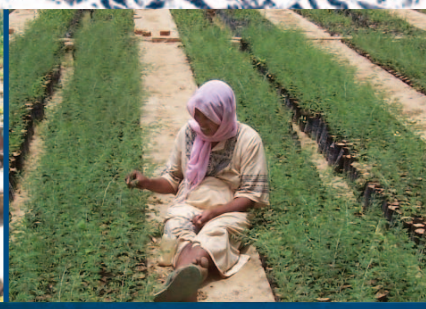

SEED SYSTEM SECURITY ASSESSMENT REPORT FOR DARFUR REGION SUDAN JUNE 2011

EUROPEAN COMMISSION
Humanitarian Aid and Civil Protection

FAO FIAT PANIS

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Last but not least, we would like to thank all those who spared their valuable time to provide us with all the necessary information (primary and secondary data) that enabled us to compile this report. Most notable are the 725 individual households, 99 grain/seed vendors, 9 agro-input dealers, 12 community members, many agroprocessors and all the key informants. Your contributions are highly appreciated.

This work is strongly based on the concepts and guidelines of the publication "When disaster strikes: a guide to assessing seed system security" (Sperling, 2008). The tools used during the assessment as well as the structure of the report are mainly those elaborated for the Seed System Security Assessment in Southern Sudan by Louise Sperling (CIAT).

Foreword

The Darfur Seed System Security Assessment (SSSA) report aims to provide the reader with the following:

- insight into seed system security scenarios;
- processes and methods used;
- a clear picture of past and current situations; and
- opportunities and actions that may be undertaken to improve the current situation.

The report comprises seven main chapters.

Chapter I provides background information on the seed security concept and on current options for seed-related response.

Chapter II introduces the SSSA methodology and reviews the methods actually used in Sudan, including the rationale for the choice of sites.

Chapter III summarizes the context of the assessment, identifying socio-political and economic progress, health trends and the food security situation. It also gives an overview of agriculture and crop production and reviews food and seed-related assistance during the last five to ten years.

Chapter IV describes the functioning of the seed system in Sudan by reviewing both the formal and informal sectors. It reviews the past and current formal plant breeding structures and processes, and how the formal seed production has been organized in the past and present, with specific reference to Darfur. It provides an extensive section describing how decentralized seed multiplication and distribution unfolds in Darfur.

Chapter V is the heart of the field findings and presents the current seed security situation in Darfur. It a) reviews the major crop types and varieties being grown; b) looks at issues related to seed availability, access, and quality (for 2010 and also projecting to 2011) at household level; c) reviews the functioning of the local grain/seed markets and agro-input dealers in improving availability, access and quality of grain for seed, as well as d) suggests alternative sources of quality vegetable seed and other agro-inputs.

Chapter VI focuses on agroprocessing that could indirectly stimulate demand for increased production of specific crop varieties. It also reviews other related opportunities in support of income generation and agricultural development.

Chapter VII presents the overall conclusion and recommendations. These are intended to lead to specific actions in a range of areas of agricultural research, seed security interventions and agro-enterprise development for improved food security and livelihoods.

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Abbreviations and Acronyms

AAH	Action against hunger
AASC	Abu zar Agricultural Services Centre
ACTED	Agency for Technical Cooperation and Development
ADRA	Adventist Development and Relief Agency
AFAG	Afag Organization for Peace and Development
	AMURT Ananda Marga Universal Relief Team
ARC	Agricultural Research Centre
ARS	Agricultural Research Station
ASSCO	Arab Sudanese Seed Company Limited
BSFP	Blanket supplementary feeding programme
CBO	Community-based organization
CIAT	International Centre for Tropical Agriculture
CFSAM	Crop and Food Supply Assessment Mission
CIMMYT	International Maize and Wheat Improvement Centre
COMESA	Common Market for Eastern and Southern Africa
COOPI	*Cooperazione Internazionale*
CRS	Catholic Relief Services
DARA	Darfur Developmental and Reconstruction Agency
DRC	Danish Refugee Council
ERCU	Emergency Rehabilitation and Coordination Unit of FAO
FAO	Food and Agriculture Organization of the United Nations
FFE	Food-for-education
FFW	Food-for-work
GDP	Gross Domestic Product
GFD	General food distribution
GRS	Gezira Research Station
HDI	Human Development Index
IARC	International Agricultural Research Centre
ICARDA	International Centre for Agricultural Research in Dry Areas
ICRC	International Committee of the Red Cross
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDP	Internally displaced person
IF	Institutional feeding
JMRDP	Jebel Marra Rural Development Project
KSC	Kenana Sugar Company
MADAR	Mobadroon Organization for Prevention of Disaster and War Impacts
MOA	Ministry of Agriculture
MOST	Ministry of Science and Technology
M&E	Monitoring and Evaluation
NCA	Norwegian Church Aid
NCAS	Noor Centre for Agriculture Service
SCC	Sudan Council of Churches
NFR	Neighbours, friends and relatives
NGO	Non-governmental Organization
NPA	Norwegian People's Aid
NSA	National Seed Administration
PGRP	Plant Genetic Resources Programme
PHA	Post-harvest assessment
QDS	Quality-declared seed
RI	Relief International
SFP	Supplementary feeding programme
SMOA	State Ministry of Agriculture
SSSA	Seed System Security Assessment
TF	Therapeutic feeding
UN	United Nations
UNDP	United Nations Development Programme
WFP	World Food Programme
WV	World Vision International

Executive Summary

Seed security interventions in Sudan have focused on improving availability and access through seed aid and seed multiplication. Over the years, determination of the need for seed aid and rehabilitation has largely been based, implicitly or explicitly, on the following studies: post-harvest assessments conducted by the State Ministries of Agriculture in close collaboration with the Food and Agriculture Organization of the United Nations (FAO); the Crop and Food Supply Assessment Missions; and other needs assessments, which have limited scope in examining seed security or the dynamics of the seed system. The comprehensive Seed System Security Assessment (SSSA) was undertaken to review the functioning of the existing seed systems (both formal and informal) in the country, with particular focus on the Darfur region. The assessment looked at whether seeds of adequate and preferred quality are available and whether farmers are able to access them. The approach is also expected to promote strategic thinking about the relief, rehabilitation and development vision needed for future interventions.

The comprehensive SSSA adopted a two-way approach: a commissioning of background synthesis, and primary data collection from the various stakeholders at field level. Background synthesis included: a) the formal plant breeding structures and processes; b) the formal seed production structures and processes; and c) current decentralized seed multiplication and distribution initiatives in Darfur. The fieldwork covered 12 localities and 19 administrative units within Darfur. The method encompassed individual interviews with 725 farming households and 99 grain/seed traders; 12 community interviews and focus group discussions with women's groups; key informant interviews with nine agro-input dealers and two agroprocessors. This is one of the most, if not the only, comprehensive agricultural and seed security assessments carried out in Sudan, with focus on Darfur region.

FORMAL SEED SYSTEM OPERATION

Formal plant breeding: The formal seed system has operated in Sudan since the early 1910s with work on cotton breeding at the Gezira Research Station. However, much of the plant breeding activity was carried out from 1970, focusing on staple crops such as sorghum, pearl millet, wheat, sesame, groundnut and sunflower; with little work on maize. Some of the research activities were supported by International Agricultural Research Centres such as the International Crops Research Institute for the Semi-Arid Tropics, International Sorghum and Millet, International Maize and Wheat Improvement Centre and International Centre for Agricultural Research in Dry Areas and development partners, particularly support from the United Nations Development Programme and FAO. Some of the notable varieties of crops currently being grown in Darfur are the result of the concerted research efforts from the 1970s through the 1990s. These include sorghum varieties such as '*Tabat*' and '*Wad Amed*', groundnut varieties such as '*Sodri*' and '*Ghubeish*', sesame varieties such as '*-promo*', and millet varieties such as '*Ashana*'.

Currently, plant-breeding programmes are conducted within the National Agricultural Research System, which comprises public research institutions, universities, and the private sector. The Agricultural Research Corporation is the largest public research institution in Sudan with 18 research stations covering most of the agro-ecological zones. Plant breeding has been grouped into eight programmes: cereal, oilseed, pasture and forage, food legumes, cotton research, horticultural crops,

fruit trees and the plant genetic resources programme. Very limited breeding work has been done by the University of Khartoum or the University of Gezira. The two major private sectors involved in plant breeding and agricultural research are the Kenana Sugar Corporation and the Arab Sudanese Seed Company Ltd (ASSCO). In Darfur, plant-breeding activities at research stations such as Nyala Agricultural Research Station (ARS) have been limited to evaluation of the introduced germplasm.

Formal seed production and supply: Rapid seed multiplication and dissemination of most varieties from the formal plant-breeding programme normally occur through the formal seed production structures. In Sudan, formal seed production activities are regulated and supervised by the National Seed Administration. Well over 200 seed companies are registered with the Administration. However, owing to the limited capacity of the administration, very few companies are considered as meeting the minimum standards. Between 2005 and 2008 about 10 000 tonnes (2 500 tonnes per year) of "certified" seed of various crop varieties were supplied to Darfur by humanitarian actors mostly in the form of emergency seed aid. These included six varieties of sorghum (38.9 percent); three varieties of millet (34.0 percent); three varieties of groundnut (16.6 percent); two varieties of sesame (6.8 percent); one variety of cowpea and wheat; and two varieties of maize, with each crop contributing about 1 percent of the volume of seed moved into Darfur. Therefore, operation of the formal seed sector, even in the form of aid, contributed significantly to the dissemination of improved or modern varieties in Darfur region.

Decentralized seed production and supply in Darfur: Decentralized seed production in Darfur is primarily in the form of a) a seed distribution-multiplication-recollection approach; b) a community-based seed multiplication and supply approach; c) a private sector seed multiplication and market supply approach; or d) an on-farm trial seed multiplication approach. In Darfur, decentralized seed production is being carried out in about 16 localities, of which nine are in South Darfur, five in North Darfur and only two in West Darfur. Of the nine organizations involved in supporting seed multiplication in Darfur, only two were from the private sector. The parent materials used for multiplication in 2010, for instance, were mainly certified seed of improved varieties of groundnut and sorghum. Over 80 percent of the multiplied millet varieties was of local origin. In 2010 alone approximately 998.4 tonnes of seed were produced from an estimated 1 615 *feddans* (678.3 ha) in Darfur. About 92.1 percent of the seed was produced in South Darfur, mainly from the two private companies (ASSCO and NCAS) working in collaboration with ARS in Nyala. At present, four seed cleaners are available and in operation in Darfur. However, complete seed processing, grading and packing units are lacking in the region.

SEED SECURITY SITUATION IN DARFUR

In Darfur, pearl millet is the most popular crop, and over 90 percent of farming households consider it to be one of their three major crops. This is followed by groundnuts (73.4 percent); sorghum (42.1 percent); okra (21.8 percent); and watermelon (13.7 percent). The other remaining crops are considered to be less important, favoured by fewer than 10 percent of the farming households. Millet and sorghum are the main staple food crops across Darfur region while groundnuts are normally considered a cash crop. Although pearl millet is the most widely grown crop, only 15 percent of farming households use improved varieties. However, it is impressive to note that the majority of farm households use improved varieties of groundnuts (73 percent) and sorghum (72.2 percent).

Seed source (availability and access): In Darfur, farming households obtain their seed from multiple sources including: their own saved seed, local grain/seed markets, social networks, seed aid from the Government and other humanitarian and development partners, local seed banks and agro-input dealers. In the 2010 planting season, over 75 percent of the seed sown by farmers came from local channels, including from farmers' own stocks (27.6 percent), the local market (44.1 percent), or through social networks (2.6 percent), demonstrating the importance of the informal seed system as the primary source for seed.

Quality of seed planted in 2010: Across all crops, 96 percent of farmers were pleased with the quality of seed they sowed, and this is evidenced both in their ratings and in their willingness to re-sow the seed in 2011. In general, 83 percent of the farmers rated the seed planted as good, with some 13 percent considering the seed as average, while only 4 percent considered it poor. Overall, 96 percent of the famers were willing to use the seed harvested from the 2010 main season in the subsequent planting season of 2011.

Change in the quantity of seed planted: In the 2010 main season, more than 60 percent of the farming households in Darfur planted the same quantity of seed or more, while 35.1 percent of the farming households planted less than normal. More farmers from West Darfur (53.13 percent) planted less than they normally plant, while 62.18 percent of the farmers from North and 82.72 percent of the farmers in South Darfur either planted the same or more. Significantly higher proportions (41 percent) of female-headed households planted less compared to male-headed households (32.2 percent). There are various reasons as to why farmers planted less in 2010 and 2011. In both North and South Darfur, the main reason for the reduced planting in 2010 was the shortage of seed (26.21 percent and 33.33 percent respectively), while in West Darfur, the main problem associated with planting less was lack of land (49.1 percent) followed by lack of money (11.9 percent) and lack of seed (9.7 percent). On the other hand, among those who planted more, improved access to seed was the main reason (21.19 percent). All these data indicate that even among the few farmers who planted less (35.1 percent), shortage and lack of seed of seed were not the only determining factors.

Access to new varieties: Over the last six years, farming households have been given access to new seed varieties primarily through humanitarian assistance, and the trend appears to be progressively increasing over time. Overall, over 85 percent of farmers in Darfur are growing varieties they obtained between 2007 and 2010. As in most traditional systems where famers typically use their own seed, about 80 percent of those who had access to new varieties were willing to continue using the same varieties for planting in the coming seasons. North Darfur had the lowest number (74 percent) of farmers who will replant the same variety next season, while West Darfur had the highest percentage (87 percent). Access to new varieties, particularly those that have been improved for high yields and disease resistance, is one of the elements that contribute to the overall productivity and food security of farming households.

Seed aid assistance: In most seed aid assistance programmes, the supporting institutions or organizations normally assume that seed is either not available within the target location or that part of the community lacks seeds of most staples owing to an emergency situation such as armed conflict. In Darfur, repeated seed assistance is being provided by development partners. Overall, 63.7 percent of the farming households in Darfur have received seed aid within the past five years, with significant variations within the three states. Nearly all (88.4 percent) of the farming households have received seed aid in West Darfur while 63.1 percent and 46.8 percent of the households interviewed received seed aid in North and South Darfur respectively. The majority (74.1 percent) of the farming households have received seed once or twice, although less than 5 percent have received aid between five and six times, mainly through direct distributions and minimally through vouchers and fair schemes.

Use of fertilizers and organic manures: In general, use of inorganic fertilizers and organic manure is still low in Darfur region with significant variation from state to state. On average, about 6.1 percent of the faming households have used inorganic fertilizers, though higher proportions (8.8 percent) of the households in West Darfur have applied inorganic fertilizers. A relatively higher proportion (15.7 percent) of the farming households have used organic manure compared to those using inorganic fertilizers. The four main reasons for why the majority of farmers are not using inorganic fertilizer are: a) unavailability; b) lack of knowledge; c) the feeling that its use is not necessary; and d) high expense of the product. For manure, the main reasons for its lack of use include: a) lack of technical know-how; b) perception that it is not necessary; and c) difficulty in obtaining the required quantities.

Grain/seed and agro-input trade: In Darfur, grain trade is well established and contributes significantly to the increasing availability, in particular, of millet, sorghum and groundnut seeds. The grain/seed market analysis showed that more than 90 percent of traders source their grain/seed from within Darfur states, an indication of having desirable varieties in the local market. Within the various markets visited, traders acknowledged that farmers sometimes buy grains for seed. Indeed, the individual farming household's data showed that 44.1 percent of the seed planted in 2010 came from the grain markets. The traders themselves have recognized the importance of doing some minimal grain/seed conditioning such as cleaning, shelling, grading and simple packaging to attract their customers. However, grain/seed trading in Darfur could easily be affected by factors such as conflict, drought and incidence of pest and disease. These factors normally reduce access to the seed source, thereby limiting availability on the market. The agro-input dealers are well established in the major towns of Darfur with some presence in the rural areas. They provide

a range of products, particularly vegetable seed, a limited quantity of sorghum and groundnut seed, agro-chemicals and fertilizers along with some tools and equipment. Operations of both the grain and agro-inputs dealers offer opportunities for alternative sources of seed to the farming communities in Darfur.

AGROPROCESSING AND AVAILABLE OPPORTUNITIES

Groundnut oil processing: The agroprocessing enterprises provide an avenue for value addition, which increases profitability and enhances competition of the products at national, regional and international levels. Groundnuts are one of the three major crops widely grown in Darfur both for food and income generation. There are a number of medium- to large-scale groundnut oil processing units in Darfur that offer reliable markets and opportunities for small-scale famers to either process or sell their products. A cost-benefit analysis showed an added value of 22.57 percent and 32.8 percent to a unit farm-gate value of groundnuts for medium- and large-scale oil processing, respectively. Most of the groundnut oil produced in Darfur is marketed within and to neighbouring states. Nearly 90 percent of the groundnut seed cake is sold to traders from outside Darfur. Some of the challenges involved in this activity include: a) a low level of groundnut production that prevents work at full capacity; b) a very limited volume of groundnuts; c) difficulty obtaining or lack of spare parts; and d) low oil output.

Opportunity for supporting livestock production: The availability of groundnut cakes offers an opportunity for supporting commercial poultry production within Darfur region. Currently more than 80 percent of the chicken and eggs sold in Darfur come from outside the region, particularly from Omdurman near Khartoum.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Multiple indicators relating to the access, availability and quality of seed in Darfur suggest that seed security overall is good and projected to remain so in the near future. The major channel through which farmers currently access their seed is the informal seed system, with some contribution from the formal seed sector within and outside Darfur. A significant percentage of farming households is growing improved varieties of crops such as groundnuts, sesame and sorghum, demonstrating the silent contribution of the formal seed sector in improving food security in Darfur. It is quite interesting to note that over the years through seed aid, the Government, humanitarian and development partners have contributed to the spread of improved seed varieties, moving significant quantities of improved varieties into the Darfur region. The contribution of the local grain/seed markets to improving seed availability is enormous and therefore the possibility of improving seed quality needs to be explored. The existence and operation of agro-input dealers is another element that has the potential to increase famers' access to quality seed of adopted crop and vegetable varieties.

The potential to stimulate agricultural development and demand for quality seed of cereal crops and oilseed is enormous and needs to be further explored, particularly through support to medium-scale oil processing and poultry production. The 'medium-' and 'large'-scale oil processing enterprises in Al Fashir are living examples of how support to agroprocessing and value addition can contribute to the economic employment of farming households in Darfur, thereby contributing to the national economy. In spite of the positive seed security situation and the potential to stimulate agricultural development, negative elements of insecurity, short and erratic rainfall, and other biotic factors could place Darfur at risk of sliding into acute seed insecurity. Therefore, these factors should be closely monitored and, if possible, mitigated to avoid any future backslide.

Recommendations

Research and development agenda: There is a well-established agricultural research system in Sudan catering to the different needs of the various agro-ecologies.

However, with respect to supporting the farming communities in Darfur, the following should be taken into consideration:

- A formal plant-breeding programme should be directed toward improving pearl millet using the available rich diversity of the local landraces. Germplasm collections of pearl millet varieties from Darfur need to be evaluated alongside the current varieties being grown. Emphasis could be placed on yield, resistance to drought and pests (particularly birds), as well as meeting the preference of consumers.
- Many people consider groundnuts and sesame as income crops in Darfur. An oilseed programme is needed to continue breeding groundnuts and sesame varieties with high oil content that are well adapted to the major groundnut and sesame-growing agro-ecologies in Darfur.
- Short-maturing crops such as cowpea and beans could be further tested and promoted to diversify the food basket of the farming households in Darfur.
- Plant-breeding activities should include the participation of farmers at the early stages of variety creation in order to ensure that varieties obtained are well adapted to farmers' needs.
- Extension programmes geared toward improving farmers' access to information on new varieties should be developed.

Decentralized seed production: In Darfur, access to basic or foundation seeds for multiplication is still very limited, forcing many of those involved in seed multiplication to use certified seeds of improved varieties produced mainly in the north (i.e. in Gezira and Khartoum). The introduction of seed cleaners in Darfur region is one step towards improving quality seed production in Darfur region. However, the following actions need to be further taken as part of the effort in supporting decentralized quality seed production:

- Deliberate efforts should be directed at establishing basic seed centres by the Government at the existing ARC in Darfur.
- Initiatives such as community-based multiplication should focus on multiplying crops in which the private sector has limited interest, if the main objective is to increase availability and access. Focus could therefore be directed at crops such as cowpea, sesame, okra and sweet potato on a revolving seed loan basis using the "seed bank" approach.
- In order to improve the sustainability of community-based seed multiplication approaches, seed grower groups should not be tied to humanitarian organizations as the major market for their seed. A market-oriented approach should therefore be promoted.
- Seed processing should further be upgraded by introduction of appropriate grading and packaging technologies. Options such as the use of super grain bags and small packs should be explored and tested by those supporting decentralized seed production activities.

Improved seed field inspection and certification: More importantly, the services of the Seed Administration should be extended to Darfur to provide technical support to the certification of various crop varieties being multiplied in Darfur.

Seed security issues at household level: The seed security situation at household level in Darfur could be described as normal with some level of vulnerability, particularly among women-headed households. Although fewer than 30 percent of the farming households normally use their own seed, the well-established grain trade provides an alternative source of seed whereby a significant proportion (44.1 percent) of households can still access seed of their choice. The presence of both agro-input dealers and seed growers provides an opportunity for alternative sources of seed, which are still under-accessed by vulnerable farming households. Though seed is generally available, vulnerable groups such as internally displaced persons, returnees and other needy segments of the community may not be able to access it, depending on their level of access to land, income, inputs and seasonal performance.

Seed security assessment: Any future seed aid assistance should be based on assessed needs identified using the most appropriate tool that will check and validate the issues related to availability, access and quality of seed.

Use of vouchers for improving access: In areas where there is need to provide pearl millet, sorghum, groundnuts or vegetable seeds to vulnerable populations, traders who provide acceptable conditioning of the grain for seed and agro-input dealers could be involved in making inputs available to target beneficiaries through voucher schemes possibly coupled with input trade fairs. However, this should only be carried out where beneficiaries are in close proximity to the grain traders and agro-input dealers. Proper quality verification will have to be put in place if this kind of arrangement is to be effective.

Input trade fairs: In situations where targeted beneficiaries have poor access to the grain/seed markets, grain traders, agro-inputs dealers and community-based seed groups could be mobilized to participate in input trade fairs where beneficiaries are provided with vouchers to access seed from the various sources. This system will also require the implementation of a solid quality control system.

Direct seed distribution should only be used in exceptional situations such as where there is total crop failure or massive displacement due to conflict. It should be implemented following an assessment of the seed needs of the affected population within a given geographical location.

Provision of agro-inputs to the markets: As a result of the sizable presence of agro-input dealers in Darfur, there is growing concern about the human and environmental risks of improper use of these inputs. Therefore, mechanisms that will allow access and proper use of inputs need to be put in place. The following actions are therefore recommended:

- **Baseline study on the use of agrochemicals:** To avoid the improper use and negative impact of agrochemicals and fertilizer on the environment, a baseline study needs to be conducted on the use and application of pesticides in Darfur region.
- **Sensitization and educating farmers on the use and dangers of pesticides and fertilizers:** A number of hazardous chemicals such as Carbaryl, phosphides, Malathion, Diazion and others are on the shelves of agro-input dealers. Some of these chemicals require proper handling and safe use by consumers to avoid any long-term residual effects on either consumers or the environment. Therefore, a concerted effort should be directed at sensitizing the population on the use and handling of these chemicals.
- **Training of agro-input dealers:** Training in the safe handling (transportation, storage, packaging and disposal) of agrochemicals on the market in Darfur should be provided to agro-input dealers.

Agroprocessing and other opportunities: Oil processing provides an unprecedented opportunity for income generation at household level as well as for support of the economy of Sudan, and that of Darfur in particular. Key areas that can be supported by the Government and other development partners in order to assist the farming communities include:

- **Medium-scale oil processing:** As demonstrated by the Cooperation Union for Al Fashir locality, medium-scale oil processing offers an opportunity for value-added production to poor farm households lacking cash. The Government and other development partners could offer support to the establishment of such oil processing units.
- **Poultry production:** The potential for poultry production in Darfur is enormous, particularly in and around the major towns. The by-product (cake) from the oil processing units and many cereals produced locally offer a good protein source for animal feed. Improved local modern poultry production (meat and eggs) can be supported. However, modern production would require a reliable supply of chicks for the interested entrepreneurs.

Other areas of intervention contributing to seed and food security: The crop-growing season is very short and sometimes erratic, placing the majority of households who depend on agriculture in a very vulnerable position.

- There is need for the food security and livelihoods partners to explore avenues for rainwater harvesting in support of crop and livestock (livelihood) production. This could be integrated with greenhouse technology for vegetable production.

I. Introduction

1.1 RATIONALE FOR SEED SYSTEM SECURITY ASSESSMENT (SSSA) IN DARFUR

Since the beginning of the Darfur conflict, the Food and Agriculture Organization of the United Nations (FAO) has been providing emergency improved seed aid to internally displaced persons (IDPs), returnees, and other vulnerable host communities in the region. On a yearly basis, FAO has been reaching over 100 000 vulnerable households with emergency seeds (approximately 1 000 tonnes) and assorted tools, mainly through seed and tool distribution packages. In addition, in recent years FAO introduced locally adapted crop varieties into the general seed and tool distribution. In 2008, FAO initiated a community-based seed production and supply scheme in order to increase availability, access, quality and timely delivery of locally produced improved seeds in Darfur. All these efforts are being exerted in close collaboration with the Government of Sudan, particularly the State Ministries of Agriculture (SMOA), Non-governmental Organizations (NGOs) and community-based organizations (CBOs).

The emergency seed aid kits together with other seed security interventions such as the community-based seed production and supply scheme are integral to FAO's efforts at ensuring seed and food security, as well as restoring the livelihoods of farming households in Northern Sudan. Over the years, the determination of seed aid needs in Northern Sudan has largely been based, implicitly or explicitly, on post-harvest assessments (PHAs) conducted by the SMOA in close collaboration with FAO, the Crop and Food Supply Assessment Missions (CFSAM) and other needs assessments. The PHAs normally review the results of the summer agricultural season in Darfur, estimating the total area cultivated and harvested and the yield of the major staple and cash crops. The CFSAM looks more specifically at the food security situation with a strong focus on cereal production in respect to supply and deficits. However, both the PHAs and the CFSAM have a limited scope in looking at seed security or the dynamics of the seed system. The food supply/deficit scenario normally leads the relief, rehabilitation and development partners in most cases to the conclusion that "seed is needed" within the areas of deficit food supply; however, this may be misleading in some instances.

In an effort to effectively determine whether there are issues of seed insecurity in the Darfur region, FAO undertook a comprehensive SSSA, which is expected to offer the opportunity to review the functioning of existing seed systems (both formal and informal) used by farmers. The SSSA has evaluated whether seed of adequate and preferred quality is available, and whether farmers are able to access it. The approach used promotes strategic thinking about the relief, recovery or development vision needed in future.

The overall objective of the SSSA was to improve the food security and livelihoods of vulnerable farming households in Darfur region by identifying strategies for addressing the continuum of acute and chronic seed insecurity problems. The assessment was also carried out to determine the benchmark for establishing an estimated overall seed demand for the Darfur states that can be used by the seed systems to plan for production and supply pipelines. Specifically, the assessment was carried out to:

- critically and constructively review past seed aid-related activity – this involved analysing the effects of diverse emergency/development response strategies and synthesizing a body of lessons learned;
- assess the current seed security situation among varied types of farmers and within a range of agro-ecological systems – the focus was on identifying the real and heightened needs and opportunities of farming households and farm communities across Darfur; and
- provide a comprehensive information base on which to ground immediate and medium-term action plans linked to promoting agricultural growth and seed security – the aim is to learn from the past, avoid duplication and create an ongoing information system that can inform planning and implementation work for diverse seed system initiatives.

1.2 INTRODUCTION TO THE SSSA

This section presents the necessary background to interpret the SSSA. It introduces the concept of seed security and the different types of seed aid approaches that might be matched to diverse seed security problems (and opportunities) encountered on the ground.

The concept of seed security

Farm families are seed secure when they have access to seed (and other planting materials) of adequate quantity, acceptable quality and in time for planting. Seed security is best framed within the broader context of food and livelihood security. Helping farmers to obtain the planting materials they need enables them to produce for their own consumption and sale.

Achieving seed security is quite different from attaining food security, despite their obvious links. One can have enough seed to sow a plot but lack sufficient food to eat, for example, during the "hungry season" prior to harvest. Conversely, a household can have adequate food but lack access to appropriate seeds for planting. Despite these important differences between food security and seed security, determinations of seed security are normally based, implicitly or explicitly, on food security assessments. This results from a lack of appreciation and understanding of seed security issues.

Seed security framework: the dimensions of seed security

The concept of seed security embodies several fundamental aspects. Differentiating among these is crucial for promoting those features that foster seed security as well as for anticipating the ways in which such security might be threatened. **Table 1.1** outlines the fundamental elements of seed security: seed has to be available, farmers must have the means to access it, and the seed quality must be sufficient to promote good production.

Table 1.1. **Fundamental elements of seed security**

Parameter	Seed security
Availability	Sufficient quantity of seed of appropriate crops is available within reasonable proximity and in time for planting.
Access	People have adequate income or other resources to purchase or barter for seed.
Quality	Seed is of acceptable quality: 'healthy' (physiological, analytical, and sanitary) adapted and farmer-acceptable varieties

Source: Remington et al., 2002.

Acute and chronic seed insecurity

Analysis of seed security requires consideration of the duration of the stress: whether it is "acute" or "chronic" (recognizing that the divisions are not absolute). Acute seed insecurity is brought on by distinct, short-lived events that often affect a broad range of the population. It may be spurred by failure to plant, loss of a harvest, or high pest infestation of seed in storage. While in normal times households may have various degrees of seed security, all may be affected by an acute event such as a flood.

Chronic seed insecurity is independent of an acute stress or disaster, although it may be exacerbated by one. It may be found among groups who have been marginalized in different ways: economically (i.e. due to poor, inadequate land or insufficient labour); ecologically (i.e. in areas of repeated drought and degraded land); or politically (in insecure areas, or on land with uncertain tenure arrangements). Chronically seed-insecure populations may have ongoing difficulties in acquiring off-farm seed due to lack of funds or they may routinely use low-quality seed and unwanted varieties. The result is households with built-in vulnerabilities.

Acute and chronic seed insecurity often coexist in emergency contexts. In cases where emergencies recur – in drought-prone areas, for example – acute problems are nearly always superimposed on chronic problems rooted in poverty.

Matching responses: refined analyses

Identification of a specific seed security constraint should lead to a targeted response. So, for example, if "seed availability" is assessed as the problem in the short-term, seed-based interventions, such as seed importation (for acute shocks) may be appropriate. (Seed availability problems rarely persist over the long-term.) In contrast, a diagnosis of a problem of "seed access" might wisely trigger a holistic analysis of livelihood strategies. In the acute phase, providing farmers with cash or vouchers to get their desired seed might be effective. However, the determination of access problems on a chronic basis should lead practitioners to look well beyond seed and seed security constraints. The inability to access certain necessary goods on a repeated basis is usually equated with problems of basic poverty. Initiatives to help farmers generate income and strengthen their livelihoods would be essential. Seed quality problems, whether they relate to concerns with the varieties or with seed health *per se*, are rarely short-term. Responses usually require significant development programmes linked to plant breeding or seed quality initiatives, depending on the specific constraint identified. **Table 1.2** provides a synopsis of seed security problems and appropriate responses.

Table 1.2. **Types of seed security problems and broadly appropriate responses**

Parameter	Acute response	Chronic response / development
Unavailability of seed	Direct seed distribution	Development of seed production enterprises; market development
Farmers do not have access to seed	Vouchers / cash / seed fairs	Income-generation activity; Agro-enterprise development (social welfare)
Seed of poor quality	Seed fairs with quality controls Direct distribution of test samples of quality seed	Programmes to improve seed quality Seed companies on-farm in local markets
Lack of appropriate varieties/crops	Limited introductions of new varieties	Introduce existing new varieties Participatory variety selection / breeding

Source: Adapted from Sperling, L. (2008).

Current major response options being used in emergencies

Various seed-related interventions are currently being implemented in emergency and chronic stress contexts in different parts of the world. Two broad categories can be distinguished: those that deliver direct forms of aid (and generally assume a "lack of seed") and those that are market-based and give recipients cash or vouchers to procure seed themselves (and hence assume "lack of access" as the driving need). Responses might also focus on seed quality issues, both varietal quality and analytical quality *per se* (health, germination rates and purity), although these tend to be medium- or longer-term interventions (**Table 1.3**).

Table 1.3. **Typology of current seed system interventions**

Approach	Rationale	Constraints to address
Direct seed aid		
1. Direct seed distribution Emergency seed provision "Seeds and tools"	Procurement of quality seed from outside the agro-ecological region for delivery to farmers: the most widely used approach to seed relief.	Short-term response to address problems of seed availability, especially in situations of crop failure and/or long-term displacement of farmers. Response sometimes also used as action to introduce new crops or varieties usually supplied by the formal sector.
2. Local procurement and distribution of seed	Procurement of quality seed from within the agro-ecological region for delivery to farmers: a variant of Approach 1.	Short-term response to address problems of seed access or highly localized problems of seed availability.
3. Food aid "Seed aid protection ration"	Food aid is often supplied along with seed aid during emergencies so that farmers do not need to consume the seed provided. Where local seed systems are functioning but the previous harvest was poor, food aid can help protect farmers' seed stocks.	Short-term response accompanying direct seed distribution to address problems of seed availability.
Market-based seed aid		
4. Vouchers / cash to farmers	Vouchers or cash can provide poorer farmers with the means to access available seed from local markets or the commercial sector. Vouchers or cash enables farmers to access crops and varieties of their choice.	Short-term response normally used to address problems of seed access, especially in situations of local seed shortages and local markets or farmer-farmer barter: can also be used to link farmers with agro-dealers.
5. Seed fairs	Seed fairs provide an ad hoc marketplace to facilitate access to seeds or specific crops and varieties from other farmers, traders and the formal sector. They are usually used with vouchers to provide poorer farmers with purchasing power.	Short- or medium-term response to address problems of seed access, especially for subsistence crops, and where local markets are normally used: increasingly used to give farmers access to new varieties as well.
Seed production and varietal development		
6. Community-based and local seed production	Farmers are trained and/or contracted to produce seed, often using formal seed standards. Some approaches focus on improving quality attributes, others are designed to move new improved varieties, while still others are conceived as basically income-generating enterprises.	Medium- or long-term response to address problems of seed quality (of local materials) or of access to, or availability of new varieties.
7. Provision or development of better varieties through small packets, varietal selection, or participatory plant breeding	Important where farmers need access to new genetic material.	Medium- or long-term response to address problems of seed quality (genetic/varietal attributes).

Source: Adapted from Sperling, L. (2008).

II. Materials and Method

Darfur SSSA was a collaborative effort among the various stakeholders; the Federal MOA, SMOA, FAO, NGOs/CBO development partners and the farming communities in Darfur. The following organizations were involved in the various stages of the assessment:

- Afag Organization for Peace and Development (AFAG);
- American Refugee Committee (ARC);
- *Cooperazione Internazionale* (COOPI);
- Catholic Relief Service (CRS);
- Darfur Development and Relief Agency (DARA);
- INTERSOS;
- Mobadroon Organization for Prevention of Disaster and War Impacts (MADAR);
- Relief International (RI);
- World Vision International (WV);
- MOA.

The methodology used is an application of the principles elaborated in the publication "When disaster strikes: a guide to assessing seed system security" (Sperling, 2008). The tools developed during the Seed System Security Assessment previously implemented in Southern Sudan, were extensively used.

A number of methods were used to collect information related to seed system security in Darfur, which included: a) review of the background information in the areas of plant breeding and the formal seed sector operations and development; b) primary data collection through individual household interviews; community interviews and focused group discussion; and interviews with the grain/seed traders and agro-input dealers (**Table 2.1**).

Table 2.1. **Methods used in the Darfur SSSA (May 2011)**

Method	Focus
Background information	Synthesis: • formal plant breeding • formal sector seed supply trends • seed multiplication and supply efforts
Interviews and discussions • Community interviews (N=9) • Women's focus groups	Issues: • agricultural overviews • variety use and trends • seed source strategies, by crop • women's crop/seed constraints/opportunities • livelihood/coping strategies
Key informant interviews • State government officials • Agro-input dealers Civil society project personnel Seed producers	Issues • agricultural overviews • input supplies and availability
Individual household interviews (N=725)	Seed and livelihood security issues: • seed source and volume • manure/fertilizer use • seed aid and new variety access
Seed/grain market analysis (N=99 traders)	Supply, availability and supply of grain/seed: • sourcing and volumes • quality management

2.1 SELECTION OF SITES

Most commonly used criteria for selecting sites for SSSA depend on factors most likely to affect seed security. Sites were chosen to simulate a fair representation of the Darfur region. Areas of assessment were selected to highlight different types of possible seed security scenarios tied to the following factors: a) agro-ecology/livelihood zones; b) intensity of crop production; c) security risks; d) environmental risks; e) border trade; and f) cropping systems. A total of 12 localities from the three Darfur states (**Table 2.2**) were purposely selected based on the considerations outlined above. Administrative units within the localities were selected based on minimal security risk as well as accessibility to the team.

Table 2.2. **Characteristics of the sites (localities) selected for SSSA**

State	Locality	Production intensity	Security risk	Cropping system	Environmental risk			Border trade
					Flood	Drought	PDW	
North Darfur	Alfashir	L	M	M/S	L	H	Hp	No
	Malet	L	M	M	L	H	Mp	Y/N
	Umkadada	L	L	G/M	L	L	Hw	No
	Kabkabia		H	So/M/G	M	L	Hp	No
South Darfur	Sheria	H	H	M/G	L	H	Hpw	N
	Salam	H	M	S/M/G	L	M	Hp	N
	Tulus	H	L	S/M/G	L	L	Hp	N
West Darfur	Zalingi	M	M	SM/G	H	L	Mpw	N
	Gashira	M	L	S/M/G	H	L	Mpw	N
	Mukjar	M	L	S/M/G	M	L	Hw	N
	Kulbus	M	H	M/G	L	M	Hp	Yes
	Habila	M	M	M/S/G	M	L	Hp	Yes

L=Low, M=Medium, H=High
M=Millet, So=Sorghum, G=Groundnut
P=Pest
D=Diseases
W=Weeds

Table 2.3. **Darfur SSSA assessment zones (May 2011)**

State	Locality	Characteristics of localities	Number of admin units	Sample size (number of households)	Implementing partners
North Darfur	Al Fashir	Agropastoral, low rainfall, millet	1	50	DARA/FAO/MOA
	Alliat	Agropastoral, average rainfall, cash crops	3	97	COOPI/SMOA
	Kabkabia	Agriculture, lowland horticulture	1	22	RI/SMOA/FAO
	Malet	Agropastoral, millet and livestock (sheep and camels)	2	100	DARA/FAO/MOA
	Subtotal		**7**	**269**	
South Darfur	Alsalam	Lowland horticulture area, mechanized and rainfed cropping	2	88	AFAG/SMOA/FAO
	Dimsu	Agropastoral with sandy soil, rainfed, groundnuts and millet, livestock (sheep)	1	28	
	Sheria	Agropastoral, cash crops, livestock (cattle)	2	82	WV/SMOA/FAO
	Tulus	Agropastoral *buta* (clay) soil, rainfed, sorghum, millet and groundnuts, livestock (cattle)	2	69	ARC/ARS/SMOA/FAO
	Subtotal		**7**	**267**	
West Darfur	Habila	Agropastoral with semi-sandy soil, staple crops and goats	1	45	INTERSOS/FAO/ SMOA
	Kereink	Lowland horticulture, staple and cash crops, cattle	1	50	CRS/FAO/SMOA
	Kulbus	Agro semi-pastoral, staple and cash crops, sheep and goats	1	43	CRS/FAO/SMOA
	Wadi Salih	Agropastoral, clay soil, staple and cash crops, cattle	1	51	MADAR/SMOA/FAO
	Subtotal		**4**	**189**	
	Grand Total		**19**	**725**	

2.2 COMMUNITY INTERVIEWS

At each of the selected sites, community interviews were conducted on the first day to obtain information on the agricultural system and practices including: crops grown both for food and income; crops and varieties gaining and losing popularity; sources of seeds and related constraints; and agro-enterprise initiatives within the community.

2.3 HOUSEHOLD SURVEYS

Within the assessment sites (localities) a total of 724 households were sampled and interviewed using a structured questionnaire. Sampling was done in an unbiased manner. Depending on the location, the team had to quickly obtain an overall settlement pattern and population density. The enumerators then moved in a radian pattern from the central point, sampling every third or sixth household depending on the population density of the settlement. The general characteristics of the households interviewed are as shown in **Table 2.4**.

Table 2.4. **Characteristics of the households interviewed in Darfur**

		North Darfur	South Darfur	West Darfur	Grand total / average
Household size (number)	Average household size	7.4	9.3	7.4	8.1
	Female	3.8	4.6	3.8	4.1
	Male	3.7	4.8	3.6	4.1
	Sample size (N)	269	263	189	721
Head of household (%)	Male	50.6%	92.1%	57.1%	66.6%
	Female	49.4%	7.9%	42.9%	32.4%
	Sample size (N)	269	267	189	725
Household type (%)	Resident	95.9%	83.5%	60.3%	79.90%
	IDP	0.4%	13.9%	33.9%	16.07%
	Permanent Returnee	1.5%	2.6%	4.8%	2.9%
	Spontaneous Returnee	2.2%	0.0%	1.1%	1.1%
	Sample size (N)	268	266	189	723
Major livelihood characteristics (%)	Crop producer	75.7%	84.0%	82.0%	80.57%
	Agropastoralist	23.6%	16.0%	18.0%	19.20%
	Pastoralist	0.7%	0.0%	0.0%	0.23%
	Sample size (N)	267	243	189	699
Farm size (%)	>3 *mukamas**	90.0%	72.2%	41.8%	68%
	1-3 *mukamas*	9.7%	18.4%	54.5%	27.53%
	<1 *mukama*	0.4%	9.4%	3.7%	4.5%
	Sample size (N)	269	266	189	724

*One mukama is an area of land equal to 6 300 m^2 (0.63 ha).

2.4 DECENTRALIZED SEED MULTIPLICATION

A questionnaire was used for collecting data and information on seed multiplication inventory. A number of organizations were identified, including NGOs, Government members of the food security and livelihoods fora in the three Darfur states, plus some private sectors that are involved in seed multiplication and seed distribution activities. The identified organizations were then interviewed to collect seed multiplication data and information.

2.5 GRAIN/SEED MARKET ANALYSIS

The SSSA team sought to gain insight into the role being played by grain traders in Darfur region as far as the supply of various grains/seeds is concerned. Within the assessment zone, accessible grain markets were visited and individual traders were randomly selected and interviewed using a structured questionnaire. A total of 99 traders were interviewed from nine markets across the three Darfur states (**Table 2.5**).

Table 2.5. **Markets from which the traders were interviewed**

State	Villages	Number of traders interviewed
North Darfur		
	Kurgal	25
	Malet	5
	Subtotal	**30**
South Darfur		
	Abu ajazo	12
	Dimso	5
	Mershing	9
	Nitaga	4
	Tullus	6
	Subtotal	**36**
West Darfur		
	Garsila	6
	Geneina	7
	Habila	6
	Kernic	8
	Kulbus	6
	Subtotal	33
Grand total		**99**

2.6 AGRO-INPUT SUPPLIES

The assessment of agro-input supply was carried out by conducting individual interviews with agro-input dealers within the major towns using semi-structured questionnaires. A total of 12 agro-input dealers (three in Nyala, four in Al Fashir and five in Kabkabia) were visited and interviewed.

III. The Sudan Sectoral Context

3.1 POLITICAL SOCIO-ECONOMIC SITUATION IN SUDAN AND DARFUR

3.1.1 Conflict in Sudan and Darfur

Since the signing of the Darfur Peace Agreement in May 2006, the security situation in Darfur has not significantly improved. The crisis in Darfur has been attributed to a complex combination of decades of economic marginalization, prolonged drought and desertification, and limited resources. Today more than 21.9 million people in Darfur depend on humanitarian assistance for survival (Sudan Humanitarian Work Plan, 2010). Women are particularly vulnerable as they face limited income-generation options and other social problems. Some 1.9 million people, a quarter of the region's population, are displaced and heavily reliant on aid agencies for their survival; a similar number of Darfurians remain in villages facing continuous threats with the uncertainty as to when the conflict will end.

The ongoing conflict and protracted humanitarian situation in Darfur continues to have severe consequences for human development as well as environmental degradation. The Darfur population has experienced erosion of their livelihoods strategies due to prolonged asset stripping, production and market failures, restricted natural resources, failed remittance transmission and inadequate basic social services. The conflict has led to weakened traditional conflict-resolution mechanisms and every type of sustainable livelihood strategy, significantly disrupting the social and economic balance of the region.

The food security and nutrition status of the population remains fragile in the face of disrupted livelihoods and limited alternative opportunities, and millions depend on humanitarian assistance.

In addition to the precarious security problem, the lack of continuity in the provision of adequate agricultural inputs, market networks and viable extension services has exposed the people to dependence on opportunistic cultivation and traditional agricultural practices. Moreover, the frequent occurrences of drought, shortage of rain and climate change have affected both the rainfed *wadi* (seasonal gully) agriculture and livestock production.

Conflict in Darfur has put intense pressure on the environment around refugee camps in the region as IDPs have depleted vegetation and other forest products around their camps. In some locations where nearby sources have been depleted, women and children have to travel a long distance from the camps for firewood, exposing themselves to attack and abuse. In other camps IDPs have resorted to using tree roots, eliminating any chance for natural regeneration.

3.1.2 The economy of Sudan

The Sudanese economy has been slow to develop owing to persistent civil wars over the last three decades. However, the nation has achieved considerable economic growth over the past few years as a result of the Government's efforts to implement macroeconomic reforms in association with the International Monetary Fund[1].

According to the 2011 African economic outlook[2], Sudan's economy picked up slightly in 2010 to grow by 5 percent, after a 4.5 percent growth in 2009, but this was one percentage point lower than expected. The economy is projected to grow by 5.1 percent in 2011 and then 5.3 percent in 2012, largely due to increased oil production and sustained gains in the non-oil sector. The non-oil sector remains buoyant and should underpin economic growth in the medium term through

1 Sudan Economy, Economy Watch (available at http://www.economywatch.com/world_economy/sudan)

2 Overview of Sudan, African Economic Outlook (available at http://www.africaneconomicoutlook.org/en/countries/east-africa/sudan)

the continued revival of agriculture and increased investment in infrastructure, especially roads, electricity and manufacturing.

The challenge ahead for the authorities is to ensure macroeconomic stability and sustainability of internal and external balances by controlling the fiscal deficit, rebuilding foreign reserves and maintaining low inflation. As a result of increased public investment in infrastructure, the national road network and electricity generation have improved in Sudan, but many parts of the country, particularly conflict areas in Darfur, South Kordofan and Abyei, suffer from a severe infrastructure deficit – even by national standards. Poor infrastructure means higher production costs and constrains opportunities for broad-based non-oil growth. At the same time, the authorities face tremendous challenges in providing public services, particularly education and clean water, to these areas, due to financial constraints and insecurity in some cases. Sudan has had limited access to external financing from donors and multilateral financial institutions over the last two decades. It remains among the most heavily indebted and least developed countries, with no signs of qualifying for debt relief on the horizon. Sudan has increased its ties with emerging country partners, which offers the possibility of resource-backed loans for infrastructure and public service projects as well as private sector development.

Sudan continues to strengthen links with key emerging country partners, especially China, Malaysia and India following the attraction of substantial "resource-seeking" by these countries from the late 1990s. The recent division of the country poses unprecedented challenges. The demarcation of the border presents major risks given the presence of several active conflict zones. Despite progress in some areas of social development, the challenge of reducing poverty and achieving other Millennium Development Goals remains formidable, with a real per capita income growth rate of about 3 percent in 2010 and skewed income distribution across regions and social groups.

Until the time of secession of South Sudan from the North in early 2010, the oil sector, which was the main driver of growth over the last decade, was hit by lower oil prices. Agriculture grew by only 2.5 percent on average over the past decade and there is room for improvement. The Government of National Unity set up to implement the 2005 peace accord between the North and South extended the Green Mobilization Program, originally scheduled to end in 2011, for an additional year. The plan focuses on the rehabilitation of agricultural infrastructure and attracting new investors, local and foreign, by removing structural distortions and rigidities, liberalizing the labour market and improving the legal system through, among other measures, reforming property rights and the land tenure system.

In 2010, agriculture accounted for 31.2 percent of Gross Domestic Product (GDP) and this is projected to increase to 32.3 percent in 2011. Growth in the agriculture sector was 4.5 percent in 2010, thanks to increased investment, higher exports and good rainfall. The continuation of the Green Mobilization Programme through 2012 is projected to boost agriculture sector growth to more than 5 percent in 2011 and 2012. In order to diversify away from oil, the authorities have boosted agribusiness by opening up the export of sorghum and wheat to the United Arab Emirates and Saudi Arabia, and by offering concessionary interest rates to support agricultural exports.

Manufacturing accounted for 10 percent of GDP in 2010 as sector growth slowed to 7.5 percent from 7.9 percent in 2009, reflecting the continuing impact of the global financial crisis and fierce competition from cheap imports. The revival of manufacturing activities is critical for non-oil growth. A boost to agriculture should in turn boost manufacturing through the increased supply of cheap raw materials and by encouraging the processing of agricultural products for export. Policy needs to focus on practical strategies to fully benefit from the incentives offered by China for Sudan's non-oil exports. Processing of high value agricultural products for the Chinese market holds great potential.

Domestic consumption contributed an estimated 5.9 percentage points to GDP growth in 2010 but this is projected to fall sharply to 3.2 percentage points this year before rising to 4.4 percentage points in 2012, with public consumption down sharply as private consumption rises. Public spending on infrastructure, and the presidential and parliamentary elections in April 2010 boosted public consumption and investment during the year. Public investment in infrastructure, especially electricity and roads, is expected to continue in 2011. Funding problems and the political uncertainties arising from the country's division in July pose a serious challenge. The external sector was a significant drag on growth in 2010, at a negative 2.9 percentage points as imports continued to grow while

exports contracted. Exports are projected to contribute 1.3 percentage points to GDP growth this year but imports will still subtract 2.2 percentage points and another 1.8 percentage points in 2012.

According to the United Nations Development Programme (UNDP) country profile of human development indicators for Sudan, between 1980 and 2010 Sudan's Human Development Index (HDI), rose by 1.4 percent annually from 0.250 to 0.379, which gives the country a rank of 154 out of 169 countries with comparable data. The HDI of Arab States as a region increased from 0.398 in 1980 to 0.590 in 2010, placing Sudan below the regional average. The HDI trends highlight the very large gaps in well-being and opportunity that continue to divide our interconnected world.

Life expectancy in Sudan fell slightly in recent years but has since recovered to around 55 years – one of the lowest levels in the world. In 2010, some 46.5 percent of the Sudanese population were estimated to live below the national poverty line. The gross enrolment rate in primary education increased from 65 percent in 2004 to 71 percent in 2009 in Sudan. The literacy rate for those aged 15–24 years increased from 27 percent in 1990 to 72.5 percent in 2010. However, only one in five Sudanese children completed primary school in 2010.

The Ministry of Labour estimated the workforce to total 12.2 million in 2010 and the employment rate for the age group 14–64 to be at 51.4 percent. Male and female participation rates were estimated at 74.9 and 30 percent, respectively. The workplace is sharply divided between a small number of formal sector wage earners and a large and highly mobile sector comprising self-employed, seasonal and casual workers. For 2010, the Ministry estimated the national employment rate at 84.2 percent. Medium- and large-sized industries remain the main creators of employment opportunities in Sudan.

The authorities face numerous challenges in reducing poverty, implementing the numerous peace agreements, and pursuing disarmament and decentralization. Infrastructure projects and services are concentrated in Khartoum and a few surrounding states, with social indicators showing very marked differences between them and remote areas. The unequal distribution of resources and services is a source of grievance that drives Sudan's many conflicts and adversely affects investment and development. To address these issues, political power and economic resources will have to be shared more fairly.

3.1.3 Health and nutrition

The prevalence of undernutrition in Sudan is among the highest in the world. According to national estimates, 31 percent of children under five are underweight, 14.8 percent are wasted and 32.5 percent are stunted. These estimates mask significant subnational and seasonal variations. Prevalence of moderate underweight children is estimated at 38.4 percent in Kassala, 39.6 percent in North Darfur, and 19 percent in Red Sea state. In Eastern Sudan, wasting among children ranged from 19.7 to 30.8 percent among different localities in the region. Localized surveys on micronutrient status report night blindness due to vitamin A deficiency from less than 1 to 4.8 percent. Undernutrition not only increases vulnerability to disease and death, it also undermines learning capacity and productivity, thereby locking vulnerable households in a cycle of destitution and undermining sustainable livelihoods.

Key factors contributing to increasing malnutrition and micronutrient deficiencies among children are poor intake of nutritionally balanced diets, chronic household food insecurity, infectious diseases, poor health services and inadequate sanitation. The 2009 Sudan Household Survey observed that low community awareness and poor healthcare-seeking behaviours by communities aggravate a situation characterized by extremely high rates of maternal and child mortality.

3.1.4 Food security

Despite the general favourable food availability and food access prospects and the overall improvement in food security in Sudan, food security is expected to be affected by the withdrawal of subsidies from fuel and wheat flour and the introduction of new taxes and custom duties on wheat flour, sugar and fuel announced by the Government in January 2011 in an attempt to reduce the expected 2011 budget deficit. The immediate impact of these policies has been a sharp increase in retail prices of essential food commodities (e.g. sugar, wheat flour and oil), fuel and transport by 20 to 30 percent compared to December 2010. This poses a significant threat to the food security of poor households in rural and urban areas, Government employees in main urban areas, IDPs, and conflict-affected households that normally rely on market purchase. Government employees are

receiving additional funds (SDG 100) per month to cope with price increases, but this is insufficient to fully mitigate the price shock.

The food security and livelihood situation for the vast majority of rural households in Darfur is undermined by a number of factors including chronic poverty, constrained agricultural production, limited economic opportunities, prolonged disruption and loss of economic activities, and reduced livestock production and productivity. High prices for food commodities have left an estimated 76 percent of the resource-limited rural population at risk of serious food insecurity and have reduced prospects for survival. The majority of resource-poor farmers are producing food below their subsistence requirements. As such, social, political, economic and environmental factors are inextricably connected as a source of vulnerability and undernutrition among affected populations. As a result, the population in Darfur is facing chronic and acute food insecurity, increased poverty levels and livelihood vulnerability. The key underlying factors contributing to the chronic vulnerability situation are:

- insecurity;
- dwindling agricultural production;
- reduced livestock production and productivity;
- recurrent natural disasters, particularly floods and droughts;
- land tenure/use issues;
- limited economic opportunities;
- institutional factors; and
- high number of IDPs.

3.2 AGRICULTURE OVERVIEW

3.2.1 Importance of agriculture to the economy of Sudan and Darfur

Agriculture is one of the main sources of livelihoods in Sudan for over 70 percent of the working population. Crop cultivation is divided between a modern, market-oriented sector comprising mechanized, large-scale irrigated and rainfed farming, and small-scale farming using traditional cultivation practices in areas where rainfall or other water sources are more limited.

The economy of Darfur is largely agrarian. Its main consumption crops are millet, followed by sorghum. Groundnuts, tobacco, vegetables, and watermelons are the main cash crops. Before the conflict in Darfur, the main household food sources were localized subsistence agricultural production, livestock and market purchases.

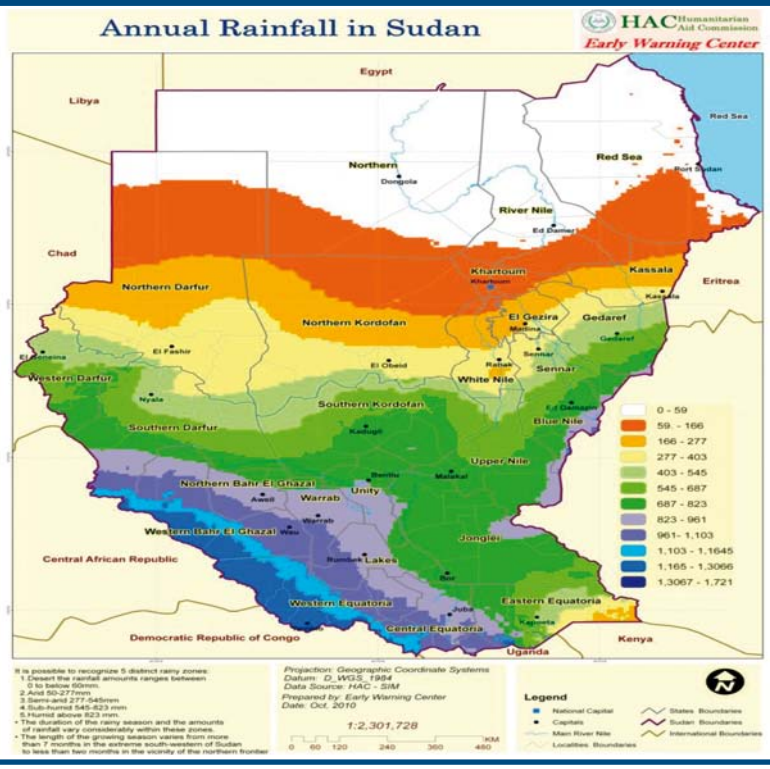
Large investments were made in the 1980s in mechanized, irrigated and rainfed cultivation, with their combined areas accounting for roughly two-thirds of Sudan's cultivated land. The early emphasis on cotton growing on irrigated land decreased with a rise in the production of groundnuts, wheat, sugarcane and sesame. Rainfed mechanized farming continued to produce mostly sorghum. Subsistence cultivators produced sorghum as their staple crop, although in the northerly rainfed, cultivated areas millet was the principal staple. Subsistence farmers also grew groundnuts and sesame.

Although Sudan lies within the tropics, the climate ranges from arid in the north to tropical wet-and-dry in the far southwest. Temperatures do not vary greatly with the season at any location. The most significant climatic variables are rainfall and the length of the dry season. Variations in the length of the dry season depend on the presence of either dry northeasterly winds or moist southwesterly winds.

The sandy soils in the semiarid areas south of the desert in North Kordofan and North Darfur states support vegetation used for grazing. In the southern part of these states and the western part of South Darfur are the *qoz* sands. Livestock keeping is the major activity in this area, but a significant amount of crop cultivation, mainly of millet, groundnuts and sesame is also practiced.

3.2.2 Natural livelihoods zones/livelihoods zones

Figure 3.1. **Annual rainfall in Sudan May 2011**



The livelihoods of the people in the region mainly depend on agriculture (crop production) and livestock keeping. Food insecurity is related to the following major factors: displacements, inadequate agricultural inputs, prolonged dry spells and uneven rainfall distribution, uncontrolled crop pests, insufficient agriculture extension services, conflict between farmers and pastoralists around migratory routes and limited grazing land. In addition, frequent clashes between armed factions prevent the farmers from accessing their agricultural lands and prohibit movement of their livestock for grazing.

According to livelihoods zoning information produced by the Famine Early Warning Systems Netowork together with Government and other stakeholders in May 2011, rainfall distribution in Sudan defined the livelihoods of the population in various parts of the country as indicated in **Figure 3.1**.

The rainfall bands in the map presented here show a gradation in mean annual rainfall from not much more than 0 mm in the semi-desert areas to above 1 000 mm in Blue Nile and South Darfur states.

Darfur states: In the most general terms, it can be said that the red band is home to pastoralists, as the rainfall will not support any kind of crop but allows enough pasture and watering points for livestock herding. The deep yellow band with rainfall up to slightly less than 300 mm is the home of agropastoralists who are usually able to grow millet, especially towards the south of the band, but rely very heavily on livestock production to guarantee their survival. It is in this sense that the term "agropastoral" is used, namely that the pastoral is at least as fundamental to household economy as the agricultural. The pastoral band is split in two, with the eastern part (SD03) dominated by the Red Sea hills ecology, where only goats and sheep can be produced in any numbers, while in the west and central pastoral areas (SD04), camels and even some cattle are also herded. The agropastoral band is also divided essentially between western millet-based zones (SD12-14, SD18) and an eastern sorghum zone (SD07), the difference resulting mainly from sandy and clay-based soils respectively.

Various factors interrupt the broad bands and result in the insertion of other livelihoods zones, the most obvious factor being the presence of surface water, whether in the form of rivers or springs issuing from underground aquifers. Zones distinguished by such water sources are all located in the eastern half of the country; both irrigated and flood recession cultivation on any scale are an eastern phenomenon, while the western half essentially has only rainfed crop production in addition to rainfed pastures.

Pastoral and agropastoral zones support only sparse rural human populations, although the value of their production to the national economy – the livestock marketed and sometimes exported – is great. Apart from the denser populations of the irrigated and flood-retreat zones, the great majority of rural North Sudanese live south of the agropastoral band in rainfed, agriculturally-based local economies with varied attributes in livestock. The biggest zone is the southeast rainfed semi-mechanized agriculture area (SD10) that today represents the modernizing face of Sudanese rainfed agriculture with improved irrigation schemes for crop production. The "semi" in "semi-mechanized" refers to two factors. First, on the vast, privately-owned commercial farms the ploughing is mechanized, but the rest of the work, from weeding to harvesting, is done by hand – essentially by paid labour, although there has been a growing usage of machinery for harvest and herbicides in recent years. Secondly, on the land between the schemes, half the resident population still practices traditional rainfed cultivation on smallholdings, with ox plough- or hand hoe-based tilling. Members of many of these households also earn money working on the commercial farms.

Together, the irrigated and rainfed semi-mechanized zones produce the vast bulk of the marketed grain surplus in the country (largely sorghum), as well as nearly all of the cotton and most of the sesame. By contrast, the ordinary western and central rainfed agriculture (Darfur/Kordofan) is usually at a subsistence level at best in terms of whole zones, and several zones are net importers of grain from the east, especially in the frequent years of poor local rainfall and production. Still, there is considerable variation among the zones in their relative dependence on crops or livestock, or on niche products. The best grain producer is the extensive rainfed sorghum belt (SD11), with its relatively high and trustworthy rainfall and its clay-based soils. But various factors have prevented it from rising above self-sufficiency to be a grain basket for the west; investment in improved agricultural production has been critically hampered by relative isolation owing to distance and poor roads from the main commercial centres of the country, and by conflict along the border with South Sudan.

Most of the remaining zones show variations on the agropastoral theme; apart from the ubiquitous cattle and small stock, these zones produce millet (SD13); groundnuts and millet (SD12); sesame and millet (SD14); and gum arabic and millet (SD18). One zone – cattle dominant agropastoral (SD19) – is defined by its particular population of transhumant Baggara (cattle) herders, whose year is roughly divided into two equal periods: the time when they are all in their home area engaged in rainy-season grazing and cultivating millet and sorghum, and the time when almost every household, in part or as a whole unit, moves south to dry-season grazing areas along the frontier with South Sudan. Finally, there is the phenomenon of the elevated area, Jebel Marra ("the Marra Mountain"), sitting on the intersection of North, South and West Darfur and resulting in three niche areas. One is the highland cultivation zone (SD15), from which onions and fruits are traded as far as Khartoum.

The second is the drainage area around much of the foot of the mountain characterized by a series of extensive *wadis* (seasonal water courses) (SD16) that allow households to add valuable market garden crops such as onion, garlic, potatoes, sugarcane, legumes and tomatoes to their production of staple millet and sorghum. Lastly there is a zone fanning out east from the foot of the mountain, where alluvial, moisture-retaining soils favour tobacco as the overwhelmingly dominant crop (SD17). This is a niche area with its own internal economy of tobacco seedling sales, leaf curing and bulk packaging before final export to the rest of Sudan for final processing and retailing. It is possible that this particular zone, the only source of tobacco in the country, benefited from the experimental cultivation long ago by a single migrant from Egypt. But the niche area par excellence lies at the opposite end of the country.

The people of the Eastern Pastoral zone (SD03) inhabit one of the harshest environments in the country and face a combination of frequent, acute rain failure that threatens the health and/or survival of their goats and sheep; they heavily depend upon marketing their livestock to be able to purchase grain as well as all other necessities. The Western and Central Agropastoral zone (SD04) is chronically food insecure because people generally have less livestock and less mobility with

them than the neighbouring pastoralists, and also have poor and climatically risky crop-production conditions. In other words, this is a critically constrained and imbalanced agropastoralism. This zone almost surrounds the third zone, the North Darfur Tobacco zone (SD17), where the valuable tobacco crop is frequently and acutely diminished by rain failure, but tobacco is what people almost exclusively 'do', so that poorer people without significant savings or assets in livestock find themselves unable to obtain the cash to buy enough food, especially if one poor season follows another.

In sum, the great majority of Sudan's rural population, despite the enormous differences in the rainfall, ecology, natural resources and general wealth of their respective zones, manage to be food secure and, what is almost synonymous, livelihood secure. Poorer people in common suffer hardships and low material standards of life; but it is only in a minority of zones (SD03, SD04, SD17) that people are threatened by the potentially lethal combination of basic poverty and acute failures of production or other income. These are the zones to be distinguished, closely monitored and responded to rapidly when early warning puts up the signals.

3.2.3 Darfur crop production overview

Darfur's location in the transitional zone between the Sahelian and the desert zones means that its natural resource base is fragile, especially in its northern areas, and this exposes it to environmental and production hazards. There is a single rainy season (mostly July–September), during which rainfall variability is more important in relation to food production than the total amount of rainfall. The Darfur region lies on the edge of a desert and suffers from a general paucity of resources, coupled with highly uneven availability of those resources that do exist. The region has low and variable annual rainfall, ranging from less than 50 mm in the northern desert to approximately 200 mm around Al Fashir and from 300–500 mm in Geneina and Nyala to 800 mm or more in the south and in Jebel Marra. Rainfall has decreased in recent decades, and dry years are more frequent. Long-term averages indicate that it rains four months of the year, with a large variation in the availability of water between the wet and dry seasons. Shortages are exacerbated by the limited capacities for water storage, a factor due to the complex geology that underlies most of the more populous parts of Darfur.

Agricultural production in Darfur is predominantly subsistence and highly dependent on rainfall. The rains are short, erratic and at times heavy and storm-driven. This means that drainage is entirely different from that of more temperate areas. *Wadis* only flow for part of the year, and in some cases for only a few days or even hours after rains carrying heavy loads of silt. The irregular nature of the *wadis*' flow means that water storage for irrigation is rarely practical.

Over 80 percent of the population in Darfur states depend on agriculture and livestock as their main source of food and income. The farming systems in the area are predominantly rainfed and traditional subsistence agriculture operating with very limited resources. However, crop production is hindered by a number of problems, including drought. The Darfur agriculture sector faces major challenges that include limited water resources, rainfall variability, declining soil fertility, climatic shocks, high levels of pest infestation, use of poor quality seeds, unstable product prices, and conflicts over land and other natural resources. Among these factors, the prevailing insecurity and conflict add an extra dimension to the livelihoods system in Darfur. The unfavourable climatic conditions and associated challenges for crop and livestock production worsen food insecurity in Darfur, stretching the limits of vulnerable communities' coping mechanisms. The current low levels of productivity are further exacerbating the food security status of affected communities in Darfur.

Darfur has five main rural production systems across the region, with local variants[3]. The five categories of rural production system in Darfur are as follows:

1) ***Goz/wadi* farming in North Darfur:** The staple crop is millet planted on large areas of sandy *goz* soil, as well as on smaller areas of alluvial *wadi* soils. Households grow part of their annual consumption requirements. Watermelon is the main intercrop, which provides useful cash income. *Goz* soils predominate in the northeast, while in Kabkabia alluvial soils are common. Livestock has traditionally been part of this production system, with camels, sheep, cattle and goats all owned in small numbers by farming households.

2) ***Goz/wadi* farming in South Darfur:** This follows the same pattern as in the north except, because of higher rainfall, there are higher and more stable yields and more varied crops. In the past, the practice of shifting cultivation with movement of residence was common. However, local population growth and immigration from North Darfur has led to continued cultivation of the same area. Millet is the dominant crop, while minor crops include sorghum and groundnuts (an important cash crop). On alluvial soils millet is less widespread. Gum arabic has remained a resource for about one in three households. Livestock production is important, especially of cattle and goats.

3) **Jebel Marra mixed farming:** The high altitude of Jebel Marra has an effect on its rainfall, which averages 450–500 mm per year. As a result, the area produces a grain surplus, except for particularly dry years. Farmers have a mixed agricultural economy, with extensive millet and sorghum cultivation at lower altitudes combined with irrigated citrus cultivation on the Jebel itself. Groundnuts and wheat are also grown, and there are vegetable gardens in the valleys (onion, chillies and okra). Livestock is widely owned, although ownership is precarious because of civil disturbance. Terracing and the concentration of water runoff, as well as some permanent streams, allow simple irrigation to be carried out.

4) **Camel, sheep and goat pastoralists:** Camel, sheep and goat pastoralists (5.7 percent) are concentrated mainly in North Darfur with the Zaghawa tribe in the northwest and the Meidob in the northeast. The famine of the 1980s caused much greater livestock losses in North Darfur than in South Darfur.

5) **Cattle pastoralists:** Cattle pastoralism is common in South Darfur (8.6 percent), and was previously significantly nomadic, practiced mainly by Arab Rizeigat groups. Small stock (i.e. sheep and goats) is also raised in South Darfur. Cattle pastoralists in South Darfur used to migrate long distances, trekking north with the rains from the Bahr el Arab River to wet-season pastures and cultivation areas, followed by a return some months later to dry-season wells and pastures along the Bahr. Widely and increasingly, cattle pastoralists also cultivate crops (millet, sorghum, groundnuts and okra). A significant number of herders are hired in the pastoral system, which becomes a livelihood strategy in itself.

South Darfur state constitutes the main agricultural production region in Darfur followed by North Darfur and West Darfur. In the 2010 summer season, a total of 6 431 430 ha was cultivated with cereals, oil and cash crops in the three states of Darfur. Of these, a total of 4 622 374 ha was cultivated in South Darfur (72 percent), 994 377 ha (15 percent) in North Darfur and 814 679 ha (13 percent) in West Darfur. South Darfur state is the main source of crops and other agricultural products and it supports other neighbouring states. The region also practices traditional agriculture, producing crops such as corn, horse beans, roselle and sesame. These are cultivated during the rainy season as well as winter crops such as fruits and vegetables, and all are cultivated around valleys.

Crops grown:
A range of crops are grown in Darfur with some significance attached to them depending on the agro-ecologies or livelihood zones. The farming zones in Darfur may be divided into two major areas: the north and west and the south and east, referred to as north/west and south/east, respectively. In the first area, alluvial soils along the *wadis* of the basement zone are the most important source of cropland. The volcanic soil of Jebel Marra massif is also important. In the second area, most of the cropland is on the large area of windblown sand sheet called *goz*. The *athmur*, sandy dunes that are found in the middle of the alluvial areas, are also farmed.

Three factors determine the way a Darfuri farmer manages his crops: ease of cultivation, soil fertility and access to water. Ease of cultivation matters because farmers who only have hand tools

3 Swift J, Gray J. 1989. *Report on Darfur Region Food Security Policy and Planning.* Darfur Regional Government, Republic of Sudan (under assignment from ODA) (mimeo).

cannot manage heavy or hard soils, even though they are usually more fertile. The light *goz* sands, which are the most easy to hoe, are infertile but the yield difference between light and heavy soils is not always as high as expected, and ease of cultivation more than compensates.

The division between north/west and south/east reflects the influence of all three factors. The north/west group is more varied but fertile soils are available. Some soils are too heavy to work but others are well suited to traditional hand cultivation, especially along the *wadi* valleys where the best alluvial soils are found. In contrast, the soils in the south/east are either light but infertile sands (*goz* and *athmur*) or compacted soils (*naggaa*), which can be more fertile but are impossible to cultivate without tractors.

Crop farming is the main economic activity for more than 80 percent of Darfur's population. The cultivation of millet, sorghum and other cash crops (groundnuts, sesame, etc.) is essential for the country's food supply and economy. Millet is the staple food for more than 75 percent of the population and is cultivated throughout Darfur, especially in the sandy and clay soils that could be exploited easily by manual labour. In turn, sorghum is the staple food for the population in the west and the south of the region. It is cultivated in the *wadi* beds, light clay (gardud) soils. The cultivation of these crops has continued for hundreds of years in Darfur; their productivity depends upon the rainfall and the fertility of the land.

In turn, the demand for agricultural crops has increased in tandem with the increase in population. However, productivity and production of the rain-fed crops declined due to the decline of the rainfall in quantity, distribution and intensity. To compensate for the declining production, horizontal expansion of farming became an option for the farmers. In turn, the average land holdings per household or person have decreased due to population increase.

Although there are no systemic and accurate official productivity figures from Darfur in the period from the 1960s to the late 1980s, based on interviews with some farmers, the figures below indicate the changes in both area and productivity. The crop harvest assessments carried out by the Agriculture Planning Unit of the State Ministry of Agriculture and Natural Resources during the years 1999, 2000, 2001, 2002 and 2003 have estimated the average productivity of staple food crops (sorghum and millet) at 65, 45, 23, 45 and 11 kg per *mokhamus*[4], respectively. Moreover, it is worth noting that this area of the *qoz* was one of the 11 animal routes for nomads before 1962 and has since become agricultural land. However, owing to continuous farming and drought and pests, the productivity of millet and the grazing carrying capacity on this land have progressively declined. Generally, by the end of the twentieth century the productivity of staple food crops had declined considerably, especially in North Darfur, to less than 25 kg per *mokhamus*. As a result of the declining production, farmers adopted the strategy of expanding the size of farms. In turn, farm sizes per household decreased due to population increase and the distribution of land through inheritance.

This expansion of cropland agriculture was ultimately made at the expense of pastureland, impacting not only the nomads, but also the settled farmers. At present in Darfur, and especially on the *goz* soils, one finds "field-to-field" millet farming without corridors for small animals to graze during farming season. The expansion of farming on the *goz* soils has not been confined to millet cultivation, but has extended to other crops such as groundnut and sesame, whose cultivation has increased due to market demand and their importance to the farmers for income generation. This expansion of farming has not been limited to *goz* soils only, but has included the *gardud* soils on the *wadi* beds where there is the possibility of exploitation by hand. Moreover, the new simple and cheap agricultural technologies have facilitated the utilization of most *wadi* soils either by the utilization of rainfall moisture for winter cropping or irrigation by the use of diesel engine-driven water pumps from the shallow wells. In previous years, the *wadi* and clay soils were normally used as dry season grazing areas for the livestock of nomads and settlers.

In conclusion, changes that have taken place in the expansion of farming in the last 40 years have been substantial. Some studies have revealed that millet cultivation on the *goz* soils in North Darfur has increased from 125 to 150 percent since 1960. Moreover, the expansion of agriculture on the clay and *wadi* soils has grown by 250 to 300 percent. From this situation, it is inevitable that competition over land would take place not only between the farmers and nomads, but also between the pastoralists themselves due to the lack of grazing lands for their animals.

4 One *mokhamus* is equivalent to approximately 0.56 ha.

Table 3.1. **Major and minor crops grown in South Darfur**

Crop type	Major crops	Minor crops
Cereals	Millet and sorghum	
Oilseed	Groundnut	Sesame
Pulse	Cowpea	
Roots and tubers	Potato and sweet potato	
Vegetable	Okra and watermelon, tomato, eggplant, onion	
Plantation crops	Gum Arabic, hibiscus,	Sugarcane
Fruit trees	Mango, citrus, gawfa	

Table 3.2. **Major and minor crops grown in West Darfur**

Crop type	Major crops grown	Minor crops grown
Cereals	Millet and sorghum	Maize, wheat, rice
Oilseed	Groundnut and sesame	Sunflower, soybean
Pulse	Cowpea, beans, faba bean, chickpea	Green gram, pigeon pea, lentil, peas, cucumber
Roots and tubers	Sweet potato, Irish potato	Cassava, yam and cocoyam
Vegetable	Okra, watermelon, onion, garlic, tomato, hot pepper, snake cucumber	Eggplant, cabbage, carrot, radish, Jew's mallow, lettuce, pumpkin, beet, purslane, squash, sweet pepper
Plantation crops	Gum arabic, hibiscus, tobacco	Sugarcane, coffee, banana
Fruit trees	Mango, citrus, guava	Local apples, pomegranate, anona

Table 3.3. **Major and minor crops grown in North Darfur**

Crop type	Major crops grown	Minor crops grown
Cereals	Millet and sorghum	Maize
Oilseed	Groundnut and sesame	
Pulses	Cowpea, broad beans	
Roots and tubers	Potato, sweet potato	
Vegetables	Okra, tomatoes, watermelon, cucumber, Jew's mallow, onion, radish, rockets, eggplant, sweet pepper, fennel, purslane	Beetroot, hot pepper
Plantation crops	Gum arabic, tobacco, hibiscus	Sugarcane
Fruit trees	Mango, guava, lemon	Orange, grapefruit, dates

Production trend over the last ten years

In Darfur, cereal (millet and sorghum) production accounts for about 60–75 percent of the total household production (pre- and PHAs, 2010). In the absence of a permanent agriculture statistical programme, FAO, in close collaboration with SMOAs, the World Food Programme (WFP), and the Food Security and Livelihood Cluster partners, has been conducting PHAs in the three states of Darfur over the past few years. The assessments, which aimed to assess the performance of the summer agricultural season, focus on:

- the production of main crops (sorghum, millet and groundnuts);
- factors affecting the performance of the agricultural season; and
- livestock health conditions and pastures.

The methodology used in the PHA was a combination of household questionnaire, focus group discussions and field visits using sample size and covering almost all localities in the three states. Information generated from PHAs was further enriched by the findings of the CFSAM conducted by FAO/WFP. The CFSAM has used the proxy indicators of a) estimated number of farming households, and b) estimated average harvested area under cereals per farming household, to estimate the total area under cereal production. The estimates of total area along with the estimates of average cereal yield are used to estimate the final cereal production.

Over the past few years the FAO pre- and PHAs have been providing fairly acceptable estimates of the annual cereal production with an insight into surplus/deficit scenarios across all three Darfur states. The yield and overall production have been fluctuating over the past ten years, and the area under cereal production was reduced significantly during the peak of the Darfur conflict (see **Table 3.4** below). The fluctuation in yield and production are mainly attributed to the compounded effects of weather, particularly on rainfall distribution and amount in a given year, in addition to the security situation. For example, the poor performance in 2003 was mainly attributed to the escalation of violence across greater Darfur region, and that of 2009 was mainly attributed to the quantity and distribution of inadequate rains, extended dry spells and pest attacks.

Table 3.4. **Estimated yields, area harvested and production of major crops grown in Darfur (2000–2010)**

Year	Area harvested (ha)			Yield (tonnes/ha)			Production (tonnes)		
	Millet	Sorghum	Total	Millet	Sorghum	Average	Millet	Sorghum	Total
2000	1 197 000	193 000	1 390 000	0.27	1.22	0.75	328 000	236 000	564 000
2001	1 660 000	753 000	2 413 000	0.22	0.64	0.43	363 000	480 000	843 000
2002	1 460 000	591 000	2 051 000	0.28	0.41	0.35	374 000	241 000	615 000
2003	1 182 000	448 000	1 630 000	0.36	0.58	0.47	423 000	260 000	683 000
2004	652 000	224 000	876 000	0.31	0.46	0.39	200 000	102 000	302 000
2005	902 000	329 000	1 231 000	0.40	0.67	0.54	357 000	220 000	577 000
2006	1 046 000	411 000	1 457 000	0.30	0.67	0.49	312 000	276 000	588 000
2007	1 146 000	466 000	1 612 000	0.32	0.49	0.41	368 000	227 000	595 000
2008	1 153 000	480 000	1 633 000	0.35	0.45	0.40	406 000	214 000	620 000
2009	872 000	457 000	1 329 000	0.29	0.49	0.39	256 000	224 000	480 000
2010	1 165 000	654 000	1 819 000	0.34	0.77	0.56	397 000	504 000	901 000

Other crops
In the 2010 summer season, the total area cultivated with oil and cash crops (groundnut, sesame, watermelon, hibiscus and peas) was estimated at 879 266 ha. Groundnut represents about 57 percent, while sesame, peas, watermelon and hibiscus represent 20.5, 12, 7.5 and 3 percent, respectively.

Surplus / deficit scenarios for cereal
Darfur region has had consecutive poor harvests due to protracted conflict coupled with unreliable rainfall and crop pests, which have greatly affected household food stocks. In fact, all three Darfur states have been experiencing food deficits since 2003. However, 2010 was an exceptional year in that cereal harvest in Darfur almost doubled compared to the harvest of the previous years. Despite the good performance, North and West Darfur states witnessed significant food deficits.

3.3 AID IN DARFUR

3.3.1 Food aid

Categories and number of beneficiaries: WFP has supported different categories of conflict- and natural disaster-affected persons in Darfur between 2005 and 2010. Food was mainly provided to the IDPs, school children, returnees, lactating mothers and people affected by HIV/AIDS, among others. An average of 10.4 million people was supported with various types of food assistance on an annual basis between 2005 and 2010, as indicated in **Table 3.5** below.

Table 3.5. **Beneficiaries of food aid assistance (2005–2010)**

	Number of beneficiaries (000)							
Type of food assistance	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**	**Percent of total food aid**
FFE	-	358	451	-	308	464	**1 583**	**1.3%**
GFD	24 337	30 184	29 889	29 566	3 731	3 655	**121 362**	**97.0%**
IF	-	22	37	40	-	-	**99**	**0.1%**
SFP for adults	-	249	247	391	28	-	**915**	**0.7%**
BSFP for children		-	-	-	363	415	**778**	**0.6%**
TF	-	15	27	27	-	-	**70**	**0.1%**
FFW		-	-	-	8	296	**304**	**0.2%**
Total	**24 337**	**30 828**	**30 653**	**30 024**	**4 438**	**4 830**	**125 108**	**100%**

Methods/approaches used in providing aid: The assistance was provided mainly through GFD that covered 97.0 percent of the total population supported from 2005 to 2010. FFE (1.3 percent), SFP for adults (0.7 percent) and BSFP for children (0.6 percent) were also some of the other approaches used to provide assistance to the affected population. Other approaches used include FFW (0.2 percent), IF (0.1 percent) and TF (0.1 percent), among others.

Volume of food aid and number of beneficiaries reached 2005–2010: Between 2005 and 2010, WFP provided a total of 2.3 million tonnes of food to an average of 10.4 million affected people. GFD accounted for 97.7 percent of food assistance provided by WFP, hence it was the main approach used in providing food to the affected population. The food distribution figures indicate that there has been a general downward trend in the quantity of food provided to the affected population

since 2005 with the peak in 2005 at 436 904 tonnes and the lowest level in 2008 at 306 482 tonnes. The reduction in GFD indicates a shift in the approach by WFP from food aid to food assistance with more emphasis on food-for-assets (FFW, food-for-training) that started in 2009. The change in WFP's approach was caused mainly by the situation in Darfur shifting from pure emergency to early recovery, requiring more livelihoods support to promote durable solutions as the population began moving from dependency on food assistance to self-reliance.

Table 3.6. **Volume of food aid assistance from (2005–2010)**

Type of food assistance	Quantity of food distributed (000 tonnes)							
	2005	2006	2007	2008	2009	2010	Total	Percent
FFE	-	1.48	1.58	-	9.49	5.47	**18.02**	0.8%
GFD	436.9	391.02	418.12	303.41	369.19	304.83	**2 223.47**	97.7%
IF	-	0.44	0.71	0.76	-	-	**1.9**	0.1%
SFP for adults	-	1.84	1.40	2.15	2.34	-	**7.73**	0.3%
BSFP for children	-	-	-	-	9.09	8.35	**17.44**	0.8%
TF	-	0.13	0.142	0.17	-	-	**0.44**	0.0%
FFW-R/T	-	-	-	-	0.019	6.58	**6.60**	0.3%
Total	**436.9**	**394.91**	**421.95**	**306.49**	**390.13**	**325.23**	**2 275.6**	**100.0%**

3.3.2 Seed aid

FAO and other relief and development partners have been very active in supporting vulnerable households in Darfur through interventions such as emergency provision of seed aid, agricultural inputs, technical assistance and coordination of the Food Security and Livelihoods Cluster. The general objective of seed aid is to contribute to the restoration of the food security and livelihoods by supporting the resumption of the agriculture sector and by improving the self-reliance of IDPs, returnees and vulnerable host communities in Darfur. Seed aid is normally provided to the target beneficiaries in three main ways:

- **Direct seed distribution:** This is normally used in areas where seed is considered unavailable and access is difficult. Most of the seed aid delivered to Darfur was provided to target beneficiaries through direct seed distribution.
- **Seed fairs and vouchers**. The seed fair is a specialized market whereby vendors and buyers (beneficiaries) meet to transact agricultural business on an agreed date. In an emergency situation, the beneficiaries are normally provided with vouchers to buy agricultural inputs of their choice during the fair. Seed fairs normally assume availability of seed for some sections of the community, with the target beneficiaries assumed to have no access to the seed available. NGOs such as CRS have been carrying out seed fairs in Darfur for quite some time now, especially in West Darfur.
- **Seed for bulking and multiplication**: The humanitarian organizations in collaboration with the research stations are responsible for procuring the proper seed (foundation seed) for multiplication/production, bulking and distribution to the vulnerable farming households.

Categories and number of beneficiaries
FAO has been targeting the following categories of beneficiaries with seed aid:

- IDPs;
- returnees;
- refugees;
- pastoralists;
- agropastoralists; and
- vulnerable resident/host communities.

Since the establishment of the FAO Emergency Rehabilitation and Coordination Unit in the Sudan in 2002/2003, over 3.5 million people have been supported in Darfur with more than 21 000 tonnes of staple crop and vegetable seeds.

Quantity of seed aid and number of beneficiaries reached over the years
Like food aid, seed aid has been provided in Darfur since the beginning of the conflict in 2003. Between 2005 and 2011, FAO, the Government of Sudan, International Committee of the Red Cross (ICRC) and international NGOs distributed over 21 433 tonnes of assorted crops seeds and over 84.99 tonnes of assorted vegetable seeds to over 3 500 000 IDPs, returnees and vulnerable households (see **Table 3.7** below). In 2011, seed aid to Darfur witnessed a substantial decrease in volume as a result of a good harvest realized in the 2010 summer season in addition to improvement in the security situation.

Table 3.7. **Volume of seed aid and number of beneficiaries reached**

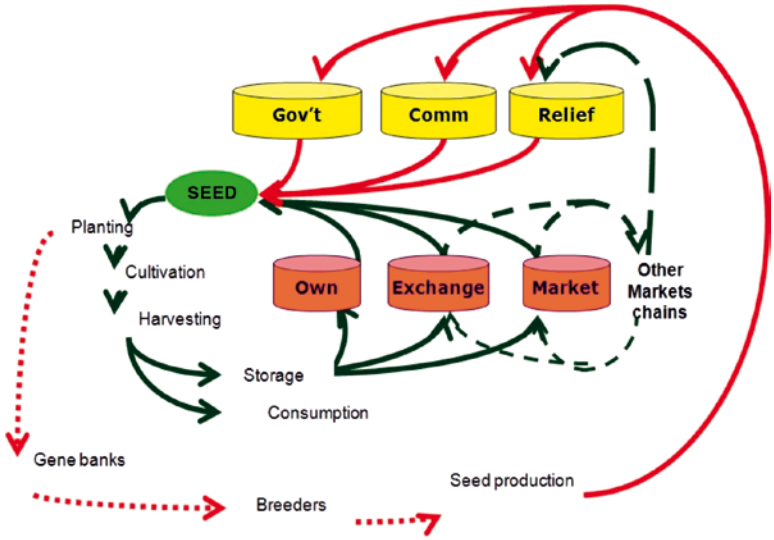
Year	Assorted crop seeds distributed (tonnes)	Assorted vegetable seeds distributed (tonnes)	Total number of beneficiaries
2005	2 450	15.79	472 030
2006	3 742	13.00	660 430
2007	4 658	9.80	707 258
2008	3 520	15.81	700 132
2009	2 208	15.85	486 261
2010	2 657	12.23	346 446
2011	2 198	2.51	179 383
Total	**21 433**	**84.99**	**3 551 940**

IV. Seed Systems in Sudan

4.1 INTRODUCTION TO SEED SYSTEMS

Small-scale farmers obtain their seeds from various sources loosely grouped into two types, called the formal and informal seed systems, with the latter sometimes referred to as the local, traditional, or famers' seed system.

Figure 4.1. **Channels through which farmers source seed**
(Adapted from Louwaars and Almekinder, 1999, appearing in Sperling, Cooper, Remington, Journal of Development Studies (2008))



The formal system provides famers with "modern/improved" varieties. This involves a chain of activities, usually starting with plant breeding, the release of varieties and the subsequent multiplication and dissemination of theses varieties. The formal system is governed by regulations intended to maintain varietal identity and purity, and to guarantee physical, physiological, and sanitary quality of the seed. Seed is marketed through officially recognized outlets. The central premise of the formal system is that there is a clear distinction between "seed" and "grain".

The informal seed system focuses on local or farmer varieties with an infusion of some second, third or fourth generation of modern varieties. This system includes most of the ways in which farmers themselves produce, disseminate, and procure seed: directly from their own harvest, through barter, as a donation from friends, neighbours and relatives (FNR), and through local grain markets or traders. Seed is produced and often sorted as an integral part of the farmers' grain production, rather than as a discrete seed production enterprise. Local technical knowledge and standards guide informal seed system performance, including the requirement of local markets. Because of its ability to meet local needs and preferences, the informal system provides most of the seed farmers use. Worldwide, this amount is between 80 and 90 percent of all seed stock[5].

Farmers normally obtain their seed through both formal and inform channels for different kind of crops. It is also not unusual for a household to meet its needs for a single crop from different seed channels. **Figure 4.1** depicts the formal and informal seed systems, their component channels, and how they are linked.

5 Moving Towards More Effective Seed Aid - Sperling et al., 2008.

4.2 FORMAL PLANT BREEDING

4.2.1 Past breeding efforts in Sudan

In what follows we briefly present breeding activities in some of the most important field crops in Sudan.

Cotton
Cotton breeding started early last century when breeding efforts were directed toward the development of long staple cotton varieties resistant to leaf curl and blackarm diseases (4). The most recently developed varieties ('*Hamid*,' '*Burhan*' and '*Abdeen*') were also bred for resistance to blackarm including new strains of the bacterium. Improved lint yield and fibre quality have also been continuous objectives in cotton breeding programs. Cotton breeders were able to open new markets for Sudanese cottons by developing varieties for different needs. New improved varieties for rainfed cotton production were also developed. (See list of released varieties in Annex 1.)

Cereals: sorghum and pearl millet
Early work on sorghum improvement, first at Tozi and later at Abu Na'ama Station, resulted in the development of high-yielding varieties such as '*Gadam elHamam*,' '*Dabar*,' '*Kerktib*' and the '*Tozi Um Benein*' (TUB) varieties: 'TUB-7', 'TUB-11', and 'TUB-22' (5, 10).

Sorghum and pearl millet breeding benefitted greatly from a cooperative programme with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) established in 1977 and also from the International Sorghum and Millet Collaborative Research Support Programme in 1980. The ICRISAT programme resulted in the release of the first sorghum hybrid in Sudan, '*Hageen Dura-1*'.

In 1990 the UNDP Regional Arab Bureau launched a regional project for the improvement and development of sorghum and millet. The training component in that project was subcontracted to ICRISAT, and three Sudanese graduates obtained their MSc degrees through funding from that project.

During the 1990s and as a result of financial support to ARC from the different projects, another hybrid, *'Rabih,'* was released. Two open-pollinated varieties, '*Feterita Wad Ahmed*' and '*Tabat*', were also released and are now the most popular sorghum varieties in Sudan.

Pearl millet: Pearl millet was included in all the major projects with sorghum but not much was achieved in the way of variety development. The ICRISAT-Sudan cooperative programme resulted in the release of Serere Composite II (SCII) under the name '*Ugandi*'. The variety did not fare well and has not been maintained. Subsequent evaluation in western Sudan of ICRISAT pearl millet varieties by plant pathologists led to the release of *Okashana-2* (released in Namibia) under the name '*Ashana*.' It is to be noted that over 95 percent of pearl millet is grown in the western states of Kordofan and Darfur. Local varieties still predominate in that region. A project to improve '*Ugandi*' by converting its grey seed colour to yellow through backcrossing started in 1990 in cooperation with ICRISAT. Backcrossing was performed at ICRISAT and selection was practiced at El Obeid Research Station. Although in 1999 it was claimed that breeder seed of the new converted variety was being produced, actually nothing materialized.

Wheat: A primary objective of wheat breeding was to push production further south, especially into the Gezira Scheme. Research at Hudeiba Station started with evaluating local material. The FAO Near East Wheat and Barley Project in the early 1960s supplied large numbers of germplasm and nurseries from which 'Falchetto I.B.O.' was released (7). With the establishment of the International Maize and Wheat Improvement Centre (CIMMYT) and the International Centre for Agricultural Research in Dry Areas (ICARDA), the supply of germplasm for evaluation increased tremendously and included pure lines and segregating generations.

The Nile Valley Project with backstopping from ICARDA and financial support from the Netherlands, OPEC and others, resulted in the release of many improved varieties and pushed wheat production further south to White Nile State (1).

Biotechnology is a recent development in Sudan but has already produced two doubled haploid wheat varieties – '*Khalifa*' and '*Tiqana*,' which are now under cultivation.

Maize: Although maize was not a research priority, Dr. A.R. Taylor was appointed in the mid-1950s as a maize breeder. He was first stationed at Shambat but was transferred to Hudeiba Station when it was opened in 1962. The important contribution made by that programme was the collection of maize germplasm from almost all maize-growing regions in the country. The programme was again moved to Shambat Station and after further evaluation, three varieties were recommended: '*Alaf*,' '*Bafrew*,' and '*Stock 113*.' Only the latter is now available. A new programme for evaluating hybrids and open-pollinated varieties started at the Gezira Research Station and at Hudeiba Station. Two open pollinated varieties, designated '*Hudeiba-1*' and '*Hudeiba-2*,' were released from the Hudeiba programme.

More research work at the Gezira Research Station was directed towards evaluating hybrids from Pannar, (South Africa) and Advanta, (India): high quality protein maize and striga-resistant material from the regional programme of CIMMYT in Nairobi. Several hybrids and open pollinated varieties were released from this programme.

Oil crops: groundnuts, sesame and sunflower
Groundnut: Groundnut improvement efforts in Sudan were begun in the 1930s. The cultivar *'Barberton'* was identified as a suitable variety for rainfed western Sudan. Because of its earliness, the spread of *'Barberton'* was quick and it almost replaced the late-maturing runner type that was cultivated at the time, especially in the drier parts of the region.

The groundnut collection assembled by A.H. Bunting and the agronomic classification he developed (3), facilitated screening the collection to select varieties adapted to irrigated central clay soils and others suitable for rain-fed production. '*MH 383*,' an alternately-branched long-maturing introduction from Nigeria, was released in 1970 (8).

In 1980, a new programme of variety introduction accompanied by an intensive crossing effort was initiated at the Gezira Research Station at Wad Medani (6). Cooperation with Jebel Marra Development Project, Western Savannah Development Corporation, and Mechanized Farming Corporation resulted in the release of '*Sodiri*' for rainfed western Sudan. '*Sodiri*' is now replacing '*Barberton*'. '*Kiriz*' was released for the irrigated clays and River Nile State as a confectionary type. From the hybridization programme, four cultivars were released: '*Medani*,' '*Ahmadi*,' '*Tozi*' and '*Bunting*' for the irrigated clays and '*Ghubeish*' for rainfed western Sudan.

Sesame: Sesame improvement started at Tozi in the early 1950s with collecting, characterizing and evaluating the yield potential of local cultivars. Selected varieties were distributed to farmers. However, farmers grew different varieties on the same farm and the subsequent outcrossing caused the varieties to deteriorate rapidly. Attempts to combine yield components did not result in the development of varieties higher in yield than the improved local selections. Efforts to develop non-shattering varieties for mechanical harvest also did not succeed.

In 1975 a cooperative programme between the University of California, Riverside and the Agricultural Research Corporation, funded by UNDP, was launched. In that project crosses were made at Riverside and selection was practiced at Kenana Research Station (Abu Na'ama). The project was successful and two selections were released: '*Kenana-1*' (UCR770011-32) and '*Khidir*' (UCR 770192).

Sunflower: Research at Abu Na'ama Station in the 1980s resulted in the release of two open-pollinated varieties given the names '*Damazin-1*' and '*Damazin-2*'.

The private sector pioneered the commercial production of the crop by planting imported unreleased hybrids. Many years later, imported hybrids were evaluated by ARC and also by the Arab Sudanese Seed Co. (ASSCO). Several hybrids were released ('*Hysun-33*' from Pacific Seed Company of Australia, *'Juwalamukhi'* from Proagro of India; and '*PAN-7392*,' '*PAN-7355*,' '*PAN-7351*,' and '*PAN-7371*' from Pannar Seed Company of South Africa). The college of Agriculture, University of Khartoum was the first to develop local hybrids: '*Shambat*' and '*Salih*'. Subsequently ARC developed three hybrids: '*Buhuth*-1,' '*Buhuth-2*,' and '*Buhuth-3*'. A list of released varieties is provided as Annex I.

4.2.2 Current structure of plant breeding in Sudan/Darfur

Plant breeding programmes are conducted within the National Agricultural Research System, which comprises (a) public research institutions, (b) universities, and (c) the private sector.

a) Public research institutions

The ARC is the largest public research institution in Sudan. The Gezira Research Station (GRS) was established in 1918. ARC now comprises 18 research stations covering most of the agro-ecological zones in the country (Annex IX). In 2001 ARC was brought under the newly established Ministry of Science and Technology (MOST) but it was returned back to the MOA this year. Breeding programmes in ARC cover almost all important field crops and horticultural crops. For research coordination, crops are grouped into centres or programmes (11):

- The Cereal Research Centre covers wheat, sorghum, pearl millet, rice, and maize.
- The Oilseed Research Centre coordinates research on groundnut, sesame, sunflower and soybean.
- Pasture and Forage Programme: Breeding work in this programme covers irrigated forage crops with an emphasis on the development of sorghum varieties and hybrids using local materials.
- Food Legumes Research Programme: In this programme, breeding work covers three winter legumes: faba beans, chickpea, and common beans. The focal point for this programme is the Hudeiba Research Station in River Nile state. Work on tropical grain legumes covers cowpea, pigeon pea, and bambara groundnut; the programme is located at El Obeid Research Station in North Kordofan state.
- Cotton Research Programme: Cotton breeding is organized into 11 projects including breeding for disease and insect resistance, biotechnology, mutation breeding, etc.
- Horticultural Crops Research Programme: Tomato breeding occupies a prominent position in this programme with emphasis on breeding for disease resistance or tolerance, specifically tomato yellow leaf curl virus. Breeding activities also cover all important vegetable crops in the Sudan. Kerkade, an important cash crop in western Sudan, is included in the vegetable crops programme.
- The Fruit Tree Programme covers grapefruit, mango, banana, date palm and guava.
- Plant Genetic Resources Programme (PGRP): This programme deals with the collection, conservation, evaluation and documentation of local genetic resources in the various agricultural crops in the Sudan. The PGRP is run by a unit located at GRS. A field gene bank has been established in the Kassala area of eastern Sudan and a new regional seed bank was established in El Obeid for conservation of an active collection from Kordofan and Darfur. PGRP provides critical support to all breeding programmes. Over 9 000 entries are maintained by the unit.

b) Plant breeding in universities

Of the 17 agricultural colleges established recently, only two contributed to the development of new varieties: the University of Khartoum, which released two sunflower hybrids and the University of Gezira, which released two tomato varieties.

c) Private sector

Two major private sector companies involved in plant breeding and agricultural research are the Kenana Sugar Company and the ASSCO.

- Kenana Sugar Company (KSC): A strong sugarcane breeding programme was established by KSC in collaboration with Guneid Sugarcane Research Station. Bilateral contracts were made with the West Indies Central Sugarcane Breeding Station at Barbados and hundreds of varieties were introduced. Screening for disease and yield resulted in the selection of the varieties released in 1998 and 2003 (see Annex I).
- ASSCO: ASSCO replaced the Plant Propagation Administration (PPA), which was the government agency undertaking seed production. Assets of PPA including land, processing plants and irrigation facilities formed the share of the MOA in the new company. ASSCO was established in 1997 in accordance with the 1925 corporate law. The Arab Authority for Agricultural Investment and Development was the second largest shareholder. ASSCO established a research and development unit in 1998. The main breeding agenda undertaken by ASSCO was to introduce and test hybrids of sorghum, pearl millet, maize and sunflower. In addition, a sorghum breeding project to develop hybrids that meet the local taste was initiated. Some selected hybrids are currently in the advanced stage of evaluation. As indicated earlier, ASSCO released a sunflower hybrid and a forage sorghum hybrid.

4.2.3 Priorities for upgrading plant-breeding facilities

In 2006, MOST requested support of the European Community for a mission to assess, evaluate, analyse and identify possible interventions needed in the research centres in the northern part of the country to upgrade them and improve their conduct. Some of the preliminary findings, (with their comments in italics) include:

- The main structures (for research purposes and staff accommodation) are in a highly variable condition, reflecting construction issues. Increasingly, rehabilitation efforts by ARC are proving effective but much remains to be done.
- Given adequate rehabilitation, most structures permit appropriate activity but rarely much more.
- Laboratories in most cases lack even the basic array of equipment, and consumables are equally deficient. This state of affairs is very prejudicial to the quality of any research effort and also limits the scope for in-house training of technicians.
- Libraries, with the exception of one, are sadly deficient. However, the electronic library facilities (available at Wad Medani) represent perhaps the outstanding example of ARC's limited success to date to move operations into the twenty-first century (the other being biotechnology, tissue culture, GIS, and the like).
- Other infrastructure and equipment such as workshops, fencing and computers are commonly not in even passable condition. This often is very prejudicial to the efficient operation of all ARC functions.
- Research station farmland and out-stations often cannot be operated well and most only in a partial fashion, due to equipment deficiencies and other constraints. This state of affairs is very prejudicial to the quality of any research effort and to the in-house training of support staff.

However, with regard to plant breeding, perhaps the most important constraints are:

- unreliable irrigation, especially at GRS;
- poor storage facilities;
- inadequate transport facilities; and
- inadequate machinery for field operations.

4.2.4 Priorities for human development for agricultural research

Dependence on local post-graduate education, the paucity of opportunities for studies abroad and the declining linkage with outside research institutions, especially with the International Agricultural Research Centres (IARCs), have resulted in the recruitment of poorly-prepared plant breeders. The retirement of better-educated and better-trained breeders has deprived the younger breeders from an inexpensive local source of training through day-to-day contact. An additional problem is that even though not well-trained, new breeders are not available in the needed numbers.

The IARCs provide an appropriate venue for training. The duration of the training should be a whole season. A six-month period should be sufficient to acquire training in most of the important field crops in Sudan.

Cotton, sesame and sunflower are not included in the mandate of any of the IARCs, but there are strong national programmes for cotton and sesame in India and programmes to provide the needed training in for sunflower in Eastern Europe.

In addition to foreign training, a policy of keeping needed breeders beyond retirement age should be considered. Because of language barriers, training of technicians could be conducted locally or in Arab countries with proper training facilities.

4.2.5 Most-preferred and existing crop varieties

Variety introduction remains the main method of crop improvement in Sudan, especially in respect of non-indigenous crops. Cotton is an exception in that all released varieties have been locally bred. In contrast, all varieties of sugarcane, fruit trees, cowpea, chickpea, pigeon pea, potato, and rice were introductions.

The main players in this system are ARC, local seed companies and foreign seed suppliers. Local and foreign seed companies constitute one group as foreign seed companies usually have a local seed company as an agent. Usually, proprietary hybrids, particularly those of sunflower, sorghum, maize, and pearl millet are introduced. A memorandum of agreement is made between individual companies and ARC whereby the responsibilities and obligations of each party are specified. Private sector seed companies emphasize the need to establish an independent national variety evaluation system. However, ARC, with its network of test locations and experienced technical staff, will always be a key player in any arrangement for variety evaluation.

There are many examples of independent variety evaluation systems in developed countries but they are too expensive to be emulated in Sudan. The interaction of foreign and native experts, however, is apt to come up with an arrangement satisfactory to all parties.

A list of released varieties and dates of release is maintained by the Seed Administration. The present list contains released varieties, year of release, and the releasing organization. However, one cotton variety, '*Nour*,' released in 1993, was missed while other varieties were duplicated. In the revised list (Annex I) the given name is shown and the other name is bracketed, for example, the pearl millet variety '*Ugandi*' was also identified separately as *(Serere Composite-2)*. The Pioneer hybrid sorghum, '*Sheikan*' was written three times - twice as '*Sheikan*' and also as '*YSW-64*.' Other observations concerning the list are:

- The spelling of names did not follow the convention of transliterating Arabic names into English.
- Many of the listed varieties are either unavailable now or out of use.
- Because the majority of varieties were introduced from abroad, the releasing agency is not the breeder and also not the maintainer in case of hybrids.
- Some older popular varieties were listed even though they were not officially released. The groundnut cultivar '*Spanco*' was neither evaluated nor released. It was introduced in bulk from the United States as a gift and was approved by an ad hoc committee.
- The cowpea cultivars, '*Ein elGazal*' and '*Dahab elGoz*' were the only varieties registered in the *American Journal of Crop Science*.

Usually the release proposal prepared by the breeder contains the zone of adaptation, which is the zone where the trials for value for cultivation and use were conducted. Annex III contains a description of some of the preferred varieties (see 4.2.6 below).

In Darfur, at present the identification of preferred varieties can only be achieved, but not unequivocally, from the seed produced during the years when the project for assisting small farmers was operational. Repeated requests for specific varieties are taken as an indicator of preference. Furthermore, the particular varieties were specified by the MOA, presumably at the request of the beneficiaries. These varieties are shown in Annex II.

4.2.6 Role of local varieties in boosting and stabilizing agriculture

Selection within landraces is usually the first step in crop improvement. In central Sudan this process was practiced with sorghum and resulted in the selection of improved pure line varieties such as '*Gadam elHamam-47*', '*Dabar-1*', '*Kerkatib*' and '*Wad Akar*.' A similar process was not performed in Darfur and it might as well start now. A participatory approach whereby local farmers and experienced plant breeders cooperate in identifying individual plants with desirable characteristics could be followed. For highly self-pollinated crops such as sorghum, single plant selections are planted in individual rows for observation and selection between and within rows. Further evaluation would be in replicated trials. For highly cross-pollinated crops such as pearl millet, simple methods of population improvement could be followed. Details of such activities need to be outlined in detail by breeders but the participation of farmers in the different stages of selection is crucial to the acceptability of the final product. For further improvement, hybridization and selection would be necessary.

4.2.7 Constraints/opportunities for public sector plant breeding

Urgent needs for breeding include:

- rehabilitation of experimental sites;
- provision of needed expendable supplies;
- assured and sufficient operational budget; and
- facilitation of staff mobility.

During the last few years the contribution of plant breeding to world food security was strongly brought to the forefront of attention. This was evident in the Declaration from the Second World Seed Conference held at the FAO headquarters in Rome 8–10 September 2009.

Also the Common Market for Eastern and Southern Africa (COMMESA), of which Sudan is a member, came up with a proposal for a COMMESA Variety Release System. Earlier, a harmonization process was started by the Association for Strengthening Agricultural Research in East and Central Africa.

Sudan also attracted the attention of Svalof Consulting AB of Sweden, whose Managing Director, accompanied by the Director of the Project on Plant Genetic Resources in Eastern Africa, conducted a fact-finding mission during May 2008. A draft memorandum of agreement was prepared by the team but it is not known whether an agreement was concluded.

4.3 FORMAL SEED PRODUCTION STRUCTURES

4.3.1 Introduction

Plant breeding and the development of new improved varieties constitute the first link in what is known as the seed chain. Subsequent activities include seed production, processing and storage, marketing and distribution, and quality control. This chain of activities comprises the seed supply system. When the seed system is backed by legislation and public polices it constitutes the seed industry (9). Another view, however, considers the seed industry to include the activities of breeding, seed production, processing and storage, marketing and distribution. This view considers the seed system and the seed sector as equivalent and comprise in addition to the seed industry, quality control, extension, and rural development.

4.3.2 Past efforts to support production of quality seed in Sudan

Interest by the Sudan Government in providing good quality seed to farmers goes back to the early 1960s when the Plant Propagation Committee was formed. In 1968 the Government established the National Seed Administration (NSA) which was formerly the plant propagation section within the Agricultural Research Division. The Gezira Scheme and the main production corporations (Rahad and New Halfa) also established seed production departments to serve their seed needs.

The Government obtained foreign technical and financial support to establish a formal seed sector with all the aforementioned components. (It should be noted, however, that cotton enjoyed formal seed production as early as 1918.) A project for seed production and certification was financed by UNDP and executed by FAO from 1974 to 1978. Another project for oil crops was financed by the Government of Iraq and extended from 1979 to 1981. The Sudan Seed Project was financed through a loan from the African Development Bank and the African Development Fund with the following objectives:

- formation of the NSA with two administrations: one for production and one for certification;
- establishment of two irrigated seed production stations;
- strengthening of the existing stations;
- support to the plant breeding section in ARC to ensure supply of breeder seed;
- establishing credit facilities to enable production corporations to expand production areas and acquire processing facilities;
- technical assistance; and
- staff training.

Within the framework of FAO project SUD/71/550 "Seed Production and Certification" the first draft of a seed act was prepared in 1980 by two experts (Martin J. Zijp of Netherlands MOA and the FAO legal expert, Dr Lufs M. Bombin). This draft was the forerunner of the 1990 seed law. In 1979 a field inspection manual was prepared by FAO consultant Professor G. R. Tatwawadi and updated by Dr S. K. Banerjee, FAO consultant, in 1983. The 1990 seed law had to be revised after the dissolution of the Plant Propagation Administration in 1997. A new seed law was enacted in May 2010 and entitled the Seed and Variety Protection Act (in Arabic).

A main feature of the 2010 seed law is that Plant Variety Protection (PVP) articles were moved from the regulations and placed in the body of the new law, probably to meet the Trade-Related Aspects of Intellectual Property Rights requirement to join the World Trade Organization. The articles dealing with PVP address the following issues concerning the rights of plant breeders: conditions for the protection, scope, transfer, duration and compulsory assignment of breeders' rights, and exceptions to those rights. These are largely concerns of the International Union for the Protection of New Varieties of Plants 1991 convention.

The law also recognizes the NSA of the MOA as a general administration. The seed council has been entrusted with:

- setting general policies to regulate and encourage production, distribution, and utilization of varieties and seeds;
- providing advice to the Minister in organizing seed production and developing the seed industry;
- setting the principles and regulations necessary for organizing production and certification of seeds and varieties;
- forming consultative and specialized committees to assist the council in performing its duties; and
- setting internal rules organizing the conduct of its duties.

Quality control is governed by the 1995 regulations, which need to be changed to conform to the new law. The NSA is responsible for certification of quality control and performs the following duties:

- Field inspection teams check on the source of seed and field conditions with regard to weeds, diseases, isolation, and crop rotation.
- At least two visits are made at flowering and before harvest when the yield is estimated.
- Seed samples are taken for purity analysis, germination, and disease assessment.
- Grow-out tests (pre-control) are required only for hybrids produced in Sudan and are conducted before the growing season.
- A seed certificate is issued but no tags are placed on seed bags.

The Seed Administration operates ten seed testing laboratories, which are well distributed around the country, including Darfur. The seed testing laboratory in Nyala, South Darfur was supported by FAO in 2008.

Western Sudan has not enjoyed any sustained seed production efforts. Even with the implementation of the Western Sudan Agricultural Research Project in the late 1970s, and the World Bank Project in support of the Mechanized Farming Corporation in the early 1980s along with other projects, very limited attention was given to crop improvement and seed production.

From 1994–1998, South Darfur conducted a seed production programme at two locations: Wad elMiram and Gireida. Multiplication of the new sorghum cultivar, '*Tabat*,' and the groundnut cultivar '*Sodiri*', started in those farms. More recently, FAO initiated some basic activities in support of a seed programme for Darfur starting with training and provision of needed seed testing equipment. Three mobile seed processing units were also provided.

At present, however, Darfur is dependent on seed companies and NGOs for much of its seed requirements.

4.3.3 Current structures and status of formal seed production

In Sudan, the seed categories of the Association of Official Seed Certifying Agencies (the American system) are recognized. This system recognizes the following seed categories: breeder seed, foundation seed, registered seed and certified seed. However, in Sudan, certified seeds are generally produced from certified seeds because of the irregular availability of higher categories of seed.

ARC is practically the only public sector organization responsible for providing breeder and foundation seed to the private sector for producing certified seed. In the past, ARC breeders were obliged to hand over to the Plant Propagation Department a quantity of breeder seed for further multiplication. ARC was supposed to organize a seed unit to produce larger quantities of breeder and foundation seed. However, this unit was not formed as originally envisaged. As a matter of fact, ARC is not meeting its responsibility for providing breeder and foundation seed for reasons touched upon earlier. It also appears that ARC did not appreciate the economic returns that could accrue to it from seed production.

ASSCO through its Research and Development Unit has been engaged, since 1998, in a process of purifying seed obtained from ARC, starting with the development of nucleus seed through higher categories of seed. Some seed producers have purchased certified seed from ASSCO and used it for further multiplication. Because of the large number of released varieties, ASSCO has restricted its effort to a limited number of varieties.

Companies involved in certified seed production are now organized in a seed trade association (Sudanese Seed Trade Association) that is member of the African Seed Trade Association. Twenty-six companies comprise its membership at present.

(a) Other means of introducing high quality seeds

Farmer-based seed production accompanied by a quality-declared seed (QDS) system is an alternative procedure that deserves consideration. It is worth noting here that all imported vegetable seeds are standard seeds. It should also be accepted that the minimum standard system currently being followed for field crops does not prevent fraud. However, details of a QDS system need to be discussed in appropriate forums.

(b) History of seeds multiplied by the formal sector

The situation concerning higher categories of seed (breeder and foundation seed has already been referred to).

Table 4.1. **Certified seed production by ASSCO Ltd. (2006–2010)**

Crops	ASSCO Certified Seed production by year (tonnes)				
	2006	2007	2008	2009	2010
Sorghum	4 691	5 147	3 044	2 436	2 731
Groundnut	1 666	1 535	1 348	906	996
Sesame	355	622	555	642	342
Millet	828	566	623	241	285
Cowpea	53	86	183	16	5
Wheat	810	2 052	2 947	2 369	1 446
Maize	306	205	341	344	68
Total	**8 709**	**10 213**	**9 041**	**6 954**	**5 873**

Source: M & E Unit, ASSCO.

Annex VI shows the same indicators applied to national production; however, these quantities are estimates of raw produce. The seed processing capacity in the country is indicated in Annex VIII.

In addition to locally produced seed, appreciable quantities of seed are imported, especially vegetable seed and seed of hybrid varieties of field crops. Government organizations involved in importing or exporting seed include the Seed Administration, Plant Protection Department, and Sudanese Standards and Metrology Corporation. For seed importation the following requirements should be fulfilled:

- A permit from the Seed Administration should be obtained before any seed is imported.
- Imported seed should be accompanied by a phytosanitary certificate, an International Seed Testing Association certificate, and a non-genetically modified organism certificate.
- Seed consignments are held by quarantine until results of seed testing are obtained.

Certified seed has been supplied to Darfur by several seed companies. Quantities of seed supplied during 2005–2008 were financed by the government programme to assist small farmers. For the period 2009–2011 supplies were provided only by ASSCO. This is probably the only documented record of seed supplied to Darfur.

(c) Analysis of seed prices by category of seeds

The quantities of seed shown in Annex II were purchased by government financial support (Ministry of Finance) for the period from 2005 to 2008. From 2009 to 2011 purchases were financed by the SMOAs in Darfur.

Thus, the main seed market has been provided by the central government or state governments. Other buyers include:

- NGOs;
- FAO;
- new large-scale producers who usually buy once and then reproduce from their own stocks; and
- small individual farmers who have access to a local seed distributor.

Seed marketing is known to be the most difficult area of the entire seed industry. In Sudan the situation is aggravated by a number of factors, including:

- the paucity of improved varieties, especially hybrids;
- weak and limited promotion activities by the Transfer of Technology and Extension Administration – most of the private seed companies do not have strong promotion activities; and
- market research is probably a non-existent activity in seed companies.

Available prices are those of ASSCO shown in Annex V. However, ASSCO's prices are usually higher than those of other seed companies. Although the trend is towards higher prices, it should be noted that seed prices are strongly influenced by grain prices during any particular season. Producers usually fix prices on a cost-plus basis.

4.4 DECENTRALIZED SEED MULTIPLICATION AND DISSEMINATION

4.4.1 Introduction

Seed production and multiplication is one of the means through which seeds are made available to farmers across the three Darfur states. Seed multiplication offers an opportunity for availing good quality and locally adapted crop varieties. Since the eruption of the Darfur conflict in 2003, a number of humanitarian and developmental organizations have been supporting seed production, multiplication and distribution activities in partnership with ARS and SMOAs. A limited number of private companies and individuals were also involved in seed multiplication and marketing.

4.4.2 Approaches used in seed multiplication

The following approaches are used for seed production and multiplication in the three Darfur states:

- seed distribution/multiplication/recollection;
- community-based seed multiplication and supply;
- private sector seed multiplication and market supply; and
- on-farm trials seed multiplication.

(i) Seed distribution/multiplication/recollection approach

In this approach, the humanitarian organizations, in partnership with ARSs and SMOAs, identify and select the farmers who are contracted to produce the seeds. Funding is provided by the NGO/United Nations (UN) agency and the ARS is responsible for the implementation and supervision of production activities. Agricultural inputs such as seeds, tools and empty bags are provided to the farmers as well as technical training in seed production aspects. The labour is provided by the farmers. After harvest, the funding organizations recollect and buy the seed produced from the farmers, mostly at a rate of 20 percent above the market price of the grains. The recollected seeds are kept in the stores of the organizations and later redistributed free of charge to the vulnerable farming households in the following season. A variety of field crops are being multiplied, including sorghum, millet, groundnuts, cowpea, maize, sesame and okra, of which some are modern/improved varieties (sorghum and groundnuts) and others locally adapted varieties (millet and cowpea).

The advantage of this approach is that good quality seed (often foundation or certified first generation) is procured by the humanitarian organizations with the involvement of research institutions.

The main disadvantage is that because the seeds produced are recollected and bought by the same humanitarian organizations and redistributed free of charge to the farmers, this might discourage the local private sector from continuing to expand into the seed production business.

(ii) Community-based seed multiplication and supply approach

The community-based seed multiplication and supply approach is being applied on a very limited scale. It was tried for the first time by FAO in North Darfur in the 2010/2011 winter season for the multiplication of okra seed of the well-known adapted and preferred variety, '*Pausa Swani*' (literally, "spineless"). FAO, in partnership with ARS and collaborating with Kutum Agricultural Extension, Development Society and the local community leaders, selected 420 farmers to be involved in the seed multiplication activity. Technical training, foundation seeds, hand tools and pest control equipment were provided to the farmers. Agreement was made with the selected farmers that they had to carry out all production activities and that whatever quantities of seeds they produced they would retain for their own use. This approach is intended to contribute to the provision of good quality seeds at local levels for the farmers directly involved in the production, and also for market sale in the local and nearby areas.

The main advantage of this approach is that it stimulates and encourages the private sector to be more actively involved in seed multiplication with a higher sense of ownership than was the case in the first approach where humanitarian organizations are the business owners and individual farmers are mere recipients of seed aid.

(iii) Private sector seed multiplication and market supply approach

Two local private companies have been involved in seed multiplication and marketing, namely, Abu zar Agricultural Services Centre and Noor Centre for Agricultural Services, both based in Nyala and operating in South Darfur from 2008 to 2011. Abu zar Agricultural Services Centre is more involved in field crop seed multiplication activity while Noor Centre for Agricultural Services is more involved in supplying and marketing improved vegetable seeds, with very little activity in seed multiplication.

Two main methods are common in the business of seed multiplication: the first involves a company contracting individual farmers. The contracted farmers are provided with technical training by the ARS and SMOA staff as well as the company's own technical staff, in the case of Noor Centre. Contracted farmers receive cash payments from the company in the form of a loan to cover operations such as land preparation and weeding. After harvest, the loan is paid back in kind in

the form of seed equivalent to the loan amount. The net value of the produce (seed) is divided equally between the two parties – the company and the farmer, (i.e. 50 percent for each, as in the case of Noor Centre). Another arrangement under this approach is that contracted farmers are free to sell or not sell their seeds to the company and at the same time the company is free to buy or not buy from the farmers (as in the case with Abu zar Agricultural Services Centre). This type of arrangement is flexible and meant to give room for the market supply and demand forces to benefit each party. Usually, the farmers receive their share in the form of cash equivalent paid by the company at current market price.

The second method is for a company to use hired labour paid in cash to work the company's own farmland. The company bears all the expense of operations, production inputs and technical supervision. All seeds produced go the company and are then sold to FAO, NGOs, and individual farmers within Darfur region. On average, 40 farmers per season are involved when the company uses hired labour on its own lands (i.e. Abu zar Agricultural Services Centre), whereas the number of contracted farmers ranges between 10 and 15 per season.

The advantage of private sector involvement is that it is more sustainable and the costs involved are lower, provided that direct humanitarian organizations' involvement in seed multiplication is reduced and their role is to provide technical support to farmers and to relevant government institutions such as ARS and agricultural extension departments in terms of training.

(iv) On-farm trial seed multiplication approach

In 2000, ARS Nyala introduced nine varieties of sweet potatoes from the International Potato Centre – Peru. Since that time, ARS has carried out:

- Evaluation and adaptive research was performed on the nine varieties from 2000 to 2005.
- On-farm variety testing and evaluation was performed by farmers.
- Out of nine varieties, two were selected and accepted by the farmers – orange flesh *440189* and *423027*. The two varieties have been officially released and the names given to them are '*Salih*' and '*Abusabi*', respectively.
- In 2006, 300 000 sweet potato stem cuttings of the two varieties, '*Salih*' and '*Abusabi*' were produced and distributed to 100 farmers in Alsalam, Gireida and Mershing localities.

None of the contracted farmers involved in seed multiplication activities in Darfur are formally organized. Contracts are made on a seasonal and individual farmer basis. This may be attributed to the fact that the seed multiplication business is in its early stages in Darfur and NGOs are designed and driven to meet specific demand on a temporary basis. Little effort has been made by the public sector toward seed multiplication.

4.4.3 Methods and approaches applied in disseminating seed production technologies

A range of methods are used for disseminating seed production technologies. These include open community meetings, theoretical and practical training, use of demonstration plots, field days, field monitoring and guidance. Technical training is mainly provided by ARS and the SMOA technical staff for the training of village extension agents and farmers.

Training topics targeting technical staff, mostly from the SMOA, include some or all of the following:

- steps of seed production;
- principles of seed multiplication;
- field inspection;
- improved farming technologies;
- seed processing;
- seed sampling;
- seed quality determents; and
- pest and disease control.

Training topics for farmers include:

- seed selection;
- site selection;
- isolation;
- proper sowing date;
- proper seed rate;
- plant spacing;
- proper weeding methods and timing;
- rouging;
- protection from pest and diseases;
- proper harvesting methods and timing; and
- seed cleaning and packaging.

4.4.4 Seed multiplication efforts in Darfur

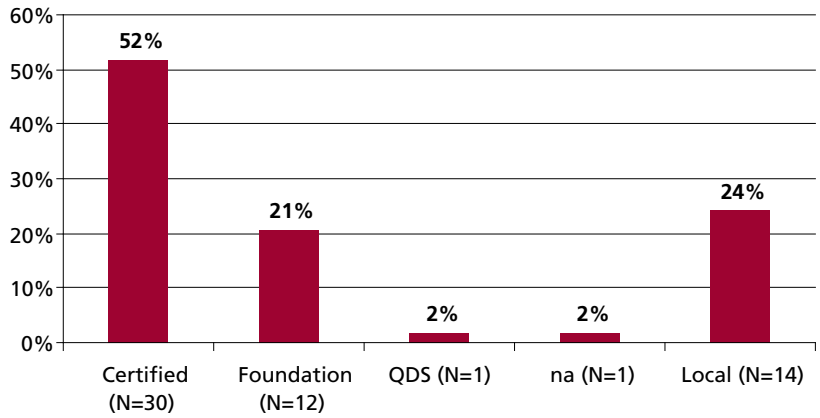
Over the last ten years the number of organizations involved in seed multiplication support has been relatively small compared with the total number of organizations providing services and assistance in the field of food security and livelihood in Darfur region. Out of nearly 67 organizations (NGOs plus government institutions), 20 are involved in seed multiplication support, representing about 30 percent. In 2009 and 2010, only eight organizations were involved in seed multiplication activities. ARS is the main technical partner that almost all organizations depend on for technical backstopping in the implementation of seed multiplication. Therefore, the presence of ARS provides an opportunity for NGOs to carry out seed multiplication activities. This can be observed in the Geneina area where ARS has no presence and no NGO was involved in seed multiplication. Seed multiplication is confined to the Zalingi corridor of West Darfur state where it is implemented by NGOs in partnership with JMRDP/SMOA. **Table 4.2** shows organizations involved in supporting seed multiplication in the 2009 and 2010 rainy seasons.

Table 4.2. **Organizations supporting seed multiplication in 2009 and 2010**

State	Locality	Administrative unit	Organization
South Darfur	Alsalam	Abu Ajora	AASC/ICRC/ARS
		Malam	ICRC/ARS
		Bulbul	ICRC/ARS
	Idd Alfirsan	Algaba	AASC
	Kabum	Umlabasa	AASC
	Kas	Kas	ICRC/ARS
	Bilail	Bilail	NCA/SCC
	ALsalam	Dimo	Abu zar and Noor Centre
		Abu Ajora	
	Iddalfursan	Algaba	
	Kabum	Um labasa	
	Bilail	Bilail	
North Darfur	Al Fashir	Al Fashir rural	FAO/ICRC/ARS
	Dar elsalam	Malam alwidyan	FAO/ARS
	Malet	Malet rural	ICRC/ARS
	Kabkabia	Kabkabia rural	FAO/ARS
	Kutum	Kutum rural	FAO/ARS
West Darfur	Zalingi	Abata and Treje	DRC/SMOA/JMRDP
		Nertiti	JMRDP/ICRC/ASD
	Wadi Salih	Waro / Urdi	DRC/SMOA

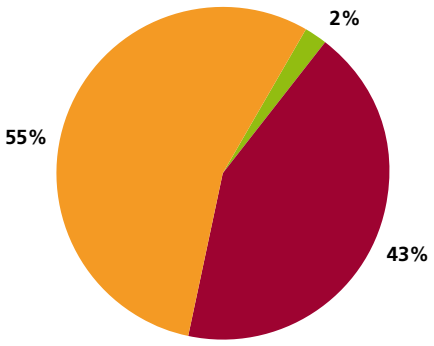
Grades of seeds used for multiplication: The grades of seeds used for multiplication include basic seeds, certified seed and local seeds. Basic seeds were used for the multiplication of the improved sweet potato varieties introduced and tested by ARS Nyala under farm research trials. Certified seeds were used for the newly introduced varieties by FAO/NGOs such as sorghum '*Tabat*,' groundnuts '*Gibeish*', promo/white colour sesame, and '*Pausa Swani*' okra. Local varieties were mainly used for the multiplication of millet crop seed.

Figure 4.2. **Grades of seeds used for multiplication**



Sources of seeds used for multiplication: Most of the seeds used for multiplication are sourced from outside Darfur region, mainly central Sudan, which accounts for 55 percent. The second seed source is within Darfur, representing 43 percent of the total sources. And 2 percent of the seeds that were mainly used by ARS Nyala for multiplication of sweet potato were sourced from outside Sudan (**Figure 4.3**). The bulk of the certified seed (first generation) comes from the Arab Seed Company and ARS.

Figure 4.3. **Proportion of the different seed sources used in multiplication**



Crop varieties targeted for multiplication: A number of staple food and cash field crop varieties have been under multiplication during the last ten years, while only three varieties of two vegetable crops were multiplied. The two main staple food crops include millet and sorghum, while the two important cash crops are groundnuts and sesame. **Table 4.3** shows crop varieties targeted for multiplication during the period 2000–2010.

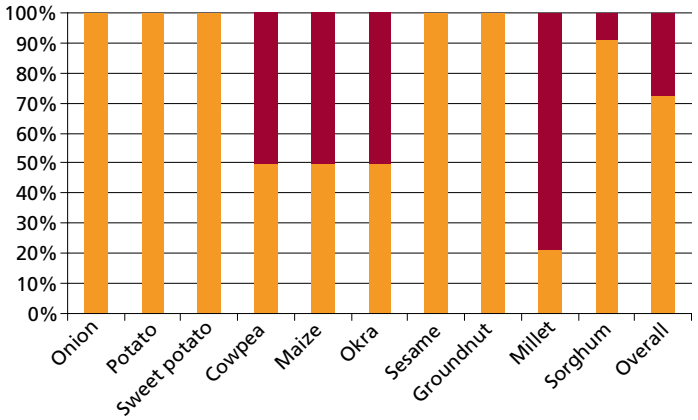
Table 4.3. **Crop varieties targeted for multiplication and partners involved (2000–2010)**

State	Crop for seed multiplication	Variety	Organization
South Darfur	Sorghum	*Wad Ahmed*	AASC/FAO/ARS/NCAS
		Tabat	AASC/ NCAS/ FAO/ARS
		Arwasha	FAO/ARS
		Arfagadak	AASC
	Millet	*Ashana*	AASC/ FAO/ARS
		Dimbi	AASC/
		Kano	FAO/ARS
		Mauya	FAO/ARS
	Groundnuts	*Gibeish*	ICRC/ARS/
		Sodari	FAO/ARS/ ICRC/ARS
	Sesame	*Brown*	AASC
	Cowpea	*Ein algazal*	AASC
	Maize	*Hudeiba 2*	AASC
	Okra	*Spineless*	NCAS
	Onion	*Kamleen yellow*	NCAS
	Sweet potato	Orange flesh 440189 and 423027	WV/ARS
North Darfur	Sorghum	*Tabat*	FAO/ICRC/ARS
	Millet	*Dimbi*	ICRC/ARS
	Groundnuts	*Sodari*	ICRC/ARS
		Gibeish	ICRC/ARS
	Sesame	*Promo*	ICRC/ARS/ DRC/FAO/JMRDP
		Herihri	ICRC/ARS
	Okra	*Climson*	FAO /ARS
		Pausa swasni	FAO /ARS
West Darfur	Sorghum	*Wad Ahmed*	ICRC/JMRDP/DRC/SMOA/SRC
		Fasikh	ICRC/JMRDP/DRC
		B9	SMOA/ SRC
		Sabiansawa	DRC/FAO/JMRDP/ARS
		Ajabsidu	DRC/FAO/JMRDP
	Millet	*Darmassa*	ICRC/JMRDP/DRC
		Bayoda	ICRC/JMRDP/ARS/DRC
		Beladi	DRC/FAO/JMRDP/ARS
		Melid Kawieye	DRC/FAO/JMRDP/ARS
	Groundnuts	*Sodari*	ICRC/JMRDP/DRC
	Potato	*Belini*	ICRC/JMRDP/DRC
	Cowpea	Local	ICRC/JMRDP/DRC

Most of the seed varieties used for multiplication are improved ones introduced by FAO/NGOs and the private companies. Improved varieties include sorghum, groundnuts, sweet potato, sesame and onion. For crops of cowpea, maize and okra both improved and local varieties were used. For

millet, about 80 percent of the seed was of local variety, which indicates that very little research has been done on millet, a crop which is highly cross-pollinated.

Figure 4.4. **Proportion of improved / local varieties for crops under multiplication**



Quantity of crop seeds produced with support from development partners: In the 2010 rainy season very few organizations in South and West Darfur were involved in seed multiplication and only sorghum, millet, maize and groundnuts were multiplied. In total, about 919.8 tonnes of seeds of the above four crops were produced, contributing a small quantity to the total seed sown in the entire Darfur region. **Table 4.4** below outlines the areas planted and quantities of seeds produced in the 2010 rainy season.

Table 4.4. **Area planted and quantity of seeds produced in 2010**

State	Crop	Area planted (*Fed**)	Seed production (tonnes)	Organizations involved	Percent of total production
South Darfur	Sorghum	165	49.3	AASC/ARS	4.9%
	Millet	270	109	AASC/ARS	10.9%
	Groundnuts	300	300	AASC/ARS	30.0%
	Maize	10	1.5	AASC/ARS	0.2%
	Groundnuts	746	460	Abu zar and Noor Centre	46.1%
	Millet				0.0%
	Sorghum				0.0%
	Onion				0.0%
	Maize				0.0%
Subtotal		**1 491**	**919.8**		**92.1%**
West Darfur	Sorghum	20	21.67	DRC/FAO/JRDP/ARS	2.2%
	Millet	20	13.2	DRC/FAO/JRDP/ARS	1.3%
	Groundnuts	80	43.68	DRC/FAO/JRDP/ARS	4.4%
Subtotal		**120**	**78.55**		**7.9%**
North Darfur	Okra	4	0	FAO/ICRC/ARS	0.0%
Total		**1 615**	**998.35**		100.0%

*Fed=*feddan*

Okra seed multiplication was implemented in the winter season of 2010/2011 and harvest of seed was not yet completed by the time of the assessment.

Seed processing: Complete and advanced seed processing, grading and packing units are lacking in Darfur region. At present four seed cleaners are available, three of them provided by FAO; there is one cleaner in each state managed by ARS in Al Fashir and Nyala and one by SMOA in Geneina.l G. The fourth seed cleaner belongs to SMOA in Nyala, South Darfur. The three seed cleaners provided by FAO are of medium size and are mainly being used for cleaning and sorting sorghum and millet seed. On average, 3 tonnes of sorghum/millet seeds are processed in one hour using the seed cleaner. Seed cleaning services are provided to humanitarian organizations, private companies and individuals. In 2009, SMOA in Geneina managed to clean and sort 100 tonnes of seeds for FAO and another 100 tonnes of seeds belonging to individuals. ARS in Nyala charges SDG 4 per 100 kg bag of millet/ sorghum for cleaning and sorting the seeds, both of them using seed cleaners provided by FAO.

Figure 4.5. **Seed cleaning**
ARS South Darfur – Seed produced by Abuzar Company

Figure 4.6. **Manual cleaning of groundnut seeds in South Darfur**

Seed storage, distribution and marketing: Most humanitarian organizations (UN and NGOs) rent stores from the private sector (mainly large traders) on a temporary basis, where they store seeds for a short period of time before redistributing them to their targeted beneficiaries. Few organizations have their own stores, with the exception of the DRC, which has a rub hall in Zalingi. All stores were described as good although rub halls are not appropriate for storing seed. In some cases there is no alternative and humanitarian organizations do not invest or build stores for temporary use; seeds are only stored for a short period of time before being distributed and are often fumigated before storage. Private companies have their own stores as well as rented spaces. The store capacities range from medium to large and are generally in good condition. Stores are located in the large towns of Nyala, Al Fashir, Geneina and Zalingi.

Most of the seeds produced with support from humanitarian organizations are recollected and bought by the organizations themselves from the contracted farmers (producers) at a premium of 20 to 25 percent above current market prices. The recollected seeds are then redistributed to needy farmers in the subsequent agricultural season. Some organizations such as WV adopted and supported the revolving seed bank system in which the initial seed stock is provided by the organization and the community manages the store and distributes the seeds to beneficiary farmers. After harvest, the beneficiaries are required to repay the seed. A farmer has to repay the same amount of seed given to him or her but no interest is owed to community banks, and the organization provides further support to the community to replenish and maintain the seed store.

The two private companies based in Nyala sell their seeds to FAO, NGOs and farmers. During the years 2008, 2009 and 2010, a total of 345.8 tonnes of seeds were sold by these two private companies whose customers come from South Darfur, West Darfur, and North Darfur states.

Seed testing and quality control: Farmers' field inspection is conducted by the ARS technical staff with involvement of the NSA. Sometimes, owing to security issues and problems of access, field inspection does not take place.

Seed laboratory testing used to be done by NSA in Khartoum, but ever since the laboratory was upgraded with FAO support in 2009, this role has been handled by ARS technical staff in Nyala. NSA has sent one of its technical staff members to join the ARS Nyala team to be involved in field inspection and laboratory testing activities.

Non-seed multiplication activities: Nearly all organizations that are members of the Food Security and Livelihoods Cluster are involved in different activities supporting food production, food security and livelihoods. These activities include seed and tool distribution. There are two methods of seed distribution: a) direct seed distribution to targeted beneficiaries with the involvement of community leaders and CBOs in the selection of beneficiaries, distribution and monitoring; and b) seed distribution using seed vouchers and the seed fair system. Farmer training and agricultural extension packages are often provided as part of the seed distribution process.

Another area of activity is environment rehabilitation and protection through the production and planting of tree seedlings. Livestock activities include animal vaccination, animal treatment, goat restocking and quality improvement through crossbreeding. Income-generating activities include agroprocessing, petty trades, community-based vegetable production and donkey carts.

4.4.5 Challenges of seed production and multiplication

Generally, the formal seed production and multiplication business is new in Darfur and supported by humanitarian organizations (mainly FAO and ICRC). Seed multiplication activities are largely focused on technical issues related to production aspects such as farmer training and provision of good quality seed inputs but little attention is given to post-production issues, particularly storage facilities, processing, laboratory testing and marketing. Nearly all the storages facilities used by Government, private sector or humanitarian organizations are used for storing grains or other commodities. A typical seed/grain store is a building made of bricks with poor ventilation; sometimes fumigation is conducted for buildings of humanitarian organizations. Seed processing remains far below standard and only recently have three medium-size seed cleaners been introduced by FAO and distributed to the three Darfur states, one in the capital of each state, for the support of the seed production business in the Darfur region.

The volume of formal seed production in Darfur (supported by humanitarian organizations with involvement of research institutions) is small, with an approximate total yield of 1 266 tonnes over

three years (2008–2010). The bulk of seed produced under humanitarian organizations is sold back to those organizations on an agreed upon arrangement. The current free seed distribution by NGOs as well as Government is hindering the local private sector from making a large investment in seed multiplication. Other challenges to seed production and multiplication in Darfur include the following:

- farmers' unwillingness to undertake soil conservation methods (e.g. organic manure making), despite loss of soil fertility on over-utilized small landholdings, especially in areas of Zalingi;
- low yields or failure due to biotic, these are mainly pest infestation (insects and birds), and abiotic stresses;
- dependence on family labour for production. The bulk of production activities are performed by women and children, usually too late in the season and hence the low yields;
- inaccessibility during the rainy season owing to impassable roads and *wadis,* causing difficulty in monitoring and provision of routine technical support;
- limited government support in areas of agricultural extension and pest control services;
- scarcity of foundation seed for some crop varieties;
- fund limitations;
- security problems hindering access and monitoring;
- as NSA sometimes cannot conduct field inspections owing to security reasons, seed certificates are not given to companies involved in seed production, and hence they cannot compete with seed companies in other parts of Sudan; and
- Abu zar Agricultural Services Centre sometimes faces a problem of selling out its seeds when the company fails to win the tender. When this happens, the company has no option other than to sell the seeds in the open market at grain price.

4.4.6 Opportunities of seed production and multiplication

The opportunities of seed production and multiplication include the following:

- Seed produced, bought back by NGOs and redistributed to communities provide the bulk of the seed requirements for community seed banks.
- Rural communities are willing to embrace community-based seed banks.
- There is a big market for seed within Darfur and in the neighbouring countries of Chad and Central Africa.
- More research could be conducted on improving local crop varieties or introducing new improved varieties adaptable to local conditions.
- The private sector could be increasingly involved in the seed-related business if field inspections and seed testing services are made available within easy reach.

V. Current Seed Security Situation in Darfur

5.1 INTRODUCTION

Darfur region has a very short growing season that normally begins in late June and ends in early October as the dry season sets in. The short season requires adoption of quickly-maturing varieties of most crops.

5.2 MOST WIDELY GROWN CROPS AND VARIETIES

Assessments revealed that the three most widely grown crops are pearl millet, groundnut and sorghum. Pearl millet is grown by over 90 percent of the farming households across the three states. It is followed by groundnut (73.4 percent); sorghum (42.1 percent); okra (21.8 percent); and watermelon (13.7 percent). The other remaining crops are grown by fewer than 10 percent of farming households (**Table 5.1**).

Millet and sorghum are the main staple food crops across Darfur region while groundnuts are typically considered income-generating crops. Other crops considered as income crops include vegetables such as tomato, okra and watermelon. Dry season vegetable production is popular with farmers who have access to reliable water sources. Vegetable production provides a much more regular source of income to the farmers who are involved in production throughout the year.

Table 5.1. **Proportion of household crops grown by state and type**

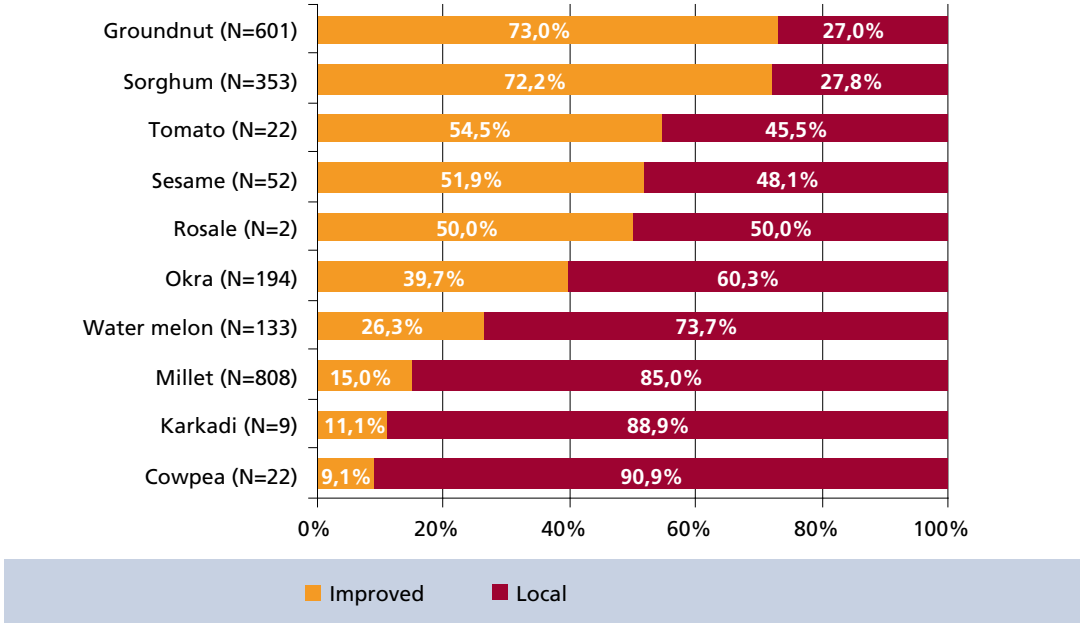
Crop	North Darfur	South Darfur	West Darfur	Regional average/total
Pearl millet	97.8%	85.8%	98.9%	94.1%
Groundnut	48.7%	87.6%	88.4%	74.9%
Sorghum	18.2%	61.8%	48.1%	42.7%
Okra	26.4%	3.7%	40.7%	23.6%
Watermelon	34.6%	0.0%	3.2%	12.6%
Sesame	12.3%	0.7%	6.3%	6.4%
Cowpea	3.3%	3.4%	2.1%	3.0%
Tomato	4.8%	0.0%	1.1%	2.0%
Roselle / Karkadi *(Hibiscus sabdariffa)*	3.3%	0.4%	0.0%	1.2%
N	**269**	**268**	**189**	**726**

5.3 USE OF IMPROVED VARIETIES VERSUS LOCAL LANDRACES

Although pearl millet is the most widely grown crop, only 15 percent of the farming households in Darfur are using improved varieties. The majority of households use improved varieties of groundnuts (73.0 percent), followed by sorghum (72.2 percent), tomato (54.5 percent) and sesame (51.2 percent). For the other crops, less than 40 percent of farmers are using improved varieties (**Figure 5.1**). Groundnut is popularly grown as an income-generating crop as it supplies the raw

material for oil processing cottage businesses in Darfur. The increase in popularity of improved groundnut varieties is due to its high oil content compared to that of the local varieties.

Figure 5.1. **Proportion of farming households using improved varieties**



5.4 SEED SECURITY AT HOUSEHOLD LEVEL (ACCESS, AVAILABILITY AND QUALITY)

Seed security issues were first scrutinized for the short term with questions such as how and where did farming households obtain seed for the main season 2010? Did they plant their usual quantity and quality of planting material? What do they assess as their seed security strategy and prospects for the 2011 season? (Note: seed system stability and resilience are assessed by reviewing multiple consecutive seasons).

5.4.1 Sources of seed planted in 2010

In Darfur, farming households obtain their seed from multiple sources such as their own saved seed, local grain/seed markets, social networks[6], seed aid from the Government and humanitarian and development partners[7], local seed banks and agro-input dealers. Overall, about 75 percent of farmers sowed seed from local channels including from own stocks, the local market, or social networks. Nearly half (44.1 percent) of farming households sourced seed from the local markets while some 27.6 percent used their own saved seed and only 2.6 percent sourced seed through social networks (**Table 5.2** and **5.3**). This demonstrates the importance of the informal seed system as the major seed source.

6 Social networks in seed sourcing include neighbours, friends and relatives (NFR).

7 UN, NGO and CBOs

Table 5.2. **Sources of crop seeds planted in the main season of 2010**

Crop	Market	Own	UN/NGO/ CBO	NFR	Gov.	Agro-inputs	Seed bank	Seed group	Total	N
Millet	45.1%	31.8%	19.1%	1.7%	1.4%	0.5%	0.0%	0.4%	100.0%	805
Groundnut	42.9%	27.0%	22.5%	1.3%	2.5%	1.7%	1.7%	0.3%	100%	599
Sorghum	44.2%	20.5%	25.1%	2.8%	4.6%	2.6%	0.0%	0.3%	100.%	351
Okra	40.0%	23.1%	30.3%	5.6%	0.5%	0.5%	0.0%	0.0%	100.0%	195
Watermelon	48.4%	32.8%	14.1%	3.9%	0.0%	0.8%	0.0%	0.0%	100.0%	128
Sesame	46.2%	19.2%	25.0%	9.6%	0.0%	0.0%	0.0%	0.0%	100.0%	52
Cowpea	45.5%	40.9%	4.5%	9.1%	0.0%	0.0%	0.0%	0.0%	100.0%	22
Tomato[8]*	36.8%	10.5%	36.8%	5.3%	5.3%	0.0%	5.3%	0.0%	100.0%	19
Roselle / Karkadi *(Hibiscus sabdariffa)*	44.4%	33.3%	0.0%	11.1%	0.0%	0.0%	0.0%	11.1%	100%	9
Average/ Total	43.7%	26.6%	19.7%	5.6%	1.6 %	0.7%	0.8%	1.3%	100%	2 180

Table 5.3. **Proportion of crop seeds planted in the main season of 2010 per state and locality**

State	Locality	Market	Own	UN/ NGO/ CBO	NFR	Gov.	Agro-input	Seed bank	Seed group	Total	N
North Darfur	Al Fashir	35.7%	33.9%	19.6%	7.1%	2.4%	0.6%	0.6%	0.0%	100%	168
	Alliat	46.0%	43.0%	0.0%	3.8%	1.1%	1.9%	3.8%	0.4%	100.00%	265
	Kabkabia	27.9%	42.6%	27.9%	1.5%	0.0%	0.0%	0.0%	0.0%	100%	68
	Malet	50.8%	29.2%	15.1%	4.9%	0.0%	0.0%	0.0%	0.0%	100.00%	305
	Subtotal	**40.1%**	**37.1%**	**15.7%**	**4.3%**	**0.9%**	**0.6%**	**1.1%**	**0.1%**	**100%**	**806**
South Darfur	Alsalam	62.4%	26.2%	8.1%	0.0%	1.4%	0.5%	0.0%	1.4%	100.00%	210
	Dimsu	69.4%	20.4%	8.2%	0.0%	2.0%	0.0%	0.0%	0.0%	100.00%	49
	Sheria	45.3%	15.1%	32.9%	0.4%	1.2%	5.0%	0.0%	0.0%	100%	258
	Tulus	58.5%	35.8%	1.9%	0.0%	0.6%	3.1%	0.0%	0.0%	100%	159
	Subtotal	**58.9%**	**24.4%**	**12.8%**	**0.1%**	**1.3%**	**2.1%**	**0.0%**	**0.4%**	**100.00%**	**676**
West Darfur	Habila	31.5%	9.4%	55.7%	2.0%	1.3%	0.0%	0.0%	0.0%	100%	149
	Kereink	28.4%	23.2%	36.0%	4.3%	7.6%	0.0%	0.0%	0.5%	100.00%	211
	Kulbus	34.0%	19.1%	43.8%	1.2%	0.6%	0.0%	0.0%	1.2%	100%	162
	Wadi Salih	38.5%	32.4%	21.2%	2.2%	5.6%	0.0%	0.0%	0.0%	100%	179
	Subtotal	**33.1%**	**21.0%**	**39.2%**	**2.4%**	**3.8%**	**0.0%**	**0.0%**	**0.4%**	**100%**	**701**
Average/ Total		**44.0%**	**27.5%**	**22.5%**	**2.3%**	**2.0%**	**1.4%**	**0.5%**	**0.3%**	**100%**	**2 183**

8 Sample size (N) is considerably low to make a conclusive decision.

Grain markets: Local grain markets are well spread across the Darfur region and act as the major source of seed to most households. The most frequently (N) sourced seeds from the local markets are pearl millet (41.5 percent), groundnuts (42.9 percent), sorghum (44.2 percent), okra (40.0 percent) and watermelon (48.4 percent). Coincidentally, the three most frequently sourced seeds by households are the most-traded grains in markets throughout Darfur. Most grain traders pointed out that the majority of their customers are individuals who sometimes buy grain for seed, particularly near and during the planting season.

Agro-inputs markets: It is important to note that most agro-input traders deal in vegetable seeds and a very limited quantity of grains, particularly improved varieties of sorghum. Only 2.6 and 1.7 percent of households sourced sorghum and groundnuts respectively from the agro-input dealers and less than 1 percent sourced vegetable seeds from them. The sample of households who indicated vegetables among the three major crops planted in 2010 is too small to make a conclusive statement on the source of vegetable seeds such as tomato (N=19), karkadi (N=9) and rosale (N=3). Although local market grain is one of major sources of okra seed, not very many traders in the grain markets deal in vegetable seeds. Therefore, there is a very high possibility that some of the respondents buying okra indicated "market" to mean buying from both the grain and agro-input dealers.

Own saved seeds: About 27.6 percent of the seeds planted in the 2011 main season are from farmers' own saved seeds. In most developing countries the majority of farming households depend on their own saved seed, particularly for cereals, legumes, oilseed crops and other easy-to-process vegetable seeds such as okra, watermelon and karkadi.

Social networks: Within the informal system, NFR appear to play an insignificant role in providing an alternative source of seeds to the farming households in Darfur. Only 2.6 percent of karkadi, and less than 1 percent of the other crop seeds come from the social networks. In most cases, access to seed through social networks logically depends on the presence of the farmers' own saved seeds.

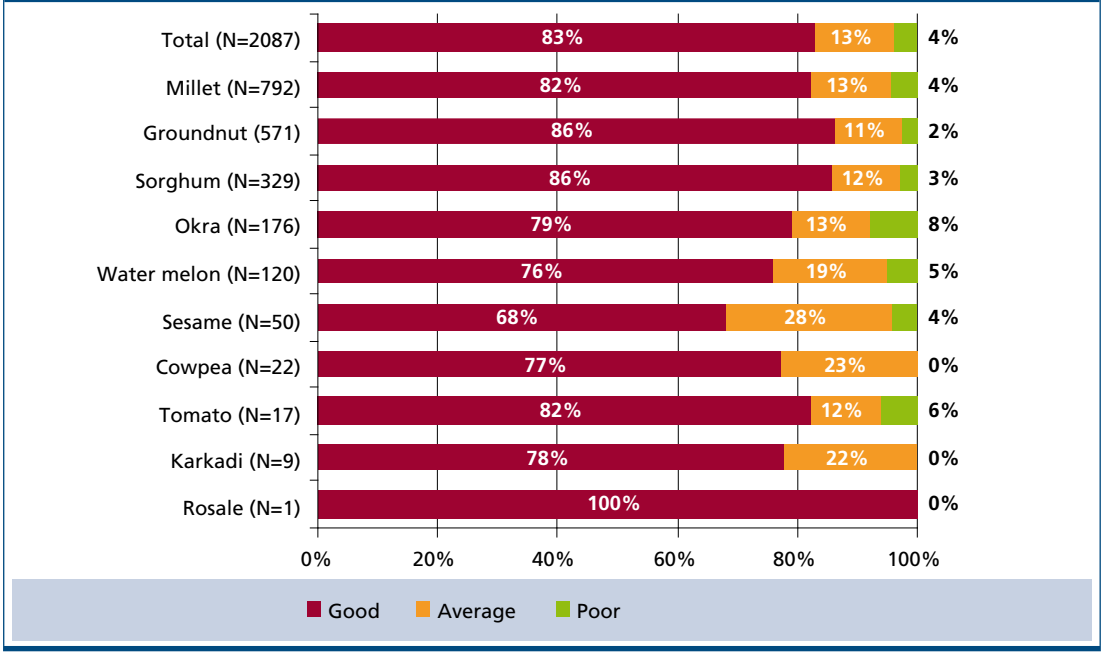
Seed aid: Seed aid tends to come through humanitarian response but sometimes through rehabilitation and development assistance from the Government and development partners such as the UN, NGOs and CBOs. The assessment revealed that slightly more than 20 percent of the seeds planted in 2010 by the farming households in Darfur came through seed aid. It is important to note that some of the seeds provided as seed aid are not necessarily from the formal sector. Experience has shown that in many cases, humanitarian assistance acquires seed from multiple sources such as local seed recollection, seed fairs and commercial suppliers or "seed companies". Therefore, both the informal and formal sectors contribute to the pool of seeds normally provided as seed aid. Interestingly, the grain traders in Darfur acknowledged that some so-called seed companies contracted to supply emergency seeds actually sourced both grains and seeds from them.

Seed production groups: Community-based groups most often mobilized by the Government and its development and rehabilitation partners (UN, NGOs and CBOs) provided only 0.3 percent of the seeds sown. Most development partners argue that the bulk of the seeds produced by the supported seed groups are recollected and channelled into the emergency response. According to FAO Sudan, the recollected seeds from the seed growers contribute to less than 3 percent of the total volume of the seeds provided in its emergency seed and tool distribution. In a nutshell, the impact of the community-based groups in availing seeds to the farming community is still very insignificant.

5.4.2 Quality of the seeds planted in 2010

Overall and across crops, 96 percent of the farmers were pleased with the quality of seeds they sowed, and this is evidenced both in the rating (**Figure 5.2**) and in their willingness to re-sow the seeds (**Figure 5.3).** In general, 83 percent of the farmers rated the seeds planted as good, with some 13 percent considering the seeds planted as average. More than 20 percent of those who planted cowpea and sesame rated the quality of the seeds planted as average while 8 percent of those who planted okra rated it as poor.

Figure 5.2. **Farmers' rating of the quality of seed planted in 2010**

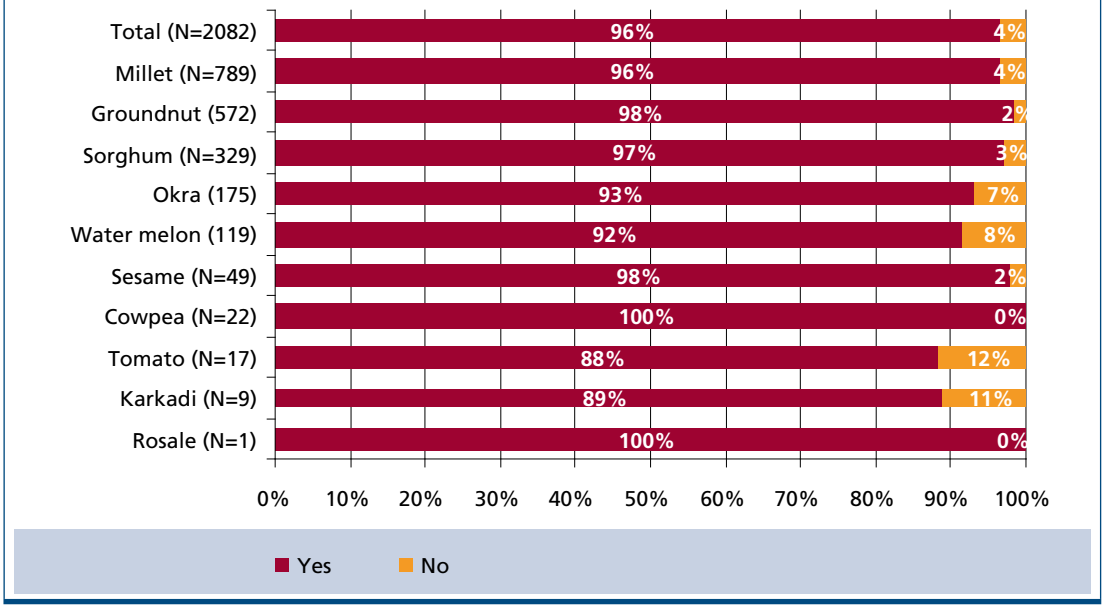


Crops	number of farmers	good	average	Poor	total
Millet	792	83%	13%	4%	100%
Groundnut	571	82%	13%	4%	100%
Sorghum	329	86%	11%	2%	100%
Okra	176	86%	12%	3%	100%
Watermelon	120	79%	13%	8%	100%
Sesame	50	76%	19%	5%	100%
Cowpea	22	68%	28%	4%	100%
Tomato	17	77%	23%	0%	100%
Karkadi	9	82%	12%	6%	100%
Rosale	1	78%	22%	0%	100%
Total	**2087**	**80%**	**17%**	**4%**	**100%**

5.4.3 Use of seeds from the previous harvest

Overall, 96 percent of the famers were willing to use the seeds harvested from the 2010 main season in the following planting season of 2011 (Figure 5.3). However, only about 10 percent of those who planted tomatoes and karkadi agreed to re-sow their seeds in the next season. The willingness of the farmers to re-sow seeds they acquired from the previous harvest depends on the acceptability of the varieties they have been exposed to over the years.

Figure 5.3. **Willingness of the farmers to sow their own seed from the previous harvest**



Crops	number of farmers	Yes	No	total
Millet	792	96%	4%	100%
Groundnut	571	96%	4%	100%
Sorghum	329	98%	2%	100%
Okra	176	97%	3%	100%
Watermelon	120	93%	7%	100%
Sesame	50	92%	8%	100%
Cowpea	22	98%	2%	100%
Tomato	17	100%	0%	100%
Karkadi	9	88%	12%	100%
Rosale	1	89%	11%	100%
Total	**2087**	**95%**	**5%**	**100%**

5.4.4 Changes in the quantity of seeds planted

In the 2010 main season, more than 60 percent of the farming households in Darfur planted either more or the same quantity of seeds of various crops compared to previous years. Over 20 percent of the farming households increased their planting of crops that included groundnuts, sesame, cowpea, tomato and karkadi, while 10–20 percent of the households increased their sowing of crops that included watermelon, okra, sorghum and pearl millet. A total of 31.1 percent of the farming households planted less than normal (**Table 5.4**).

Table 5.4. **Amount of seed planted in 2010 compared to norm by crop type**

Crops	Number of farmers	Farmers planting more (%)	Farmers planting same (%)	Farmers planting less (%)	Total (%)
Peal millet	675	18.8	45.3	35.9	100.0
Groundnuts	528	24.6	39.8	35.6	100.0
Sorghum	301	18.6	49.5	31.9	100.0
Okra	155	16.8	45.2	38.	100.
Watermelon	93	15.1	43.0	41.9	100.0
Sesame	45	22.2	51.1	26.7	100.0
Cowpea	22	31.8	36.4	31.8	100.0
Tomato	15	26.7	53.3	20.0	100.0
Karkadi	11	40.4	41.5	18.2	100
Overall	**1 845**	**23.9**	**45**	**31.1**	**100**

Whether a farmer planted less, the same or more than they normally plant is statistically associated with the gender of the household head and the state he/she lives in (**Table 5.5**). Each table has Chi-square statistics and associated level of statistical significance (p-value). More farmers from West Darfur (53.13) planted less than they normally plant, while 62.18 percent of the farmers from North Darfur and 82.72 percent of the farmers in South Darfur either planted more or the same as they usually plant. A significantly higher proportion (41.0 percent) of female-headed households planted less compared to the proportion (32.2 percent) of male-headed households. Lower planting could be partly attributed to acute seed stress.

Table 5.5. **Factors affecting relative seed amounts planted in 2010 vs. norm**

Factors	Number of farmers	Farmers planting less (%)	Farmers planting more (%)	Farmers planting same (%)
State				
a) North Darfur		37.83	19.30	42.88
b) South Darfur	648	17.28	23.46	59.26
c) West Darfur	544	53.13	18.38	28.49
Total	**1 845**	**35.12**	**20.49**	**44.39**
Chi-square =178.27, p<0.001				
Gender of household head				
a) Male	1 233	32.2	22.5	45.3
b) Female	612	41.0	16.5	42.5
Total	**1 845**	**35.1**	**20.5**	**44.4**

Chi-square =178.27, p<0.001.

Why farmers planted less: In both the 2010 and 2011 seasons, lack of land, shortage of seeds and lack of labour were the three main factors associated with farmers planting less than their norm.

These three factors appear to cut evenly across all the crops (**Table 5.6**) but varied significantly by state in both 2010 and 2011. In Both North and South Darfur, the major reason for reduced planting in 2010 was shortage of seeds (26.21 and 33.33 percent for North and South Darfur, respectively) while in West Darfur, the main problem associated with the 2010 reduced planting was lack of land (49.1 percent) followed by lack of money (**Table 5.7**). A similar trend was also observed in 2011 (**Table 5.8**).

Differences in amount to be planted in 2011 compared to norm (same, less or more): The table below indicates that among the 454 farmers who grow pearl millet, 41.9 percent reported that they are planning to plant the same acreage as in the previous season (2010), while 34.6 indicated that they are planning to plant more land than in 2010. The lowest percentage (23.5) of farmers mentioned that they are planning to plant less than they planted in 2010. The farmers' stated reasons include limited access to agricultural land, unavailability of labour, limited access to seeds, insufficient rainfall, lack of money, low market prices and insecurity.

For the 115 farmers who planned to grow groundnuts in 2011, 42.6 percent indicated that they were planning to plant the same size of land as in 2010. Thirty-two percent were planning to plant less acreage than in 2010. The reasons for this are the same for those given for pearl millet. However, the least number of farmers (25.2 percent) said that they were going to increase their planting from 2010, provided there will be availability of labour, seeds, good market prices, access to land and improvement in the security situation.

A significantly higher proportion (39.6 percent) of farmers who grow sorghum were planning to increase their planting in 2011, followed by 37.7 percent who planned to grow the same quantity, while 22.7 percent planned to cultivate less land due to insecurity, pest infections, lack of land, shortage of seeds and lack of money.

The majority of farmers who grow okra, watermelon, sesame and tomatoes indicated that they will plant the same or more of the crops in 2011 but their number was significantly low as compared to those who grow pearl millet, groundnuts and sorghum, the major crops in the region. Other crops like karkadi and cowpea were not listed among farmers' interests for 2011.

Table 5.6. **Planting estimates for 2011 vs. baseline 2010**

Crops	Number of farmers	Farmers planting more (%)	Farmers planting same (%)	Farmers planting less (%)	Total (%)
Pearl millet	454	34.6	41.9	23.5	100
Groundnuts	115	25.2	42.6	32.2	100
Sorghum	53	39.6	37.7	22.7	100
Okra	26	23.3	61.5	15.3	100.
Watermelon	4	0	100	0	0
Sesame	4	50	50	0	100
Tomato	8	25	25	50	100
Overall	**664**	**28.2**	**51.2**	**20.5**	**100.**

In terms of the states, overall a high proportion of respondents (40.5 percent) indicated that they were planning to plant the same size of land in terms of crop size and type, while 32.9 percent said that they were planning to plant more crops; the smallest group of respondents (26.6 percent) planned to plant fewer crops than they did in 2010.

Apart from West Darfur, where the majority (42.7 percent) of farmers indicated that that they were planning to plant less in 2011, the majority of farmers in North Darfur (39.8 percent) and South Darfur (54.1 percent) said they would plant the same crops in 2011 as they did in 2010. In West Darfur the reasons cited for planting less include shortage/high cost of seeds, lack of land, shortage of labour, poor rainfall, pest infections, high cost of land preparations and insecurity.

Table 5.7. **Projection of 2011 planting quantities vs. 2010 by state**

State	Number of farmers	Farmers planting less (%)	Farmers planting more (%)	Farmers planting same (%)
North Darfur	239	28.0	32.2	39.8
South Darfur	237	9.2	36.7	54.1
West Darfur	188	42.7	29.7	27.6
Total	**664**	**26.6**	**32.9**	**40.5**

Table 5.8. **Reasons cited for planting reductions in 2010 and 2011**

Reasons	2010 (planted)		2011 (to be planted)	
	Number of times cited	Percent	Number of times cited	Percent
Lack of land	150	26.83	**82**	**22.97**
Shortage / poor quality seeds	108	19.32	**71**	**19.89**
Lack of money	81	14.49	**41**	**11.48**
Shortage of labour	70	12.52	**71**	**19.89**
Poor rainfall	49	8.77	**20**	**5.60**
Pest problem	44	7.87	**23**	**6.44**
Insecurity	35	6.26	**16**	**4.48**
Lack of land/seed/money	15	2.68	**9**	**2.52**
High cost of seed	3	0.54	**8**	**2.24**
Sickness/old age	-	-	**9**	**2.52**
Lack of plough	-	-	**5**	**1.40**
Low productivity	3	0.54	-	-
Late in the season	1	0.18	-	-
Low market price	-	-	**1**	**0.28**
Others	-	-	**1**	**0.28**
Grand Total	**559**	**100.0**	**357**	**100**

Table 5.9. **Reasons cited for reduced planting in 2010 by state**

Reason	North Darfur (%)	South Darfur (%)	West Darfur (%)	Total (%)
Lack of land	4.37	10.71	49.07	26.83
Shortage / poor quality seeds	26.21	33.33	9.67	19.32
Lack of money	16.5	17.86	11.9	14.49
Shortage of labour	19.9	13.1	6.69	12.52
Poor rainfall	17.48	2.38	4.09	8.77
Pest problem	12.14	3.57	5.95	7.87
Insecurity	0.97	17.86	6.69	6.26
Lack of land/seed/ money	-	1.19	5.2	2.68
High cost of seed	1.46	-	-	0.54
Low productivity	0.97	-	0.37	0.54
Late in the season	-	-	0.37	0.18
Total (%)	100	100	100	100
Number of times cited	213	86	282	581

Table 5.10. **Reasons cited for projected reduced planting in 2011 by state**

Reasons	North Darfur (%)	South Darfur (%)	West Darfur (%)	Total (%)
Lack of land	3.57	11.63	48.32	21.17
Shortage of seed	32.86	23.26	10.07	22.06
Shortage of labour	26.43	18.6	0.67	15.23
Lack of money	15.71	11.63	9.4	12.25
Pest problem	8.57	4.65	6.04	6.42
Poor rainfall	7.86	11.63	2.68	7.39
Insecurity	-	11.63	7.38	6.33
Limited land/labour	1.43	-	4.7	2.04
Sickness/old age	2.86	2.33	2.68	2.62
High cost of seed	0.71	2.33	4.03	2.36
Lack of ploughs	-	-	3.36	1.12
Low market price	-	2.33	0	0.77
Access to inputs	-	-	0.67	0.22
Total	100	100.0	100	100.00

Why farmers planted more seeds: The main reasons why some farmers in 2010 planted more than what they normally plant were: access to seed (20.95 percent); availability of family labour (18.39 percent) and prospects for good rain (14. 57 percent).

In 2011 the main factors for planting more seeds included labour availability, access to land and the need to increase production (**Table 5.11**)

Table 5.11. **Reasons cited for increased 2010 planting**

Reasons cited (2010)	North Darfur (%)	South Darfur (%)	West Darfur (%)	Total (%)
Access to seeds	25.53	21.05	16.25	20.94
Availability of labour	29.79	7.89	17.5	18.39
Good rainfall	23.4	7.89	12.5	14.60
Good market price/income	11.7	15.79	8.75	12.08
Access to land	7.45	10.53	17.5	11.83
Increased production	2.13	7.89	8.75	6.26
Improved security	-	14.04	1.25	5.10
Access to ploughs/tools	-	-	15	5
Good variety	-	9.65	-	3.22
Access to money	-	5.26	2.5	2.59
Total	100	100	100	100

Table 5.12. **Reasons cited for increased projected planting in 2011**

Reason	North Darfur (%)	South Darfur (%)	West Darfur (%)	Overall (%)
Availability of labour	29.5	6.04	12.5	16.01
Access to land	12.95	4.7	39.77	19.14
Increase production	13.67	16.78	17.05	15.83
Good rainfall	14.39	20.81	9.09	14.76
Good market price/income	10.07	20.13	13.64	14.61
Access to seed	17.99	12.08	5.68	11.92
Access to money	1.44	5.37	2.27	3.03
Good variety	-	8.05	-	2.68
Improved security	-	5.37	-	1.79
Access to inputs	-	0.67	-	0.22
Total	100	100	100	100

5.4.5 Access to new varieties

Farming households have had access to new seed varieties over the last six years and the trend appears to be increasing over time, with the majority of farming households receiving the new varieties in 2010. Overall, over 85 percent of farmers grew new varieties they obtained between 2005 and 2010 (**Table 5.13**). Access to new varieties, particularly to those that have been improved

for high yields and disease resistance, is one of the elements that potentially can increase the overall productivity of farming households in Darfur.

Table 5.13. **Percentage of farmers who planted new seed varieties obtained (2005–2010)**

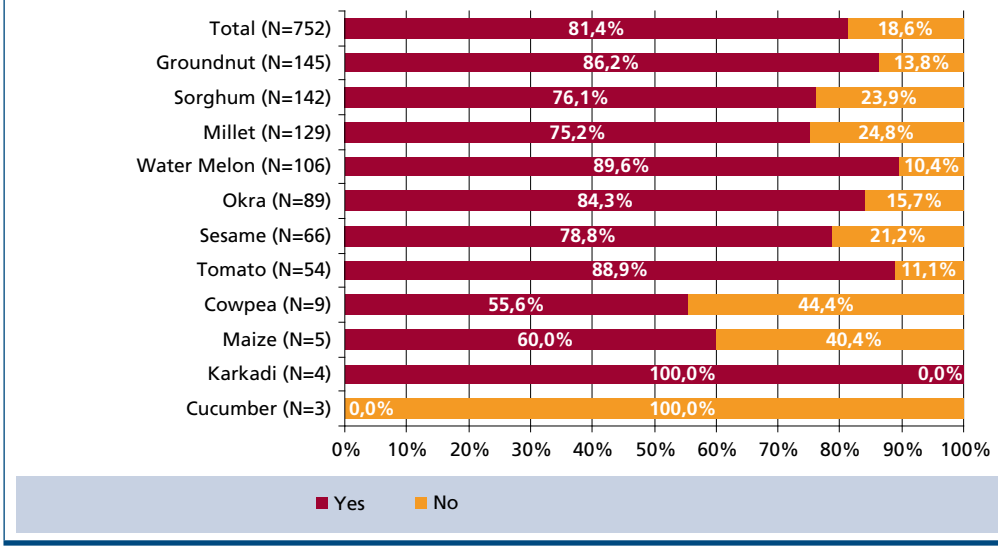
Crops	Number of farmers	Farmers who planted new varieties obtained in year (%)					
		2005	2006	2007	2008	2009	2010
Groundnut	146	0.68	8.22	17.12	19.86	21.92	32.19
Sorghum	139	6.47	8.63	11.51	19.42	26.62	27.34
Millet	129	4.65	15.50	12.40	17.83	13.18	36.43
Watermelon	98	0.00	21.43	17.35	21.43	20.41	19.39
Okra	88	1.14	9.09	21.59	17.05	29.55	21.59
Sesame	62	1.61	6.45	25.81	12.90	32.26	20.97
Tomato	55	0.00	14.55	29.09	27.27	23.64	5.45
Cowpea	8	0.00	12.50	0.00	62.50	12.50	12.50
Maize	5	0.00	0.00	0.00	20.00	0.00	80.00
Roselle / Karkadi *(Hibiscus sabdariffa)*	5	0.00	40.00	0.00	20.00	0.00	40.00
Cucumber	3	0.00	0.00	0.00	66.67	33.33	0.00
Total/average	**738***	1.32	12.39	12.26	27.72	19.4	26.89

*Note: Farmers who did not know the year the varieties were acquired were excluded from the analysis. Some farmers planted more than one variety, so the total number of farmers will change from table to table

5.4.6 Replanting of the same varieties in the next season

As in most traditional systems where famers use their own seed, about 80 percent of those who had access to new varieties were willing to continue using them for replanting in subsequent seasons (**Fig. 5.4**). North Darfur had the least number (74 percent) of farmers who would replant the same varieties while West Darfur had the highest percentage (87 percent).

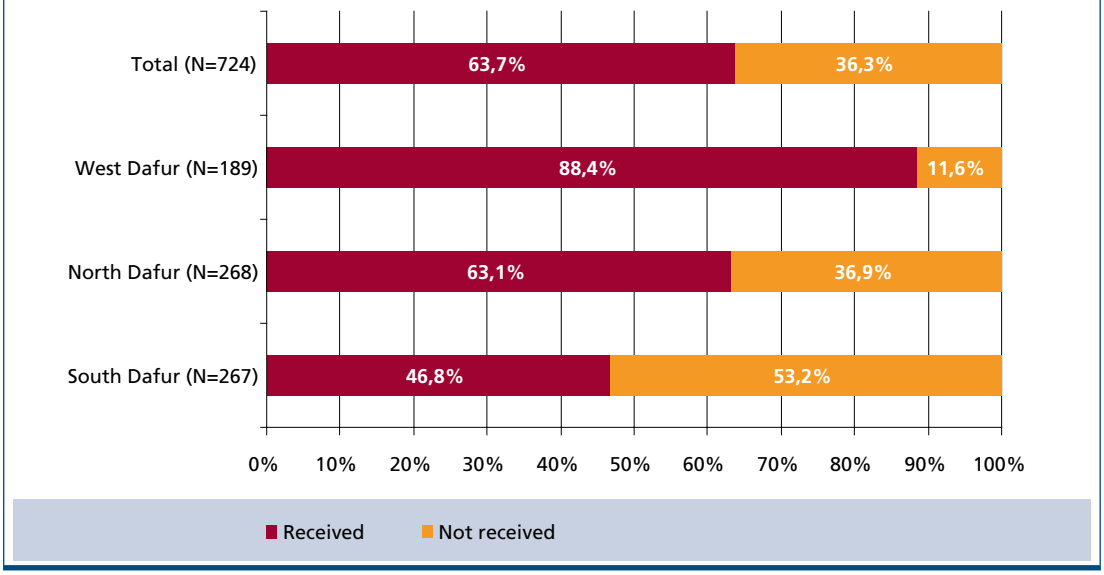
Figure 5.4. **Percentage of farmers who would replant the same varieties in the next season**



5.4.7 Seed aid

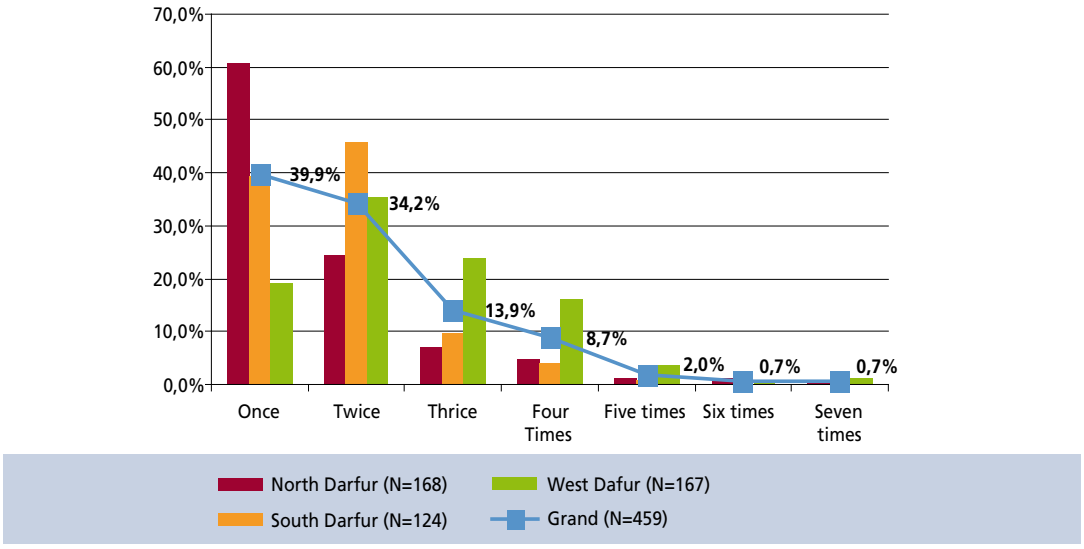
For most seed aid assistance, the supporting institution and/or organization normally assumes that seed is either not available within the target location or that some section of the community lacks access to seeds of most staple crops. In Darfur, as in many vulnerable regions in the world, seed assistance continues to be provided by development partners on a repeated basis. The assessment revealed that overall, 63.7 percent of farming households in Darfur have received seed aid at some time over the past five years, with significant variations in the proportion within the three states (**Figure 5.5**). Nearly all (88.4 percent) of the farming households in West Darfur have received seed aid while 63.1 and 46.8 percent of the households interviewed in North and South Darfur received seed aid, respectively.

Figure 5.5. **Proportion of farming households who have received seed aid in Darfur (2006–2010)**



About 74.1 percent of the seed aid beneficiaries have received seed aid once or twice over the five years 2006–2010, while about 22.6 percent received the aid three and four times (**Figure 5.6**).

Figure 5.6. **Number of times beneficiaries received seed aid over five years (2006–2010)**



5.4.8 Fertilizer and manure use

In general, use of inorganic fertilizers and organic manure is still low in Darfur, with significant variation across the states. On average, only about 6.1 percent of the farming households have ever used organic fertilizers, although a relatively higher proportion (8.8 percent) indicated having used inorganic fertilizers.

A higher proportion (15.7 percent) of the farming households has used organic manure compared to use of inorganic fertilizer on crops. A relatively higher proportion (23.4 percent) of farming households in South Darfur have used organic manure in their fields (**Figure 5.7**). The majority of farmers are not using either inorganic or organic fertilizer/manure for the following reasons: a) it is not available; b) they have no knowledge about fertilizers; c) it is not necessary for them to use; and d) it is too expensive (**Table 5.14**). In North Darfur, lack of knowledge (48.6 percent) followed by unavailability of the fertilizers (26.1 percent) were frequently cited as the main reasons, while some 19 percent considered use of inorganic fertilizer unnecessary. In South Darfur, unavailability (28.0 percent), lack of technical know-how (28 percent), consideration of the fertilizer as unnecessary (24.7 percent) and high cost of fertilizer (14.8 percent) were among the top-rated reasons. On the other hand, in West Darfur unavailability, high cost, consideration of the fertilizer as not necessary and high cost of fertilizers were the most-cited reasons.

Figure 5.7. **General use of inorganic fertilizers and organic fertilizers/manure in Darfur**

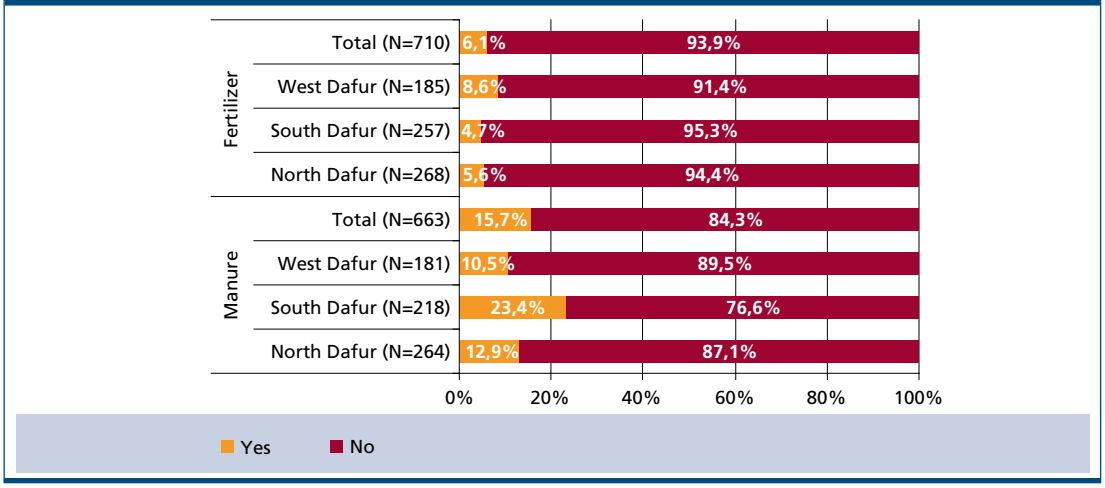


Table 5.14. **Reasons why majority of farmers are not using fertilizers**

Reasons	North Darfur	South Darfur	West Darfur	Overall
a) Not available	26.1%	31.7%	39.6%	32.47%
b) No knowledge	48.6%	28.0%	6.5%	27.70%
c) Not necessary	19.0%	24.7%	29.0%	24.23%
d) Expensive	5.1%	14.8%	22.5%	14.13%
e) Others	1.2%	0.4%	1.8%	1.13%
f) Not profitable	0.0%	0.4%	0.6%	.33%
g) Not allowed	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%
Frequency	253	243	169	665

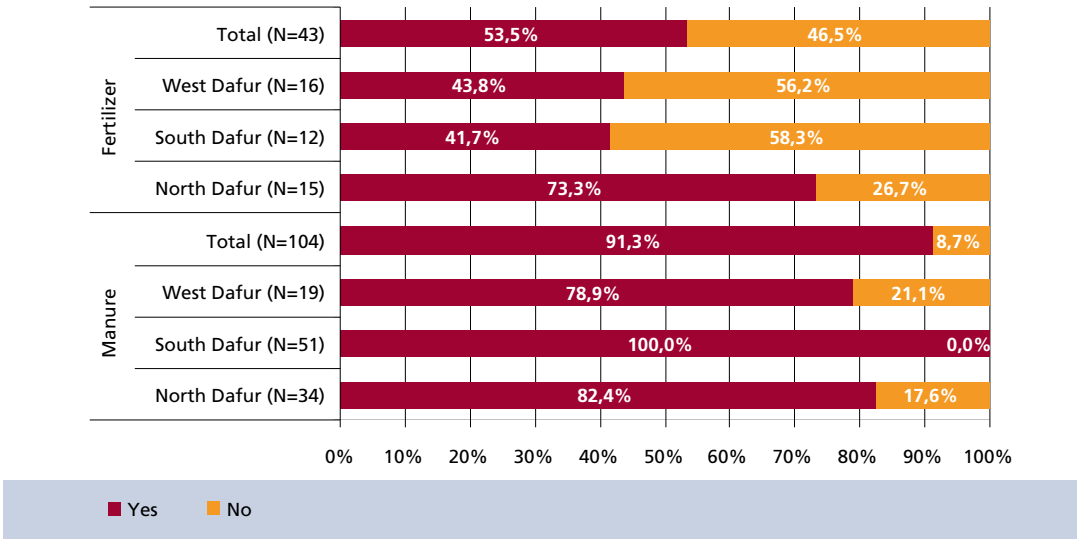
The four major reasons why farmers are not using organic manure include: a) lack of technical know-how, (b) perception that it is not necessary; c) difficulty obtaining a sufficient quantity to manure their fields (Table 5.15). Lack of technical know-how was repeatedly expressed in North Darfur while the perception that organic manure application is not necessary was a top concern in South Darfur. On the other hand, difficulty in obtaining organic manure was frequently cited as the reason why farmers in West Darfur are not using organic manure.

Table 5.15. **Reasons why majority of the farmers are not using organic manure in Darfur**

Reasons	North Darfur	South Darfur	West Darfur	Overall
a) No knowledge	68.3%	14.7%	1.9%	28.30%
b) Not necessary	20.7%	51.5%	26.6%	32.93%
c) Difficulty in obtaining enough	7.5%	31.9%	61.4%	33.60%
d) Expensive	1.3%	1.8%	5.1%	2.73%
e) Not profitable	0.9%	0.0%	1.3%	0.73%
f) Not allowed	0.9%	0.0%	0.0%	0.30%
g) Others	0.4%	0.0%	3.8%	1.40%
Total	100.0%	100.0%	100.0%	100%
Frequency	227	163	158	548

Among the farmers who have ever used fertilizers, a total of only 53.5 percent used fertilizers in the 2010 seasons. This varied from state to state with the highest users registered in North Darfur (73.3 percent) while West and South Darfur users stood at 43.8 and 41.7 percent, respectively. A significantly higher proportion (91.3 percent) of the farmers continues to use manure (**Figure 5.8**). The fact that some have not used fertilizer over the past five years could partly be attributed to unavailability and/or poor access owing to high costs; lack of proper technical knowledge could lead to under or over application of the product leading to high cost and low production.

Figure 5.8. **Farmers using fertilizer and manures in 2010 as percentage of all users**



5.5 FUNCTIONING OF GRAIN/SEED TRADE IN DARFUR

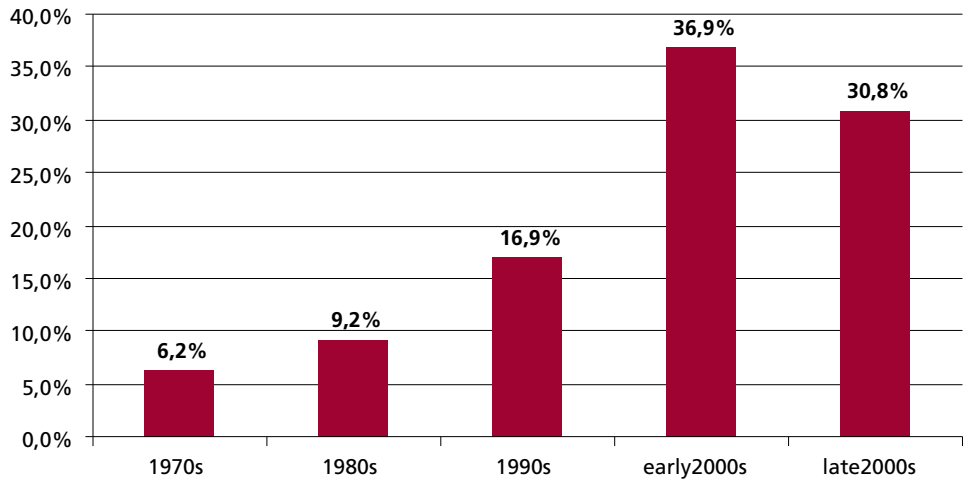
One of the main sources of seed in Darfur is the local market. In most developing countries, where there are no well-established chains of seed stockists, grain markets provide alternative sources of seed to those in need. Farmers have their own ways of selecting grain for seed. The seed security assessment in Darfur looked at the functioning of both the agro-inputs and grain market in providing alternative sources of seed to farming communities within the states.

5.5.1 Grain/seed trade business profile

Trade in grain normally consists of chains of supply and outlets. The big markets such as Nyala, Geneina and Al Fashir are supplied by wholesale traders who source grains from within Darfur states as well as from other states. Retail grain traders normally obtain their supply from the wholesale traders in the major markets.

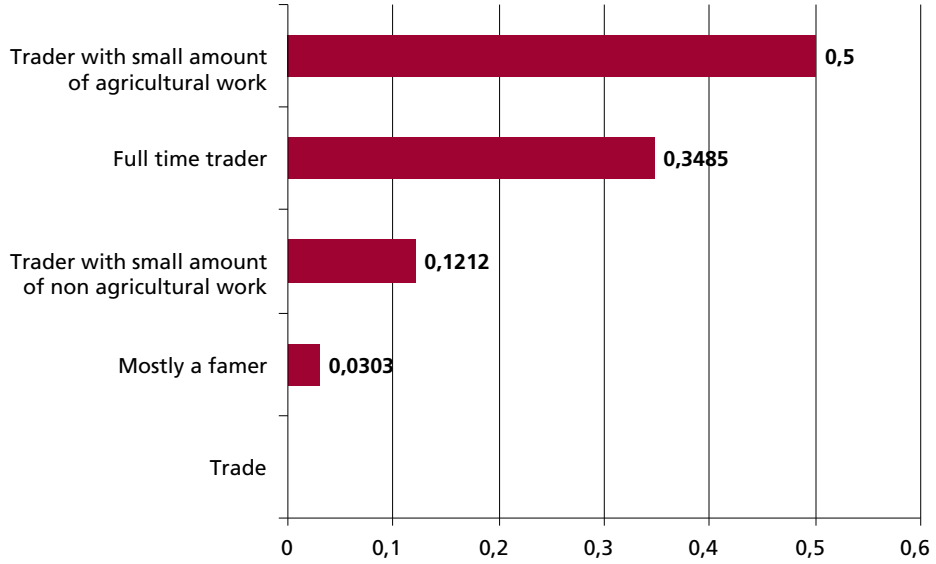
Of the grain markets visited, the majority (67 percent) of grain/seed dealers started their businesses between 2000 and 2011. Slightly more started their businesses in the early 2000s (2000–2005) than in the late 2000s (2006–2009). About 16 percent of the traders have been in the business for more than 20 years (**Figure 5.9**). The grain/seed trade in Darfur is dominated by males, with about 65 percent of dealers being men.

Figure 5.9. **Years traders started business**



About half (50 percent) of the grain/seed vendors are traders who also do a small amount of agriculture-related work to supplement their trade while 35.85 percent of the vendors are full-time traders (**Figure 5.10**). With 53.3 percent of the grain traders doing some agricultural work, the chance of providing quality grain for seed is much higher in Darfur.

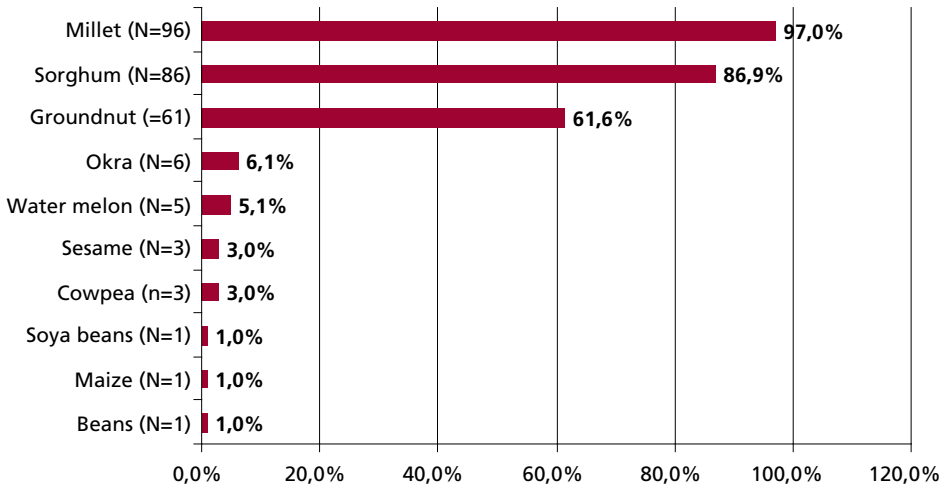
Figure 5.10. **Characteristics of grain traders**



5.5.2 Most-traded grains/seeds and their sources

In Darfur, the most-traded grain/seed in the markets is millet, traded by nearly all (97.0 percent) of the grain traders interviewed. This is followed by sorghum (82.8 percent) and groundnuts (58.6 percent). Less than 7 percent of the traders dealt in the other crops (**Figure 5.11**).

Figure 5.11. **Percentage of the traders dealing in a particular grain**



Overall, 41.34 percent of the grains/seeds are sourced from farmers, 28.2 percent from those who collect directly from the farmers and 20.86 percent from other traders. Although the traders' own production contributes only 6.83 percent to seed sources, 33.3 percent of okra seed comes from farmers' own production. Most traders (80 percent) selling watermelon get the seed directly from the farmers (**Table 5.16**).

Table 5.16. **Suppliers of grains to the grain traders**

Crop	Farmers	Collectors	Other traders	Own production	Whole-salers	Others	N
Millet	51.7%	20.0%	15.8%	11.7%	0.8%	0.0%	120
Sorghum	50.5%	22.0%	11.0%	11.0%	3.3%	2.2%	91
Groundnuts	56.2%	23.3%	6.8%	12.3%	1.4%	0.0%	73
Okra	33.3%	16.7%	16.7%	33.3%	0.0%	0.0%	6
Watermelon	80.0%	0.0%	0.0%	0.0%	20.0%	0.0%	5
Sesame	25.0%	50.0%	25.0%	0.0%	0.0%	0.0%	4
Cowpea	66.7%	0.0%	33.3%	0.0%	0.0%	0.0%	3
Soya beans	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1
Maize	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	1
Beans	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	2
Total	41.34%	28.20%	20.86%	6.83%	2.55%	0.22%	306

Over 95 percent of the grain traders (mostly retailers) indicated that they source their grains locally from within the Darfur region while about 2 percent of them have sourced millet, sorghum and groundnuts from either Central African Republic and/or Chad (**Table 5.17**). Up to 87 percent of the traders indicated that the agro-ecological conditions of their grain/seed sources are quite similar to the areas where their grains/seeds are sold.

Table 5.17. **Geographic locations where grains/seeds are sourced**

Grain/seed type	Darfur	Other Sudan states	Central African Republic/Chad	N
Pearl Millet	97.0%	1.0%	2.0%	100
Sorghum	97.5%	1.2%	1.2%	81
Groundnut	95.8%	0.0%	4.2%	71
Okra	100.0%	0.0%	0.0%	8
Watermelon	100.0%	0.0%	0.0%	4
Sesame	75.0%	0.0%	25.0%	4
Cowpea	100.0%	0.0%	0.0%	2
Maize	100.0%	0.0%	0.0%	1
Beans	100.0%	0.0%	0.0%	2
Total/average	96.14%	0.24%	3.6%	273

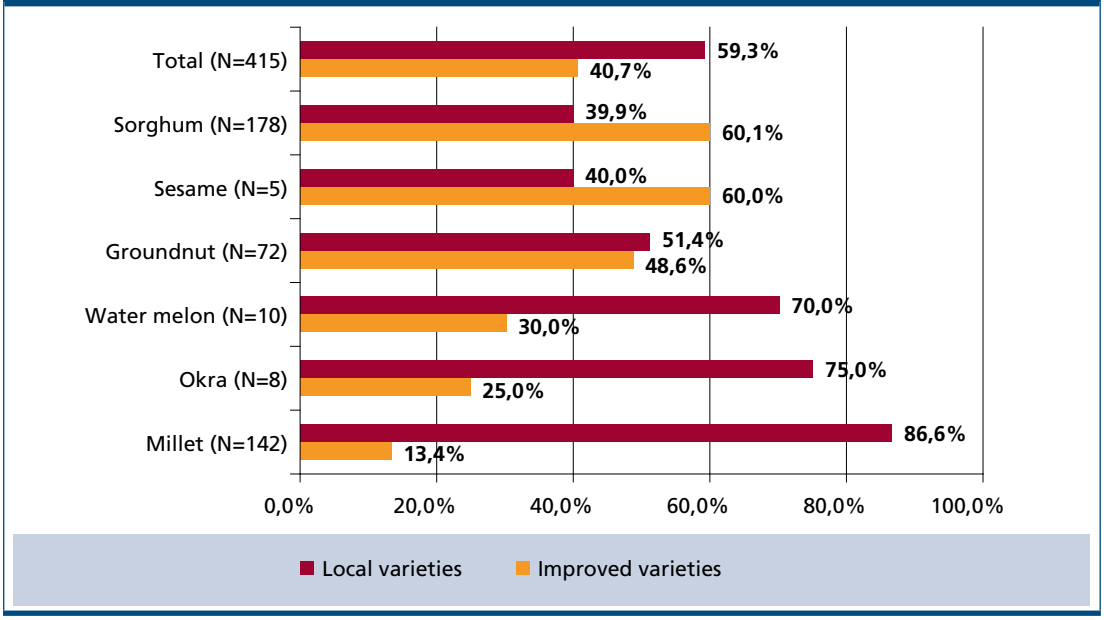
Although most of the traders obtain their supply from within the three Darfur states, it is important to recognize the role being played by the wholesalers and other traders. Most of these operate within state capitals and supply the grain markets from beyond the Darfur states.

In North Darfur, because a very limited quantity of sorghum is produced, the traders rely on a supply from other states. For example, a key informant[9] interviewed in Umdafsou market, Al Fashir, North Darfur estimated that up to 50 percent of the sorghum traded in the market comes from Gadaref state, some 30 percent from North Kordofan state and the remaining 20 percent is from local producers within the state. On average, the market receives about 30 tonnes of groundnuts per week during a good season.

5.5.3 Availability of improved varieties in the markets

Relatively, 40.7 percent of grains/seeds in the markets are improved varieties of the various crops; about 60 percent of sorghum and sesame varieties are improved. Some 48.6 percent of the traders who deal in groundnuts use improved varieties (**Figure 5.12**). Although pearl millet is considered the main crop in Darfur region, most of the varieties are of local origin. This is well noted within the grain markets, where up to 86.6 percent of the varieties of pearl millet displayed by the grain traders are local.

Figure 5.12. **Relative proportion of improved and local varieties in the grain/seed markets**



The most popular variety of sorghum in Umdafsou market in Al Fashir is '*Fetriet*', which takes up to 70 percent of the total volume of grain in the market; this is followed by '*Tabat*' (25 percent) and '*Debar*' (5 percent). '*Fetriet*' is commonly used as animal feed.

Pearl millet is one of the common crops found with the traders in all the three states of Darfur. It is widely grown and consumed by the local population. Pearl millet comes mainly from the local producers within the Darfur states. There are three major varieties; white, which constitutes about 70 percent of the pearl millet in the market; yellow, which constitutes 20 percent; and red, which comprises only 10 percent of all pearl millet on the market. Most of the customers prefer the white varieties for consumption.

5.5.4 Volume of the grain trade in Darfur

The grain traders in the markets in Darfur region had varying volumes of grains/seeds. Overall, 79.36 percent of traders had 1–10 bags of grains/seeds; 10.16 percent had 11–50 bags; 4.4 percent had between 51–100 bags; and 6.38 percent of the traders had more than 100 bags of the various grains/seeds (**Table 5.18**).

9 Market administrator

Table 5.18. **Quantity of grains/seeds of traders at the time of the assessment**

Crop[10]	1–5 bags	6–10 bags	11–20 bags	21–50 bags	51–100 bags	>100 bags	N
Pearl millet	31.2%	11.8%	10.8%	23.7%	16.1%	6.5%	93
Sorghum	35.0%	21.3%	11.3%	21.3%	6.3%	5.0%	80
Groundnuts	22.4%	5.2%	6.9%	27.6%	19.0%	19.0%	58
Okra	60.0%	40.0%	0.0%	0.0%	0.0%	0.0%	5
Watermelon	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%	3
Sesame	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3
Cowpea	66.7%	0.0%	0.0%	0.0%	0.0%	33.3%	3
Soya beans	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Maize	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Beans	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Total/average	**68.20%**	**11.16%**	**2.90%**	**7.26%**	**4.14%**	**6.38%**	**248**

Table 5.19. **Quantity of grains/seeds sourced on a monthly basis**

Crops	1–5 bags	6–10 bags	11–20 bags	21–50 bags	51–100 bags	>100 bags	Total
Pearl millet	15.1%	20.6%	6.9%	26.0%	12.3%	19.2%	73
Sorghum	24.2%	22.6%	22.6%	6.5%	12.9%	11.3%	62
Groundnuts	15.0%	12.5%	5.0%	17.5%	15.0%	35.0%	40
Okra	40.0%	20.0%	0.0%	0.0%	20.0%	20.0%	5
Cowpea	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	2
Sesame	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2
Watermelon	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Soya beans	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Beans	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Maize	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
Total	**64.43%**	**12.57%**	**3.45%**	**5.00%**	**6.02%**	**8.55%**	**188**

5.5.5 Grain/seed trade customers

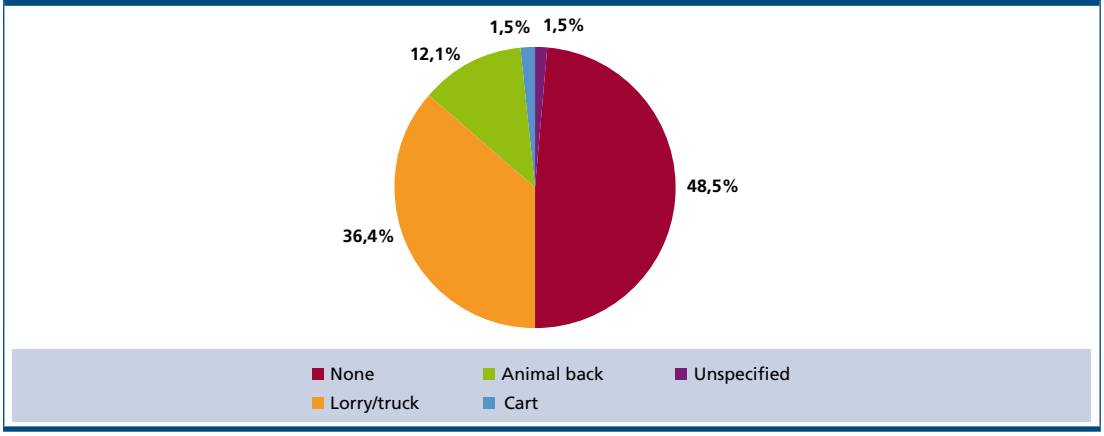
Grain trading is popular in all the major towns in Darfur state and provides both food and an alternative source of seeds to farmers during the planting season. Although the bulk of the grains is offered for home consumption, most traders agree that a significant amount is bought as seed during the planting season. Typically, most of this seed is bought by individuals, but occasionally some seed companies also procure grains to supply relief and rehabilitation organizations for their emergency seeds distribution programmes.

10 Approximate weight of each bag of grains/seeds: pearl millet=90–100 kg; sorghum=80–90 kg; groundnuts (unshelled)=40–45 kg; okra=70–80 kg; watermelon=50–60 kg; sesame=10–110 kg; cowpea=70–80 kg; soybean=90–100 kg; maize=90–100 kg; beans=90–100 kg

5.5.6 Grain/seed trade infrastructure and logistics

Transportation and storage: Access to transport and storage facilities are very important in any trade. About 51.5 percent of the grain/seed traders have access to transport facilities and only 16.67 percent have their own transport means. The most common means of transport of grains/seeds is motor vehicle (lorry/truck) used by about 36.4 percent of the traders, followed by use of animals (12.1 percent) (**Figure 5.13**).

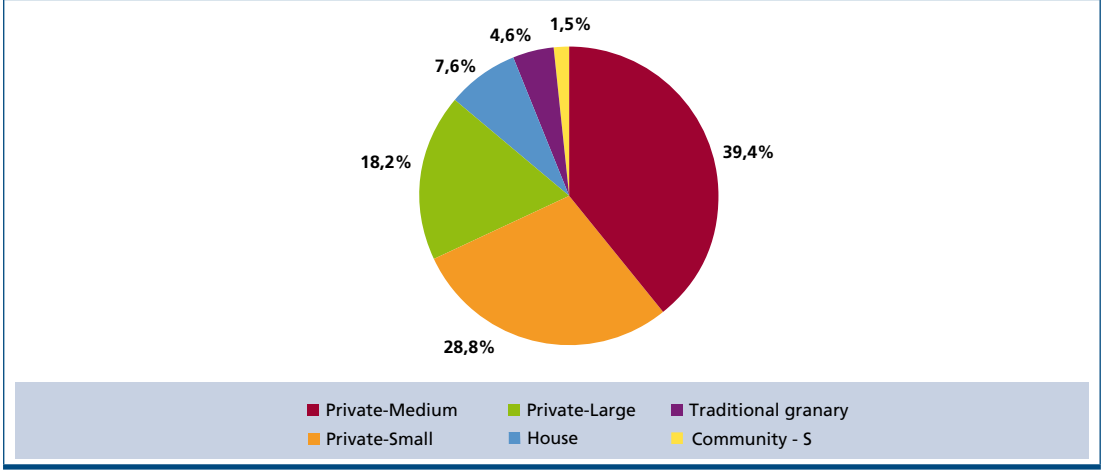
Figure 5.13. **Transport means commonly used by grain traders**



A significant number of grain/seed traders (48.5 percent) do not use any means to transport their grain due to the specialized nature of the grain trade within the Darfur region, where retailers' stores are located within a few metres of their storage facilities. In most cases it is the wholesalers who play a key role in transporting grains to their stores.

Nearly all (98 percent) of the traders have access to storage facilities, with 86.4 percent having access to privately-owned storage structures of varying sizes, i.e. medium[11] (39.4 percent), [12]small (28.8 percent) and large[13] (18.2 percent). Some 7.6 percent, 4.6 percent and 1.5 percent of the traders store their grains/seeds in their houses, local granaries[14] and community stores, respectively. Most storage structures within the markets are permanent.

Figure 5.14. **Access to different types of storage facilities by the grain/seed traders**



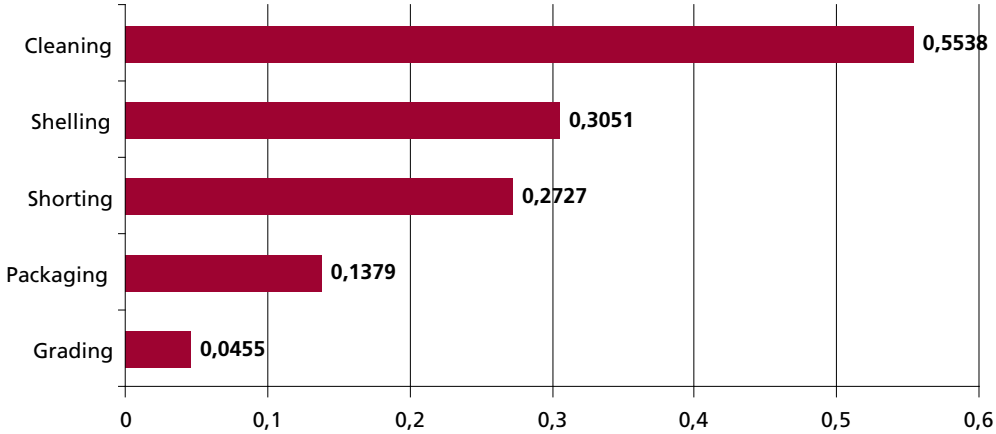
11 Medium-sized stores have an estimated storage capacity of 10–20 tonnes.
12 Small-sized stores have an estimated storage capacity of 2–10 tonnes.
13 Large-sized stores have an estimated storage capacity of >20 tonnes.
14 Local granaries store between 0.5–1 tonnes depending on the size.

Although nearly all the traders have access to storage facilities, only 48 percent own the structures. Slightly more than half (52 percent) of the traders rent their facilities at a cost of SDG 30–180, depending on the location, nature and size of the of the storage facilities.

5.5.7 Seed grain quality

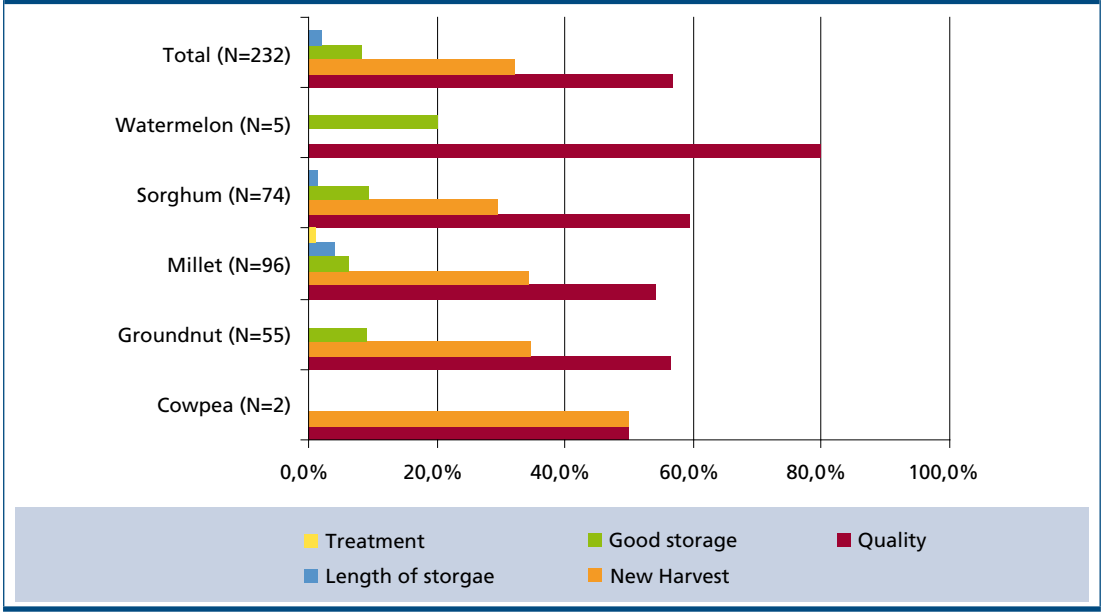
Traders engage in cleaning, shelling and sorting their grains in order to attract customers, although sorting and packaging are considered practices that minimize pest infestation of the products in storage. Slightly more than half (55.4 percent) of the traders clean their grains/seed, 30.5 percent shell it, 27.3 percent sort their grains, while less than 20 percent either package or grade it for sale (**Fig. 5.15**).

Figure 5.15. **Percentage of the traders carrying out grain/seed conditioning**



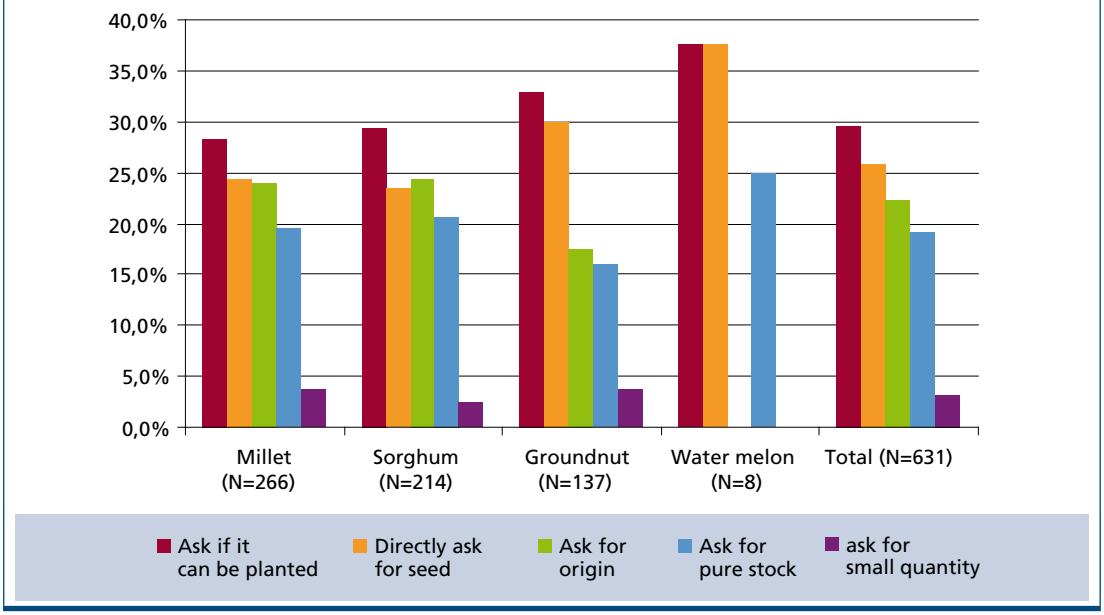
Recognition of some seed quality parameters by the grain traders helps in meeting farmers' demand for grains as seed. About 77.08 percent of respondents were able to distinguish grains from seeds. Overall, 56.9 percent of those who distinguish grain from seed based their selection on key quality parameters such as uniformity in size, colour of the grains and cleanliness. Other considerations for distinguishing grains from seeds include newly harvested products (32.3 percent) and good storage of the products (8.2 percent) (**Fig. 5.16**). Rarely do grain traders consider treating their products specifically for seed because the primary purpose of the grains in the market is for food. Both quality and new harvest are key features in qualifying the cowpea grain as seed.

Figure 5.16. **How traders distinguish grains from seeds**



Over 90 percent of the grain traders in Darfur acknowledge that farmers sometimes buy grains for seeds, particularly towards and during the planting season. Generally, farmers ask traders the following: if the grains can be planted as seeds (29.6 percent); the origin of the grains/seeds (22.3 percent); directly request seeds (25.8 percent); or request a pure stock of a given crop variety (19.1 percent) (Fig. 5.17). This normally happens before and during the planting season, which normally runs from June to September.

Figure 5.17. **How traders know farmers are buying/want seeds**



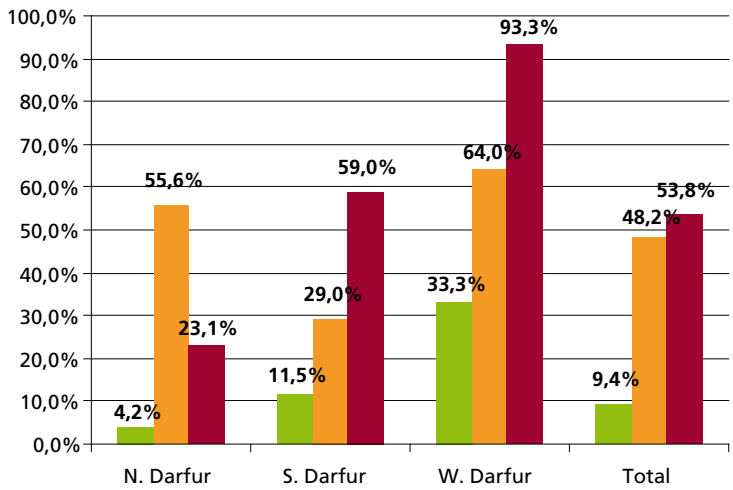
5.5.8 Factors that affect availability and access to grain/seed in Darfur

Grain/seed trading increases the potential sources of seeds in areas affected by natural disasters and human-induced conflict. Availability and access to grains/seeds in Darfur highly depend on factors such as conflict, drought, incidence of crop pests and diseases (**Fig. 5.18**), price fluctuation, taxation and cost of transportation.

Conflict plays a critical role in the traders' access to grains as well as in the availability of grains/seeds in the market; about 53.8 percent of the traders agree that conflict is the major contributing factor to access and availability of the grains/seeds in the market. However, the magnitude of this varies from state to state with conflict-related concerns well cited in West Darfur (93.3 percent) and South Darfur (59.0 percent).

After conflict, drought is considered to be the second largest concern, with 48.8 percent of traders naming it as a limiting factor to access and availability of grains. This was expressed in West Darfur by 64.0 percent of traders and in North Darfur by 55.6 percent. Traders were also keen to recognize biotic stressors, particularly pests and diseases, which not only impact productivity of the crops but also limit availability of significant quantities of grains/seeds on the markets.

Figure 5.18. **Factors affecting grain/seed availability and access**



Changes in the price of any good may have a significant impact on access to products by the final consumer. In Darfur, a significant price increase in most grains was noted by the traders preceding and during the planting season; the assessment revealed a general increase by about 34.3 percent in the price of grains at that time. However, this varies by crop and from state to state (**Table 5.20**). Price increases normally have a negative impact on the resource-poor farmers who sometimes depend on the grain market as their primary source for specific types of crop seeds and varieties.

Table 5.20. **Mean percentage increase in prices of agricultural commodities in Darfur**

Crop	South Darfur	West Darfur	North Darfur	Total/average
Pearl millet	36.4%	17.7%	18.8%	24.30%
Sorghum	52.8%	31.1%	17.9%	33.93%
Groundnuts	65.3%	22.5%	23.9%	37.23%
Okra	-	19.4%	30.0%	24.70%
Watermelon	42.9%	-	26.5%	34.70%
Sesame	44.2%	-	-	44.2%
Cowpea	61.5%	-	-	61.5%
Beans	-	-	25.0%	25.0%
Total/average	**50.5%**	**22.7%**	**23.7%**	**30.9%**

Other factors that were considered to be affecting the operation of the grain/seed traders in Darfur include multiple taxations along their trade routes, poor access roads and poor access to credit facilities.

5.6 AGRODEALER OPERATIONS IN DARFUR

In Darfur region, there are a number of registered agro-input dealers in the major towns such as Nyala, Al Fashir and Geneina. In Nyala, South Darfur, there are five major agro-input dealers while in Al Fashir, North Darfur, there are four specialized dealers of agro-inputs. In both states, there are a number of dealers who operate both agro-input and vet-input shops besides the specialized inputs.

There are no associations of agro-input dealers in the region and the dealers operate independently of each other. Most operate both as retail and wholesale shops and deal in a range of products such as vegetable seeds, staple crop seeds, fertilizers and agro-chemicals (fungicides and insecticides), and offer hand tools and equipment such as knapsacks, hand sprayers, watering cans and donkey ploughs. Items such as vegetable seeds, fertilizers and agro-chemicals are normally sourced from Khartoum while crop seeds and some hand tools are sourced from various areas within the country.

5.6.1 Vegetable seeds

More than ten types of vegetable seed are sold on the market by the agro-input dealers in Darfur. The most popular of these include watermelon, tomato, okra, cucumber, onion, *girgir*, eggplant, radish, green pepper and carrot. Some of the most common and popular varieties are indicated in **Table 5.21** below. Most of these are improved varieties produced in countries such France, Holland, the United States and India, although seeds of some varieties of okra, radish and watermelon are considered to be produced within Sudan.

Table 5.21. **Common types of vegetable seeds and varieties on the market in Darfur**

Vegetable	Variety	Popular ranking
Watermelon	*Crimson Sweet*	1
	Charleston Grey	2
	Congo	3
Tomato	*Castle Rock*	1
	Rio Grande	2
	Supper Strain	3
	Petro III	4
	Petro 86	5
Okra	*Pousa Swani*	1
	Clemson Spineless	2
	Bhindi Champion	4
	Baledi (local)	3
Onion	Yellow	
Eggplant	*Black Beauty*	1
	Early Long Purple	2
Carrots	*Redco*	
	Chantenary Red Cored	1
	Cored 2	2
Cucumber	*Supper Zagross* hybrid	1
	Silca (local)	2
Melon	*Ananas Etra* hybrid	-
		-
Green pepper	*California Wonder*	-
Radish		

The majority of agro-input dealers in the state capitals source vegetable seeds from companies in Khartoum. The seeds are mainly sold to both individual farmers (retailers) as well as other smaller traders (wholesalers) from the different localities within the state. In North Darfur, the smaller traders mainly come from areas such Kutum, Kabkabia, Malet and Dar-es-Salaam, hence amplifying the market outlets from the state capital.

The demand for vegetable seeds varies significantly within seasons and from year to year. According to Hafiz Adburahman, the proprietor of Almuzdalifa for Agriculture Services in Al Fashir, higher prices are normally charged at the beginning of the rainy season (i.e. between June and July) when the demand for vegetable seeds is high, whereas in the subsequent months of September to December, very few customers in Al Fashir demand vegetable seeds. Yearly fluctuation in demand for vegetable seeds depends much on the rainfall pattern and distribution. In years when rain is good, the demand for vegetable seeds is considered high. For instance, the demand for vegetable seeds in 2008 was considered low compared to 2009 (medium) and 2010 (high). This was mainly attributed to rainfall distribution and amounts.

5.6.2 Crop seeds

The major crop seeds sold by the agro-input dealers are sorghum, pearl millet and cowpea, with a number of varieties offered. Agro-input dealers carry four main improved varieties of sorghum in Al Fashir, i.e., *'Tabat,' 'Arfra Gandmk,' 'Hagien'* and *'Wad Ahamed'*. Very limited quantities of pearl millet are carried by agro-input dealers. This is attributed to the fact that the farmers already have a dozen well-adapted local varieties, and stocking them would not attract significant numbers of customers. The proportion of each variety to the total stock held by the dealers (**Table 5.22**) is determined by the popularity of the grain and its demand from the farmers.

Table 5.22. **Crop varieties with agro-input dealers in Al Fashir and Nyala**

Crop	Varieties	Type	Estimated percent of total stock	Price per kg (SDG)
Sorghum	*Tabat*	Improved	50%	4-5
	Arfa Gandamk	Improved	20%	8
	Hagein	Improved	15%	4
	Wad Ahamed	Improved	15%	4
Millet	*Umbayata* (white)	Local	-	4
	Red	Local	-	3.5
	Yellow	Local	-	3.5

All the improved sorghum varieties are sourced from the seed companies based in Khartoum, although the traders noted that most of the varieties are grown in Gezira state. Millet seeds are sourced locally during harvest season from farmers who have clean and uniform grain of the different varieties. The demand for these seeds normally peaks at the beginning of the rainy season, which forces the suppliers to slightly increase the prices from 20–30 percent.

5.6.3 Inorganic fertilizers

The majority of the local agro-input dealers have good stock of inorganic fertilizers. The most widely popular and available fertilizer is Urea, used in the production of onions and other vegetable crops in the winter season. Liquid fertilizers such as Tabat Nebras 11-8-6+TE (nitrogen: phosphorous: calcium + trace elements) are also common on the market with agro-input dealers. These are mainly used as foliar fertilizers on leafy vegetables such as amaranth, cabbage and kale.

5.6.4 Agrochemicals (pesticides)

Agrochemicals are a common sight on the counters of most agro-input dealers. Most of these chemicals are in the categories of insecticides used for control of field and storage pests and fungi. The most common are; Confidor, Servin (Carbaryl); Bayleton 25WP, Thiram 25%DP, Malathion 57%EC, and Cypermethrin 25%EC

Table 5.23. **Some of the agrochemicals on the shelves of agro-inputs dealers in Darfur**

Common Name	Active ingredients	Classification	Common use
Confidor	• Imidacloprid • Ethanol • Propanol/butane	Insecticide–systemic, broad-based	Field pests: controls aphids, mealy bugs, scale, thrips, whitefly and other sucking insects on ornamentals, roses and vegetables
Carbosulfan 25%EC	• 2,3-dihydro-2,2-dincethyl-7-benzofuranyl		
Decis 50% EC	• Deltamethrin		
Baythroid 50% EC	• Cylluthrin	Insecticide	Control of field and storage pests
Malathion 57%EC	• *S*-1,2-bis (ethoxycarbonyl) ethyl *O,O*-dimethyl phosphorodithioate	Insecticide	Control of storage pests
Diazenon 60% EC	• Diazinon	Acaricide–insecticide contact, broad-based	Insects and mites
Bayleton 25% WP	• Thiamethoxan	Fungicide	
Servin (Carbaryl) 85% DP	• Carbaryl		
Thiram 25% DP	• Tetramethylthiuram disulfide	Fungicide – contact, broad-based,	
Phostoxin (Celphose) 57% w/w	• Aluminium phosphide	Fumigant- wide spectrum	Control of storage pests

The agro-input dealers in all the locations visited noted that Malathion is becoming less effective in the control of most field pests. This could be the result of development of pest resistance due to repeated and unprofessional use of the insecticide. Use of Servin in a powder (dust) form could pose great environmental danger, especially in areas where beekeeping is common.

5.6.5 Equipment

An array of equipment ranging from simple hand tools (hoes, pangas, sickles, etc.), chemical application equipment (knapsacks and hand sprayers), and animal traction equipment (ploughs) is usually stocked by the agro-input dealers.

5.6.6 Provision of credit to farmers

Agro-input dealers mentioned that they give credit to individual farmers for all types of inputs; the loans are usually paid in cash with no interest.

5.7 AGROPROCESSING IN DARFUR: AL FASHIR LOCALITY STUDY

In most developing countries, establishment of agroprocessing enterprises offer an opportunity for agricultural expansion. The agroprocessing enterprises provide an avenue for value addition, which increases profitability and enhances product competition at national, regional and international levels. However, in order to meet the demand of any medium- to large-scale agro-enterprise, there is need to have reliable and sustainable sources of the raw materials. This calls for increased agricultural production and productivity. Increasing productivity in most developing countries partly depends on the use of high-yielding, disease-resistant and drought-tolerant varieties. The identified varieties need to be suitable for a given soil type but there is also specific need for soil and water resource management, adequate knowledge of agronomic practices, control/management of pests and diseases, and proper post-harvest handling.

5.7.1 'Large'-scale oil processing in Al Fashir

Groundnuts are one of the three major crops widely grown in Darfur both for food and income generation. There are a number of medium- to large-scale groundnut processing units in Darfur that offer reliable market and/or opportunity for the small-scale famers to either process or sell their products. A typical example of a large-scale unit is the processing plant owned by Al Shroug Oil Company in the outskirts of Al Fashir, which receives the bulk of its raw materials from South Darfur due to the limited level of production in North Darfur. Although the bulk of groundnuts processed by Al Shroug comes from South Darfur, the centrality of the unit allows the company to meet internal demand as well as supply the surrounding states of South Darfur, West Darfur and North Kordofan.

Figure 5.19. **Women feeding the oil processing machine (left) and young man packaging oil for sale**

Al Shroug Oil Company's operation of the two processing units is dependant on the availability of the raw materials. At full capacity (24 hrs/day), the unit is able to process a maximum of 8 000 kg of groundnuts with an estimated oil output of 4 000 litres (approximately 3 000 kg) per day. The cost-benefit analysis of the oil processing unit showed that a large-scale processor adds up to 32.8 percent to the unit value of the groundnuts compared to 22.57 percent for a small-sale processor (**Table 5.24**).

The oil produced by the company is normally marketed within the three Darfur states as well as the neighbouring states such as North Kordofan. About 90 percent of the cake is bought by the traders from Omdurman and other northern towns and the remaining 10 percent is bought by local livestock owners as feed.

Table 5.24. **Cost-benefit analysis of oil processing at maximum capacity per day**

Items	Unit	Quantity	Unit cost (SDG)	Total value (SDG)
Production cost				
a) Raw materials (groundnuts)	Kg	8 000	3.3	26 400
b) Labour	persons	30	30	900
c) Packaging containers (jerrycans)	Pcs	200	5	1 000
d) Other costs		1	500	500
Subtotal				28 300
Value of the products				
a) Output (oil)	Litres	4 000	7	28 000
b) Cake	Kg	4 480	2	8 960
Subtotal				36 960
Gross Margin				**8 660**
Value-added				**32.8%**

Figure 5.20. **Groundnut oil (left) and the by-product (cake) ready for market**

From the proprietor's point of view, some of the key challenges include:

a) low level of groundnut production that prevents work at full capacity;
b) very limited volume of sesame;
c) lack of and/or difficulty getting spare parts; and
d) low oil output per unit volume of groundnuts (estimated at 37.5 percent). This could be attributed to either low extraction efficiency of the machines or low oil content or a combination of both.

5.7.2 'Medium'-scale oil processing in Al Fashir

The Cooperation Union for Al Fashir locality was established ten years ago to assist the farmers to process their oilseed crops, particularly groundnuts and sesame. Unlike the large-scale processing units, the medium-scale units provide services to two categories of famers:

- those who can afford to pay in cash: these farmers are required to pay at least SDG 180 for every 1 tonne of groundnut processed. The farmers then take all the oil and the cake by-product.
- those who do not have cash and are provided the service in exchange for cake valued at about SDG 200.

The cost-benefit analysis of small-scale processing shows that a farmer who engages in processing groundnuts into oil adds up to 22.57 percent of the value of his product (**Table 5.25**).

Table 5.25. **Cost-benefit analysis for a farmer who takes groundnut for processing**

Items	Unit	Quantity	Unit cost (SDG)	Total value (SDG)
Production cost				
a) Raw materials (groundnut)	Kg	1 000	3.3	3 300
b) Processing	Kg	1 000	0.18	180
c) Packaging containers (jerrycans)	Pcs	23	5	115
Other costs		1	100	100
Subtotal				**3 595**
a) Value of the products				
b) Output (oil)	Litres	460	7	3 220
c) Cake	Kg	560	2	1 120
Subtotal				**4 340**
Gross margin				745
Value added				22.57%

Figure 5.21. **Medium-scale oil processing unit in Al Fashir**

5.7.3 Opportunity for supporting livestock production

The availability of groundnut cake offers opportunity for supporting the commercial poultry production within Darfur region. Currently more than 80 percent of the chicken and eggs sold in Darfur come from outside the region, particularly from Omdurman.

VI. Conclusion and Recommendations

6.1 CONCLUSION

Multiple indicators relating to the access, availability and quality of seed in Darfur suggest that seed security overall is good and projected to remain so in the near future. The major channel through which farmers access their seed is the informal seed system with some contribution from the formal seed sector within and outside Darfur. In addition, a significant proportion of farming households are growing improved varieties of crops such as groundnuts, sesame and sorghum, hence demonstrating the silent contribution of the formal seed sector in improving food security in Darfur. It is quite interesting to note that over the years, significant quantities of improved varieties have been moved into the Darfur region through seed aid by the Government and humanitarian and development partners, hence contributing to their spread. The contribution of the local grain/seed market to improving availability is enormous; therefore, the possibility of improving grain quality needs to be further explored. The existence and operation of the agro-input dealers is another element that has the potential to enable farmers to access quality seed of adopted crop and vegetable varieties.

The potential to stimulate agricultural development and demand for quality seed of cereal crops and oilseed is enormous and needs to be further explored, particularly through support to medium-scale oil processing and poultry production. The medium- and large-scale oil processing enterprises in Al Fashir are living examples of how support to agroprocessing and value addition can contribute to the economic empowerment of households in Darfur, hence contributing to the national economy.

In spite of the positive seed security situation and the potential to stimulate agricultural development, the negative elements of insecurity, the short and erratic rainfall, and other biotic factors could put Darfur at high risk of sliding into acute seed insecurity. Therefore, these factors should be closely monitored and if possible, mitigated, to avoid any future backslide.

6.2 RECOMMENDATIONS

6.2.1 Research and development agenda for plant breeding

There is a well-established agricultural research system in Sudan catering to the different needs of the various agro-ecologies. However, with respect to supporting the farming communities in Darfur, the following should be taken into consideration:

- A formal plant breeding programme should be directed at improving pearl millet, using the available rich diversity of the local landraces. Germplasm collections of pearl millet varieties from Darfur need to be validated against the current varieties being grown. Emphasis could be placed on yield, resistance to drought and pests, particularly birds, and meeting the preference of the consumers.
- Groundnuts and sesame are considered income crops by many in Darfur. There is a need for an oilseed programme to continue breeding for groundnut and sesame varieties with high oil content that are adapted to the major groundnut- and sesame-growing agro-ecologies in Darfur.
- Short-maturing crops such as cowpea and beans should be further improved, tested and promoted to diversify the food basket of the farming households in Darfur.

6.2.2 Decentralized seed production

Access to basic or foundation seed for multiplication is still very low in Darfur, forcing many of those involved in seed multiplication to resort to using certified seeds of improved varieties coming

mainly from the north. The introduction of seed cleaners in Darfur is one step towards improving quality seed production in the region. However, the following actions need to be further taken as part of the effort in supporting decentralized quality seed production:

- Deliberate efforts should be directed at establishing basic Government seed centres at the existing ARS in Darfur.
- Initiatives such as the community-based multiplication system should focus on multiplying crops in which the private sector has limited interest, if their major objective is to increase availability and access. Focus could therefore be directed at crops such as cowpea, sesame, okra and sweet potato on a revolving seed loan basis using the seed bank approach.
- Where the objective of the community-based seed multiplication is to enhance the income level of the seed growers, the production and supplies should not be tied to humanitarian organizations as the major market. A market-oriented approach should therefore be promoted.
- Seed processing should further be upgraded by the introduction of appropriate grading and packaging technologies. Options such as the use of super grain bags and small packs should be explored and tested by those supporting decentralized seed production activities.

Improved seed field inspection and certification: More importantly, the services of the NSA should be extended to Darfur to provide technical support to the certification of various crop varieties being multiplied in Darfur.

6.2.3 Seed security issues at household level

The seed security situation at household level in Darfur could be described as normal with some level of vulnerability, particularly among women-headed households. Although fewer than 30 percent of the faming households use their own seed, the well-established grain trade provides an alternative source of seed where a significant proportion (44.1 percent) of households can still access seed of their choice. The presence of both agro-input dealers and seed growers provides an opportunity for alternative sources of seed, although it is still little accessed or recognized by the farmers.

Seed security assessment: Any future seed aid assistance should be based on assessed needs identified using the most appropriate tool to check and validate issues related to availability, access and quality of seed.

Use of vouchers for improving access: Where there is need to provide pearl millet, sorghum, groundnuts and/or vegetables to vulnerable populations in Darfur, the traders, who normally carry out some acceptable conditioning of the grain for seed, and agro-input dealers should be involved in providing inputs to the target beneficiaries through vouchers. However, this should only be used where beneficiaries are in close proximity to the grain traders and the agro-input dealers.

Input trade fairs: In situations where the intended beneficiaries have poor access to the grain/seed markets, grain traders, agro-input dealers and community-based seed groups could be mobilized to participate in input trade fairs. The beneficiaries are provided with vouchers to access the seed from various sources. However, proper quality checks will have to be put in place if this kind of arrangement is to be effective.

Direct seed distribution should only be used in exceptional situations such as where there is total crop failure and/or massive population displacement due to conflict. This intervention should be made after an assessment of the seed needs of the affected population within a given geographical location.

6.2.4 Agro-inputs in the markets

Much as there is an impressive presence of the agro-input dealers in Darfur, the concern about proper use and human and environmental risk as a result of improper use of these inputs should not be underrated. Therefore, mechanisms that will allow access and proper use of these inputs need to be put in place.

The following are therefore recommended for further action:

- **Baseline study on the use of agrochemicals:** To avoid the improper use and negative impact of agrochemicals and fertilizers on the environment, a baseline study needs to be instituted on the use and application of pesticides in Darfur.
- **Sensitization and educating farmers on the use and dangers of pesticides and fertilizers:** A number of hazardous chemicals such as Carbaryl, Phosphides, Malathion, Diazion and others are on the shelves of agro-input dealers. Some of these chemicals require proper handling and safe use by the consumers to avoid any long-term residual effects on the consumers as well as the environment. Therefore, a concerted effort should be directed at sensitizing the masses on the use and handling of the chemicals.
- **Training of agro-input dealers:** There is need to train agro-input dealers on the safe handling (transportation, storage, packaging and disposals) of agrochemicals in the markets in Darfur.

6.2.5 Agroprocessing and other opportunities:

Oil processing provides unprecedented opportunity for income generation at the household level as well as for the support of the economy of Sudan in general and Darfur in particular. Key areas that can be supported by Government and other development partners include:

- **Medium-scale oil processing**: As demonstrated by the Cooperation Union for Al Fashir locality, medium-scale oil processing offers an opportunity to farm households who do not otherwise have cash to pay for the services they need. The Government and other development partners could offer support to the establishment of such processing units.
- **Poultry production**: The potential for poultry production in Darfur is enormous, particularly in and around major towns of Darfur. The availability of the cake by-product from the oil processing units and many cereals produced locally offer a good protein source for animal feed. Improved local and modern poultry production (meat and eggs) can be supported. However, modern poultry production would require a reliable supply of chicks for the interested entrepreneurs.

6.2.6 Other areas of intervention

The crop-growing season is very short and sometimes erratic, placing the majority of households who depend on agriculture in a very vulnerable position.

- There is need for the food security and livelihoods partners to explore avenues for rainwater harvesting in support of agricultural production. This could be integrated with greenhouse technology for vegetable production.

Annexes

ANNEX I. LIST OF RELEASED VARIETIES

Species	Variety	Breeder / maintainer	Year of release
Banana	*Grand Nain*	ARC	2001
	Albeely	ARC	2003
Bread wheat	*Giza 144*	ARC	1940
	Falsheto	ARC	1970
	Giza 148	ARC	1972
	Giza 155	ARC	1972
	Mexipak	ARC	1976
	Mexicani	ARC	1977
	Mukhtar	ARC	1978
	Chiniab	ARC	1978
	Condor	ARC	1979
	Debiera	ARC	1979
	Giza 157	ARC	1980
	Wadi elNeil	ARC	1987
	Sasariab	ARC	1992
	elNeileen	ARC	1992
	Argeen	ARC	1996
	Nasr	ARC	1996
	Sham-1	ARC	2000
	Imam	ARC	2004
	elTagana	ARC	2004
	Gezira	ARC	2006
	Bohein	ARC	2006
	Nebta	ARC	2007
Sugarcane	*CO6806*	KSC	
	CO997	KSC	
	B 63349	KSC	1998
	B 705531	KSC	1998
	BJ 7939	KSC	1998
	BT 74209	KSC	1998
	COC 671	KSC	1998
	Kn H 80412	KSC	1998
	Co 775	KSC	2001
	TUC 75-3	KSC	2003
	BJ 8532	KSC	2003
	CO527	KSC	
	R-579	KSC	2010
Citrus	*Kinnow*	ARC	1997
	Karra	ARC	1997
	Honey	ARC	1997

Chickpea	*NEC 2491*	ARC	1987
	Gebel Marra	ARC	1995
	Atmor	ARC	1996
	Wad Hamid	ARC	1996
	El Metamma	ARC	1998
Cotton	*Shambat-B*	ARC	
	Barac (67)B	ARC	1993
	Barac (69)2	ARC	1993
	Nour	ARC	1993
	Brakat S	ARC	1998
	Dr. Knight	ARC	2004
	Hadi	ARC	2004
	Hamid	ARC	2004
	Khairalla	ARC	2004
	Sidig	ARC	2004
	Burhan	ARC	2004
	Khalefa	ARC	2006
	Abdeen	ARC	2006
	Wagar	ARC	2006
Cowpea	*Ain elGazal*	ARC	2000
	Dhab elGoz	ARC	2000
	Gamar dourin	ARC	2000
	Hidob	ARC	2000
Common bean	*Basabeer*	ARC	1998
	Giza-3	ARC	1998
	Sirage	ARC	1998
	Motwakkil	ARC	2003
	Ibariea	ARC	2003
Faba been	*BF 2/2*	ARC	1971
	Hudeiba 72	ARC	1972
	Sulaim	ARC	1985
	Improved Sulaim	ARC	1987
	Shambat 75	ARC	1991
	Shambat 104	ARC	1991
	Basabeer	ARC	1993
	Hudeiba 93	ARC	1993
	Shambat 616	ARC	1993
	Damar	ARC	2006
	Salih Hussein	ARC	2009
Forestry	*Altragma*	ARC	1998
	Kaly	ARC	1998
Garlic	*Chinese Garlic*	ARC	1995

Groundnut	*Ashford*	ARC	1960
	Barberton	ARC	1960
	MH-383	ARC	1970
	Natal	ARC	1970
	Spanco	ARC	1984
	Sodiri	ARC	1986
	Kiriz	ARC	1987
	Medani	ARC	1993
	Gubaish	ARC	1997
	Tozi	ARC	2000
	elAhmadi	ARC	2000
	Bunting	ARC	2007
Lentil	*Gebel Marra*	ARC	1993
	Robatab	ARC	1993
	Ndea	ARC	1998
Maize	*Stock 113*	ARC	1975
	Mexican June (Fodder)	ARC	1978
	Bafrew	ARC	1978
	Hudeiba-1	ARC	1998
	Hudeiba-2	ARC	1998
	PAN-6480	ARC	1998
	PAN-6578	ARC	1998
	PAN-6966	ARC	2009
	PAN-6026	ARC	2009
	PAN-6568	ARC	2009
	Yai-1	ARC	2010
	Yai-2	ARC	2010
Millet	*Biuda-1*	ARC	1970
	Ugandi (= Serere Composite-II)	ARC	1981
	Ashana (= Okashana-2)	ARC	2000
Okra	*Higairat*	ARC	1987
	Raeba	ARC	1987
	Sennar	ARC	1987
Onion	*elHelo*	ARC	1987
	Kamleen	ARC	1987
	Sagai mohasen	ARC	1987
	Aldnglawy (Balady)	ARC	1993
	Baftim	ARC	2007
Pea	*Karima*	ARC	1989
	Shambat	ARC	2003
Pigeon pea	*Taiba*	ARC	2000
Potato	*Desiree*	ARC	2004
	Diamant	ARC	2004
	Draga	ARC	2004
	Frisia	ARC	2004
	Spunta	ARC	2004
Sunflower	*Gila*	ARC	1965

Sesame	*Ziraa-1*	ARC	1964
	Ziraa-2	ARC	1964
	Al Ziraa-3	ARC	1964
	Ziraa-9	ARC	1985
	Huria-49	ARC	1985
	Huria-31	ARC	1985
	Kenana-1	ARC	1985
	Hiraihri	ARC	1991
	Kenana-2	ARC	1991
	Khidir	ARC	1998
	Promo	ARC	1998
	Um Shagara	ARC	2003
	Gadarif	ARC	2003
Sorghum	*Dwarf White Milo*	ARC	1957
	Feterita Ma'atug	ARC	1971
	TUB-11	ARC	1971
	TUB-22	ARC	1971
	TUB-7	ARC	1971
	Karkateib	ARC	1975
	Dabar/1/1/1/1	ARC	1978
	Gadam elHamam-47	ARC	1978
	Hageen Dura-1	ARC/ICRISAT	1983
	Mogawim Buda-1	ARC/ICRISAT	1991
	Mogawim Buda	ARC/ICRISAT	1991
	Pioneer-988 (Fodder)	Pioneer	1991
	Pioneer-877 (Fodder)	Pioneer	1992
	Ingaz	ARC	1992
	Sheikan	ARC	1992
	Feterita Wad Ahmed	ARC	1992
	Rabih (= YSW-64)	ARC	1996
	Tabat	ARC	1996
	PAN-888 (Fodder)	Pioneer	1998
	PAN-606	ARC	1998
	Arous elRimal	ARC	2000
	YarWasha	ARC	2003
	Safed Moti (Fodder)	ASSCO	2003
	Kambal	ARC	2004
	Bashayir	ARC	2008
	Butana	ARC	2008
	Sudani-1	ARC	2009
	Arfa'a Gaddamak-8	ARC	2009
	Hageen Grawia (Fodder)	ARC	2010

Sunflower	*Damazin-1*	ARC	1991
	Damazin-2	ARC	1991
	PAN-7392	ARC + ASSCO	2003
	PAN-7355	ARC	2003
	Hysun-33	ASSCO	2003
	Jwalmukhi	ASSCO	2003
	Salih	U.K	2004
	Shambat	U.K	2004
	PAN-7351	ARC	2006
	PAN-7371	ARC	2006
	Buhooth-1	ARC	2009
	Buhooth-2	ARC	2009
	Buhooth-3	ARC	2009

Squash	*Gezira-1*	ARC	2009
	Gezira-2	ARC	2009
Tomato	*Sennar-1*	ARC	1993
	Sennar-2	ARC	1993
	Gezira	U.G	2000
	Abdalla	U.G	2000
	Elsalama-1	ARC	2009
	Elsalama-2	ARC	2009
Sweet Potato	*Salih Hussein*	ARC	2009
	Abusabi	ARC	2009
Rice	*Kosti-1*	ARC	2010
	Kosti-1	ARC	2010
	Umgar	ARC	2010
	Warda	ARC	2010

Source: Seed Administration

ANNEX II. CERTIFIED SEED (TONNES) SUPPLIED TO DARFUR SMALL FARMERS FOR THE PERIOD 2005–2011

Crop	Variety	Seed quantity supplied by year (tonnes)						
		2005	2006	2007	2008	2009	2010	2011
Sorghum	*Fetarita Wad Ahmed*	400	300	300	270			
	Tabat	100	130	350	310			
	Arfa'a Gadamak	450	330	250	155			
	Zahrat elGeddambalia	150	50	0	0			
	YarWasha	0	0	50	50			
	Arous elRimal	0	0	0	65			
	Sorghum total	1 100	810	950	850	120	0	291
Groundnut	*Sodiri*	375	260	300	350			
	Gubeish	75	460	600	500			
	Medani	0	0	0	0			
	Groundnut total	**450**	**250**	**400**	**495**	**170**	**510**	**370**
Pearl millet	*Ashana*	140	200	525	420			
	Dimbi	140	250	665	600			
	Hiraihri	0	320	0	0			
	Pearl millet total	**280**	**770**	**1 190**	**1 020**	**48**	**100**	**260**
Sesame	*Promo*	103	60	130	150			
	Khidir	40	70	60	40			
	Sesame total	**143**	**130**	**190**	**190**	**70**	**0**	**60**
Maize	*Hudeiba-2*	0	24	5	20			
	Mujtama'a-45	0	0	20	20			
	Maize total	**0**	**24**	**25**	**40**	**70**	**0**	**0**
Cowpea	*Ein elGhazal*	**25**	**25**	**50**	**40**	**2.5**	**0**	**2**
Wheat		**20**	**22**	**50**	**50**	**0**	**0**	**0**

Source: M & E Unit, ASSCO

ANNEX III. CERTIFIED SEED PRODUCTION BY ASSCO LTD. 2006 – 2010 (TONNES)

Crop type	Seed production by year (tonnes)				
	2006	2007	2008	2009	2010
Sorghum	4 691	5 147	3 044	2 436	2 731
Groundnut	1 666	1 535	1 348	906	996
Sesame	355	622	555	642	342
Millet	828	566	623	241	285
Cowpea	53	86	183	16	5
Wheat	810	2 052	2 947	2 369	1 446
Maize	306	205	341	344	68
Total	**8 710**	**10 213**	**9 041**	**6 953**	**7 883**

Source: M & E Unit, ASSCO

ANNEX IV. CERTIFIED SEED PRICES FOR ARAB SUDANESE SEED CO. LTD. 2006 – 2011 (SDG /TONNE)

Crop / variety	Seed prices by year (SDG/tonne)					
	2006	2007	2008	2009	2010	2011
Sorghum						
Wad Ahmed	2 000	1 500	1 800	1 800	2 500	2 500
Tabat	2 200	2 000	2 500	2 400	2 600	2 500
Arfa'a Gadamak	1 800	1 500	1 600	1 700	2 500	2 250
Zahrat elGadambalia	1 800	1 500	1 800	1 700	2 500	2 250
Yar Washa		2 000	2 400	2 700	3 000	2 500
Butana						2 800
Groundnut						
Sodiri	2 300	2 100	2 800	3 000	3 000	4 500
Ghubeish	2 300	2 100	2 800	3 000	3 000	4 500
Pearl Millet						
Ashana	2 300				3 000	2 500
Sesame						
Promo	4 100	4 500	7 875	6 000	6 000	6 000
Khidir	4 100	4 500	7 875	6 000		
Maize						
Hudeiba-2	2 300	2 500	3 000	2 400	2 800	2 800
Mujtama'a-45	2 300	2 500	3 000	2 400	2 800	2 800
Cowpea	6 000	7 000	7 000	7 000	7 000	7 000
Wheat	2 000	2 000	3 000	3 000	2 800	3 000

Source: Commercial Administration ASSCO

ANNEX V. ESTIMATED CERTIFIED SEED PRODUCTION IN SUDAN (TONNES) 2006 – 2010

Crop type	Seed production by year (tonnes)				
	2006	2007	2008	2009	2010
Sorghum	10 708	15 191	14 966	15 898	18 715
Sesame	1 902	2 845	2 472	2 640	2 920
Groundnut	1 116	1 992	1 838	1 870	2 302
Millet	902	1 716	1 427	1 434	1 849
Maize	576	648	729	794	922
Wheat	2 592	2 621	3 234	35 491	25 497
Cowpea	16	69	40	65	58
Total	**17 812**	**25 082**	**24 706**	**58 192**	**52 263**

Source: Seed Administration

ANNEX VI. QUANTITY OF IMPORTED SEEDS (KG) 2006–2010

Crop type	Seed imported by year (Kg)				
	2006	2007	2008	2009	2010
Field crops					
Sunflower (F1)	0	213 200	1 306 090	8 084	103 370
Maize (F1)	1 500	1 500	94 141	58 562	33 559
Wheat (OP)	0	710 000	4 400 300	665 640	4 458 000
Sorghum (F1)	0	0	60 000	140 410	1 140 000
Rice (OP)	0	1 200	8 000	20	71 900
Groundnut (OP)	0	0	0	0	1 242 000
Total field crops	**1 500**	**925 900**	**5 868 531**	**872 716**	**7 048 829**
Vegetable crops					
Potato				3 154 950	441 100
Onion				65 639	75 726
Tomato				38 871	30 425
Watermelon				30 321	14 852
Total vegetables				**3 289 781**	**562 103**

Source: Seed Administration

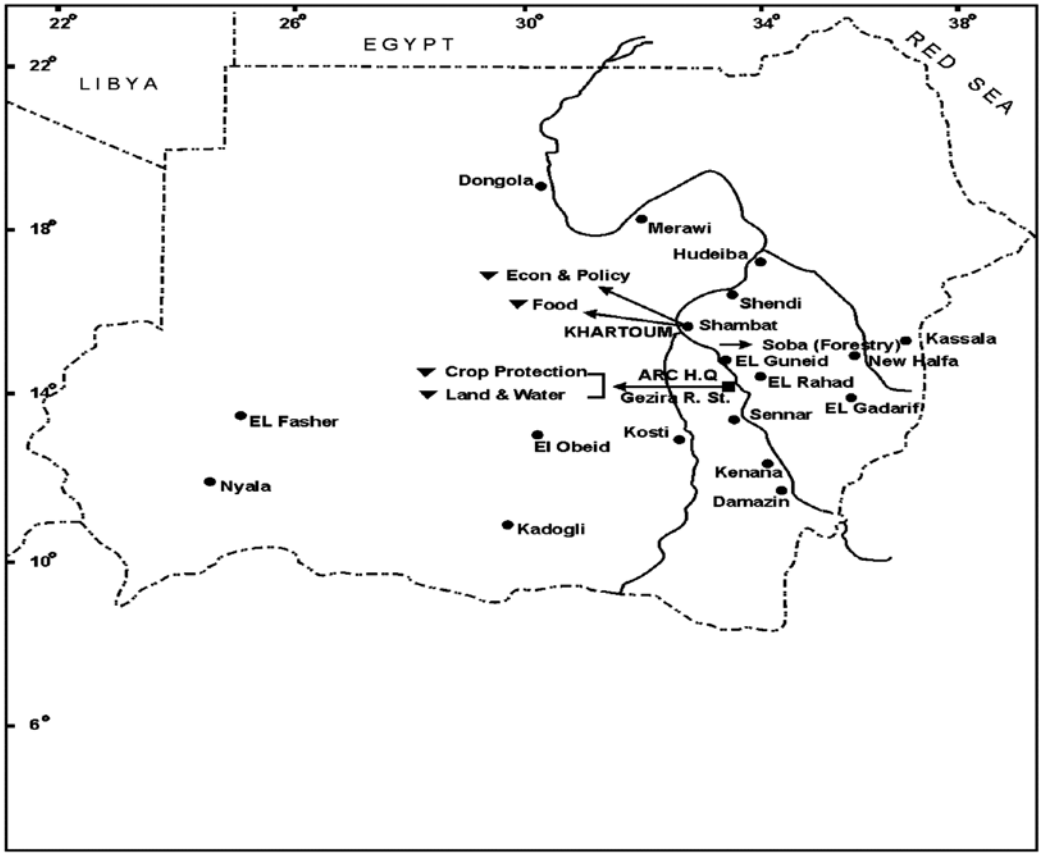
ANNEX VII. SEED PROCESSING PLANTS AND STORAGE IN SUDAN

Location city / state	No of units	Total capacity (tonnes/hr)	Storage capacity	Ownership	
Meringan / Gezira	6	9		(SGB)	Public
New Halfa / Kassala	1	1.5		New Halfa Corp.	
FAO / Gedaref	1	1.5		Rahad Corp.	
Meroe / Northern	1	1.5		Northern	
Debeibat / North Kordofan	1	1.5		North Kordofan	
Habila / South Kordofan	1	0.5		South Kordofan	
Total public	**11**	**15.5**			
Medani / Gezira	1	2.0		Bionil Co.	Private
Sennar / Sennar	1	7.5	1 300	ASSCO	
Khashm elGirba / Kassala	1	1.5	350	ASSCO	
Gedaref / Gedaref	2	6.5	350	ASSCO	
Hudeiba / River Nile	1	3.0	400	ASSCO	
Dongola / Northern	1	1.0	350	ASSCO	
El Obeid / North Kordofan	1	1.5	350	ASSCO	
Total private	**8**	**23**	**3 100**		

Source: Eng. A. Aziz Ahmed & Eng. Farouq M. Elamin

ANNEX VIII. MAP SHOWING LOCATIONS OF ARCS IN SUDAN

Agricultural Research Corporation ARC Sudan
Research Stations and Centers



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