other component actors is critical to the growth and success of interventions to improve food security. Resilient seeds need to be recognized as only one , yet critical component of improving food security through climate smart interventions. Any interventions introduced within the seeds market need to be worked out at commercial scale through effective collaboration with other actors in other areas aside seeds such as soil and water.

Some areas that will improve adoption of resilient seeds are:

- Access to loan facilities to buy machines that make production mechanized.
- Irrigation facilities
- Cash-flow improvement through better repayment of buyers.

Resilient seed producers stand to make more sales of maize compared to rice seeds as maize has had a higher adoption rate than rice. This is attributed to interventions by input dealers and the government to expose farmers to resilient seeds. However recent initiatives by government to promote made in Ghana rice might affect this dynamic.

To keep the private businesses incentivized to produce potent quality resilient seeds when supplying farmers in government projects, there needs to be a structure in place to repay/reimburse private seed companies promptly, compared to the current lag time of 6-8 months which is not feasible in the long term for small and growing seed companies. NASTAG/Government can therefore liaise with financial institutions to extend credit lines to seed producers supplying seeds under the PFJ program with government serving as a guarantor.

Appendix

Project	Project Description	Partners	Funding	Duration
Scaling Seeds and Technology Partnership (SSTP)	**Location:** Ethiopia, Ghana, Malawi, Mozambique, Senegal, and Tanzania Crop focus: Maize, Rice, Soybean, Cassava, Cowpea and Sorghum **Purpose:** • Improve capacity of public and private sector groups to deliver quality seed and other technologies to smallholder farmers • Increase the use of quality seed and other technologies by smallholder farmers • Improve regional and country-level policy and regulation mechanisms for the production and delivery of quality seed and technologies to smallholder farmers. Effect on adoption of seeds: The average amount of SSTP-promoted maize seed planted by sampled farmers in Ghana increased from 12.8 to 18.7 kilograms (kg) an increase of about 46%. Project Report Findings: Farmers were found to be the greatest influence in motivating other farmers to apply and adopt SSTP-promoted improved varieties while motivation from agro- dealers and seed companies was less important, especially among the indirect beneficiaries. In Ghana, proportionally more women reported to have been influenced by other farmers, whereas proportionally more men said they were influenced by seed companies, agro-dealers, and extension agents in terms of the motivation to apply improved varieties. In terms of seed acquisition, a greater proportion of sampled women purchased seed at full cost, whereas more men acquired seed for free or at reduced cost, most likely from seed companies and extension agents, both of whom were giving free “tester packs” to direct beneficiaries	USAID and AGRA	$46.8 million	2013 - 2018

	Beneficiaries chose not to adopt varieties for reasons relating to the varietal characteristics, (e.g., yield, storability), marketability of the output; vulnerability to weather, preferences for other varieties, and the cost and availability of seed. **Project Recommendations:** Future efforts to encourage smallholder farmers to adopt improved varieties should encourage farmer-to-farmer learning ensure that appropriate varieties are selected for promotion; support linkages to output markets support seed companies to enhance their marketing and distribution channels (including their relationships with agro-input dealers and the use of free varietal "tester packs") **Other:** Preceded by PASS which focused on crop improvement; education and training, seed production and support to agro-dealers' development followed by AGRA-led Partnership for Inclusive Agricultural Transformation in Africa (PIATA)			
Agriculture Technology Transfer Project (ATTP)	**Location:** Northern, Upper West, and Upper East **Crop focus:** Rice, soybean and maize Purpose: To improve the seed-sector to increase competitiveness in the rice, soybean and maize value chains in Northern Ghana Program was implemented by IFDC focusing on 6 components namely: • Information Communication • Promotion and Scaling of High-Quality Seeds, • Integrated Soil Fertility Management (ISFM) • ConservationAgriculture/Climate Smart • Agriculture • Harvesting rain to enable cropping seasons • Capacity Building for Agricultural Research	Feed the Future Initiative/ USAID **Implementer:** IFDC **Technical support:** Iowa State University (ISU) and the Center for Development Innovation through the University of Wageningen	$22 million	2013 - 2018

	Effect on adoption of seeds: As at 2013, informal seed systems (farmer saved seeds) accounted for about 80% of total seed supply in the Northern region. The project resulted in an increase in certified seed use from 10% of total seed use in 2013 to 25% in 2018.Through various dissemination mechanisms, from demonstration plots to starter packs to video extension, ATT created sustained demand for certified seed, ISFM technologies, and good agricultural practices. Coupled with improved fertilizer application practice, e.g. urea deep placement (UDP) technology, these interventions resulted in farmers in the Northern Region improving their rice output and gross margins. **Project Report Findings:** For measurable impact or transformation, interventions must target the whole system, along with its actors, rather than just one aspect of the value chain. For example, promoting the use of certified seed must not only focus on the users; it must start with researchers and breeding agencies. **Project Recommendations:** ATT engaged the private sector to produce certified seed in a timelier manner by helping them access modern seed processing equipment. Financing mechanisms can help additional seed processor procure new seed testing and processing equipment to replace obsolete ones.			
Ghana Advanced Maize Seed Adoption Program (GAMSAP	**Location:** Ghana **Crop focus:** Maize **Purpose:** Aimed at facilitating a transformation of Northern Ghana's agricultural sector to achieve a greater degree of food security among the rural population in the north with the use of acceptable high-quality inputs and production techniques while increasing competitiveness in the domestic markets. This was done as part of the Agricultural Development and Value Chain Enhancement (ADVANCE) program of ACDI-VOCA.	DuPont Pioneer and the USAID	$4 million	2013 - 2017

Agricultural Policy Support Project (APSP)	**Location:** Ghana **Purpose:** • Policy formulation and implementation - focused on improving the policy process of evidence-based decision-making related to food security • Policy Research-focused on increasing the availability of rigorous policy analysis and capacity for evidence-based policymaking • Policy Advocacy-focused on building the capacity of civil society and farmer-based organizations to strengthen and amplify their voice in the agriculture policy process. **Effect on adoption of seeds:** APSP has supported the Government of Ghana in improving the legal and technical framework to enable the private sector to develop, commercialize and use certified seeds to increase smallholder productivity and incomes, including: • The harmonization of the Seeds Regulations to ECOWAS protocols, the manuals on crop variety release, certification and accreditation, seed licensing, production of foundation seeds and is training over 20 seed enterprises on quality management for production of certified seeds. APSP has supported the formation of an umbrella association, the National Association of Seed Traders of Ghana (NASTAG) to spearhead the agenda to transform Ghana's seed industry. NASTAG has now become the leading private sector organization in Ghana, representing the voice of the seed industry	USAID		2013 - 2018
ECOSIB	**Purpose:** An incubation initiative that seeks to build the technical and managerial competencies of seed businesses in order to increase the availability and accessibility of superior seed varieties to smallholder farmers in Ghana. It aims to enhance productivity and profitability within the seed value chain.	Scaling Seeds and Technologies Partnership (SSTP) of AGRA through FARA **Implementation partners:** Agri-Impact consult, KNUST CRI and (GLDB)		

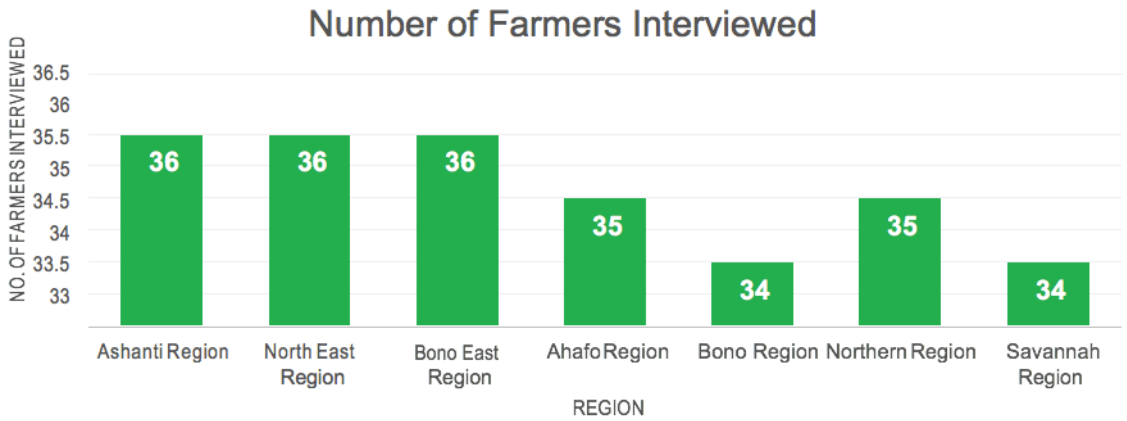
AVISA	**Purpose:** The Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA) project consolidates the gains made by TL-III, HOPE-II and HarvestPlus while refocusing the work to improve the CGIAR and key NARS breeding and seed delivery systems. Expected outcomes of the project include • National institutions with the technical capacity to support a robust early generation seed (EGS) seed system. • A continuous stream of improved varieties for smallholders generated to achieve greater yields as well as higher incomes and improved livelihoods. • Increased varietal turnover mitigating losses from evolving climate patterns, and pest and disease complexes, while enabling public- private partnerships for enhanced seed delivery. • High functioning, integrated CGIAR/ NARS breeding networks and coordinated seed delivery partnerships built to facilitate smallholder farmers' access to high quality seed.	Bill and Melinda Gates Foundation		2019 -

Results from Interviews with Smallholder farmers

Rice, Soybean and Maize farmers were interviewed in the regions under review to help assess the rate of adoption to resilient seeds and what factors affected their rate of adoption.

Profile of Smallholder farmers

This section captures the profile of the interviewees to give context to the audience. It is also referred to during further analysis in this report. Insights have been drawn from this section to come to factual conclusions. A total of 247 smallholder farmers were interviewed across the 7 regions of Bono, Bono East, Ahafo, Savannah, North East, Northern and Ashanti Regions of Ghana. Smallholder farmers typically have subsistence farms. They usually sell some produce to aggregators. Below is a distribution of the respondents across the regions.



65% of the smallholder farmers were male and **35%** of them were female. The questionnaire was administered to rice, soybean and maize smallholder farmers. Some of the farmers farm more than one crop. Below is a breakdown of the different crops farmed:

TABLE 4

CROP	Number of farmers
Rice	77
Maize	114
Soybean	22
Rice, Soybean	2
Rice, Maize	5
Maize, Soybean	4
Rice, Maize, Soybean	23
Total	**247**

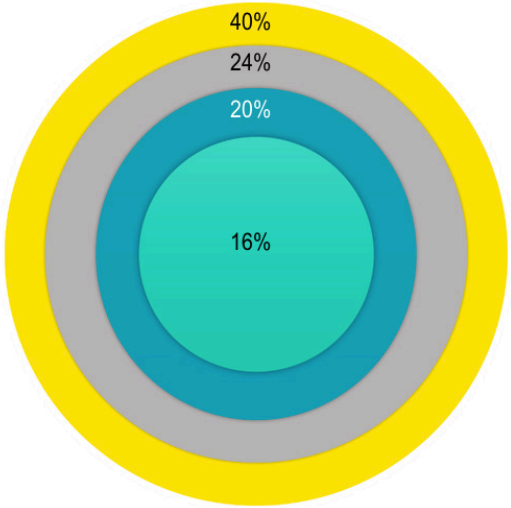
Of the smallholder farmers interviewed 74% of them identified as family heads while 22% and 4% respectively identified as Spouse and Child respectively. 71% of the smallholder farmers owned the farmland they farmed on. This goes to show that majority of respondents are decision-makers when it comes to the farming and have a large influence on the seeds used.

The chart below shows the number of years which the farmers had been farming on their farmland.

PERCENTAGE OF FARMERS WHO HAVE FARMED FOR X NUMBER OF YEARS

6 – 10 years	**40%**
11 – 15 years	**24%**
0 – 5 years	**20%**
16+ years	**16%**

40% of the farmers have farmed for 6-10 years on the farmland.



In relation to formal education, 63 % of the farmers interviewed had formal education. Below is a table with further details.

TABLE 5

Educational Level	Frequency	Percentage
None	92	37%
Primary	57	23%
JHS/Middle School	62	25%
SHS	30	12%
Tertiary	6	2%
Total	**247**	**100%**

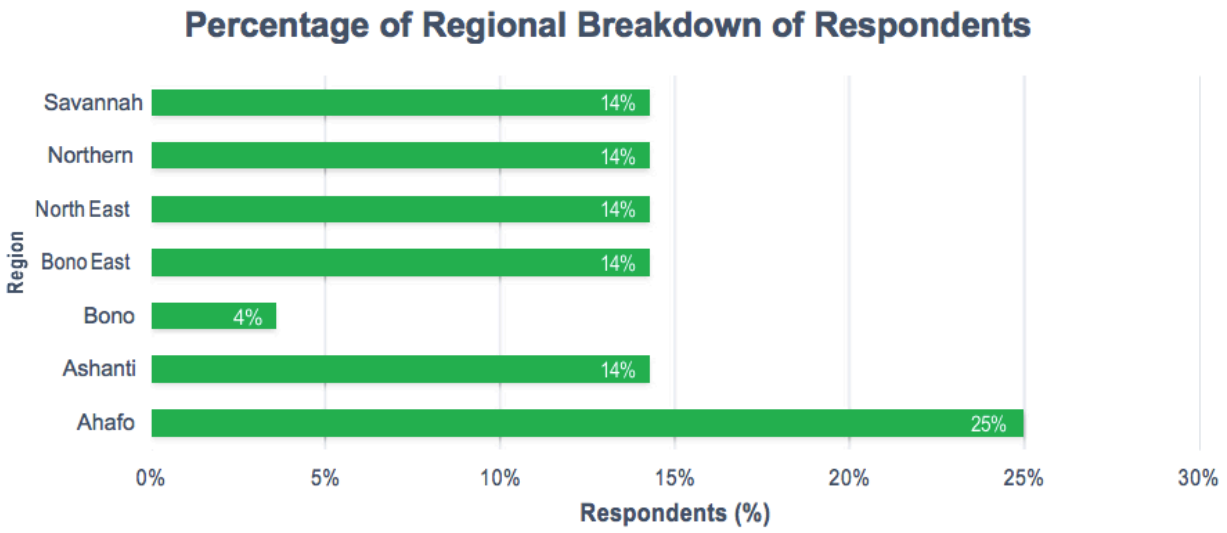
93% of all respondents were aged 31 years and above.

TABLE 6

Age	Frequency	Percentage
19 - 30	17	7%
31 - 40	74	30%
41 - 50	102	41%
51 - 60	51	21%
60 and above	3	1%
Total	**247**	**100%**

Results from interviews with Commercial Farmers and Aggregators
Commercial farmers and aggregators were interviewed to understand the factors that lead to their adoption (or otherwise) of resilient seeds. This group of farmers run larger farming businesses aimed at making profit. They typically have out growers who are made up of smallholder farmers and they typically largely influence the farming decisions including inputs fertilizer, seeds, and farming practices used by their smallholder farmers.

Profile of Commercial Farmers and Aggregators
A total of 28 commercial farmers and aggregators were interviewed across the 7 regions of Bono, Bono East, Ahafo, Savannah, North East, Northern and Ashanti Regions of Ghana. Below is a distribution of the respondents across the regions.

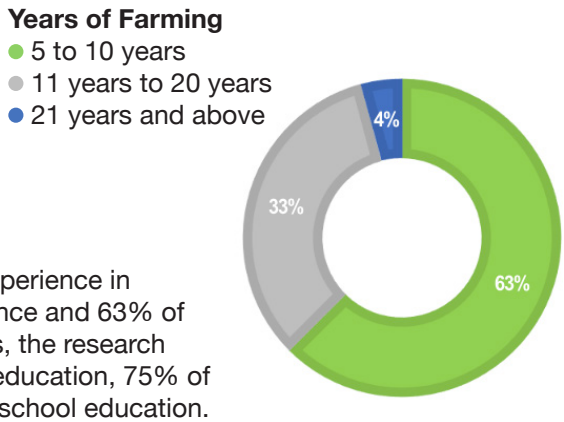


57% of the respondents were male and 43% of them were female. The questionnaire was administered to rice, soybean and maize commercial farmers and aggregators. Of the 28 commercial farmers and aggregators, 46% work with outgrowers while 54% of the respondents do not work with outgrowers. Some of the farmers farm more than one of the crops. Below is the breakdown of different crops farmed by commercial farmers and aggregators:

TABLE 7

CROP	Number of farmers
Soybean only	3
Rice Only	8
Maize Only	9
Rice and Maize	1
Rice and Soybean	1
Rice, Maize and Soybean	2

Below is the breakdown of commercial farmers interviewed and their years of experience in farming.



With 4% of the respondents having 21 years' and above experience in farming, 33% of the farmers having 11 to 20 years' experience and 63% of all respondents having 5 to 10 years' experience as farmers, the research had a sample of experienced farmers. In relation to formal education, 75% of commercial farmers interviewed had at least a JHS/Middle school education.

TABLE 8

None	7	25%
Primary	6	21%
JHS/Middle School	5	18%
SHS	6	21%
Tertiary	4	14%
Total	28	100%

89% of all respondents were aged between 31 and 50 years.

TABLE 8

Important seed attributes (Ranking)	1 (Least Important)	2	3	4	5 (Most important)
Seed is climate resilient i.e. drought or lodging tolerant	25%	13%	29%	17%	17%
Yield per hectare	4%	0%	17%	17%	63%
Disease resistance	22%	17%	26%	35%	0%
Storability of seeds	23%	0%	8%	38%	31%
Days to maturity	4%	21%	25%	50%	0%
Input requirements e.g. how much fertilizer is required to get a good yield	22%	30%	22%	17%	9%

Of the 46% of respondents who work with outgrowers representing 13 respondents, only 3 do not provide resilient seeds to the out growers they work with. This shows the influence aggregators and commercial farmers have in the adoption of new farming practices and technology.

List of tables referenced in the report

TABLE 1: RANKING OF SEED ATTRIBUTES IN ORDER OF IMPORTANCE

Important seed attributes (Ranking)	1 (Least Important)	2	3	4	5 (Most important)
Seed is climate resilient i.e. drought or lodging tolerant	25%	13%	29%	17%	17%
Yield per hectare	4%	0%	17%	17%	63%
Disease resistance	22%	17%	26%	35%	0%
Storability of seeds	23%	0%	8%	38%	31%
Days to maturity	4%	21%	25%	50%	0%
Input requirements e.g. how much fertilizer is required to get a good yield	22%	30%	22%	17%	9%

TABLE 2: RANKING OF CRITERIA FOR COMMERCIAL FARMER SELECTION OF SEEDS

Rank in order of priority from 1-5 with 5 being the most influential	1(Least influential)		2	3	4	5 (Most influential)
Availability of or access to seeds	9%		43%	17%	17%	13%
Price of seeds	13%		26%	35%	22%	4%
Farming season, i.e. major or minor season	50%		0%	35%	15%	0%
Quality of seeds	5%		5%	10%	57%	24%
Specific attributes of seeds e.g.: yield	0%		4%	13%	17%	65%

TABLE 3: RANKING OF CRITERIA FOR SMALLHOLDER FARMER SELECTION OF SEEDS

Ranking	1(Least influential)	2	3	4	(Most influential)
Availability of or access to seeds	17%	26%	19%	15%	23%
Price of seeds	8%	29%	29%	19%	16%
Farming season (major or minor)	51%	14%	16%	14%	5%
Quality of seeds	7%	15%	13%	35%	30%
Specific attributes of seeds e.g. yield	12%	9%	9%	18%	52%

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