Three Country (Burkina Faso, Ghana and Mali) Case Studies on the PASS Value Chain Strategy/Approach and its Effect on Smallholder Farmer Yields in Africa

FINAL REPORT

Submitted to

ALLIANCE FOR A GREEN REVOLUTION IN AFRICA (AGRA)
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BY

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ACRONYMS

ADP	Agro-dealer Development Programme
AGRA	Alliance for a Green Revolution in Africa
CAADP	Comprehensive Africa Agriculture Development Programme
CNEV	National Species and Varieties Committee
CNRST	Centre National de la Recherche Scientifique et Technologique
CNS	National Seed Committee
CSIR	Council for Scientific and Industrial Research (Ghana)
CSVs	Cellules Semencieres Villageoises (Village Seed Cells)
CRI	Crops Research Institute (Ghana)
DFID	(UK) Department for International Development
EACI	Education for African Crop Improvement
EU	European Union
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
FIAAC	Fund for the Improvement of and Adoption of African Crops
GDP	Gross Domestic Product
GPS	Global Positioning System
GSS	Ghana Statistical Services
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institute of Rural Economy (Mali)
IPR	Rural Polytechnic Institute (Mali)
INERA	Institut de l'Environnement et de Recherches Agricoles
M&E	Monitoring and Evaluation
MOFA	Ministry of Food and Agriculture (Ghana)
MTR	Mid-Term Review
NEPAD	New Economic Partnership for Africa's Development
NGO	Non Governmental Organization
NNS	National Seed Service
PAFISEM	Projet d'Appui a la Fille Semenciere
PASS	Programme for Africa's Seeds Systems
SARI	Savanna Agricultural Research Institute (Ghana)
SCVR	Scientific Committee for Varieties Registration
SEPA	Seed Production for Africa
SPSS	Statistical Package for Social Scientists
SRID	Statistics, Research and Information Department (of MOFA, Ghana)
UPB	University Polytechnique de Bobo Dioulasso

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EXECUTIVE SUMMARY

1. The starting point of a green revolution is the development of a good seed supply system. Thus, the AGRA Program for Africa's Seed System (PASS) is definitely an important prerequisite for increasing food production, improving farmers' incomes and ensuring food security in Africa.

2. PASS aims at introducing over 1250 new varieties of at least 10 important staple crops that would significantly improve the productivity of smallholder farmers in Africa and the purpose of the evaluation was to critically assess the role played by the PASS in the diffusion of improved seeds to smallholder farmers and the effects of the program's seed systems on fertilizer use and farm yields in Burkina Faso, Ghana and Mali.

3. The evaluation consisted of a comprehensive desk study, field data collection and observations as well as data analysis and reporting. Four field instruments comprising two semi-structured questionnaires for household surveys and input dealer interviews and two checklists for group discussions and key informant interviews were used for data collection.

4. The evaluation was undertaken in four of Burkina Faso's thirteen regions; three of Ghana's 10 regions and four of Mali's eight regions. One hundred and sixty (160) households were selected in each country by multi-stage stratified sampling and 320, 160 men and 160 women, were interviewed in each of the countries.

5. In Burkina Faso, it was clear that there had been significant increases in the production and use of certified seeds by both men and women. An interesting and very welcome phenomenon is that more women than men used improved seed.

6. The evaluation sought to explore for differences in levels of utilization of varieties supported by AGRA and those already existing in the system or not supported by AGRA. That was not possible in Burkina Faso (as well as Ghana and Mali) because the seed companies and input dealers do not distinguish between improved varieties on the basis of support by AGRA.

7. In 2010, seed companies and input dealers in Burkina Faso supplied improved seed to over 20% of farmers and farmer-to-farmer seed sourcing declined to less than 1% from a baseline level of 40%.

8. The data analysis indicates there has been appreciable increase in the use of fertilizer in Burkina Faso even though that is still far short of recommended rates for most of the crops. Limited access to fertilizer was reported by farmers as one of the major challenges with the use of improved varieties.

9. The Burkina Faso results also indicate that maize varieties such as Massongo, Wari and FBC6 which are supported by AGRA yielded higher (than other varieties such as Banka)

under farmer conditions. It was however not so in the case of cowpea. The yields of AGRA supported cowpea varieties such as KVX 745-11P and KVX 61-1 were not significantly higher than other varieties such as Gorom and Wango .

10. In the case of Ghana, the use of improved seed shows great diversity. While majority (55.2%) of maize farmers in the three northern regions keep their own seed for planting the next season, 40% of cowpea farmers do so. However over 75% of cowpea farmers in the Upper East Region use improved seeds but over 83% of maize farmers in the same region use their own seed. It is difficult to see any discernable trend in the adoption of improved seed varieties in the northern Ghana case.

11. What is easily seen as a trend in Ghana (and also in the other countries) is the high positive correlation between adoption of improved varieties and fertilizer use. While 96.2% of farmers who purchased improved maize seed in 2010 used some chemical fertilizer and about 90% of farmers who recycled improved maize used chemical fertilizer, only 65.2% of farmers who planted local varieties used chemical fertilizers.

12. Yields of improved varieties cultivated in northern Ghana showed better performance than the local varieties. The yields are however still far less than the potential yields.

13. As in Burkina Faso, data analysis for Mali indicate appreciable increase in the use improved seeds of maize, sorghum and rice as well as increased fertilizer use on the improved varieties. Also more women than men used improved seeds. The use of fertilizer is however still far short of the recommended rates for most of these crops. Limited access to and high prices of fertilizer were reported by farmers as some of the constraints.

14. Also as in the other cases, yields of improved varieties that are supported by AGRA PASS in Mali showed better performance than the local varieties even though they are far less than potential yields.

15. The overall conclusion of the evaluation is that the AGRA PASS intervention has been very relevant to all the countries; has been effective though so far limited; has been quite efficient since several milestones have been achieved; and there are indications of very positive effects and impacts on small farmers and households in the three countries.

16. The major threat to the AGRA PASS interventions that was identified by farmers, input dealers, researchers and government officials in all the countries was limited prospects for sustainability. Many of respondents felt AGRA PASS interventions have ignored established structures in all the countries and the parallel structures being established through few private input dealers cannot sustain the laudable interventions.

CHAPTER 1

INTRODUCTION

I.1 BACKGROUND

Seeds represent a key technology component for the improvement of agricultural productivity (Tripp 1998). The development and use of high yielding seed varieties have been the technological forces behind the Asian green revolution, the availability of food at prices profitable for farmers and affordable by the populace, and a reduction in rural poverty (Louwaars and Marrewijk, 1999). The development of seed supply systems both in normal and disaster years is a prerequisite for increasing food production, improving farmers' income through increased productivity (higher output per unit input), alleviating poverty, and ensuring food security. According to Tripp (2001), concerns about the viability of agricultural systems usually centers on the diversity and stability of the seed supply system.

The development and use of high yielding fertilizer-responsive seed varieties was the driving force behind the Asian green revolution. Efficient seed supply systems are critical for increasing food production, improving farmers' income through increased productivity (higher output per unit input), alleviating poverty, and ensuring food security. Limited diversity and instability of Africa's seed supply systems is widely perceived as a challenge to land factor productivity and efficiency in general. The need to expand production frontiers through the development of diverse and stable seed systems in Africa has been recognized by stakeholders across the globe.

The Alliance for a Green Revolution in Africa (AGRA) is a partnership of the Rockefeller Foundation, the Bill and Melinda Gates Foundation and the UK Department for International Development (DFID) working with African governments, other development partners, NGOs, the private sector and African farmers to significantly and sustainably improve the productivity and incomes of resource poor farmers. AGRA is contributing to the vision of a food secure and prosperous Africa by accelerating agricultural growth through a number of initiatives targeting smallholder farmers who are the primary producers of staple food in Africa. AGRA has three main goals to be achieved by 2020, namely to:

(i) Reduce food insecurity by 50% in at least 20 countries;
(ii) Double the incomes of 20 million smallholder families; and
(iii) Put at least 30 countries on track for attaining and sustaining a uniquely African Green Revolution.

The Program for Africa's Seed Systems (PASS) is one of the four programs[1] of the Alliance for a Green Revolution in Africa (AGRA). The PASS was launched in 2007 and aims to increase income, improve food security and reduce poverty through the development of seed systems that deliver improved, locally-adapted crop varieties to small-scale farmers in an efficient, equitable and sustainable manner. The PASS consists of four sub-programmes that are working to strengthen the seed supply value chain in Africa. These are:

- **Education for African Crop Improvement (EACI)** which provides training for a new generation of crop breeders and agricultural scientists to promote growth and higher productivity of seed systems. This programme has to-date trained about 170 African crop scientist at MSc Degree level and 80 breeders at PhD level.
- **The Fund for the Improvement of and Adoption of African Crops (FIAAC)** which is funding crop breeding programmes in Africa to improve crop varieties and promote their adoption by smallholder farmers. This programme has to-date funded about 70 crop breeding programmes that have steered more than 125 new improved varieties for maize, beans, and cassava, among others, onto the market.
- **The Seed Production for Africa Initiative (SEPA)** which helps to ensure that improved crop varieties are multiplied and distributed through private and public channels (including seed companies, publicly-supported seed programmes, and public extension) so that farmers can have access to, and adopt these varieties. This initiative has so far provided start-up capital to at least 35 Africa seed enterprises which have collectively produced approximately 15,000 metric tons of certified seed, nearly all of which was sold out within one season.
- **The Agro-Dealer Development Programme (ADP)** which provides training and credit to establish and support the growth of agro-dealers, as a primary conduit of seeds, fertilizers, other farm chemicals, and knowledge of their proper use, to smallholder farmers to increase their productivity and incomes. The ADP provides grants for the expansion of the agro-dealer network, including the opening of outlets in previously underserved areas to shorten the distance and reduce the cost that farmers incur in sourcing seed.

PASS is investing $150 million in the first 5-year phase to mount an across-the board effort to improve the availability and variety of seeds that can produce higher and more stable yields in the often harsh conditions of Sub-Saharan Africa. PASS aim to introduce over 1250 new varieties of at least 10 important staple crops that would significantly improve the productivity of smallholder farmers and contribute to the reduction of hunger and extreme poverty of up 40 million people.

[1] AGRA has three complementary programmes in Soil Health, Market Access and Policy and Partnerships. Cross-cutting issues relating to water management, extension, gender and youth are mainstreamed into the four programmes.

Mid-Term Review (MTR) of the PASS showed that PASS had attained significant milestones and is on course to achieve set targets. The MTR examined the underlying assumptions and hypotheses, progress in the achievement of major targets and milestones as well as challenges in the implementation of the programme.

According to the MTR Report, the main achievements of the PASS in its first three years of operation included:

- **EACI** - support for 2 PhD and 9 M.Sc programmes, completion of PhD studies by 19 out of the total 41 PhD-level crop scientists funded under EACI, completion of MSc training by 4 out of 78 crop scientists supported, and production of 19 scientific publications (3 of which have been approved and 16 were still under review at the time of the MTR);

- **FIACC** - provision of 54 grants to support breeding projects and the release of 94 new varieties (of which 64 varieties were already being commercialized);

- **SEPA** – provision of financial support to 47 African small-to-medium scale seed companies which produced a cumulative total of 12,806 MT of seed, and provision of support to 7,000 agro-dealers recruited for seed sales in nine countries; and

- **ADP** – support for the opening up of approximately 7,000 new agro-dealer shops in nine countries.

1.2 MAIN FEATURES OF THE EVALUATION

The purpose of the evaluation was to critically assess the role played by the PASS in the diffusion of improved seeds to smallholder farmers and the effects of the program's seed systems on fertilizer use and farm yields in Burkina Faso, Ghana and Mali. Value chain analysis of the PASS diffusion pathways was carried out and the effects of the PASS on farmers' perception of the improved seed, fertilizer use and farm yields were evaluated.

The following specific analyses were undertaken:

1. Trace the uptake pathways of selected improved seed varieties released with support from PASS across the seed supply chain till they reaches the farmer – assessing the strengths, constraints and opportunities (if any);
2. Assess farmer's yields stemming from PASS improved seed supply and compare with yields of other improved varieties being applied by farmers;
3. Assess the level of women farmers accessibility to improved seeds
4. Assess farmer's perceptions/expectations on the utility of small seed packs and the quality of improved seed being supplied by PASS supported seed companies, cooperatives and farmer groups.

CHAPTER 2

APPROACH AND METHODOLOGY OF THE EVALUATION

2.1 THE APPROACH

The evaluation approach was essentially a quasi-experimental design where AGRA participants (farmers within a given radius of AGRA grantees and using varieties supported AGRA) were compared with pre-AGRA control group (baseline). First we examined the overall effects of PASS on farmers' knowledge and access to improved seed and second the effects on specific crop output of beneficiaries. We asked the question whether farmers at the time of evaluation (2010) were different in terms of their knowledge, access to improved seed and use of fertilizer than they were before the PASS interventions began in 2007. The essential hypothesis is that differences in the specified indicators among households at the end of the program relative to differences in indicators at the beginning are measured by *Y*, where *Y* is defined as: $Y = (I_{PASSt} - I_{PASSt-i}) - (I_{nonPASSt} - I_{nonPASSt-i})$;Where I denotes the average over the relevant sample households (e.g., households in PASS districts in 2010) of indicators of well-being.

The evaluation was conducted in three phases – Desk Phase, Field Phase and Data analysis and Reporting phase. In the desk phase, the team held meetings with AGRA and other the relevant stakeholders including local implementing partners [communities, National, Regional and District/Provincial focal persons]. The team also examined relevant documentation on the planning, implementation and monitoring of program. The field phase involved interaction with communities and households, input dealers, seed companies and research institutions. The third and final phase involved the analyses of information gathered and compilation of reports.

2.2 FIELD DATA COLLECTION

Three sub-teams for Burkina Faso, Ghana and Mali were formed so that data could be collected almost simultaneously in all three countries. Each country team had a leader whose duty was to supervise sets of field enumerators and to administer checklists to the various stakeholders identified. Lists of local seed companies being supported by AGRA as well as agro-dealers in the three countries were obtained from the Accra office of AGRA and samples of them were interviewed. They were also the sources for the sampling of farmers in the various countries.

A main challenge in the formation of the Burkina Faso and Mali teams was the need to find people who understood both French and English and can read and write very well in both languages.

Four field instruments comprising two semi-structured questionnaires for household surveys and input dealer interviews and two checklists for group discussions and key informant interviews were used for data collection. The instruments were pretested during the third week of November 2010 in a community in the Tolon/Kumbungu District of the Northern Region of Ghana. Final versions of all the survey instruments were produced after the pretest.

The evaluation was undertaken in four of Burkina Faso's thirteen regions (Central, Central Plateau, Central South and Central West); three of Ghana's 10 regions (Northern, Upper East and Upper West) and four of Mali's eight regions (Koulikoro, Sinkasso, Segou and Kayes). The selection of the regions in the various countries was informed by the geographical scope of AGRA's intervention. Two districts/provinces were sampled from each region. The sampling of communities and households was done by proportional stratification first, of each province into sub-urban and rural areas and followed by the selection of one village from each stratum. Ten (10) households were then selected from each village for in depth semi-structured interviews. To capture the perspective of women in relation to knowledge, access and use of improved seed, a separate semi-structured questionnaire was designed specifically to be administered to women in households. This implied that for every household two individuals (the household head/plot manager and a woman within the household) were interviewed. In all, one hundred and sixty (160) households were selected in each country and 320, 160 men and 160 women, were interviewed in each of the countries. Many households cultivated both improved and local varieties of the target crops thus yield comparisons were obtained from the same households in many cases. Two households per community that did not cultivate any improved variety in the last season were included in the sample. Thus of the 10 households per community, two households were "non-adopters".

The following three tables constitute summary of the sampling that was done for the three countries.

Table 1: Regions, districts and communities sampled and numbers of sampled households and respondents in Ghana

Region	Sampled District (Capital)	Sampled Communities/ Villages	Number of sampled households	Number of respondents
Northern	West Mamprusi (Walewale)	Wungu	10	20
		Guabuliga	10	20
	Karaga (Karaga)	Komoayili	10	20
		Monkula	10	20
	Central Gonja (Buipe)	Nakpiegu	10	20
		Wambong	10	20
	Zabzugu/Tatali (Zabzugu)	Sakpaleegabani	10	20
		Tasundo	10	20
Upper East	Bawku West (Zebilla)	Kukore	10	20
		Saaka	10	20
	Kassena/Nankanni East (Navrongo)	Kandiga-Afunton	10	20
		Vuanani	10	20
Upper West	Sissala East (Tumu)	Bulima	10	20
		Taffiase	10	20
	Nadowli (Nadowli)	Goriyiri	10	20
		Kalsegra	10	20
Total		16	160	320

Table 2: Regions, districts and communities sampled and numbers of sampled households and respondents in Burkina Faso

Region	Province (Chef-lieu)	Communities/ Villages	Number of sampled households	Number of respondents
Western (Ouest)	Houet (Bobo-Dioulasso)	Douna	10	20
		Kiefoura	10	20
	Comoe (Banfora)	Banzou	10	20
		Karangasso	10	20
Central South (Central Sud)	Bazega (Kombissiri)	Monoptenga	10	20
		Vosse	10	20
	Nahouri (Po)	Betare	10	20
		Kadro	10	20
Central West (Central Ouest)	Sissili (Leo)	Kayero	10	20
		Nadiou	10	20
	Ziro (Sapouy)	Tare	10	20
		Kasso	10	20
Central Plateau (Plateau Central)	Oubritenga (Ziniare)	Tenslogodo	10	20
		Souka	10	20
	Ganzourgou (Zorgho)	Dapilgou	10	20
		Ziga	10	20
Total		16	160	320

Table 3: Regions and numbers of sampled households in Mali

Region	Koulikoro		Sikasso		Segou		Kayes		Total
Number of Sampled households	20	20	20	20	20	20	20	20	160

CHAPTER 3

EVALUATION FINDINGS

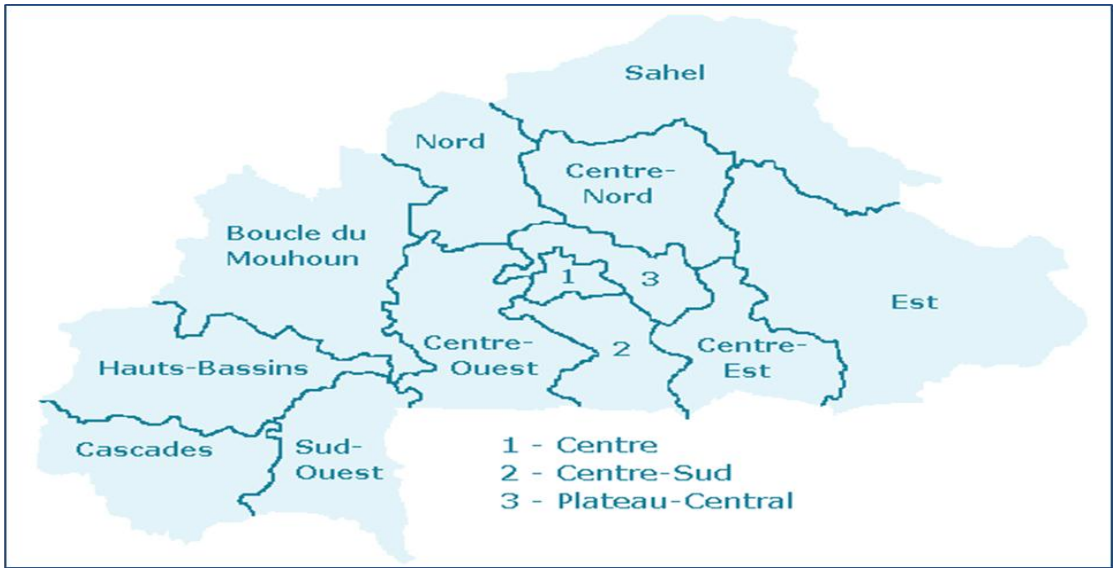
3.1 BURKINA FASO CASE STUDY

3.1.1 Country and Seed System Contexts

Burkina Faso occupies an area of 274,200 square kilometers (105,900 sq mi) and has an estimated population of more than 15,757,000. The country is regarded as one of the poorest in the World with a GDP per capita of about US$1,200. The Burkinabe economy relies heavily on a livestock-dominated agriculture sector that also includes limited crop production to the south and south western parts of the county. Crops commonly grown include sorghum, pearl millet, maize (corn), groundnuts, rice and cotton. Mining of copper, iron, manganese and gold has also been reported. Agriculture accounts for between 32% - 35% of its gross domestic product and employs between 80% - 85% of the working population. Crop production is largely rain-fed and subject to significant variations in response to climatic conditions. The climate is primarily tropical with two very distinct wet and dry seasons with an average annual rainfall of between 600 and 900 millimeters.

Burkina Faso is divided into thirteen regions, forty-five provinces, and 301 departments. This study was undertaken in four of the southern regions (Centre, Centre-Sud, Plateau Central and Centre Quest) were most of the country's crop production takes place.

Map 1: Map of Burkina Faso indicating sampled regions



Source: Maptune.net

3.1.2 The Seed Value Chain and Improved Seed Use

Seeds constitute the raw material of crop production and under optimum conditions account for up to 40% of yields. Any strategy to improve agriculture must therefore be anchored in a vibrant and effective seed value chain that originates, evaluate, multiplies and distribute well-adapted and input responsive varieties seeds to farmers. The Burkinabe government understands this philosophy and has since independence been actively involved in the seed system.

The seed sector in Burkina Faso is a state system with five key stakeholders overseeing the development, multiplication and distribution of improved seeds. The National committee for seed (CNS), the Scientific Committee for Varieties Registration (SCVR), the National Seed Service (NSS) and the Research and extension Board are specialized agencies within the Ministry of Agriculture responsible for varietal creation, registration, certification distribution and quality control. The CNS is responsible for the development of policy and regulatory framework in all aspects pertaining to the production and distribution of seed including imports and exports. The National Seed Service (NSS) oversees the Organization of seed production, distribution, quality control and certification. The *Institute de l'Environnement et de Recherches Agricoles* (INERA) and the Universities are mandated to develop create new varieties. INERA has the sole responsibility for the production of foundation seed.

After the CNS and the SCVR are notified by the INERA of new varietal creations, the SCVR would meet to examine the characteristics of the new variety and make sure it is original. A scientific committee was created in 1982 to assist the seed committee in the seed sector management (evaluate new varieties technically through their characteristics). The scientific committee was mandated to monitor on-field varietal performances, assessing among other things genetic integrity and suitability to local conditions. When the scientific committee passes the new crop as a variety, the research begins the production of foundation seed that the National Seed Service and the seed growers association would use to produce the certified seeds for farmers. Even though on paper the proposed value chain appeared to function, the National Seed Committee and its scientific committee in reality had difficulty collaborating effectively INERA. In its place, INERA and the University created crop-specific internal committees to evaluate proposed new varieties. The production of certified seed is undertaken by seed growers under the supervision NSS control. Seventeen seed production stations have been created where seed growers can produce certified seeds under NSS supervision. The NSS independently (of extension and research) undertakes quality control and certification of seed.

Burkina Faso has over the past three decades placed emphasis on the production and distribution of improved seed (Zongo, 2005). The trend in the production of improved seed for the selected crops shows that the production and use of improved maize was consistently below the levels for crops like cowpea, rice and groundnut. Maize however became a priority after 2004. In 2006, the

production and supply of improved maize seed inched above the two-thousand tonne threshold (see figure 3). Between 2009 and 2010, the production of certified seed of Maize, Sorghum, Rice and Cowpea doubled. A total volume of 36,072.02 tonnes of certified seed of selected food crops including sorghum, rice, millet, maize, cowpea, sesame, groundnut and soybean was produced between 2004 and 2010. The share of maize seed in total volume of the seed produced stood at 81.2 percent, an indication of growing emphasis on maize. There was a doubling of volumes of certified seed produced between 2009 and 2010. The significant quantum jump in the production of certified for staple food crops has been largely attributed to significant changes in the country's agricultural focus and also to some extent emergence of new actors in the seed value chain. In subsequent sections of this report, we focus on analyzing the sources and drivers of the increases in certified seed production. Emphases would be placed on exploring possible relationship between AGRA and the various stakeholders in the seed value chain and how collaboration with AGRA has influenced the seed value chain.

Less than a third of the African countries surveyed by FAO in 1984-1985 have established seed production and distribution facilities for major crops (FAO, 1987). Moreover, in countries where seed industries are well established, these concentrate on major commercial crops at the expense of commercially minor crops, e.g. small grains or legumes. AGRA-PASS targets the development of seed systems of the common food crops as means of initiating Africa's Green Revolution.

The PASS implemented a two-tier strategy in Burkina Faso that, supported research to create improved varieties and private seed companies to multiply and distribute improved varieties created by research. The private seed sector in Burkina Faso consist largely of semi-formal farmer-networks who produce certified seed and distribute to members often at subsidized prices. Poor organizational structure coupled with inability to self-sustain operations has been described as major obstacle hindering the development of private seed entities in Burkina Faso (Zongo, 2005).

In 2008, AGRA supported two private seed entities, AGRO PRODUCTION based in PO and NAFASO based in Bobo-Dioulasso with grants to enhance their capacities to produce and distribute improved seed across the country. Each company received a grant of US$ 140,000 over a period to two years. The grants were intended to help the companies restructure their organization and build capacities to expand the scope of their production. To a large extent, the grants have succeeded in increasing the production capacity to the two seed companies. In the space of one year, AGRO PRODUCTION increased its output of improved seed from 45 tonnes in 2008 to 150 tonnes in 2099 and projects to produce up to 250 tonnes in the 2009/2010 season. NAFASO on the other hand operated as a semi-formal seed company in 2006 with an annual production of 30 tonnes. Grants from AGRA enabled NAFASO formalize all its operations and increase production to 300 tonnes in 2009.The increasing contribution of the AGRA grantees to

national seed production not only underscores the effectiveness of AGRA's interventions in Burkina Faso but also assertions that if semi-formal seed grower networks and input dealers were supported to formalize they could play a significant role in developing seed systems across Africa.

Despite the success in creating two leading seed companies out of semi-formal enterprises, actors across the seed value chain and the formal agricultural sector in general expressed some reservation concerning AGRA's interventions in Burkina Faso. The Ministry of Agriculture is of the view that AGRA's intervention in Burkina Faso does not reinforce the existing seed systems and agricultural policy. Private seed companies may never be able to compete in a system were much of the certified seed is produced and distributed by subsided farmer networks. The need to work with government to deregulate the production and distribution of certified seed is urgent if AGRA's model is to succeed.

Table 4 presents a SWOT analysis of AGRA-PASS intervention in Burkina Faso. AGRA like in other countries collaborated with stakeholders involved in breeding, dissemination and distribution of improved seed. The intervention of AGRA across the seed value chain produced desirable outcomes but was also confronted with a few challenges, notably the apparent disconnect between AGRA-PASS and important stakeholders like the Ministry of Agriculture. Among the strengths of AGRA-PASS intervention was the fact that the programme targeted vital components of seed value chain such as human resource development, logistics and material and above funds for breeding of specific crops. In addition, the funding was regular with no delays once the relevant documentation and key milestones were reached. This removed uncertainties often associated with funded research programmes and enabled breeders make long-term plans.

The emphasis on the development of hybrid varieties and the few AGRA grantees was largely seen as constraints. Some stakeholders questioned why AGRA provided grants for two seed out-growers when there were several out-growers in the country. Stakeholders at the Ministry of Agriculture expressed reservations with the strategy of AGRA, arguing that the involvement of the Ministry and government was limited and this meant the Ministry could not allocate resources or contribute meaningfully to the process. The involvement of the Ministry is particularly important if interventions of AGRA are expected to main-streamed into government programmes sometime later.

Many farmers acknowledged that the distance travelled to acquire improved seed and other important farm inputs had significantly reduced with the increase in distributors across the country. Farmers also had favorable views of the varieties promoted by AGRA even though fertilizer requirements associated with the varieties was regarded as a constraint. AGRA has other programmes aimed at influencing fertilizer and market access policies across the intervention countries, the seeming disjoint (time gap) between the various programmes could significantly lessen the impact of the entire AGRA strategy. For example, it is important that

fertilizer programs closely follow seed programmes so that farmers who adopt improved varieties get access to fertilizer in order to realize the potential of the new varieties.

Table 4: A SWOT Analysis of AGRA-PASS Intervention in Burkina Faso

	Strengths	**Constraints**	**Opportunities**	**Threats**
Research (seed breeding)/Agricultural Policy makers	AGRA support is well targeted, supporting aspects such as the acquisition irrigation facilities to allow for dry season breeding activities **Development of critical aspects of research:** AGRA grants are being used to addressing human resource challenges **Regularity of funding** allowed for medium term planning of breeding activities since researchers were sure of funding.	**Rigid** condition to produce hybrid varieties is a major challenge because it takes time and secondly breeders need OPVs as parents. The Agriculture Ministry describes **AGRA's intervention in Burkina Faso as a two-man activity** with no government involvement.	**Extended/renewed grants** would help in the development of more hybrids given significant progress has been made in development of hybrid varieties	**AGRA is not working in tandem with the public agricultural sector** hence it would be difficult to get government to support its initiatives when grants are withdrawn. **There is no official (government) acknowledgement** of AGRA's support of the county's seed sector
Seed Merchants/Input Dealer	**AGRA support built on** existing capacities of seed companies to expand and improve upon their own activities. Companies were not compelled to go into	**The rigorous documentation** (including reports and applications) involved in securing release of AGRA funds is a challenge and	**Intervention could be scaled** up with support to more seed out-growers. **Deregulation (total privatization) of**	Some **policy makers are not entirely supportive of privatization drive** fearing hikes in seed prices. We encounter difficulties obtaining foundation seed. In most cases the seed

	something new. **Facilitated Formalization of structure/operations**: Workshops and exposure to best practices has improved the management capacities of AGRA-grantees	sometimes results in delays **The AGRA grantees lack competitive edge** since they compete with out-growers on government subsidies.	**certified seed** production would create conducive environment for private seed companies to thrive.	companies have to rely on R1 to produce certified seed. **The market for most of our varieties (OPVs)** is slow because farmers start saving their own seed after the first purchase.
Use of "AGRA" seed by farmers	**The varieties yield more** (in most cases over three times more than the local varieties we use. **Has brought seed and other inputs closer to farmers.** **Adaptive varieties**: Most of the varieties mature early hence suitable for the mostly low and reducing amount of annual rainfall	**The new varieties require fertilizer** otherwise the harvest is bad. We have difficulty getting the required fertilizers For some improved varieties (hybrids), **farmers are unable to save or develop their own seed systems**	If **AGRA and other NGOs provide fertilizer subsidies or fertilizer credit** it would help in the use of the varieties especially in the first years of adoption	**There is overemphasis on breeders and seed companies but the end-users (farmers)** are not being supported to utilize the technology generated Some of the new varieties are well suited for industrial use however smallholder farmers to not have **access to these markets.**

3.1.3 Uptake of Improved Crop Varieties and Fertilizer Use

The aim of supporting research to develop improved varieties and the setting up of channels of distribution is to ensure that smallholder farmers get access to acquire and use the improved seed. Table 5 highlights the use improved seeds by men and women. It is clear from the table that increases in the production of certified seed in recent times has been matched by significant appreciation in the use of improved seed at the smallholder farmer level. Among men for example, the use of purchased improved seed increased by about 338% over the baseline level while at the same time, the use of recycled improved seed and local declined significantly. The data also showed an interesting phenomenon where more women than men use improved seed. Over half (51%) of male farmers still used local seed, compared with 46% for women. Recycling of improved seed was however more common with women.

Table 5: Use of improved seed by men and women in Burkina Faso (% of farmers using particular seed types)

	Purchased Improved (%)		Recycled Improved (%)		Local Seed (%)		Local/ Improved/ Recycled (%)	
	Men	Women	Men	Women	Men	Women	Men	Women
Central	43.4	44.2	1.9	3.3	54.5	53.3	0.0	0.0
Central Plateau	48.6	46.5	5.7	10.3	44.8	43.2	0.9	0.0
Central South	38.1	45.9	5.7	6.8	52.5	45.5	3.7	1.8
Central West	44.5	49.1	0.6	0.9	51.1	43.6	3.9	6.4
National	43.0	46.3	3.7	5.3	51.1	46.4	2.2	2.1
Baseline Survey		12.7		18.0		64.4		4.8

Source: Field Survey, 2010/11 and Baseline Survey, 2009

Even though the general levels of improved seed use is important for production and marketing decisions, improved seed use on crop basis would inform policy makers including extension on resource allocation for the breeding and dissemination of specific crops. A comparative assessment of the popularity of improved varieties was one of the key requirements in the terms of reference of this evaluation. The assessment sought to explore for differences in levels of utilization of varieties supported by AGRA and those already existing in the system or not supported by AGRA. It is important to however caution that differentiating between AGRA-supported varieties and other improved varieties may only be feasible at the research (breeding)

level. As far as seed companies and input dealers are concerned, there is no difference between improved varieties.

Table 6 highlights improved varieties grown by farmers across the country. The Massongo maize variety is by far the most popular of all maize varieties. About 53% of maize farmers nationwide grow this variety. Other popular maize varieties include FBC6 (33.8%) and Wari (16.2). The KVX 745-11P variety is the most popular of the cowpea. About 15% of farmers who grow cowpea use this variety.

Table 6: Common varieties of maize, cowpea and rice grown (% of farmers cultivating particular varieties by regions)

	Central	Central Plateau	Central West	Central West	National
Maize					
Massongo*	53.6	57.3	41.2	51.7	51.0
Wari*	24.0	12.4	15.4	12.5	16.1
Bondofa*	5.5	3.2	2.9	3.8	3.9
FBC6*	21.0	13.8	12.4	25.3	18.1
Banka	7.3	5.1	3.4	2.5	4.6
Cowpea					
Gorom	9.3	7.7	8.4	1.0	6.6
Wango	12.1	5.9	8.1	0.2	6.6
KVX 745-11P *	13.3	19.8	16.3	17.2	16.7
KVX 61-1*	17.8	22.4	15.1	14.8	17.5
Rice					
NERICA 62N*	18.0	23.2	11.2	19.4	18.0

* Varieties supported by AGRA. Varieties with less than 1% of use not reported.
Source: Field Survey, 2010/11

3.1.4 Sources of Improved Varieties

The seed landscape in Burkina Faso has transformed significantly over last three years. Seed companies and input dealers have become the major sources of improved seed for a significant number of farmers. In 2010, seed companies and input dealers together supplied improved seed to over 20% of farmers (see Table 7). Farmer to farmer seed sourcing declined to less than 1% from a baseline level of 40%. On the other hand, farmers' use of seed saved from previous production inched up slightly from 20.6 to 20.8. The use of OPVs makes it possible for farmers

to preserve their own seed and use form year to year without significant loss in the yield potential. The phenomenon is a desirable outcome for the Agriculture Ministry who want to see farmers develop their own resilient seed systems and an undesirable one for seed companies who lose market under such circumstances.

Table 7: Sources of improved seed

	Central	Central plateau	Central South	Central West	National	Baseline Survey
Input Dealer	18.1	14.2	17.2	20.5	17.3	13.9
Seed company	5.9	2.8	1.8	0.8	2.7	3.1
NGO	11.1	17	25.4	33	28	1
Farmer	6.4	28.4	24.6	14.1	0.8	40.9
Government	24	10.4	2.7	12	28.1	9.1
Local Market	4.4	2.1	1.5	2.3	2.3	2.6
Own seed	30.1	25.1	26.9	17.4	20.8	20.6

Source: Field Survey, 2010/11.

3.1.5 Access and Intensity of Fertilizer Use

Access to chemical fertilizer remains a big challenge for many smallholder farmers in Burkina Faso. The local market prices of 50 kg of Urea and 50 kg of NPK cost the equivalent of about US$80 (SOGEDIF, 2010). This price is beyond the reach of many smallholder farmers. Average national intensity of fertilizer use has over the years been relatively low compared with global use rates. Between 1996 and 2002, chemical fertilizer use (by kilograms of NPK/ha/yr) was estimated at 5.9 Morris et al (2007).

Table 8 presents the intensity of fertilizer use (kg/ha) by men and women. The data in the table indicates that fertilizer use by both men and women is higher (in most cases double) the levels reported (Morris et al. 2007). Nationally, men apply an average of 32.6 kg of fertilizer per hectare as compared to 24.3 kg/ha for women. Two possible factors may account for the significant increases in fertilizer consumption rates. First, this study was conducted in the southern part of the country where much of the country's crop production takes. It is therefore possible that the recorded figures will thin out as more non-food producing areas are covered. Secondly it is plausible to assume that fertilizer use may have intensified over the decade (between 1999 and 2009).

Table 8: Intensity of fertilizer use by men and women

	Men		Women	
	Mean (kg)/ha	Standard Deviation	Mean(kg)/ha	Standard Deviation
Central	33.7	31.4	28.3	14.3
Central Plateau	30.7	19.6	23.4	18.3
Central South	34.7	23.2	20.1	19.6
Central West	38.9	29.8	22.8	23.2
National	32.6	25.6	24.3	22.4

Source: Field data, 2010/11

Many farmers have indicated that the achievement of potential yield levels, often associated with improved varieties, depends largely on the ability of the farmer to apply recommended levels of inputs such as fertilizer and pesticides. For example, the CSM 219E variety of sorghum has the potential to produce 2.5 ton/ha. To achieve this, it is recommended that a total of 150kg/ha of fertilizer made up 100kg of bulk fertilizer and 50kg of urea be applied. Thus in assessing the productivity of improved varieties under farmer conditions, it is important to examine the quantities of fertilizer that farmers apply to improved crop varieties. Table 9 presents the application of fertilizer to various improved varieties. On the average, farmers apply about 30kg/ha of fertilizer on Massongo farmers, the highest quantity applied to any crop. An average of 22.2kg/ha is applied to the Wari variety. About 15kg/ha is applied to NERICA 62N. The lowest quantity of fertilizer is applied to cowpea varieties KVX 61-1 and KVX 745-11P.

Even though the baseline did not indicate the intensity (kg/ha) of fertilizer use by crop, comparison with existing secondary data levels reported by Morris et.al. (2007) indicates there have been appreciable increase in the use of fertilizer although still far short of the recommended rates for most of these crops. The low reported fertilizer use perhaps underscores need for comprehensive fertilizer programmes that would make fertilizer more accessible to local farmers. Limited access to fertilizer was reported by farmers as one of the major challenges with the use of improved varieties (refer to table 4). During focus group discussions, farmers indicated they used improved varieties in years they were able to afford fertilizer and local landraces when in times they did not have enough funds to purchase fertilizer. Since the latter is more common, farmers indicated overwhelming preferences for varieties that offered reasonable yields under low fertilizer use. The implication of this scenario is straightforward, improved seed programmes would only succeed if they are effectively supported by well-targeted fertilizer subsidy or credit programmes.

Table 9: Intensity of fertilizer by crop

	Central	Central Plateau	Central South	Central West	National
	Mean (kg/ha)	Mean (kg/ha)	Mean (kg/ha)	Mean (kg/ha)	Mean (kg/ha)
Massongo*	30 (18)	31.7 (16)	29.8 (18.8)	32.8 (34.9)	30.4 (17.8)
Wari*	23.4 (14)	19.7 (13.4)	21.7 (14.2)	25.1 (14.8)	22.2 (9.1)
Bondofa*	25.5 (12.1)	26.8 (18.9)	21.3 (15.9)	24.7 (18.8)	24.2 (12.6)
FBC6*	14.5 (13.2)	12.9 (16.3)	13.0 (81.6)	15.0 (1.2)	13.4 (5.2)
Banka	14.3 (16.0)	19.8 (14.6)	18.3 (18.9)	25.2 (17.1)	25.3 (6.4)
Gorom	19.4 (17.0)	12.8 (19.6)	13.3 (17.6)	14.2 (10.4)	11.0 (3.8)
Wango	15.2 (14.4)	16.8 (13.1)	16.6 (23.9)	13 .2 (19.6)	14.3 (7.7)
KVX 745-11P*	14.5 (16.4)	16.3 (12.1)	18.4 (11.6)	12.6 (13.1)	14.3 (11.1)
KVX 61-1*	12.2 (11.8)	10.1 (12.3)	10.3 10.8)	13.4 (7.2)	11.3 (4.4)
NERICA 62N*	18.3 (8.8)	16.6 (14.1)	15.4 (17.1)	13.5 (4.7)	15.2 (5.9)

*Varieties supported by AGRA

Source: Field Survey, 2010/11. (Standard deviations are in parenthesis)

The study also employed quantitative measures to examine the productivity of improved varieties. Tonnes of output per hectare are a useful indicator productivity of improved varieties. Table 10 presents productivity (ton/ha). Under existing farmer conditions, the Massongo variety on the average, yields up to 3.3tons/ha. Wari, Bondofa and FBC6 yield up to 2.8tons/ha, 3.0tons/ha and 2.7 tons/ha respectively. Espori and Banka are also two popular improved maize varieties grown across the study area. These varieties on the average yield about 1.4 tonnes per hectare. It is clear that varieties such as Massongo, Wari, FBC6 which are supported by AGRA deliver higher yield per hectare under farmer conditions.

Table 10: Productivity and returns to fertilizer of improved varieties

	Central	Central Plateau	Central South	Central West	National
	Tonnes/ha	Tonnes/ha	Tonnes/ha	Tonnes/ha	Tonnes/ha
Massongo*	3.9 (3.8)	3.4 (2.1)	3.0 (1.1)	3.8 (3.0)	3.5 (3.8)
Wari*	2.4 (2.5)	3.1 (2.8)	2.5 (0.4)	3.0 (0.9)	2.8 (1.7)
Bondofa*	3.1 (2.2)	2.3 (0.2)	3.2 (0.9)	3.2 (0.5)	3.0 (1.3)
FBC6*	2.9 (2.3)	2.4 (2.7)	3.1 (0.8)	3.0 (4.6)	2.7 (2.1)
Banka	2.9 (1.3)	2.1 (2.9)	2.4 (3.2)	1.0 (0.4)	1.7 (1.2)
Espori	1.9 (1.8)	1.2 (1.0)	1.7 (0.3)	1.2 (0.4)	1.6 (1.2)
Wango	2.6 (1.4)	0.9 (0.7)	1.0 (1.1)	1.3 (0.4)	1.2 (0.4)
KVX 745-11P*	1.1 (0.0)	0.9 (0.4)	1.2 (0.4)	1.0 (0.2)	1.0 (0.3)
KVX 61-*1	0.8 (1.0)	1.0 (0.2)	0.8 (0.7)	1.1 (1.0)	0.9 (0.4)
NERICA 62N*	2.2 (0.7)	1.6 (0.7)	1.8 (0.8)	2.3 (0.4)	2.1 (0.6)

Source: Field Survey, 2010/11

3.1.6 Burkina Faso Case Study Conclusions

The framework for the evaluation of AGRA-PASS value chain in Burkina Faso was organized around the OECD-DAC five-point of criteria relevance, effectiveness, efficiency, impact and sustainability.

1. **Relevance** sought to explore whether the interventions were right and well suited within the context of agriculture in general and the seed value chain in Burkina Faso. The Burkinabe economy relies heavily on livestock-dominated agriculture with limited crop production, making it a net importer of most food crops. The fact that Burkina Faso has over the years not concentrated on crop agriculture meant seed systems in the country were significantly weakened and needed strengthening if it to support a crop sector

revolution. Even in countries with vibrant crop agricultural sectors, seed systems are still underdeveloped. The FAO reports that less than a third of the African countries it surveyed had established seed production and distribution facilities for major crops (FAO, 1987). As indicated, the Asian green revolution was successful because there was success in developing fertilizer-responsive crop varieties. The African green revolution cannot be any different. Zongo (2005) reports that the poor organizational structure coupled with inability to self-sustain operations has been described as major obstacle hindering the development of private seed entities in Burkina Faso. This implies that AGRA's strategies in Burkina Faso were well aligned to the needs of the country and therefore relevant.

2. ***Effectiveness*** examines among other things whether the implementation of activities under the project were successfully completed. AGRA successfully disbursed grants to two private seed enterprises in Burkina Faso, AGRO PRODUCTION based in Po and NAFASO based in Bobo-Dioulasso with grants to enhance their capacities to produce and distribute improved seed across the country. Each company received a grant of US$ 140,000 over a period to two years. In addition, funding collaborations were established with INERA in three areas including, logistics and material to facilitate the development of improved varieties and human resource capacity building in research.

3. The intervention of AGRA especially in the private seed sector had significantly influenced seed relationships in Burkina Faso. Fully private seed companies are new evolutions in the Burkina Faso seed system. The production of seed is usually undertaken by the state and the distribution done through farmer cooperatives and networks. A lot of subsidies are involved along the chain of distribution. The grants given to AGRO PRODUCTIONS and NAFASO by AGRA effectively facilitated the emergence of new actors with different roles in the seed value chain.

4. Closely related to effectiveness is ***Efficiency*** under which the study examined the timeliness of the implementation. We sought to investigate whether planned activities were implemented on schedule if at all. The mid-term review report to a large extent indicated that the programme had achieved important milestones and was on target to meeting agreed timelines in relation to the implementation of activities (refer to mid-term review report and section 3.1 of this report).

5. If the objectives are relevant, and the implementation effective and efficient, then the possibility exist that **effects/impacts** have been created which could then be identified and measured. The two AGRA grantees, AGRO PRODUCTIONS and NAFASO together produced about 600 tonnes of improved seed. At the farmer level there have significant achievements in the promotion of improved seed use. Among men for

example, the use of purchased improved seed increased by about 338% over the baseline level and has been accompanied by reductions in the use of recycled improved seed and local seed.

6. Field data show that varieties supported by AGRA have become popular with farmers across the country. About 53% of farmers nationwide grow Massongo, a maize variety promoted by AGRA. Other AGRA varieties such as FBC6 (33.8%) and Wari (16.2) is grown by 33.8% and 16.2% of farmers respectively. About 15% of farmers grow KVX 745-11P, a cowpea variety grown by AGRA.

7. Seed companies and input dealers supported by AGRA have become the major sources of improved seed for a significant number of farmers across the country. In 2010, Seed companies and input dealers together supplied improved seed to over 20%.

8. It was clear that varieties promoted by AGRA, such as Massongo, Wari, FBC6 deliver very high yield per hectare under farmer conditions. The Massongo variety on the average, yields up to 3.3tons/ha. Wari, Bondofa and FBC6 yield up to 2.8tons/ha, 3.0tons/ha and 2.7 tons/ha respectively.

9. Under **Sustainability** we examined whether the outputs, outcomes and impacts generated by the PASS are sustainable. Sustaining achievements has been a major problem with most interventions in Africa. In Burkina Faso in particular, there is the challenge of realigning AGRA interventions with programmes of the Ministry of Agriculture. It would be difficult to promote sustainability of interventions if the relevant state agencies are not part and parcel of the intervention strategy.

3.2 GHANA CASE STUDY

3.2.1 Introduction

Ghana's agricultural sector accounts for about 34.5% of Gross Domestic Product (GDP), and employs in excess of 60% of the country's working population (GSS, 2009). The food sub-sector of Ghanaian agriculture parades a large array of staple crops, made possible by the diversity of agro-ecological production zones. The major food crops are:

- Cereals – maize, rice, sorghum, and millet.
- Tubers - yam, cassava, cocoyam and sweet potatoes.
- Legumes - groundnut, cowpeas, and soybeans.
- Others – fruits and vegetables including plantain/banana.

Cattle, sheep, goats and poultry on the other hand, constitute the major types of livestock produced in Ghana. According to Alhassan et al (2006), Ghana's agricultural sector can be characterized as follows:

- low-input,
- rain fed (a paltry 0.05% is under irrigation),
- small holder dominated,
- heavily dependent on women's labour and management,
- very poorly served by basic infrastructure and support services.

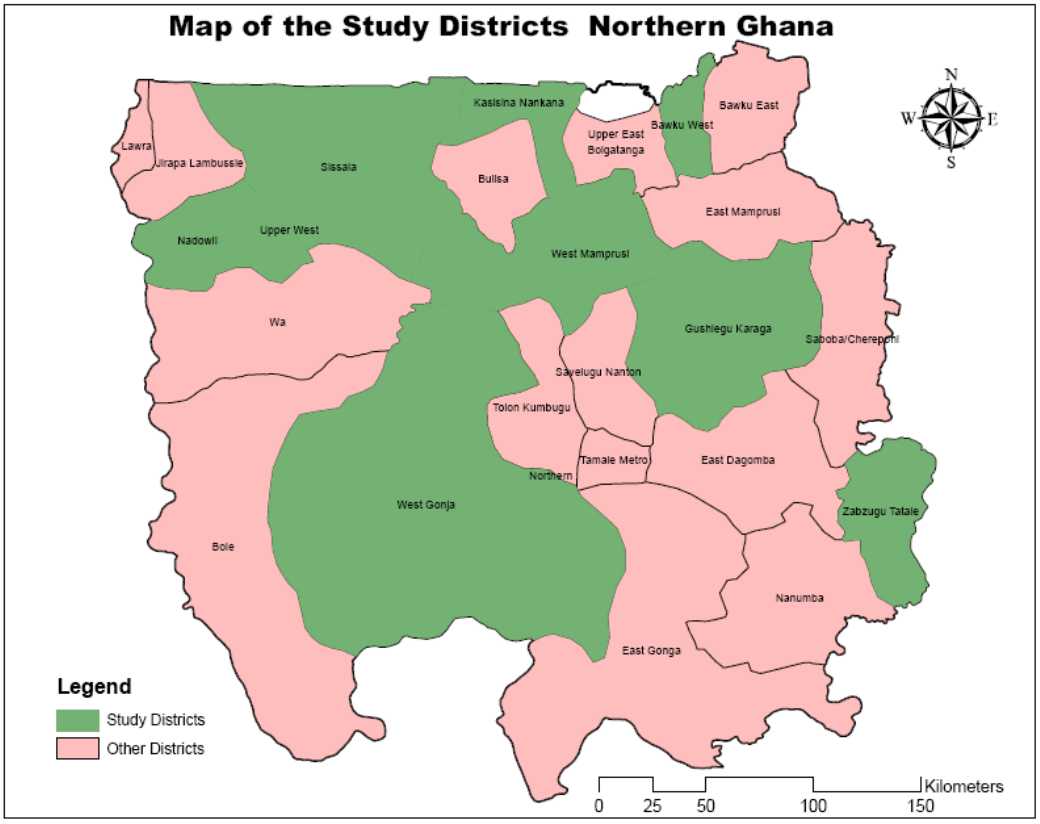
The above, coupled with other constraints has stagnated the agriculture sector to a performance of less than half its potential. Current crop production levels are said to average less than 50% of the achievable levels.

Northern Ghana, the focus of this study comprises three regions: the Upper East Region (UER), the Upper West Region (UWR) and the Northern Region (NR). These regions cover an area extending approximately between lat. 8^0N and lat. 11^0N. They comprise over 40% of the entire land area of Ghana, but contain about 20% of the national population of about 24, million people. The total land area of Northern Ghana is about 98,000 km^2, of which 16,000 km^2 are intensely farmed and about 8,000 km^2 are less intensely farmed. The major soils of the area are Alfisols and Plinthic Luvisols with their integrates. About 47% of the soils is considered not suitable for agricultural production, 25% are marginal, and about 28% are suitable for agriculture.

Northern Ghana has two distinct ecologies, namely the Guinea and the Sudan savanna. Most of Northern Ghana falls within the Guinea Savanna Ecological Zone, which is associated with total annual rainfall of about 1000–1300 mm, while Sudan Savanna normally records precipitation below 1000 mm/annum. Typically, the rainy season starts in the last week of April or first two

weeks of May. However, in some years it can start as late as the last week in June. The peak rainfall period is usually late August or early September. About 60% of the rainfall occurs within the three months (July to September); with torrential rains creating serious drainage problems, creating high amounts of runoff, with flooding being one of the most significant agricultural constraints in the area.

Map 2: Map of Ghana indicating sampled districts



3.2.2 General Overview of Agricultural Input Use

The liberalization of Ghana's economy in the early 1980s marked the end of subsidies on farm inputs such as seeds, fertilizers, herbicides, and machinery purchase. The demise of state owned input suppliers such as the Farmers Services Company (FASCOM) gave rice to the evolution of private sector supply system which appears to meet some needs, although not without some dissatisfaction. The regular availability and affordability of fertilizers and other inputs sometimes gives cause for complaint by farmers particularly in Northern Ghana.

Following persistent complains from farmers on the non-availability and/or high cost of fertilizers, the Ghana government has introduced a fertilizer subsidy program which started in July, 2008. In 2008, region-specific coupons were distributed by agricultural extension agents to

farmers in northern Ghana. Beginning from the 2010 production season the fertilizer subsidy is no longer distributed through coupons, but directly to the supplier so that every farmer can purchase at the subsidized price without any coupons. The government and other stakeholders believe soil fertility improvement is one of the very critical factors for increased productivity to feed the growing population of the nation.

Table 11 shows the prices of fertilizers with and without subsidies in the Northern Region for the 2008 and 2009 production seasons.

Table11: Prices of fertilizers with and without subsidy

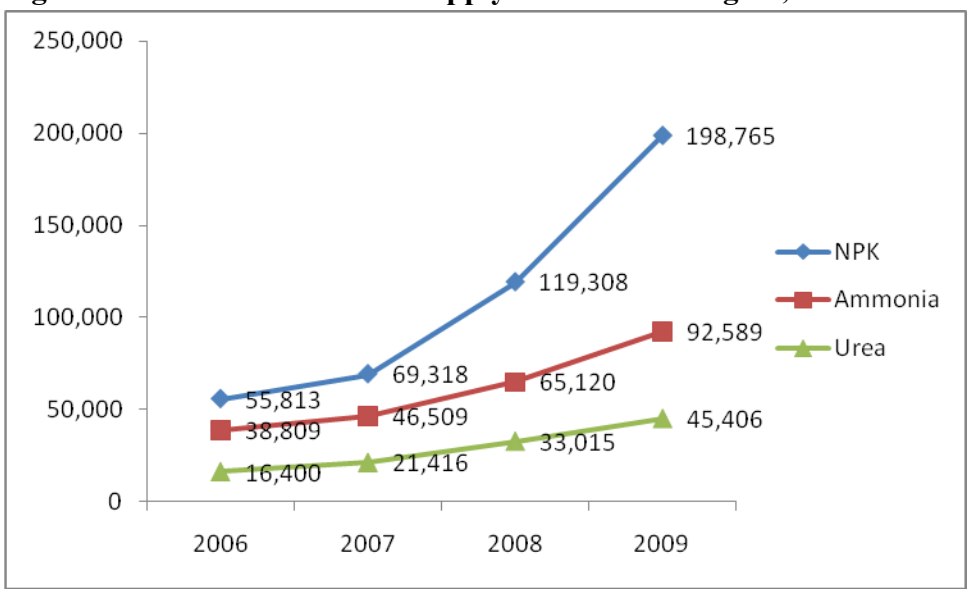
	2008		**2009**	
Fertilizer Type	**Price Without Subsidy (** GH¢)/bag	**Price with subsidy(** GH¢)/bag	**Price Without Subsidy(** GH¢)/bag	**Price with subsidy(** GH¢)/bag
NPK 15-15-15	49.00	25.70	49.00	28.90
NPK 23-10-05	48.00	24.70	48.00	26.90
AMMONIA	33.00	16.70	33.00	14.90
UREA	40.00	26.70	40.00	12.90

Source: MOFA, Northern Region (2010) * 1bag of fertilizer =50kg

3.2.3 Trend of Fertilizer Consumption/Usage

In northern Ghana, particularly in the Northern Region, fertilizer consumption has been on the ascendency for the past 2-3 years. Figure 1 shows the quantities (in bags, 1bag = 50kg) of fertilizer supplied in the Northern Region by YARA, one of the main fertilizer distribution companies in northern Ghana. The increased fertilizer consumption is attributable to the government's subsidy program as well as efforts by other stakeholders such as AGRA-PASS in promoting fertilizer usage for improved agriculture productivity.

Figure 1: Trends of fertilizers supply in Northern Region, Ghana



Source: YARA, Tamale, 2010

3.2.4 General Seed Supply and Use in Ghana

Various stakeholders are involved in the production and supply of improved seed in Ghana. Improved varieties of maize and cowpea as well as other crops cultivated in northern Ghana have their origin from two main breeding institutions, the Council for Scientific & Industrial Research's Crops Research Institute (CSIR-CRI) in Kumasi, and Savannah Agricultural Research Institute, (CSIR-SARI) at Nyankpala, near Tamale. Breeders at these institutions produce breeders' and foundation seed. Commercial seed multipliers such as the Seed Growers' Association multiply foundation seed to produce the equivalent of certified seed, although no statutory certification procedure is as yet established. There are no legal definitions of certified seed and the standards to which it should comply, but the Ministry of Food and Agriculture (MOFA) has an active seed inspection unit that enforces formally accepted standards of 98% purity and 98% germination.

The roles of various stakeholders involved in the formal sector production and distribution of improved plant varieties is shown in Table 12. However, the formal seed sector supplies only about 10% of the seed requirement of Ghanaian farmers. The bulk of seed used by Ghanaian famers is said to come from informal sources such as farmers who produce and save some of their own seed or crop material for planting, planting materials obtained from neighbors or other farmers in the village or local area. About 90 to 95% of seed planted is from the informal sector.

Yields from of planting material obtained through this source are usually low and lack uniformity.

Table 12: Seed system value chain roles and responsibilities in Ghana

Activity	Agency Responsible	Remarks
Production of breeder seed	CSIR-CRI CSIR-SARI KNUST-College of Agric University of Ghana Cape Coast University	Major producer Major producer Minor producer Minor producer Minor producer
Registration/Varietal Release	National Varietal Release Committee	
Breeder Seed Production	CSIR-CRI; CSIR-SARI; KNUST; University of Ghana; Cape Coast University	The CSIR institutions are the major producers. Government covers the cost of production.
Foundation Seed Production	Grains and Legumes Development Board	This is the sole producer of foundation seed.
Certified Seed Production	Certified Seed Growers/Seed Growers Association of Ghana (SEEDPAG).	Has a southern sector and a northern sector.
Quality Control and Seed Certification	Ghana Seed Inspection Division	This belongs to the Plant Protection and Regulatory Services Directorate (PPRSD)of MOFA.
Processing (including packaging)	Seed Growers Association of Ghana	Processing equipment (threshing, drying, cleaning, warehousing) services provided at a fee by the Grains and Legumes Development Board (Southern Sector), CSIR-CRI (Southern Sector) and the PPRSD (Northern Sector)
Marketing (promotion)	Ghana Agri-Input Dealers Association (GAIDA)	
Distribution (to smallholders)	GAIDA, Donor funded projects, NGOs	

Source: Alhassan et al (2006)

3.2.5 AGRA-PASS Interventions: General Achievements

As noted earlier, PASS consists of four sub-programs that focus on different elements of the input supply value chain. Table 13 displays the general achievements of AGRA-PASS in Ghana.

Table 13: General Achievements of AGRA-PASS in Ghana

Component	Activity	Achievement
Education for African Crop Improvement (EACI	Provides training for a new generation of crop breeders and agricultural scientists.	An amount of about $5,781,859 and & $ 387,000 allocated to WACCI University of Ghana and KNUST respectively. 28 students trained or at various stages of training at the Master and PhD level at the two Institutions
Fund for the Improvement and Adoption of African Crops (FIAAC)	Funds crop breeding in Africa to improve African crop varieties and promote their adoption by small holder farmers.	$918,595 provided to CSIR CRI &SARI for improvement work on Cassava, Maize, Cowpea and Groundnuts
Seed Production for Africa Initiative (SEPA)	helps ensure that improved crop varieties are produced and distributed through private and public channels (including seed companies, publicly-supported seed programs, and public extension) so that farmers can adopt these varieties	Four Seed production companies namely: Savanna Seeds Services Company, Alpha Seed Enterprise, M & B Seeds and Agricultural Services Ltd, have collectively received about $ 449,737 for production of maize, cowpea, groundnuts , rice and sorghum seeds
Agro-Dealer Development Program (ADP).	provides training and credit to establish and support the growth of small agro-dealers, who are a primary conduit of seeds, fertilizers, and knowledge of their proper use, to smallholder farmers to increase their productivity and incomes	AGRA- PASS partner the IFDC has provided r capacity building training to about 564 agro-dealers

Source: Review of Various Documentations

3.2.6 Use of Improved Seeds

The AGRA–PASS program is promoting the following improved varieties of maize in northern Ghana; Obatampa, Dodzi and DTMA. For cowpea, the following improved varieties are promoted; Apaghbaala, Padi Tua, Songotura, and Bawutabawuta. Presented in Table 14 are varieties of maize and cowpea cultivated for two successive seasons (2009 and 2010 production seasons)

Table 14: Distribution of improved varieties cultivated

Crop Type	2009 Season					2010 Season		
	Variety	Freq.	%	Avg. Age (years) of variety with farmer		Freq.	%	Avg. Age (years) of variety with farmer
Maize	Obatampa	125	83.9	6.9		140	83.3	7.2
	Dodzi	4	2.7	9.3		4	2.4	10.3
	Laposta	18	12.1	8.2		19	11.3	8.7
	Pannar	1	0.7	1.0		4	2.4	1.3
	Doke	1	0.7	5.0		1	0.6	1.0
Cowpea	Apaghbaala	12	27.9	4.8		11	26.2	5.0
	Songutura	4	9.3	6.5		4	9.5	7.5
	Ammudor	20	46.5	6.7		19	42.5	7.1
	Tubalgu	2	4.7	9.0		6	14.3	4.8
	Others	3	7.0	-		2	4.8	-

Source: Field Survey, 2010/11

The main improved varieties of maize cultivated by the farmers are Obatampa, Laposta and Dodzi. These varieties are not new to the farmers; they have been cultivating them for at least seven years. Other improved varieties of maize reported by the farmers include Pannar and Doke. Obaatampa appears to be the most popular variety, for the 2009 and 2010 cropping seasons 125 (83.9%) and 140 (83.3%) of farmers cultivated the Obatampa variety respectively. The Dodzi variety seems to be the oldest cultivated improved. Farmers reported that the variety has been with them for over nine years now. The results also indicate that the Pannar variety is the newest variety found among farmers, it is barely a year with very few farmers cultivating it. According to the farmers the Pannar variety was introduced to them about 2 years ago by an NGO called Masara Ariziki.

For cowpea, the Ammudor and Apaghbaala varieties are the commonest varieties found among farmers in the two cropping seasons with frequencies of 12 (28.9%) and 20 (46.5%) for the 2009 cropping season and 11 (26.2%) and 19 (42.5%) for the 2010 cropping season. Two improved of cowpea varieties promoted by AGRA- PASS; Apaghbaala and Songtura are among the top three varieties cultivated by farmers in northern Ghana.

Below are reasons farmers gave for accepting improved varieties:

- The improved varieties have shorter maturity periods
- They yield better than the local varieties
- The soils can no longer support the local varieties
- The market value of improved varieties is higher than the local varieties
- Unlike the indigenous varieties, improved varieties can even yield when planted late.
- Introduced varieties have lower water requirements than improved varieties

Despite the advantages of the improved varieties, farmers listed the following constraints militating against the adoption of improved varieties

- Difficulty in accessing and high cost of tractor services
- Improved seeds are expensive
- Improved seeds require a lot of fertilizer.
- Rising cost of fertilizers
- Unreliable rainfall pattern
- High cost of chemicals especially for to spraying cowpea

3.2.7 Sources of Improved Varieties

Generally, majority (55.2%) of maize farmers keep their own seeds for planting in the next season. Though the number of farmers who keep their own seed for planting in the next season can be considered high, there is an improvement over what pertained about six years ago. Alhassan and Bissi (2006) reported that less than 10% of seed planted by Ghanaian farmers is obtained from formal seed sources. There is a wide difference between the three northern regions in terms of source of seed for maize farmers. Whilst only 37.9% of farmers in the Upper West Region reported using their own seed for planting, as much as 59.0% and 83.3% of maize farmers in the Northern and Upper East Regions respectively use their own seed. There appears to be more seed growers in the Upper West Region who sell their seed through input dealers and NGO's to farmers.

The Northern Region recorded the highest number, (12.8%), of maize farmers receiving seeds from governmental sources with the Upper West Region recording no farmer receiving seeds from government sources (Table 15). For cowpea, 40.5% of respondent farmers obtain their

seeds from the local market; another 40.5% used their own seed saved from the previous farming season (Table 16). Cowpea farmers in the Upper East Region tend to rely more (75.0%) on input dealers for their seed supply. Unlike the case of Maize farmers in the Upper West Region, as much as 51.9% cowpea farmers from the region use their own seed.

Table 15: Distribution of improved seed sources (Maize)

Sources of Improved Seed	Northern Region		Upper East		Upper West		All regions (Northern Ghana)	
	Freq	%	Freq	%	Freq	%	Freq	%
Agric Input Dealer	4	5.1	4	9.5	7	24.1	15	12.0
Seed Company	-	-	2	4.8	2	6.9	4	3.2
NGO	-	-	-	-	8	27.6	8	6.4
Farmer	2	2.6	-	-			2	1.6
Local community Dealer	-	-	-	-			-	-
Government	10	12.8	1	2.4			11	8.8
Farmer Group	1	1.3	-	-			0	0.0
Research institute/university	-	-	-	-			-	-
Local Markets	15	19.2	-	-	1	3.4	16	12.8
Faith Based group	-	-	-	-			0	0.0
Women group	-	-	-	-			0	0.0
Own Seed	46	59.0	12	83.3	11	37.9	69	55.2

Source: Field Survey, 2010/11

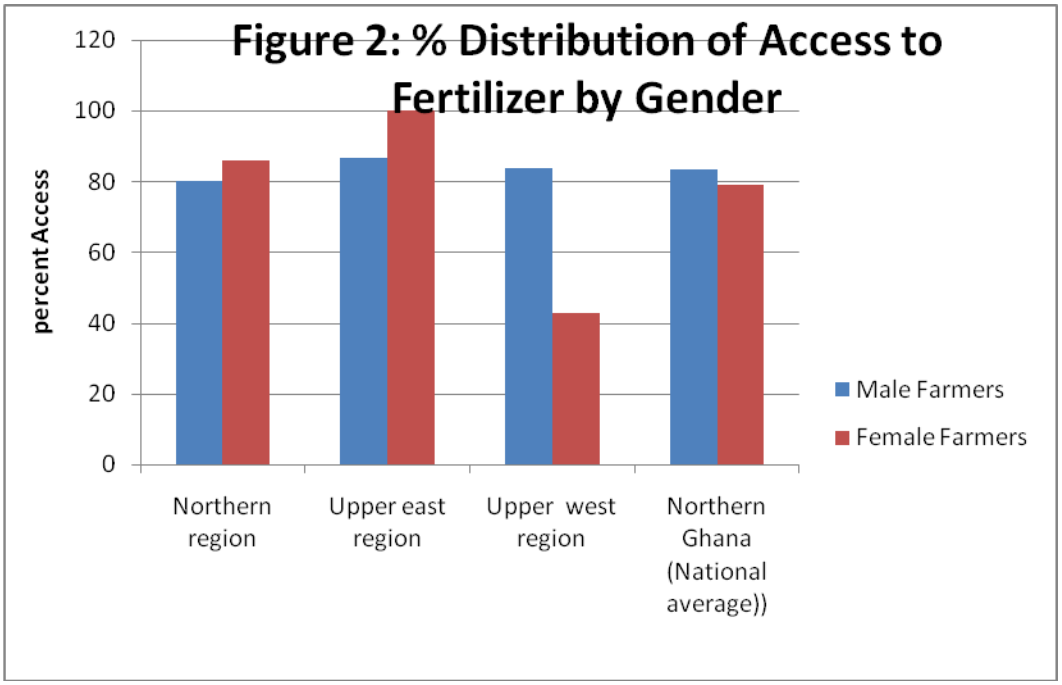
Table 16: Distribution of improved seed source (Cowpea)

Sources of Improved Seed	Northern Region		Upper East Region		Upper West Region		All regions (northern Ghana)	
	Freq	%	Freq	%	Freq	%	Freq	%
Agric Input Dealer	-	-	3	75.0	-	-	3	7.1
Seed Company	-	-	-	-	1	3.7	1	2.4
NGO	-	-	-	-	3	11.1	3	7.1
Farmer	1	8.3	-	-	-	-	1	2.4
Local community Dealer	-	-	-	-	-	-	-	0.0
Government	-	-	-	-	-	-	-	0.0
Farmer Group	1	8.3	-	-	-	-		0.0
Research institute/ university	-	-	-	-	-	-	-	0.0
Local Markets	8	66.7	-	-	9	33.3	17	40.5
Faith Based group	-	-	-	-			-	0.0
Women group	-	-	-	-			-	0.0
Own Seed	2	16.7	1	25.0	14	51.9	17	40.5

Source: Field Survey, 2010/11

3.2.8 Access to, and Use of Chemical Fertilizers

Farmers' accessibility to chemical fertilizer is an important determinant of their use for soil fertility improvement. Figure 2 depicts respondents' assessment of access to fertilizer. Averagely 83.5% and 80.0% of male and female farmers respectively indicated that they have access to chemical fertilizers. Access to fertilizers is however, averagely higher in the Upper East Region 86.8% for males and 100% for females relative to the Northern and Upper West Regions. According to farmers, accessibility to chemical fertilizer is not a limiting factor to its use, cost and other factors may account for the less than recommended dosage of fertilizers applied in the area. During the focus group discussions, farmers often explained that education from governments Ministry of Food and Agriculture augmented by efforts of NGOs such as AGRA has provided them enough information on the right input combination to improve productivity. However, the cost of such inputs is the main barrier to their use.



Soils in northern Ghana are inherently low in fertility. Also the unfavorable moisture regime, as a result of unreliable rainfall, makes the potential productivity of the soils in the area very low (Boateng and Ayamga, 1992). Fertilizer use is therefore very important for the improvement of productivity, a necessary condition for increased income and food security among farm households in the area. The level of fertilizer use particularly in relation to the use of improved crop varieties was assessed**.** Table 17 shows the percentage distribution of farmer's use of chemical fertilizer in relation to the type of variety (improved or local). Averagely, 96.2% of farmers who purchased improved varieties of maize seed for planting in the 2010 production season used some chemical fertilizer to improve soil fertility. Also 90% of farmers who recycled improved varieties of maize used chemical fertilizer. However, only 65.2% of farmers who planted local varieties used chemical fertilizers. Farmers who mixed both improved and local varieties of maize for planting in the northern and upper west regions did not use chemical fertilizers. All respondent households in the Upper East Region indicated that they used chemical fertilizer for fertility improvement on their maize; this may not be surprising since soils in the Upper East Region are relatively more degraded due continuous cropping caused by high population density. It is important to note that no respondent in the Upper East Region cultivated local varieties or mixed local with improved varieties of maize for planting. This result indicates that farmers that use improved varieties are more likely to use chemical fertilizers. However, the quantity of fertilizer use is often far less than the recommended dosage. The PASS Agro-Dealer Development Program (ADP) is said to provide training and credit to establish and support the growth of small agro-dealers, who are a primary conduit of seeds, fertilizers, and knowledge of their proper use, to smallholder farmers to increase their productivity and incomes.

Table 17: Percentage distribution of chemical fertilizer use

Crop Type	Used Fertilizer in 2010 Season?							
	Northern Region		Upper East Region		Upper West Region		National Average	
	Yes	No	Yes	No	Yes	No	Yes	No
MAIZE								
Purchased improved	96.2	3.8	100.0	0.0	95.5	4.5	96.2	2.8
Recycled improved	84.8	15.2	97.1	2.9	90.0	10	90.1	9.9
Local	63.6	36.4	-	-	66.7	33.3	65.2	34.8
Purchase improved+ local	0	100.0	-	-	0.0	100.0	0.0	100.0
COWPEA								
Purchased improved	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Recycled improved	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Local	0.0	100.0	-	-	0.0	100.0	0.0	100.0
Purchase improved+ local	0.0	100.0	-	-	0.0	100.0	0.0	100.0

Source: Field Survey, 2010/11

3.2.9 Comparison of Yield

Figure 3 and Table 18 show the yields reported by maize and cowpea farmers in northern Ghana. Improved varieties of maize cultivated by the farmers include Obatampa, Dodzi, Laposta, Pannar and Doke. Generally yields of improved varieties are higher than the local varieties. Farmers who purchased or recycled improved varieties of maize seed for planting reported yields of about 1.6 tons per hectare, about 14% more than local varieties which reported to be 1.2 tons per hectare. According to Statistics, Research and Information Directorate (SRID) of MOFA (2006) the national average of maize yield is estimated at 1.6 tons per hectare. However, the average yield of maize for northern Ghana is 1.2 tons. Though yields of improved varieties cultivated in northern Ghana show better performance than the local varieties, the yields are still far less than the potential yield of the improved varieties. A lot still needs to be done at the farm level if yields are to improve significantly.

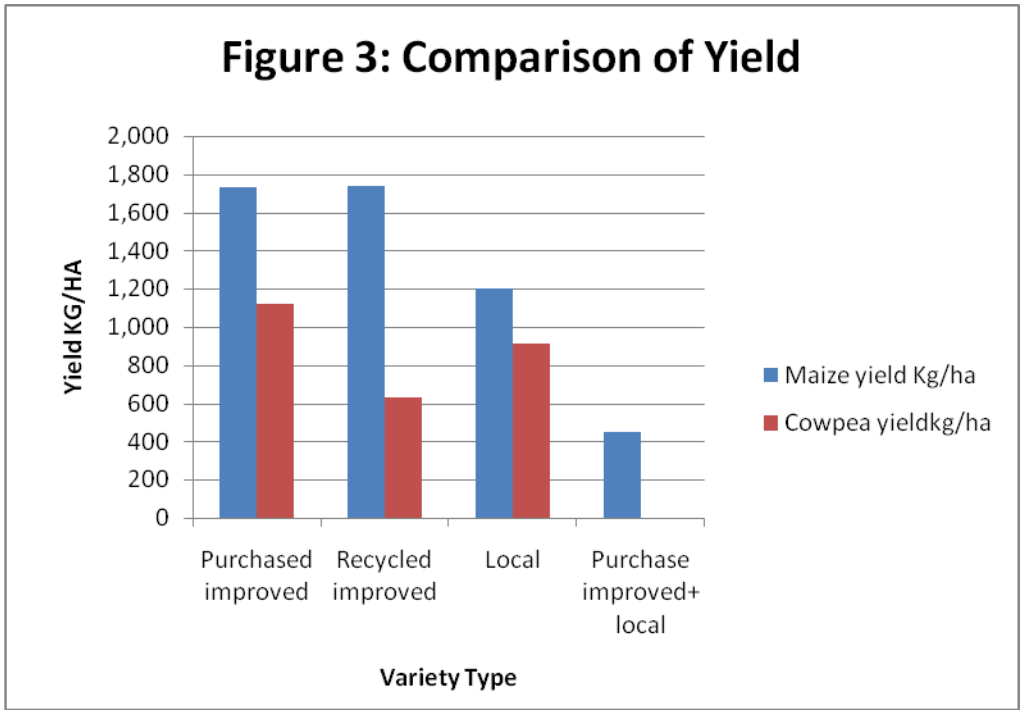


Table 18: Comparison of yields (Kg/Ha)

Region Crop/Seed Type	Northern Region	Upper East Region	Upper West Region	National Average
MAIZE				
Purchased improved	1,957.5	985.5	2,250	1,731
Recycled improved	495.0	1,035	3,690	1,740
Local	1,980.0	-	427.5	1,203.5
Purchase improved+ local	450.0	-	450.0	450.0
COWPEA				
Purchased improved	1,237.5	1,350	765.0	1,117.5
Recycled improved	720.0	495	675	630.0
Local	1, 305	-	517.5	911.25
Purchase improved+ local	-	-	-	-

Source Field Survey: 2010/11

Improved varieties of cowpea cultivated include; Apaghbaala, Songutura, Ammudor and Tubalgu. Average yields of improved varieties of cowpea reported by farmers is 1.1 tons per hectare and the local varieties yield average 0.9 tons per hectare. Interestingly farmers that recycled improved varieties of cowpea reported the lowest yields of about 0.6 tons per hectare.

3.2.10 Farmer's Perceptions/Expectations on the Utility of Small Seed Packs

The size of seed pack preferred by farmers depends largely on area cultivated. Farmers that cultivate relatively large acreage prefer large seed packs. Such farmers argued that the larger the pack the better for them since they just need a pack to plant a whole area ploughed. However, farmers with smaller plots tend to prefer smaller packs; they argued that buying large may results in wastage of funds since the area to plant may not need large quantity of seed. Table 19 presents the preference of seed pack by farmers in northern Ghana. About 20.6% prefer smaller packs while 37.3% prefer the large packs. About 39.7% of the respondents are indifferent on the size of seed packs.

Table 19: Preferred seed pack

	Which Seed Pack Do you Prefer							
Size of Seed pack	Northern Region		Upper East Region		Upper West Region		All regions (Northern Ghana	
	Freq	%	Freq	%	Freq	%	Freq	%
Small Pack	16	14.2	27	36.5	9	13.8	52	20.6
Medium Pack	2	1.8	1	1.4	3	4.6	6	2.4
Large Pack	42	37.2	1	1.4	51	78.5	94	37.3
No preference	53	46.9	45	60.8	2	3.1	100	39.7
Total	113	100.0	74	100.0	65	100.0	252	100.0

Source: Field Survey, 2010/11

3.2.11 Ghana Case Study Conclusions

1. Following Ghana's economic recovery program in the 1980s, governments' role in the agriculture input supply sector has been limited. Private input suppliers have tried to fill the vacuum but their concentration has mostly been in the provision of agro-chemicals. The seed sector has long suffered some neglect; as a result, the bulk of seed used by Ghanaian farmers came from informal sources. About 90% to 95% of seed planted is sourced from the informal sector. Yields from planting material obtained through this

source are usually low and lack uniformity. This affects marketability of farmers produce with repercussions on income. AGRA-PASS intervention in the Ghanaian input supply sector is therefore **very relevant** in improving the productivity of agriculture.

2. AGRA-PASS has established funding amounting to $5,781,859 and & $ 387,000 for the West African Crop Improvement (WACCI) at the University of Ghana and the Kwame Nkrumah University of Science & Technology (KNUST) respectively. Some 28 scientist have been trained or are at various stages of training at the Master and PhD level at the two Institutions.

3. Four Seed production companies namely: Savanna Seeds Services Company, Alpha Seed Enterprise, M & B Seeds and Agricultural Services Ltd, have collectively received about $ 449,737 for the production of maize, cowpea, groundnuts, rice and sorghum seeds this has added the needed impetus to the Ghanaian seed industry.

4. Through linkage with CSIR -CRI &SARI improvement work is on-going on Cassava, Maize, Cowpea and Groundnuts. Again through its partner the IFDC capacity building training has been provided to some 564 agro-dealers in Ghana. The support given by AGRA-PASS has effectively re-invigorated key stakeholders in Ghana for the supply of quality seeds

5. Survey results show that some varieties promoted by AGRA-PASS are popular with farmers in northern Ghana. 83.9% and 83.3% of farmers cultivated the Obatampa variety in the 2009 and 2010 seasons respectively. Two improved cowpea varieties promoted by AGRA- PASS; Apaghbaala and Songtura are among the top three varieties cultivated by farmers in northern Ghana.

6. The improved varieties have demonstrated a potential for improving farmers income and food security. Farmers that cropped improved varieties of maize reported yields of about 1.6 tons per hectare, which is 14% more than local varieties with average yields of 1.2 tons per hectare.

7. It is now more than ever, the urgent need for development projects and programs Such AGRA-PASS to show results that are sustainable. Sustainability could prove difficult to attain without a strong local ownership. Interaction with key stakeholders in northern Ghana suggest there is limited understanding on AGRA-PASS activities. Key stakeholders such Ghana's Ministry of Food and Agriculture at the district/ or local level do not appear to fully understand what AGRA-PASS is doing. To ensure sustainability collaboration at local should be strengthened.

3.3 MALI CASE STUDY

3.3.1 Country Agriculture and Seed Value Chain Context

Mali is a landlocked country in West Africa with a population of 14.5 million spread over an area of 1,240,192 square kilometers. Mali is divided into eight regions (*régions*) and one district (the District of Bamako). Each region is headed governor. Since Mali's regions are very large, the country is subdivided into 49 cercles, 288 *arrondissements* and 703 communes. Mayors and elected members of the city councils run the *arrondissements*.

Map 3: Map of Mali indicating sampled regions

Source: Maptune.net

Mali's economy is largely agriculture and fishing driven even though the country is endowed with natural resources including gold, uranium, and salt among others. Agriculture employs about 80% of the labour force and contributes up to 36% of GDP. The country is confronted with a number of environmental challenges, including desertification, deforestation, and soil erosion. Seasonal variations also lead to regular temporary unemployment of agricultural sector workers. Crop production is largely rain-fed and is dominated by smallholder grain cultivation.
Only the southern part of Mali is suited for farming, and less than 2% of Mali's area is cultivated. About 90% of farmland is used for sorghum, millet, and maize cultivation. Input use and mechanization is relatively low.

3.3.2 Improved Seed Production and Supply Value Chain

Mali is one of the countries in Sub-Sahara Africa with a huge potential for arable crop production. Alongside Ghana, Mali is described as a breadbasket because the relevant basic agricultural infrastructure and policy framework required to transform and modernize crop production are in place. This notwithstanding, agricultural productivity remain low with significant gaps between observed cereal yields and the global potentials. Smallholder maize yields on the average, are less than 2 tonnes per hectare or less than 25% of the 8 tons per hectare achieved in research plots within the region (See for example, Tittonell et al., 2007; Bishop-Sambrook, 2003). The yields for millet and sorghum have not reached the 1 tonne per hectare threshold. It is only in production of rice that yields have reached the lower bound of the potential 2.4-4.5 yields under rain-fed conditions.

A number of constraints have been cited for the country's low cereal productivity. Low level fertilizer use, limited adoption and use of improved varieties, pest and diseases and wide variations in rain patterns are listed among the factors that impact negatively on cereal production. A good number of policies are being proposed and implemented across the county. Small-scale farmer-managed irrigation schemes are among the measures being implemented to reduce the effects of wide variations in rainfall. Targeted fertilizer subsidies aimed at improving farmer households' access to fertilizer are also being implemented although on a limited scale. Finally and of relevance to this study are the efforts puts in place to increase use of improved seeds by smallholder farmers. During group discussions, farmers revealed that the productivity of improved varieties was subject to wide variations depending on the conditions. Fertilizer is required to guarantee reasonable yields and, under drought conditions some improved varieties performed poorer than established local varieties. This notwithstanding, farmers still expressed a desire to use improved varieties if access to the seed was guaranteed. Between 1992 and 2003 the distribution network of improved seed was not well-developed. Many farmers depended on extension services and NGOs as sources of improved seed. Distances farmers had to travel to buy seed in the open market were considerable. On a general note, the drive to get farmers to use improved seed was not strong compared with periods after 2005.

The low levels of cereal productivity coupled with limited technology use (improved seed and fertilizers) underscored the **relevance** of AGRA's interventions. In relation to seed, both the production and supply chains required significant investments to improve their efficiencies to create new varieties and also to effectively transfer the new varieties to the farmer end user. The distance a farmer travels to acquire improved seed and other complementary inputs needed to be significantly reduced through the establishment of supply chains that allows improved seed to reach the smallholder farmer in his village or close to his farm. The apparent lack of market for improved varieties had more to do with dissemination and distribution of improved seed and little to do with farmer dissatisfaction with improved seed. AGRA PASS two-pronged approach

to improve the creation and dissemination of improved seed through EACI and FIACC and the supply chain through SEPA are relevant interventions with the potential of creating resilient seed systems across the African continent.

The seed value chain in Mali has been described as a state based system in transition that consists that of government agencies in research and extension support services, private sector actors who are gaining prominence with the devolution of some state agency seed production activities to private companies and selected farmer cooperatives across the country.

Market traders, community level table top input dealers, NGOs and farm households constitute the supply chain which is linked to the production chain by the end product, certified seed. Mali's government has over the years implemented reforms aimed at creating conducive environment for private seed sector development. One major reform was the Project to Support the Seed Value Chain (Projet d'Appui à laFilière Semencière, PAFISEM). Under the PAFISEM, the state would devolve activities related to the commercial production of certified seed to private sector companies who would be supported through the provision of credit to improve their capacities. Under the pre-PAFISEM system, private seed companies were heavily disadvantaged to operate in the market that was dominated by subsidized public sector seed entities who sold seed at below cost recovery prices.

Under the existing framework, breeder seed is produced by the Institute of Rural Economy (IER) and other research institutions—such as the Rural Polytechnical Institute (IPR) and the International Centre for Research in the Semi-Arid Tropics (ICRISAT). The National Seed Service (SSN) and the National Species and Varieties Committee (CNEV) validate and coordinate the production and release of foundation seed. The production of foundation seed used to be solely undertaken by IER, ICRISAT, IPR. Under the existing system however, seed companies have joined in the production of foundation seed. Two of AGRA's grantees (Faso Kaba and Comptoir 2000) have reported production of their own foundation seed. Comptoir 2000 attributed the new development to significant improvement in their organizational structure and production capacities which has been facilitated by AGRA's grants.

After the production of foundation seed, the SSN would usually support farmers to produce first reproduction (R1) and second reproduction (R2) registered seed. R1 seed was to be produced by farmers on state farms and on other selected farms under strict monitoring and contractual obligations to provide the required soil fertility improvements. R2 was produced by the then Village Seed Cells (Cellules Semencières Villageoises, CSVs). During the implementation of PAFISEM, the CSVs was replaced by selected farmer cooperatives. AGRA has provided grants to some of the farmer cooperatives involved in the production of certified seed.

The aim of supporting research to develop improved varieties and the setting up of channels of distribution is to ensure that smallholder farmers get access to and use improved seeds. Tables 20 and 21 highlight the use of improved seeds by men and women respectively. It is clear from the tables that recent government efforts to improve the production and dissemination of improved has been matched by significant increase in the use of improved seed by smallholder farmers across the country. Among men for example, the use of purchased improved seed increased by about 7% over the baseline level while at the same time, the use of recycled improved seed and local declined significantly.

The data also showed an interesting phenomenon where more women than men use improved seed. About 17% of male farmers still used local seed, compared with 10% for women. Recycling of improved seed was however more common with women.

Table 20: Use of improved seed by men

	Purchased Improved	Improved Recycled	Local Seed	Local/ Improved/ Recycled
Koulikoro	56.9	29.8	11.6	1.6
Sikasso	60.8	43.6	14.1	0.4
Segou	55.7	39.1	12.4	2.9
Kayes	53.1	53.8	12.0	0.0
National	55.3	41.6	12.8	1.2
Baseline	*48.2*	*9.2*	*16.8*	*25.8*

Source: Field Survey, 2010/11

Table 21: Use of improved seed by women

	Purchased Improved	Improved Recycled	Local Seed	Local/ Improved/ Recycled
Koulikoro	58.5	36.9	14.6	0.0
Sikasso	55.3	54.4	8.8	1.5
Segou	65.6	40.9	8.7	4.7
Kayes	63.9	57.7	7.7	0.8
National	59.8	47.4	10.0	1.8

Source: Field Survey, 2010/11

As indicated with respect to Burkina Faso and Ghana, a comparative assessment of the popularity of improved varieties was one of the key requirements in the terms of reference of this evaluation. The assessment sought to explore for differences in levels of utilization of varieties supported by AGRA and those already existing in the system or not supported by AGRA. It is important to however caution, as noted with respect to the other countries, that differentiating between AGRA-supported varieties and other improved varieties may only be feasible at the research (breeding) level. As far as seed companies and input dealers are concerned, there is no difference between improved varieties.

Table 22 highlights improved varieties grown by farmers across the country. The Sotubaka maize variety is by far the most popular of all maize varieties. About 34% of farmers nationwide grow this variety. Other popular maize varieties include Dembanymum (17.4%) and Jorobana (12.6). In the case of sorghum, Grinkan and Sumalemba are the most popular varieties. About 6.5% and 5.4% of farmers use these varieties. About 6.7% of farmers grow the NERICA 62N rice variety. It should be noted the analysis is based on the percentage of all farmers using the variety not the percentage use among farmers of the particular crop. Within crop analysis would not give accurate information of the popularity since the use of a crop is dependent on the relative importance of the particular crop to the people.

Table 22: Use of improved varieties of maize, sorghum and rice

	Koulikoro	Sikasso	Segou	Kayes	National
Maize					
Dembanyuman	14.4	19.5	22.9	13.7	17.4
Nieleni	0.6	0.3			0.2
Sotubuka	31.8	30.5	36.8	33.3	33.5
Jorobana	13.3	18.0	8.5	10.2	12.6
Sorghum					
CSM63E	0.3	1.4	-	-	0.4
Lata	0.3	1.1	0.5	-	0.5
Grinkan	8.5	9.3	2.7	5.7	6.5
Sumalemba	8.5	1.4	4.9	7.6	5.4
Rice					
NERICA 62N	10.1	8.5	6.5	1.3	6.7
FKR19	1.9	0.6	5.7	6.0	3.6

Source: Field Survey, 2010/11

Seed companies and input dealers have become the major sources of improved seed for a significant number of farmers. In 2010, Seed companies and input dealers together supplied improved seed to over 45% of farmers (Table 23). Farmer to farmer seed sourcing declined to more than 35% from a baseline level of 52.4%. On the other hand, farmers' use of their own seed saved from previous production inched up by about 80% from 10.0% at baseline to 18.2.

Table 23: Sources of improved seed for smallholder farmers

	Koulikoro		Sikasso		Segou		Kayes		National	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2101
Input Dealer	37.1	42.5	29.2	27.9	43.9	44.4	29.2	31.9	35	37.3
Seed company	9	8	10.8	11.7	5.6	6.7	6.5	5.7	7.9	8
NGO	2.9	2.9	0.0	0.0	2.8	2.2	0.0	0.0	1.5	1.3
Farmer to Farmer	20.3	17.3	25.3	26.4	9.5	6.7	23.4	19.9	19.3	17.2
Government	2.3	2.6	4.5	2.7	12.3	8.3	4.2	2.6	6	4.2
Farmer group	4.8	5.1	3.92	7.1		5.3	2.9	8.7	2.7	10.2
Local Market	2.9	3.5	0.0	0.0	4.8	5.8	3.6	5.3	2.9	3.6
Own seed	20.6	18.2	26.2	24.4	21.2	20.6	30.2	25.9	24.7	18.2

Source: Field Survey, 2010/11

Tables 24 and 25 present the intensity of fertilizer use (kg/ha) by men and women respectively. The data in the table indicates that fertilizer use by both men and women is higher (in most cases double) the levels reported national average of 9kg/ha (FAOSTAT, 2006). Nationally, men apply an average of 18.6 kg of fertilizer per hectare as compared to 16.7 kg/ha for women. Fertilizer use among both men and women is far below the recommended rates for most crops. This notwithstanding, the observed intensity of fertilizer use higher than the 15kg/ha average for sub-Saharan Africa.

Table 24: Fertilizer use by men

	Mean (kg)/ha	Standard Deviation
Koulikoro	14.6	3.5
Sikasso	20.0	9.4
Segou	19.8	8.2
Kayes	16.9	12.9
National	17.6	7.4

Source: Field Survey, 2010/11

Table 25: Fertilizer use by women

	Mean (kg)	Standard Deviation
Koulikoro	22.3	4.2
Sikasso	19.7	7.9
Segou	14.5	5.4
Kayes	16.1	3.2
National	16.7	3.8

Source: Field Survey, 2010/11

Even though it is widely acknowledged that improved varieties yield more than local varieties, the achievement of such potential output levels is often associated with the application of recommended levels of inputs such as fertilizer and pesticides. For example, the CSM 219E variety of sorghum has the potential to produce 2.5 ton/ha. To achieve this, it is recommended that a total of 150kg/ha of fertilizer made up 100kg of bulk fertilizer and 50kg of urea be applied. Thus in assessing the productivity of improved varieties under farmer conditions, it is important to examine the quantities of fertilizer that farmers apply to improved crop varieties. Table 26 present the application of fertilizer to various improved varieties. On the average, farmers apply about 19.2kg/ha of fertilizer on farms planted to Dembanymum, 20.8kg/ha on Sotubaka farms and about 12kg/ha for farms planted to Nieleni. the highest quantity of fertilizer is applied to maize and rice. About 16kg/ha is applied to NERICA 62N. The lowest quantity of fertilizer is applied to Sumalemba.

Comparison with existing secondary information indicates there have been appreciable increase in the use of fertilizer in Mali. The use is however still far short of the recommended rates for most of these crops. Limited access to fertilizer was reported by farmers as one of the major challenges with the use of improved varieties. During focus group discussions, farmers indicated they used improved varieties in years they were able to afford fertilizer.

Table 26: Intensity of fertilizer use

	Koulikoro	Sikasso	Segou	Kayes	National
Maize					
Dembanyuman*	18.7 (9.8)	19.3 (3.1)	24.8 (4.1)	21.2 (12.6)	19.2 (7.2)
Nieleni*	11.7 (2.5)	10.4 (1.3)	11.2 (5.4)	16.0 (16.9)	12.4 (2.3)
Sotubuka*	19.9 (9.4)	21.8 (4.6)	22.5 (3.2)	19.2 (1.4)	20.8 (5.7)
Jorobana	12.2 (9.4)	10.8 (7.7)	9.2 (6.8)	8.8 (4.2)	8.6 (3.3)
Sorghum					
CSM63E	2.3 (3.4)	6.7 (3.5)	7.3 (6.2)	9.6 (4.8)	5.3 (2.2)
Lata*	4.3 (2.6)	2.1 (1.1)	1.0 (3.5)	1.3 (0.3)	1.9 (2.3)
Grinkan*	8.4 (3.6)	5.6 (3.3)	4.4 (6.9)	5.6 (48.1)	5.7 (2.8)
Sumalemba*	5.5 (2.8)	3.3 (2.5)	3.9 (4.8)	7.2 (2.9)	4.1 (3.1)
Rice					
NERICA 62N	13.1 (3.3)	17.3 (8.2)	19.6 (6.5)	20.3 (10.0)	15.6 (10.1)
FKR19	1.5 (1.9)	1.2 (1.7)	2.0 (2.2)	1.8 1.7)	1.3 (2.9)

Source: Field Survey, 2010/11

Two quantitative indicators (tonnes of harvest per hectare and tonnes per 50 kilograms of fertilizer applied) are used in examining the productivity of improved varieties. Table 27 presents productivity (ton/ha). Under existing farmer conditions, the Dembanymum and Sotubaka varieties on the average, yield up to 4.2tons/ha. Nieleni and Jorobana yield up to 3.9tons/ha, 3.2tons/ha respectively the most productive sorghum varieties include CSM63E and Sumalemba. These two varieties on the average yield about 1.6 tonnes/ha and 1.5tonnes/ha respectively. The data in Table 27 indicates that varieties such as Sotubaka, Dembanymum, CSM63E and

Sumalemba which are also supported by AGRA deliver higher yield per hectare even under farmer conditions.

Table 27: Productivity of improved varieties

	Koulikoro	Sikasso	Segou	Kayes
	Tons/ha	Tons/ha	Tons/ha	Tons/ha
Maize				
Dembanyuman*	3.9 (2.2)	4.2 (1.3)	4.4 (2.6)	4.2 (2.3)
Nieleni*	3.8 (1.7)	3.4 (1.5)	3.2 (2.4)	3.9 (3.1)
Sotubuka*	4.5 (2.6)	5.6 (2.1)	4.3 (3.3)	4.2 (2.1)
Jorobana	2.8 (1.5)	2.7 (1.3)	2.6 (1.4)	3.2 (1.7)
Sorghum				
CSM63E	1.4 (2.1)	1.8 (1.4)	1.9 (1.5)	1.6 (1.1)
Lata*	1.8 (1.4)	1.7 (1.4)	1.4 (0.7)	1.3 (1.1)
Grinkan*	1.8 (1.3)	1.9 (1.4)	1.5 (1.8)	1.4 (1.3)
Sumalemba*	1.7 (2.1)	1.6 (1.7)	2.1 (1.6)	1.5 (1.4)
Rice				
NERICA 62N	2.3 (1.4)	2.8 (1.9)	2.9 (1.5)	2.5 (2.4)
FKR19	1.3 (1.2)	1.8 (1.7)	1.4 (1.3)	1.2 (1.0)

Source: Field Survey, 2010/11

Table 28 presents a SWOT analysis of AGRA's intervention in the seed value chain. The strong points of AGRA's interventions included; comprehensiveness, well-targeted, flexibility in funding arrangements, facilitated ownership of interventions, and support for varieties that offered high yields per unit area. The short duration of funding relationship, emphasis on hybrid varieties among others were mentioned as some of the constraints. Joint long-term planning, de-emphasis of short-term results were described as opportunities that could be explored to strengthen the relationships. The main threat to AGRA interventions was identified as limited prospect for sustainability. The fear was that government may not show the same level of commitment to seed as AGRA does and this could lead to erosion of gains made in the seed sector.

Table 28: SWOT analysis of seed value chain.

	Strengths	Constraints	Opportunities	Threats
Research (seed breeding)/Agricultural Policy makers	The AGRA grant support is **comprehensive:** targets all aspects of breeding activities for logistics to manpower. The AGRA **support targets vital aspects of our operations**: has helped to improve the capacity of IER to produce improved seeds (financially and logistics) and also to train scientists and others staff. **Flexibility of AGRA fund**: Allowed us channel resources to areas such as irrigation facility that has reduced the period it takes to resources	T**he grant period is short:** Breeding takes time. A long term partnership would allow for medium to long term planning. **The condition to produce hybrid** varieties is a major challenge because it takes time and secondly breeders need OPVs as parents. **AGRA expects results every year** and sometimes every quarter. That is not possible with breeding there are years nothing comes from the activities	**Joint long-term planning** would allow for complementary use of AGRA and National funding for research **De-emphasise short-term results** to focus more on medium to long term goals	There is the likelihood that some of the gains made with AGRA will erode if the relationship is short and mainstreaming at the institutional level is not achieved.

Seed Merchants/Input Dealer	AGRA support is devoid of the bureaucracies associated with some projects **Delivery of grants is effective**: Seed business is time sensitive little delays result in massive losses. AGRA responds to this time needs. There is **ownership:** AGRA has not imposed new activities on the company. They rather offered proposals and we could disagree with some of the proposals. Workshops and exposure to best practices has improved the management capacities of AGRA-grantees	The level of documentation (including reports and applications) involved in securing release of AGRA funds is a challenge and sometimes results in delays The AGRA grantees do not have the competitive edge since they compete with out-growers on government subsidies.	Intervention could be scaled up with support to more seed out-growers.	Some farmer cooperatives sell their seed in the market at subsidized prices. This is threatening private seed companies. Market is a problem especially for hybrids. With OPVs farmers start saving their own seed after the first purchase.

Use of "AGRA" seed by farmers	The varieties yield more (in most cases over three times more than the local varieties we use. Most of the varieties also mature early hence suitable for the mostly low and reducing amount of annual rainfall	The new varieties require fertilizer otherwise the harvest is bad. We have difficulty getting the required fertilizers For some improved varieties (hybrids), farmers are unable to save or develop their own seed systems	If AGRA and other NGOs provide fertilizer subsidies or fertilizer credit it would help in the use of the varieties especially in the first years of adoption	There is overemphasis on breeders and seed companies but the end-users (farmers) are not being supported to utilize the technology generated Lack of market for crops produced threatens the continued use of improved varieties.

3.3.3 Mali Case Study Conclusions

The AGRA-PASS value chain evaluation was organized around the OECD-DAC five-point of criteria relevance, effectiveness, efficiency, impact and sustainability. Under **relevance** we sought to answer the question whether AGRA's interventions were consistent with needs and aspirations of country in general and the various actors along the seed value chain in particular and whether the objectives were right.

Despite the huge crop production potential of Mali, farm output per unit land had remained significantly low with growing gaps between observed cereal yields and the global potentials. Smallholder maize yields were less than 2 tonnes per hectare or less than 25% of the 8 tons per hectare achieved in research plots within the region (See for example, Tittonell et al., 2007; Bishop-Sambrook, 2003). The yields for millet and sorghum were less than 1 tonne per hectare. It was only in production of rice that yields reached the lower bound of the potential 2.4-4.5 yields under rain-fed conditions. AGRA baseline information indicated that less than half of farmers in the country used improved seeds. The average fertilizer consumption per hectare of land was about 9kg and less than the Sub-Sahara Africa average. Against this backdrop, AGRA's goal of improving access to improved seed for smallholder farmers through enhancement of the seed value chain was a relevant intervention.

With **effectiveness,** the evaluation assessed among other things the implementation of activities under the project. Regardless of the relevance of the objectives, the capacity of implementing institutions to accurately execute the plans and activities under the project has great implications for success. Within a period of three years, AGRA worked across the seed chain to improve cooperation and collaboration between various actors and links in the seed value chain. AGRA support research and breeding by facilitating human capacity improved through the EACI programme. Under the programme plant breeders are being supported to augment the research staff strength. For a number of years, the IER in Sotuba has been without a maize breeder. This capacity issue is being addressed under EACI with the training of a maize breeder. On-field breeding activities have also received significant funding under FIACC. The IER has proposed 7 hybrid varieties, three (SAMA, WASSOLO and Techba) will be released in 2010. In addition, AGRA has provided grants to seed companies to expand their production and distribution of improved seed. Faso Kaba, Comptoir 2000, La Cooperative Nipagnon Des Productuer Agricole de Loufana (CNPAL) among others have received grants from AGRA which they have used to expand their production and distribution across the country. The AGRA grantees in Mali have each received about US$ 140,000 to support their activities. In 2010, Faso Kaba increased its production of improved maize seed to 120 tonnes from 80 tonnes 2008.

Closely related to effectiveness is **efficiency** under which the study examined the timeliness of the implementation. We sought to investigate whether planned activities were implemented on

schedule if at all. The mid-term review report to a large extent indicated that the programme had achieved important milestones and was on target to meeting agreed timelines in relation to the implementation of activities (refer to mid-term review report and section 3.2 of this report).

If the objectives are relevant, and the implementation effective and efficient, then the possibility exist that **effects/impacts** have been created which could then be identified and measured. The effect of AGRA grants on the output of grantees is immense. In 2010, Faso Kaba increased its production of improved maize seed to 120 tonnes from 80 tonnes 2008. Comptoir 2000 produced about 100 tonnes of maize, cowpea and sorghum in 2010. This compares with less than 20 tonnes produced in 2009 and 0 in 2008. Data obtained from CNPAL indicates that their production of certified seed increased significantly in the last two years. The production of Dembanymum and Sotubaka increased from 9 tonnes in 2006 to 28 tonnes in 2008.

At the farmer level, the use of improved seed has exceeded the 50% threshold. Over 55% of men and 60% of women farmers now use improved varieties (refer to tables 1and 2). Close to half (45%) of farmers obtain improved seeds companies and distributers supported by AGRA. Fertilizer use among farmers in areas served by AGRA-supported input dealers report fertilizer use per of 17.6%, about twice the national average reported for 2006. In terms of yield, farmers who planted Sotubaka report yields around 5.6 tonnes per hectare in Sikasso and about 4.5, 4.3 and 4.2 in Koulikoro, Segou and Kayes respectively. Dembanymum provided yields of about 4.2 tonnes per hectare on the average (refer to table 7). The observation is that farmer yields have improved significantly with use of the improved varieties even though they are yet to attain the potential for these crops.

Under **sustainability** we examine whether the outputs, outcomes and impacts generated by the PASS are sustainable. Sustaining achievements has been a major problem with most interventions in Africa. Some stakeholders in research and distribution channels (seed companies) foresee a challenge in sustaining the momentum when funding from AGRA is withdrawn. There is the need for effective collaboration between the government, AGRA and other stakeholders to provide funding periods long enough to enable most of the actors in the value chain build capacity to sustain interventions and gains.

CHAPTER 4

GENERAL CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL CONCLUSIONS

4.1.1 Relevance

The evaluation clearly indicates that the AGRA PASS intervention has been very relevant in all the countries. The activities are in consonance with the policies and programmes of the various governments and the aspiration of farmers and other actors in the agricultural value chains. The data analyses indicate that varieties supported by AGRA PASS have within a relatively short period of time become popular with farmers across the countries.

4.1.2 Effectiveness

Effectiveness examines, among other things, whether the implementation of activities under the project were successfully completed. AGRA successfully disbursed grants of about US$280,000 to two private seed enterprises in Burkina Faso, US$449,737 to four private seed companies in Ghana, and about US$420,000 to three private seed companies in Mali. The aim was to enhance their capacities to produce and distribute improved seed across the countries. Also, funding collaborations were established with INERA in Burkina Faso to facilitate the development of improved varieties and human resource capacity building in research as well as with the University of Ghana and Kwame Nkrumah University of Science and Technology in Ghana for the training of scientists at the Master and Ph.D levels. There have also been linkages with CSIR -CRI & SARI for improvements in on-going work on Cassava, Maize, Cowpea and Groundnuts in Ghana. Again through its partner, the IFDC, capacity building training has been provided to some 564 agro-dealers in Ghana. The support given by AGRA-PASS has thus been clearly effective in all the countries.

4.1.3 Efficiency

Efficiency is concerned with the timeliness of the implementation. The mid-term review reports in all the countries to a large extent indicated that the programme had achieved important milestones and was on target to meeting agreed timelines in relation to the implementation of activities. Discussions with stakeholders in the evaluation confirm the findings of the mid-term reviews.

4.1.4 Effects/Impact

The AGRA grantees, in all the countries, produced and distributed considerable quantities of improved seed. At the farmer level there have significant achievements in the promotion of improved seed use. The data analysis shows that many varieties promoted by AGRA-PASS are popular with farmers in all the three countries. Also improved varieties have demonstrated a potential for improving farmers income and food security. Yields of target crops varieties have increased considerable though there is a lot of room for improvements.

4.1.4 Sustainability

Sustaining the AGRA-PASS achievements seem to be a major problem in all the countries. In Burkina Faso, in particular, there is the challenge of realigning AGRA interventions with the programmes of the Ministry of Agriculture. The Burkina Faso Ministry of Agriculture feels AGRA is creating a parallel ministry and ignoring Government's policies and programmes on seed production and use. It would be difficult to promote sustainability of interventions if the relevant state agencies are not part and parcel of the intervention strategy. Interaction with key stakeholders in northern Ghana also suggests that there is limited understanding on AGRA-PASS activities. Key stakeholders such as the Ghana's Ministry of Food and Agriculture at the district level do not appear to understand what AGRA-PASS is doing. To ensure sustainability collaboration at local levels have to be strengthened. In Mali, stakeholders in research and distribution channels (seed companies) foresee a challenge in sustaining the momentum when funding from AGRA is withdrawn. There is the need for effective collaboration between the Governments, AGRA and other stakeholders to provide funding periods long enough to enable most of the actors in the value chain build capacity to sustain interventions and gains.

4.2 RECOMMENDATIONS

1. It is obvious from the analyses that that varieties supported by AGRA PASSS are becoming increasingly popular with farmers across the countries and therefore the momentum of AGRA PASS activities must be maintained.

2. Even though the seed companies and input dealers supported by AGRA PASS have become the major sources of improved seed for a significant number of farmers across the countries, their numbers are still very small compared to the millions of small holders that need to be reached. There is need to find modalities to expand the production and distribution of improved seeds especially in the breadbasket countries.

3. The major threat to AGRA PASS interventions, as identified several stakeholders in the countries, is limited prospects for sustainability. AGRA needs to redesign its implementation strategy to mainstream key activities into some established structures in the countries but at the same time ensure that the bureaucracy and lack of transparency in some of the structures do not derail the green revolution.

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