



**“Integrated Agricultural Production Systems for the Poor and Vulnerable in Dryland Areas”**

Grant number: 2000000172

**Technical Progress Report**

(June 2014 - September 2015)

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# OVERVIEW

The project on “Integrated Agricultural Production Systems for the Poor and Vulnerable in Dryland Areas” (Phase II) has two objectives or components: the *first* is the development of profitable and climate change-proof packages/models of tested and proven technology options. The *second* is the facilitation of the institution and policy environment for an accelerated scaling up of these technologies. The project is targeting six countries: Egypt, Eritrea, Ethiopia, Kenya, Sudan and Yemen.

The first steering committee meeting of the project (Phase II) took place in Cairo on April 14/2014. In this meeting, it was decided to give the teams in the six countries until end of August 2014 to finalize their respective detailed work plans (e.g. activities, deliverables, timetable, and budget) and to communicate and liaise with IFAD-funded projects in respective countries in order to identify the entry points of collaboration which will add value to IFAD’s investments. The first draft work plans of Year I submitted by countries to ICARDA (in August/September 2014) were to a large extent a duplication of what has been done in Phase I of the project with little attention paid to the conceptualization of the research-to-business model and to linkages with IFAD investment projects. This necessitated field visits by ICARDA’s project leader to Egypt, Eritrea, Ethiopia, and Sudan over the period of September-November 2014. The main purpose of these visits was to address, in discussion with country teams, the following points in order to refine and strengthen the work plan of Year I:

* Prioritization of the interventions/packages to be scaled up.
* Economic viability of the interventions.
* Linkages with other IFAD-funded projects in respective countries and identification of entry points for collaboration.
* Identification of the elements of the research-to-business model which will be implemented in the second year of Phase II.

The first draft work plan and budget of Year I was submitted by ICARDA to IFAD on October 30/2014. Final version was approved by IFAD on December 11/2014.

In the first year of project’s implementation, priority interventions were identified and further validated with research gap filling and at the same time the elements of the research-to-business model were identified. The second year (March 2015-March 2016) will focus on the scaling-up of the model. Linkages with IFAD investment projects were established in Ethiopia and Sudan. Gender dimension is addressed in a household survey in Kenya and in the selection of participant farmers in Ethiopia. A regional gender workshop is planned in Cairo before the end of 2015. This workshop will aim at integrating, whenever relevant, gender dimension in the scaling up phase of the project in the target countries.

This first technical report will summarize the activities undertaken in each target country over the period of June 2014 to September 2015 and will outline the elements of the research-to-business model. Linkages with IFAD investment projects in Ethiopia and Sudan will be presented.

# EXECUTIVE SUMMARY

The focus of the project (Phase II) in its first year of implementation is to prioritize the technological interventions tested and validated in Phase I, to package and further validate them with research gap filling as well as to identify the elements of the research-to-business model which will allow the scaling up of these interventions.

*A common conceptual framework:*

Upgrading productive strategies for smallholder farmers in a value chain approach was identified as a suitable conceptual framework across the six countries for the research-to-business model of Phase II. Upgrading is a central idea behind productive strategies. It is considered a desirable change in farmers’ participation in the value chain that increases rewards and/or reduces exposure to risk. Upgrading considers horizontal as well as vertical elements of value chains. The issue is twofold: first, how to incorporate smallholder farmers into value chains, and second, how these farmers can change the terms of incorporation to increase the benefits at the upstream end of the chain. Focus will be on ***horizontal coordination*** (as one form of upgrading strategies, aiming at addressing shared constraints, interests and entry barriers associated with scale, such as weak negotiating power, high transaction costs, low output, and lack of capital) as well as on ***vertical coordination*** (as a second form of upgrading strategies involving moving along the continuum from one-off spot transactions toward longer-term relationships between actors in different functional nodes). A third form of upgrading strategies is ***process upgrading*.** Process upgrading relates to transforming inputs into outputs more efficiently by re-organizing the production systems or by bringing in better know how and skill level. One of the most common kind of process upgrading in value chains is improvements to agronomy resulting in higher yields and higher production. A fourth form of upgrading strategies is ***functional upgrading***. Functional upgrading means increasing or reducing the number of activities performed by individuals or firms. This may typically involve small-holder farmers adding value by primary processing of their crops before selling them to traders.

In the implementation of the common conceptual framework, ***horizontal coordination*** as a strategy in the upgrading process is based on strengthening existing structures (such as the case of the existing cooperative in the action site of the project in Egypt) or on creating new structures (such as the case of the goat husbandry and marketing cooperative in Ethiopia).

***Vertical coordination*** is based on contract farming such as the case of wheat producers in Eritrea who will be in contract farming with the milling factory in Asmara, and chickpea producers in Ethiopia who will be in contract farming with a farmers’ cooperative union. Contracting is not the only form of vertical relationship such as the case in Kenya where farm gate selling to middlemen is one of the practiced options by wheat producers.

***Process upgrading*** is applied in the six countries. Improved wheat varieties were introduced and tested in Eritrea, Ethiopia, and Kenya and resulted in higher yields. Improved chick pea and vetch varieties were introduced and tested in Ethiopia. In Sudan, pipe conveyance technology was introduced and resulted in water saving. Sheep fattening will be tested in Kenya and Yemen.

**Functional upgrading** was applied in Egypt with the making of silage from Maize production.

A summary of priority technological interventions/packages to be scaled up and of elements of the research-to-business model per country is presented in Table 1. It should be noted that activities in Yemen have been frozen due to security break-down.

**Table 1: Summary of technological interventions for scaling up and of elements of the research-to-business model per country**

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Technological interventions/packages** | **Research-to-business model** | **Notes** |
| **Egypt** | Cultivation of Berseem Clover as a mono-cut forage crop to be planted after harvesting corn (summer season) and before planting wheat (winter season). This intervention was tested with 20 farmers in two villages with positive impact on milk yield, soil fertility and farmers’ income. | * Horizontal coordination of milk producers in the two target villages. * Installation of a milk collection unit in agreement with a local cooperative. | The project is currently working on the needed administrative arrangements for the installation of the milk collection unit. |
| **Eritrea** | Improved wheat varieties with agronomic practices. This intervention was further validated with 33 farmers in two villages.  310 farmers are currently participating in the scaling up of the technology package. | * Horizontal coordination of wheat producers. * Vertical coordination with a milling factory through contract farming. * Multiplication of improved seed during the off-season (with the participation of 27 farmers) to supply target farmers for scaling up. | The project is currently facilitating the contract farming between the 310 participating farmers in the Tselema plain and the milling factory. |
| **Ethiopia** | *First component:*   * Cultivation of improved varieties of chick pea and vetch (plus agronomic practices). This intervention was validated with 42 farmers (for chick pea) and 32 farmers for vetch. * 139 farmers are currently participating in the scaling up of chick pea and vetch packages. * Community-based breeding was tested and validated in one village with 60 farmers. * 103 farmers from two other villages are currently participating in the scaling up of the community-based breeding.   *Second component:*   * Cultivation of improved wheat varieties (during the rainy season). This intervention was tested and validated with 60 farmers. * Cultivation of high value crops (during the dry season). This intervention was tested and validated with 180 farmers. | *First component:*   * Establishment of a goat husbandry and marketing cooperative. * Horizontal coordination of goat keepers (producing improved varieties of chick pea and vetch) and vertical coordination with buyers (contract farming) through this cooperative   *Second component:*  The project is currently working on facilitating contract farming between wheat/high value crops producers and buyers. | *First component:*  The project facilitated the establishment of the cooperative and is now working on contract farming. All goat keepers in the Gumara-Maksegnit Watershed (estimated at around 600 households, including the currently participating 163 farmers from the three villages) will be targeted for the scaling up of the chickpea and vetch package (including improved production and marketing) and of the community-based goat breeding.  *Second component:*  All members of the Irrigation Cooperative established by IFAD development project (estimated at 195 farmers) will be targeted for the scaling up of tested and validated packages. |
| **Kenya** | * Cultivation of improved wheat varieties (plus agronomic practices). This intervention is tested and validated with 34 farmers. * Sheep fattening. 20 farmers were selected to participate in this activity. | * The project is currently working on linking wheat producers with buyers through contract farming. * With respect to sheep fattening, an auction market will be created by Kenya Agricultural and Livestock Research Organization. | All farmers in the action site (Nturumeti village) who are growing wheat and keeping sheep (mixed crop-livestock farming system) will be targeted for the scaling up of packages related to wheat production and sheep fattening (including marketing). They are estimated at around 300 farmers. |
| **Sudan** | * Pipe conveyance water saving technology was selected as the priority intervention from Phase I to be scaled up in Phase II. * 6 innovation platforms were established to demonstrate the performance of this technology under different crops. | This technology will be scaled up though facilitating access to microcredits. | A total of 106 smallholder farms are targeted for the scaling up. |
| **Yemen** | The priority technology package to be scaled up is the improvement of sheep production through introducing improved males, improved feeding diet and fattening. | The research-to-business model focuses on vertical coordination between sheep producers and buyers. | Activities have been frozen due to security concerns and conflicts |

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# EGYPT

***Summary:***

The priority tested intervention for scaling up was identified to be silage production from maize residues. The research-to-business model focused initially on linking farmers with a large-scale private company for animal production (Misr El Kheir) to purchase their silage. Negotiations with Misr El Kheir as a potential key actor in the silage value chain did not reach an agreement on a contract farming. Consequently, the project reset its priority interventions for scaling up and explored the linkage of farmers with large-scale private company manufacturing milk and milk products (Juhayna), with a focus on milk value chain. No agreement was reached with Juhayna because of the required quality standards which cannot be fulfilled by small holders. The project demonstrated positive impact on livestock productivity and on farmers’ income resulting from the production of Berseem Clover as a part of the livestock technology package. The key elements of the revised research-to-business model are: horizontal coordination of milk producers and installation of a milk collection unit in agreement with a local cooperative. The project is currently working on the needed administrative arrangements for the installation of the unit.

***Activities and results:***

The project demonstrated making silage from corn stalks after harvesting corn ears. Demonstration included making silage for **10 farmers** in each of the two target villages (El-Hammam and Arab Motair) in Assiut governorate. Negotiations with Misr El Kheir as a potential buyer of silage did not reach an agreement with farmers because of the low price offered by the company. Farmers decided to make silage to cover their farm’s needs only and to market excess silage within their villages. The project introduced Fahl Berseem (clover) as a mono-cut forage crop to be planted after harvesting corn (summer season) and before planting wheat (winter season). The main target of introducing Fahl Berseem is to increase farmers' income through crop intensification instead of leaving the farm fallow between summer and winter seasons. Planting a leguminous crop (berseem) between two graminea crops (maize and wheat) will help in building up soil fertility. Moreover, Fahl Berseem has a better nutritional quality than wheat and maize straw and corn silage. Farmers are used to feed their animals on wheat and corn straw and they used corn silage after the project started its activities. Fahl Berseem was planted last season (2014/2015) and farmers used it in feeding their animals and noticed the better performance of the animals and the increase in milk yield. Chemical analyses of Fahl Berseem, maize straw and silage are presented in Table 2.

**Table 2: Total nitrogen and protein percentages of Fahl Berseem, maize straw and maize silage**

|  |  |  |  |
| --- | --- | --- | --- |
| No | Sample | Total nitrogen % | Total Protein % |
| 1 | Fahl Berseem | 2.85 | 17.82 |
| 2 | Maize silage | 1.51 | 9.45 |
| 3 | Maize straw | 0.58 | 3.65 |

Data presented in Table 2 show that Fahl Berseem has the highest protein percentage (17.82%) while maize straw contains 3.65% and maize silage 9.45%. Farmers gained more milk after feeding their animals on Fahl Berseem. Planting Fahl Berseem (with a cropping season of 75 days) added about 3000 Egyptian pound to farmers’ income and increased soil fertility after harvest. Table 3 shows soil analysis of total nitrogen after harvesting maize and berseem.

**Table 3: Soil analysis of total nitrogen in soil samples after harvesting corn and after cutting berseem**

|  |  |  |
| --- | --- | --- |
| No. | Soil Sample | Total Nitrogen % |
| 1 | After harvesting corn | 0.163 |
| 2 | After cutting berseem | 0.171 |

Data revealed higher nitrogen percentage in the soil after cutting berseem. The project provided ten farmers in each village with berseem seeds and results are shown in Table 4. This type of crop intensification resulted in higher wheat grain yield after cutting berseem compared to planting wheat after harvesting corn (Table 5).

**Table 4: Average yield of Fahl Berseem in twenty fields in El-Hammam and Arab Motair villages**

|  |  |  |
| --- | --- | --- |
| No | El-Hammam | Arab Motair |
| Yield (ton/feddan) | Yield (ton/feddan) |
| 1 | 18.55 | 16.35 |
| 2 | 18.36 | 17.40 |
| 3 | 18.25 | 18.33 |
| 4 | 18.90 | 14.20 |
| 5 | 18.00 | 15.45 |
| 6 | 18.00 | 16.23 |
| 7 | 15.25 | 17.75 |
| 8 | 14.20 | 13.95 |
| 9 | 14.00 | 14.13 |
| 10 | 14.15 | 14.6 |
| **Mean** | **16.67** | **15.84** |
| **General Mean 16.26** | | |

The project provided **20 farmers** in the two villages (ten in each village) with wheat seeds to be planted after cutting berseem for comparison with wheat planted after harvesting corn. Wheat was planted on raised beds to demonstrate and disseminate this technology to farmers. Grain yield of wheat was evaluated under the two conditions (after corn and after Fahl Berseem). Table 5 shows wheat grain yield in the two villages and data revealed higher grain yield of wheat planted after cutting Fahl Berseem. These findings confirm increasing farmers' income through planting Fahl Berseem.

**Table 5: Average grain yield (ton/ha) of wheat planted after harvesting corn and after cutting Fahl Berseem.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | **El-Hammam** | | **Arab Motair** | |
| **After corn** | **After berseem** | **After corn** | **After berseem** |
| 1 | 8.4 | 9.3 | 8.4 | 9.1 |
| 2 | 4.3 | 9.4 | 7.9 | 8.6 |
| 3 | 4.2 | 9.4 | 8.7 | 8.3 |
| 4 | 8.6 | 8.4 | 7.6 | 8.9 |
| 5 | 4.3 | 9.4 | 7.3 | 8.2 |
| 6 | 7.9 | 10 | 8.2 | 8.9 |
| 7 | 8.9 | 8.8 | 7.9 | 8.7 |
| 8 | 7.9 | 8.6 | 7.3 | 8 |
| 9 | -- | 9.7 | 8.8 | 9.6 |
| 10 | -- | 9.2 | 8 | 9.2 |
| **Mean** | **6.8** | **9.2** | **8** | **8.8** |

**Milk Marketing:**

Farmers of the two villages produce excess milk and they have many problems in selling it especially cow milk. Traders buy milk with very low prices and sometimes they leave the milk for farmers and farmers lose their production and sometimes they give the excess milk to their neighbors for free. Farmers started to produce higher amounts of milk after the project activities especially improving the animal nutrition package, introducing concentrates and planting Fahl Berseem. Therefore, the project decided to establish a milk collection center under cooperative’ supervision and started many efforts to market milk especially cow milk because farmers use buffalo milk for their needs and the main problem is the marketing of cow milk. Efforts for marketing milk can be summarized as follow:

* Juhayna is the major company for milk and milk products all over Egypt. Its products cover the Egyptian market. Juhayna Company has a special factory for making yogurt in Assiut and it was a good opportunity to link farmers with Juhayna. The team visited Juhayna factory and explained the project’s objectives. The prices offered by Juhayna are high and they receive cow milk only. However, the administration of Juhayna refused to contract farmers because they need big amounts of milk from big farmers owning big numbers of cows and use mechanized milking. Farmers are used to do milking by hand which increases the risk of infection and the factory uses the milk in making yogurt which requires low bacterial count. This condition (low bacterial count) can be fulfilled through mechanized milking in big farms. Therefore, Juhayna refused to contract farmers to receive milk.
* The project started to look for another option and visited many milk traders and milk product factories in Assiut but all investors reported that they buy buffalo milk only due to its preference in Assiut market and they agreed to buy any amounts of buffalo milk.
* Another visit to the Dairy Department of the College of Agriculture in Assiut University resulted in an agreement on the possibility of buying small amounts of both buffalo and cow milk and they offered to train some farmers on keeping milk , making cheese and yogurt and other dairy products and performing milk quality tests.

During these efforts to link farmers with milk market in Assiut, there were parallel efforts to look for a farmer to establish the milk collection unit in agreement with local cooperatives. These efforts can be summarized as follows:

* The co-op of El-Hammam village nominated a farmer who agreed to prepare the milk collection center in a big hall in his house. After three weeks he apologized for some family problems.
* Another farmer in the same village recommended by the co-op agreed and he apologized after ten days.
* The project looked for another farmer in Arab Motair and he was ready to establish the collection unit in his house. However, he refused after few days because he got a work opportunity in Saudi Arabia.
* The project contacted one of the farmers who has a good experience in marketing milk and has some cows and agreed to establish the collection unit in his house under the supervision of the co-op and to make monthly payments to the co-op to cover the price of the collection unit equipment over ten years and the co-op can re-establish another model using the seed money.

The project team visited the co-op and its manager agreed on this arrangement provided the agreement but after the agreement of the Under Secretary of the MOA in Assiut. The Under-Secretary agreed provided the agreement of the Ministry of Agriculture and Land Reclamation in Cairo. The project team contacted ARC and the ministry to finish all needed agreements and both sides agreed and promised to send documents to Assiut.

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below. As explained before, the project shifted its focus from silage value chain to milk value chain as no agreement was reached with the potential buyer of silage. The high interest rate of microcredits facilitated by IFAD investment project was not attractive for farmers to disseminate the livestock-related package. Therefore, there was no synergy with this project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Egypt** | Improved new wheat varieties + agronomic practices (planting time, fertilizer, raised bed)  Crop rotation and intensification  Silage from corn and sorghum  Urea treatment for wheat straw  Developing new packages for animal feed, health care and housing | * Livestock-related package (better breed of sheep and goats + better nutrition formula)   Silage production from corn residues | Using IFAD investment project in Upper Egypt (Promotion of Rural Incomes through Market Enhancement) as a vehicle to disseminate the livestock-related package through the provision of microcredits.  Development of silage value chain through better engagement of key actors: forage producers, feed traders and livestock keepers. |

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# ERITREA

***Summary:***

The priority tested intervention for scaling up is improved wheat varieties plus agronomic practices. The project is piloting with two groups of farmers in two villages (a total number of 33 farmers) horizontal coordination as well as vertical coordination through contract farming between the organized two groups and a milling factory in Asmara. Improved seed multiplication took place in this first year of project’s implementation in order to target a much larger number of farmers in Year II following the same research-to-business model tested in Year I. 310 farmers were targeted in the rainy season of 2015 for the scaling up.

***Activities and results:***

The package (improved varieties of wheat + agronomic practices) was implemented in June 2014 (start of the rainy season) **by 33 farmers** from two villages (Adi Gheda and Tera Emni) in the Tselema plain. The productivity of improved wheat varieties with agronomic practices suggested by the project ranges between 2.5t to 3 t/ha compared to 0.8t to 1.2 t/ha for local varieties.

In the dry season of 2015, a total of 28 farmers participated in the wheat seed multiplication for scaling up, using their existing irrigation facilities. The area planted varies from one farmer to another due to availability of land, ranging between 0.25 ha and 2.0 ha. A total of 22ha is planted with four varieties of wheat (Sidra, Croc-1, Pavon 76 and Hi 8498). In the rainy season of 2015, 310 farmers from 5 different villages of the sub-zoba Dubarwa in the Tselema plain were identified to be part of the scaling up. They received 16 tons of improved seed (drought tolerant, resistant to diseases and high yielding) and16 tons of fertilizer DAP and 8 tonsl of Urea. Fertilizer costs were equally shared between the project and participating farmers. Wheat was planted mid July 2015 because of the late start of rain. The project will facilitate the signature of contract farming between the target wheat producers and the milling factory which will buy the wheat yield at 25% premium above the market price.

**Table 6: Distributed improved wheat varieties to participating farmers in the scaling up**

|  |  |  |
| --- | --- | --- |
| Varieties | Seed description | Remark |
| Sidra-1 | This is a new ICARDA Variety released in 2014 | Bread Wheat |
| Croc-1 | This is a new ICARDA Variety released in 2014 | Bread Wheat |
| Kucuk | Durum wheat CIMMIT Variety released in 2006 | Durum wheat |
| HI 8934 | Durum wheat India Variety released in 2006 | Durum wheat |
| Pavon 76 | New pavon-76 Variety developed from a single pavon spike | Bread Wheat |
| Goumria 15 | Durum wheat CIMMIT Variety released in 2006 | Bread Wheat |

Trials were conducted in Halhale research station to determine the superiority of organic and chemical fertilizer on local and improved wheat variety, namely Mana and Sidra respectively. The treatment used was organic fertilizer (manure) and chemical fertilizers (urea and DAP). The experimental design used is RCBD with three replication of plot size 5m X 2.25 m, planted in rows with spacing of 0.60 m. Manure and DAP was applied once during the planting time while urea was applied twice.



**Figure 1: Improved wheat production in the Tselema plain (package introduced by the project)**

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below. The project implemented the approved work plan with respect to wheat production and scaling up. The target number of farmers was reduced to 310 instead of the planned 600 farmers due to budget limitations.

With respect to the livestock-related package, the research team was not able to identify the different actors along the value chains, the best horizontal coordination of livestock producers and the best vertical coordination between these producers and the different actors. Therefore, project’s focus was limited to the wheat value chain.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Eritrea** | Wheat-related package (improved varieties + agronomic practices)  Livestock-related package (introduction of improved rams + feed block + veterinary services) | Seed production in Year I to prepare for the scaling up in Year II (600 farmers, 500 ha)  Livestock-related package (introduction of improved rams + feed block + veterinary services) | Piloting vertical coordination (contract farming) as well as horizontal coordination in the value chain of wheat. |

# ETHIOPIA

***Summary:***

The project in Ethiopia has two components. The first component is implemented in the Gumara-Maksegnit Watershed with a focus on livestock-based farming system. The second component is implemented in the region of Arsi-Negela with a focus on cereal-based farming system.

*With respect to the first component:*

The priority tested intervention for scaling-up relates to chick pea and vetch production (improved varieties + agronomic practices). This intervention is considered as integral to the livestock-based farming system, aiming at increasing the cash income of goat keepers through the sale of grain and at improving the feed availability and quality. The community-based goat breeding (tested in one community in Phase I) is extended to two neighboring communities in Phase II. An improved organizational structure of goat keepers (market-oriented structure) is under testing in order to enable contract farming for chick pea and vetch. On-going discussions are taking place with a farmers’ cooperative union to pilot contract farming for the purchase of chick pea production.

*With respect to the second component:*

The action site of this second component is located in two of the schemes of IFAD investment project “Participatory Small-Scale Irrigation Development Program (2010-2015)”. The focus of this component is on cereal-based farming system whereby improved wheat is cultivated during the rainy season (June – September) and high value crops are grown in the dry season (November-May) on the same fields irrigated by IFAD investment project. This investment project created two Water Users Associations and one Irrigation Cooperative in the two schemes. The two IFAD-funded projects (investment project and Phase II grant project) are collaborating to capacitate the Irrigation Cooperative (as a potential key actor in the value chain of high value crops) and to support the establishment of an innovation platform for wheat and high value crops. All members of the Irrigation Cooperative established by IFAD investment project (estimated at 195 farmers) will be targeted for the scaling up of tested and validated packages.

***Activities and results:***

**First component:**

In the Gumara-Maksegnit Watershed two Kabuli chickpea varieties (*Shasho* and *Arerti)* and two vetch varieties (*Vicia atropurpurea* and *Vicia villosa*) were selected through participatory variety selection studies conducted in the 2011 and 2012 cropping seasons. During the participatory variety selection studies it was realized that by growing *Shasho* and *Arerti* farmers were able to gain 20% and 64% more income, respectively over growing the local variety. Furthermore, chickpea residue is a highly nutritious livestock feed widely used by farmers. On the other hand, Vetch varieties (*Vicia atropurpurea* and *Vicia villosa)* with a potential dry matter yield of 6.5 to 8.2 t ha-1 were selected through participatory variety selection. By supplementing crop residue, which is the main feed resource for the long dry season in the area, the productivity of farmers’ goat flocks could be improved. Goat fattening in the watershed is largely dependent on grazing, consequently goats are often marketed at low body weight. Therefore, through introducing the two Kabuli chickpea and vetch varieties with their agronomic packages farmers’ income could be increased, farmland soil fertility could be maintained and feed availability and quality could be improved. By integrating goat production with chickpea and vetch production farmers can fatten their goats and sell goats at better prices.

For chickpea, the technology package for the second phase includes two improved Kabuli chickpea variety *Arerti* with improved agronomic packages (row planting, proper weeding, bollworm control). In year one (2014), the project was implemented with the active participation of **42 farmers** on a total plot of 20 hectares. Each participating farmer planted 0.25 ha of land to improved varieties. There were two clusters one at each village of Das Dinzaz and Degola Chinichaye. Each cluster grew only one of the varieties.

For vetch, the technology package includes two improved vetch varieties (*Vicia atropurpurea* and *Vicia villosa*) with improved agronomic packages (row planting, proper weeding, insect control). In year one (2014), the project was implemented with the active participation of **32 farmers** on a total plot of 4.5 ha. Each participating farmer planted 0.125 ha of land to either of the vetch varieties. The activity was done in Das Dinzaz and Degola Chinichaye villages.

Gondar Seed Laboratory Office inspected the seed production process of chick pea and certified the seed. Tsehay farmer’s cooperative union is in the process of purchasing the seed. A planning workshop was held with farmers and business platform actors to have common ground and understanding on the research objectives and processes. Roles and responsibilities of actors and detailed activities were jointly planned in the workshop. Training on the production and management of chickpea and vetch were given to participating farmers. Two field days at vegetative and maturity stage were organized to assess farmers and local policy makers views and reactions.



**Figure 2: Performance of improved chickpea**



**Figure 3: Training sessions organized by the project**



**Figure 4: Field day organized by the project**

Sample grain yield were collected from participating farmers’ and neighboring farmers’ fields. Since kabuli chickpea was introduced for the first time, there is no any other kabuli chickpea variety under use in the area. However, the comparison was done with the dessi type chickpea. Farmers widely grow dessi type for many years. The highest yield recorded from the *Ararti* variety was 1645 kg/ha and the lowest was 1263 kg/ha while the highest and the lowest yields of sampled local variety were 920 kg/ha and 628 kg/ha, respectively. The improved kabuli type variety (*Arerti*) gave a mean seed yield of 1488 kg/ha while the local dessi type gave 814 kg/ha. This shows that kabuli chickpea variety has a yield advantage of 674 kg/ha over the local one. Due to a severe feed shortage in the watershed, the entire vetch produced by participating farmers was used as a feed for their livestock and farmers could not produce vetch seed as planned. A partial budget analysis was also carried out to compare the improved chickpea variety against the local variety by using CIMMYT (1988) manual. The prevailing input and output prices were used to calculate the financial return. As illustrated in Table 7, the marginal rate of return for Arerti variety over the local variety is 601.4%. The figure obtained is much greater than the generally accepted minimum rate of return which is 100%.

**Table 7: Partial budget analysis**

|  |  |  |
| --- | --- | --- |
| Items | Local | Improved |
| Mean GY (kg/ha) | 814 | 1488 |
| Adjusted yield (kg/ha) | 732.60 | 1339.20 |
| Gross Field Benefit (ETB/ha) | 6512.00 | 12052.80 |
| Labor cost (ETB/ha) | 0.00 | 240.00 |
| Seed cost (ETB/ha) | 770.00 | 1320.00 |
| Total cost (ETB/ha) | 770.00 | 1560.00 |
| Net benefit (ETB/ha) | 5742.00 | 10492.80 |
| Marginal cost (ETB/ha) |  | 790.00 |
| Marginal net benefit (ETB/ha) |  | 4750.80 |
| Marginal rate of return (%) |  | 601.37 |

Seed inspection was jointly done by zonal seed inspection office, Tsehay farmer’s cooperative union, GARC and Office of Agriculture. The main purpose of seed quality control is to identify those fields which can qualify for quality seed. Farmers’ field which met the inspection criteria were selected and will be used as seed for next year and linked to market. Tsehay farmer’s cooperative union agreed to buy the seed produced by participating farmers and will provide 15% premium price from the prevailing market price. Each participant’s field was visited by the inspection team.

Since Tsehay farmer’s cooperative union con not buy directly the produce from farmers, it uses primary cooperatives to reach to farmers as agents. As a result, two primary cooperatives at Dinizaz and Degola kebeles were used as agent to buy chickpea seeds produced by participant farmers. The project facilitated the signature of agreement papers between Tsehay farmer’s cooperative union and the two primary cooperatives. However, due to legal issues, the chick pea produced by farmers in the rainy season of 2014 was not sold to Tsehay farmer’s cooperative union.

In the rainy season of 2015, 101 participating farmers from three villages (Dinzaz, Denkele and Chinchaye) cultivated in August one improved variety of kabuli chickpea (*Arerti*) and 38 farmers from two villages (Dinzaz and Chinchaye) cultivated in July one improved variety of vetch (*Vicia villosa*). The harvest of chickpea is expected in December; vetch can be harvested in October for fodder or in December for seed.

Main agreements reached with respect to chickpea which will be produced in the rainy season of 2015:

* Tsehay farmer’s cooperative union will purchase chickpea produced by farmers as seed but their field must pass the inspection criteria.
* The Office of Agriculture will ensure the implementation of seed production based on full packages.
* GARC will provide seed, training and technical backup.
* The Office of Cooperative will create market linkage with Tsehay union.

Main agreements reached with respect to vetch which will be produced in the rainy season of 2015:

* All participating farmers agreed to sell the vetch as seed.
* The office of Agriculture and GARC will find vetch buyers otherwise GARC will buy the seed from the farmers.

A goat husbandry and marketing cooperative was established at Dinizaz. This cooperative can serve as basis to create horizontal coordination of goat keepers in a scalable structure (allowing community-based breeding as well as the marketing of agricultural commodities) and the vertical coordination with key buyers of their produces. Of the 62 community goat breeding members 42 members have paid the registration fee and bought initial share. They have opened bank account by the name of the established cooperative and elected different committees like excutive, auditing, marketing, and credit committee. The cooperative is now under the process of getting legal certificate from the district cooperative office.

To scale up community-based goat breeding which was tested in Phase I in the village of Dinizaz, two other villages (Chinchaye and Denkele) were selected.

The following activities were undertaken:

* **Site selection and community mobilization:**

After consultation of the development agents working on the livestock extension, two villages (Chinchaye and Denkele) which are close to the old village (Dinzaz) were selected based on the relative importance and population size of goats. Before implementation of the actual work, a village level meeting was held to clarify the procedure and the importance of community-based breed improvement. After the meeting, farmers agreed to participate and to follow the community-based breed improvement procedures such as providing the performance data of their animals to the enumerators and using only the selected bucks and culling the unselected ones. Following the village level meeting, a total of 103 (56 from Chinchaye and 47 from Denkele village) have been registered as participant farmers.

* **Data collection and monitoring:**

Identification numbers with Plastic ear tag were given to all goats’ population of the study villages. The base line information of the animal such as age, color and weight was recorded at the beginning of the work (Table 8 ).Three trained enumerators have been employed for collecting the growth performances, reproductive performances, health data and off take rate.

* **Bucks selection and management:**

As the performance recoding is at early stage to select bucks based on their performance record, one round simple sire selection (without recording) have been undertaken. All breeding male goat available in the village were presented as the candidate animal. Among them 11 best bucks, the bucks having good physical appearances, color and horn were selected through the participation of the farmers. Following the same procedure at Dinzaz village, the prices of the bucks were paid to the owners. The bucks have been distributed to the participant farmers based on the male to female ratio (1:15-20) and the neighborhood of farmers.

**Table 8: Flock structure and weight of base population goats**

|  |  |  |  |
| --- | --- | --- | --- |
| Age \*sex group | No. | Proportion | Average weight(kg) |
| Does | 300 | 0.49 | 28.00 |
| Does kids | 87 | 0.14 | 16.70 |
| Bucks | 38 | 0.06 | 25.84 |
| Bucks kids | 53 | 0.09 | 15.55 |
| Female kids | 60 | 0.10 | 12.92 |
| Male kids | 76 | 0.12 | 10.68 |
| Total | 614 | 1.00 | 22.80 |

**Future plan:**

**Plan for 2015 (until December 2015):**

* **Biological data collection**: The productive and reproductive performance and other relevant data will be collected through the enumerators by close supervision of the researchers from Gondar Agricultural Research Center. The main objectives of data collection are: 1) to select the best bucks based on their performance and 2) to evaluate the biological performance before and after selection.
* **Bucks selection and management**: The best bucks having superior biological performance and farmers’ preferences will be selected. The selected bucks will be distributed to the buck user groups and unselected bucks will be culled through castration and selling.
* **Training**: The training about selective breeding and improved goat management will be given for all participant farmers.
* **Economic impact assessment**: The economic impact of community-based goat breeding on the livelihood of the community will be assessed.

**Plan for the year 2016 (from January 2016 to March 2016):**

* **Field day**: Eight field days, one field day for 50 farmers, will be organized to further reach out the remaining goat keepers (400 households) in the watershed.
* **Scaling up**: Based on the lessons learned from the three pilot villages, the community-based breeding scheme will be scaled up to 400 households.
* **Dissemination workshop**: Stakeholder workshop will be organized to present the result of the project and to discuss further the scaling up of the activity at the national level. Policy makers at national and regional level, relevant expertise from different governmental and non-governmental organization, researchers working in the national and international research centers will be invited.

All goat keepers in the Gumara-Maksegnit Watershed (estimated at around 600 households, including the currently participating 163 farmers from the three villages) will be targeted for the scaling up of the chickpea and vetch package (including improved production and marketing) and of the community-based goat breeding.

**Second component:**

* + - * The focus of this component is on cereal-based farming system. Improved wheat was cultivated during the rainy season (June – September) by **60 farmers**. High value crops (onion and tomato) were grown in the dry season (November-May) by **180 farmers** on the same fields irrigated by IFAD investment project. Farmers were selected from three villages: Buku Wolda (in Gedemso area where IFAD investment project is operating), Argeda and Degaga. The criteria for selection were: 1) proximity to accessible roads, 2) willingness to collaborate with the research team, and 3) gender consideration (around 20% of selected households were female-headed).
* Farmers used one quarter of a hectare of land for the production of each crop and followed researchers’ advices for the management of their land. Seeds of wheat were row planted as opposed to the local practice of broad casting. Farmers were advised to irrigate their wheat field when rainfall is insufficient and/or remain absent for more than two weeks between two rainy periods.
* Wheat producers were provided each with 25 kg of seed and 25 kg of DAP and urea. Tomato and onion producers were provided each with 25 kg of seed and with 38 kg (for tomato) and 23 kg (for onion) of DAP and urea. Chemicals for anticipated pest and diseases occurrence were provided.
* Farmers participating in high value crops seeded onion and tomato in well prepared seed bed and were advised on how to prepare and manage nursery fields.
* Three milling factories were identified and approached but without reaching an agreement because of quality criteria.
* A value chain study for wheat and vegetables was conducted and a group discussion has been carried out for SWOT analysis. Members of the Irrigation Cooperative and beneficiaries of the project gave their feedback on the strength, weakness and constraints with regard to production and marketing of tomato, onion and wheat. **Results are presented in Annex 1(page 33).**



**Figure 5: Performance of improved wheat (mid-season)**



**Figure 6: Performance of tomato during transplanting**

 

**Figure 7: Performance of onion before transplanting**

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below.

The project implemented the annual work plan with respect to the production of chick and vetch as well as to the horizontal and vertical coordination for their scaling up.

With respect to wheat and high value crops, the project implemented the priority technological packages as planned; however, it did not succeed yet in linking farmers to the market (vertical coordination). All members of the Irrigation Cooperative established by IFAD investment project (estimated at 195 farmers) will be targeted for the scaling up of tested and validated packages. Therefore, there is a strong synergy with this investment project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Ethiopia** | Community-based goat breeding  Introduction of forage species for grazing  Improved horticulture production (onion, tomato, pepper, potato)  Improved field crop production (wheat, barley, Maize, tef, chick pea, faba bean)  Introduction of improved bee hives  Introduction of poultry production | Establishment of innovation platforms for improved chick pea and vetch production in the livestock-based farming system  Establishment of innovation platforms for improved wheat production and high value crops (one or two crops) in the cereal-based farming system | Piloting vertical coordination (contract farming) in the value chains of wheat, chick pea and vetch.  Using IFAD investment project “Participatory Small-Scale Irrigation Development Program” as a vehicle to disseminate the production of high value crops on irrigated fields during the dry season. |

# KENYA:

***Summary:***

The project is targeting the mixed crop-livestock farming system in Narok County. Baseline surveys were conducted with respect to wheat production systems and marketing, sheep production systems and marketing, stakeholder involvement in wheat-sheep interface, access to information and credit in wheat-sheep enterprises. The interventions to be tested include improved wheat varieties + agronomic practices as well as fattening of sheep + improved husbandry. The research-to-business model for wheat and sheep production will be based on a value chain approach. Targeted wheat producers will be storing their yield in the two existing public warehouses in Narok County against receipts. These producers will be grouped together and their warehouse receipts will serve as basis for contract farming with a milling factory or other buyers. On-going discussions are taking place with the milling factory to pilot contract farming in 2015 and to scale it up in 2016. Targeted sheep producers will be fattening their animals and pooling them for finishing and auction at a predetermined period. For this purpose, Kenya Agricultural and Livestock Research Organization will help in the establishment of two auction markets in Narok.

**The detailed technical report is presented in a separate annex.**

***Activities and results:***

1. Selection of action sites:

* Conducted a 2 day workshop to revise and finalize the project concept and work plan at the Pastoral Training Centre (5th to 6th August 2014).
* Two sites were selected during field reconnaissance.

A total of 63 stakeholders were met and interviewed in focused groups during the site selection process.

1. Establish baseline conditions, conduct ex-ante analysis and set up research-to-business best bet elements of technological options for improvement of integrated wheat-small ruminant value chain in the mixed crop livestock system in Narok:

Baseline survey was conducted in October 2014 covering 30 single household interviews and 5 focused group discussions.

Key findings from the survey are:

1. Sheep enterprise:

* Most of the respondents (56%) received new farming knowledge and information, informal farmer to farmer interactions and organized exchange visits. However, 100% of them reported that the information on marketing and new technology in sheep they obtained was not adequate.
* All respondents interviewed indicated that they have not received any formal training in sheep production. This was confirmed by their inability to classify the sheep breeds currently produced in Narok area.
* All respondents (100%) reported to experience feed shortages particularly during the dry season. However, only 20% of respondents could conserve the surplus forage available during the wet season. The major feed shortage coping strategy was by practicing pastoralism (75%) and use of purchased forages (12.5%). There was very low usage of wheat straw (3.1%).
* Wheat stubble left after harvesting is used to support the sheep enterprise. The majority of farmers left the wheat straw in the fields either for animals to feed directly or used it as mulch. Few baled it for use as hay and some sold it outside the farm. There was no treatment to increase digestibility of the straw.
* The survey revealed that farmers are faced with various challenges in marketing their livestock that include poor market prices, exploitation by brokers and poor infrastructure facilities. These challenges are compounded by lack of market information, delay in payment by Kenya meat commission (KMC) and lack of breeding technology leading to waste and poor returns on investment value.
* Results showed that although men perform a major role in deciding when to sell farm produce, they involve their wives on decisions of what to sell.
* Women in the target area retain primary responsibilities for sheep milking and utilization of the milk and marketing of surplus milk. They also do pen cleaning and assist in providing sick animals with water.
* Results also indicated that although men decide on when and where to purchase and deploy sheep production inputs, they do not make some decisions such as utilization of proceeds from the sale of sheep in isolation; other household members, particularly women are consulted.

1. Wheat enterprise:

* 48.4 % of the farmers in both sites use certified seed followed by 35.5% who use both certified and recycled, few 16.1% recycle seed. Of the interviewed farmers, 48.4% source seed from the stockists followed by 31.9% who source seed from fellow farmers. A few 9.6% plant from their own seed.
* Of the interviewed farmers it was however noted that the wheat marketing has remained complicated with very many players, brokers and middlemen taking a greater share of it all.
* It was noted that farmers still sell wheat at the farm gate immediately after harvest due to poor post-harvest handling techniques, lack of grain stores, processing machines and other commitments which urgently require cash. While this lowers the storage costs, it weakens farmers marketing leverage (hence receiving low prices).
* On average 57% of the respondents said they had access to new wheat technologies with the rest having no access. 85% of the respondents felt that this level of access was not adequate. As with the sheep enterprise the common source of new farming knowledge and information was through informal farmer to farmer interactions.

c) Recommendations:

Sheep keepers in Narok can benefit from capacity building in a variety of areas. From the baseline study it was evident that there has not been any opportunity for capacity building in sheep husbandry. The limited opportunities only existed for knowledge sharing amongst farmers themselves. Markets and marketing strategies that enable sheep farmers to reap maximum benefits for the enterprise are also recommended. Finishing sheep by fattening is weak albeit the readily available and unmet market for mutton. Wheat straw can enhance the fattening strategy since it is readily available in most parts of the county.

The wheat farmers in Narok can improve their productivity by provision of capacity building support in some of the areas identified during the baseline survey. Among these areas are wheat variety selections for high yielding qualities, early maturing and disease and pest tolerance, usage of fertilizer as well as soil management practices to check land degradation. Marketing strategies that guarantee wheat farmers maximum returns should also be considered. Packaging and dissemination of available new technologies for both wheat and sheep enterprises can help improve access by the farmers. A hand book on wheat and sheep husbandry as well as production of brochures with specific aspects of the technologies are some of the recommended ways of improving access. These could be in addition to other methods of information dissemination during the lifespan of the project. These include farmer field days, field demonstrations as well as other organized farmers training.

1. Sensitize stakeholders and share results of baseline survey:

* Project inception workshop involving 22 stakeholders was held on 20th Jan 2015.
* Results of the baseline survey was presented to the stakeholders and discussed.
* Research-to-business model was elaborated within a value chain framework focusing on: 1) productivity improvement of wheat through adoption of high yielding, drought tolerant and disease resistance varieties and marketing through warehouses and milling factories; 2) productivity improvement of meat sheep through fattening, use of fast growing Dorper breeds, husbandry and marketing through auctions.
* Cost and benefit associated with sheep production and marketing were evaluated through estimating the expected net present value (NPV), gross margin (GM) and cost benefit ratio (CBR). Based on these cost benefit parameters, a positive NPV and GM and a CBR above one was reported indicating that the costs invested in the sheep production are recovered and high benefit realized. The discounted net benefit was far above zero implying that it is worthy investing in sheep production for enhanced future benefit. In addition, a sensitivity analysis was conducted. An increase in price of sheep through strategic fattening technologies, breed and breeding programme and collective marketing bargaining approach would enhance the profitability of the enterprise. Equally a better result would be realized through the reduction of production costs through strategic deworming regime and proper utilization of wheat straws. A combination of the two scenarios would improve the profit of small scale farmers by a greater margin. Deworming can increase productivity by up to 140%. The current deworming regime is four times per year. Proposed deworming regime is three times. Targeted pre/post mortality rate of 10% and a zero weight loss. Return of 215-248%.
* It was noted that wheat farming can be profitable using the appropriate varieties and management practices. For example, variety Eagle 10 remained the most profitable followed by Robin with CBR above 1. Kwale remained the most unprofitable variety having negative Gross Margins.

1. Undertake community-based validation, adaptation and promotion of best bet technology packages with respect to wheat and sheep production:

* 28 participating farmers (20 from Nturumeti village and 8 from olololunga village) cultivated improved wheat varieties (plus agronomic practices) in April 2015. A total of five wheat varieties were distributed. Each participating farmer grew one of these varieties on 2 acres (0.8 ha) except of few who cultivated two varieties.
* The same 20 farmers from Nturumeti village who cultivated improved wheat varieties are also participating in sheep fattening.
* Six improved rams were distributed to these farmers. The first off-springs of these improved rams are expected in December 2015.
* 2 acres of communal land will be managed by the project for seed multiplication of a grass (Boma rhodes). It will be harvested in November 2015 and seed will be distributed to participating farmers who will be sowing it in April 2016.
* 10 acres of communal land will be established and managed by the project as pilot plot and innovation platform for sheep fattening.
* 200 weaners (at the age of 4 months) will be provided by the 20 participating farmers beginning of September 2015. Animals will be fattened over a period of three months on the 10 acre innovation platform. The community-based organization of Nturumeti village will be involved in the management of this platform.
* An auction market will be established by KALRO in December 2015 to sell the fattened 200 sheep.

The introduction of sheep fattening by the project and the management of this activity by a community-based organization on a communal land is expected to have impact on the workload of women who are engaged in traditional sheep husbandry. This presents an opportunity for the research team to address and analyze the gender dimension of the project.

1. Marketing options for wheat:

A menu of marketing options (scenarios) of improved wheat based on empirical research and providing a comparative analysis among them will be one of the key outputs of this project. These scenarios include:

* **Scenario A (Warehouse receipting**) - where NCPB (National Cereals and Produce Board) buys the wheat and provides a receipt which farmers can use to redeem their money from a bank. This idea was discussed but farmers felt that NCPB could not be trusted. It was also noted that the warehouse receipting innovation currently applies to maize and not wheat. The NCPB officials were also not present in the meeting with farmers to present their case.
* **Scenario B:** Farmers can enter into a contract with millers to buy their produce on agreeable terms. However there was no representation from millers and therefore this option could not be pursued further. It was also noted that millers operate through middlemen who source wheat from farmers.
* **Scenario C:** Contract with large scale grain handler and trader. Rupian Technologies LTD made a presentation of their contract model. Their philosophy is “Farmer on Top – partnership with the farmer”. They have experience in dealing with large scale grain purchase particularly maize; and are now set to venture into wheat. Their model is to overcome the situation where farmers are price takers due to their inability to organize themselves into marketing groups or cooperatives. Farmers would sign a contract to sell their wheat to the company. The company would aggregate wheat, store for a month or two and then sell when prices are good. The profits would then be shared on 40 (farmer):60 (company) basis over and above an agreed minimum payment given to farmer at the time of sale. The company intends to include an input provision package during the next planting season. This solves the problem of farm-gate sales and leverage on bargaining power of numbers and volumes. It is worth-mentioning that Narok accounts for 80% of all wheat produced in Kenya.
* **Scenario D: Farm gate selling to middlemen**

In this scenario farmers would continue with normal practice of individual selling to the highest bidder. Farmers felt that this system although somehow exploitative guarantees the farmer instant payment and is more reliable. Farmers lose up to 5 bags per acre in the measurement unit. The project economist provided profitability margins for all these options to guide farmers in reaching an informed decision as shown in the table below.

**Table 9: Profitability margins of different marketing options for wheat in Narok**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario (option) | Minimum Production per acre (100kg-bags) | Price per bag (Kshs) | Total revenue per acre (Kshs) | Total Costs per acre (Kshs) | Profit (Kshs) | Comments |
| A | 15 | 3000 | 45,000 | 21495 | 23495 |  |
| B | Not discussed |  |  |  |  |  |
| C | 15 | 2400 | 36000 | 20830 | 15170 | Additional sharing of 40:60 profits over and above the selling price (about Kes 4500) per acre |
| D | 15 | 2500 | 37500 | 20830 | 16700 |  |

Source: survey data

After lengthy deliberations,

1. The farmers agreed to sale their wheat through a contract with Rupian technologies on mutually agreeable terms.
2. The agreement must be reached within a time line agreed upon by the farmers otherwise they would individually sell their wheat to the highest bidder i.e. option D.
3. This decision would be ratified by the large group of farmers.

**Visit to Kenya IFAD office:**

On 24th March 2015, Dr. Keya and Mr. Kibet visited IFAD regional office at UN complex in Gigiri to introduce the on-going IFAD-ICARDA project funded by IFAD. The two IFAD officers (Ms. Faten Bokri and Mr. Peter Yuexiong) were met and briefed on the status of project by the National Project Coordinator, Gr. Keya. The aim of the visit was to see where the project could synergize with other IFAD funded projects in the country. On the other hand, IFAD officers stated that their office supports cereal farmers through Cereal Enhancement Support Project implemented in collaboration with the Ministry of Agriculture, Livestock and Fisheries in three counties including Nakuru and Kitui. They further stated that IFAD is not funding livestock projects which could collaborate with the IFAD-ICARDA project. IFAD country project does not operate in Nark where IFAD-ICARDA project is being implemented and therefore there is little room for synergies.



**Figure 8: Participants at the consultative and work plan development workshop (June 2014)**

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below.

The project succeeded in implementing the annual work plan with respect to both wheat and sheep production.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Kenya** |  | Undertake community based validation, adaptation and promotion of best bet packages for improvement of small ruminant value chain in the mixed crop-livestock farming systems  Undertake community based validation, adaptation and promotion of best bet wheat value chain packages/technological models. | A value chain approach for small ruminant and wheat production. |

# SUDAN

***Summary:***

Pipe conveyance water saving technology was selected as the priority intervention from Phase I to be scaled up in Phase II. Lower Atbara River was identified as the geographical area for the scaling up of this technology. IFAD investment project “Butana Integrated Rural Development Project” has a window on micro credits which are provided to smallholders through the Agricultural Bank of Sudan. The Manager of this project expressed commitment to support IFAD grant project in scaling up the pipe conveyance technology in Lower Atbara River to benefit around 60 smallholders through facilitating the provision of credits. Six innovation platforms were established in this first year to implement pipe conveyance technology with a menu of improved crops and agronomic practices (including wheat, faba bean, chick pea and common bean varieties, in addition to forage crops). These platforms will bring together relevant stakeholders, including the smallholders who will be benefiting from the micro credits in the second year.

***Activities and results:***

**Activity 1:** On-farm demonstration, training and dissemination of improved wheat and winter grain legumes (Faba Bean, Chickpea and Common Bean):

**The details of this activity are shown in Annex 2 (page 40).**

Four demonstration plots, at the farm level, were implemented in collaboration with well-trained farmers. A reference site (researcher-managed plot) was executed at Hudeiba Research Station for comparison purposes.

The area of each demonstration plot is around 4000 m2. This area was divided into eight subplots (500 m2). Four crops, namely wheat, faba bean, chickpea, and common bean were demonstrated. Each subplot was designated to a crop variety.

Wheat production package includes (in addition to the improved varieties):

* Optimum planting date (during first half of November)
* Seeding rate of 140 kg/ha
* Fertilizer –N at a rate of 129 kg N/ha for Debeira and 107.5 kg N/ha for Nebta
* Frequent watering
* Pest management

Faba bean production package includes (in addition to the improved varieties):

* Optimum planting date (early November)
* Seeding rate of 120 kg/ha
* Chemical weed control (Pursuit + Stomp)
* Frequent watering

Chickpea production package includes (in addition to the improved varieties):

* Optimum planting date (mid-November)
* Seeding rate of 70 kg/ha for Borgeig and 80 kg/ha for Wad Hamid
* Chemical weed control (Goal) plus supportive hand weeding
* Fertilizer – N at a rate of 43 kg N/ha
* Insect management

Common bean production package includes (in addition to the improved varieties):

* Optimum planting date (late October to early November)
* Seeding rate of 60 kg/ha for RO/2/1 and 80 kg/ha for Ibberia
* Fertilizer – N at a rate of 86 kg N/ha
* Chemical weed control (Pursuit + Stomp)
* Frequent watering

A set of neighboring farmers’ plots were monitored for comparison purposes. Grain yields attained in participating farmers’ plots were very much comparable to yields attained at the reference site. In comparison to neighboring farmers’ plots (wheat and faba bean), yields were more than double with use of improved technologies indicating potentiality and need for more extension work to improve farmers’ yields in the target area.

**Table 10: Grain yield (kg/ha) of wheat in Lower Atbara area during 2014/2015**

|  |  |  |  |
| --- | --- | --- | --- |
| Testing site | Variety | | |
| Debeira | Nepta | Mixed |
|  | | | |
| Reference site (Hudeiba Station) | **4097** | **3749** | - |
|  | | | |
| On-farm demonstration plots: |  |  |  |
| Al Gilaia – 1 | 2754 | 3533 |  |
| Al Gilaia – 2 | 4413 | 3183 |  |
| Albiara | 4221 | 4072 |  |
| Gangari | 3879 | 3600 |  |
| Mean | **3817** | **3597** |  |
|  | | | |
| Neighboring farmers’ plots | - | - | **1731** |
|  | | | |

**Table 11: Grain yield (kg/ha) of faba bean in Lower Atbara area during 2014/2015**

|  |  |  |  |
| --- | --- | --- | --- |
| Testing site | Variety | | |
| Hudeiba 93 | Ed Damer | Local |
|  | | | |
| Reference site (Hudeiba Station) | **1610** | **2041** | - |
|  | | | |
| On-farm demonstration plots: |  |  |  |
| Al Gilaia – 1 | 1744 | 1781 |  |
| Al Gilaia – 2 | 1050 | 1142 |  |
| Albiara | 1789 | 1701 |  |
| Gangari | 1862 | 2051 |  |
| Mean | **1611** | **1669** |  |
|  | | | |
| Neighboring farmers’ plots | - | - | **1337** |
|  | | | |

**Table 12: Grain yield (kg/ha) of chickpea in Lower Atbara area during 2014/2015**

|  |  |  |
| --- | --- | --- |
| Testing site | Variety | |
| Borgeig | Wad Hamid |
|  | | |
| Reference site (Hudeiba Station) | **2283** | **3313** |
|  | | |
| On-farm demonstration plots: |  |  |
| Al Gilaia – 1 | 2534 | 1916 |
| Al Gilaia – 2 | 1371 | 555 |
| Albiara | 2363 | 2899 |
| Gangari | 1692 | 3734 |
| Mean | **1990** | **2276** |
|  | | |

**Table 13: Grain yield (kg/ha) of common bean in Lower Atbara area during 2014/2015**

|  |  |  |
| --- | --- | --- |
| Testing site | Variety | |
| Ibberria | RO/2/1 |
|  | | |
| Reference site (Hudeiba Station) | **2411** | **2647** |
|  | | |
| On-farm demonstration plots: |  |  |
| Al Gilaia – 1 | 2394 | 2611 |
| Al Gilaia – 2 | 1515 | 1959 |
| Albiara | 1645 | 2488 |
| Gangari | 2251 | 1796 |
| Mean | **1951** | **2213** |
|  | | |

Two farmers’ field days were carried out early January 2015 at both on-farm and on-station levels. Improved production technologies were explained and discussed with trainee farmers. In addition, extension pamphlets of improved production technologies for the four crops were distributed to invited farmers. Participants in field day activities included research scientists (Hudeiba Research Station), the team of IFAD Butana development project in Lower Atbara area, extension officers, students (Faculty of Agriculture, Nile Valley University) and farmers (50 trainees). Field day activities were carried out in close collaboration with IFAD team.

Improved seed units of 8 to15 kg each (based on crop and variety) from the reference site seed source of the four evaluated crops were prepared and stored at Hudeiba Research Station. Each seed unit will plant an area of about 1000 m2. Sixty seed units (together with detailed extension pamphlets) of the four evaluated crops will be distributed to trained farmers, shortly before planting time, by the team of IFAD Butana development project in Lower Atbara area.

Current activities focus on the analysis and reporting of yield and crop management data, economic evaluation of improved interventions, and the preparation of detailed extension pamphlet for wheat and winter grain legumes.

**Activity 2:** Water saving technologies (pipe conveyance system)

**The details of this activity are shown in Annex 2 (page 53).**

Six units of the pipe conveyance system were installed at farm level in Al-Abaar and Gangari communities as innovation platforms (1 feddan each unit). Four units were planted with okra, one unit with alfa alfa and one unit with wheat. The research team conducted subsequent visits for repair, maintenance, operation and management checkup of the innovation platforms. Regular monitoring and follow up on data collection was performed by the extension agents of IFAD Butana development project. Data analysis is under processing. A field day was organized in collaboration with IFAD Butana development project with the participation of farmers from six communities and representative of the River Nile Ministry of Agriculture.

In preparation for the scaling up of the pipe conveyance system in Lower Atbara River, researchers and extension agents from IFAD Butana development project conducted survey visits to target communities. The team oriented the communities about the project, its objectives, approaches, the benefits of the technology, and expected results. The team also explained to the targeted communities that participation requires partnerships; the communities provide the inputs, including irrigation systems, seeds, fertilizers and pesticides and herbicides through micro-loans from institutions such as Bank of Sudan and other institutions involved in rural microfinance. The project will facilitate access to microfinance and will design and install the pipe conveyance system and provide technical advice, training, field days, and follow up on data collection and reporting. A total of **106 smallholder farms** are targeted for the installment of the pipe conveyance system.



**Figure 9: Wheat under the pipe conveyance system at Gangari village in Lower Atbara area**



**Figure 10: Field day event in Lower Atbara area**

**Activity 3:** Livestock production

**The details of this activity are shown in Annex 2 (page 56).**

Interventions focused on:

* Strategic supplementary feeding for breeding ewes
* Fattening weaned lambs and kids as value addition and income generation
* Concentrates and saltlick blocks for lactating animals (goats, cows) to improve milk yields and household food security
* Rural dairy processing for income generation

The interventions are based on forage legumes and agricultural byproducts produced under improved pipe conveyance irrigation systems.

**Activity 4:** Socioeconomics studies

**The details of this activity are shown in Annex 2 (page 63).**

Activities conducted:

* Diagnostic appraisal: reviewed background information, visited project domain, observations, informal consultations to understand the context, issues along the value chain - agricultural systems: farming / production systems; input and output markets; formal and informal institutions of service providers, research, extension / advisory services; farmer groups.
* Identified the main value chain components or sub-systems, functions undertaken along the chains and the key stakeholders and business partners.
* Conducted situation analyses of the key stakeholders and institutions to analyze internal and external business environments, as well as the quality of linkages and coordination between business partners in the value chain.
* Value chain stakeholders identified and surveyed/interviewed are: service providers – credit institutions, input-output markets, extension services, formal public institutions – ministry of agriculture / various departments, community-based and farmers’ groups, and producers (scheme owners and sharecroppers).
* Meeting with Sudanese Company for Rural Development (Bank of Sudan):

It was agreed in this meeting to write a short proposal to the company explaining the project objectives and activities and indicating its geographical location. A team from the company will conduct a quick survey in the target area to assess the possibility of providing micro-credits to farmers.

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below.

The project succeeded in implementing the innovation platforms for pipe conveyance technology as per the work plan. Strong linkages were established with IFAD investment project to scale up this technology.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Sudan** | On-farm demonstration and yield maximization of wheat and winter grain legumes  Mineral and concentrate supplementation to lactating animals and sheep fattening  Demonstration of small-scale water savings irrigation schemes (pipe conveyance, drip irrigation and sprinkler irrigation systems) | Establishment of innovation platforms for pipe conveyance technology with a menu of improved crops and agronomic practices. | Using IFAD investment project “Butana Integrated Rural Development Project” as a vehicle to disseminate the pipe conveyance technology through the provision of microcredits. |

# YEMEN

***Summary:***

The priority technology package to be scaled up is the improvement of sheep production through introducing improved males, improved feeding diet and fattening. The research-to-business model focuses on vertical coordination between sheep producers and buyers. The military operations in Yemen which started in March 2015 affected the implementation of the work plan. The activities of the project are currently pending.

***Activities and results:***

During phase I of the project, attempt to improve sheep production was achieved through introducing improved males and feeding diets to farmers’ community at Telhama village. Two additional villages are targeted in Phase II (Bani-Saba’a and Al-Kubbah). Nine pure improved males were distributed to 9 farmers, 3 in each village. Activity was followed up in order to identify the mating process and to introduce the feeding to the selected sheep. Suggested diet consisted of 45% crushed wheat, 45% crushed barley, 2% urea and 8% salt. Weight of sheep was taken before and after mating in each village.

Feeding treatment was introduced two weeks before mating and two weeks after mating with the purpose to enhance metabolism and fertility. Second dosage will be introduced after delivery in order to increase milk production that will enhance growth and weight. Amount of feeding was 250g per head per day for 30 days at the two dosages. Farmers, researchers, livestock specialists, extension agents, and a cooperative participated in implementing the activity.

A questionnaire was prepared to collect farmers’ opinion regarding some characteristics of sheep produced from mating with improved males in comparison to local males. Data show that some important characteristics appeared in the offspring of improved males such as the weight of born lamb (Table 11).

Data analysis show that the price of a new born sheep from an improved male was higher at age of six month compared to a new born from a local male. Average price of a six month sheep from improved male was 22111 Yemeni Riyal while the price of a six month sheep from local male was 18000 YR (Table 12). New born from local males cannot be sold at age of 6 month because size and weight are low and farmer keeps feeding the sheep till it reaches the age of 8 months. The cost of feeding for an extra 2 months period was calculated at 7200 YR.

During the period of April to September 2015, many visits were conducted for distribution of feeding in the three villages and to collect data on new born lambs.

Several meetings with different stakeholders took place to discuss how to link sheep producers with buyers:

* A meeting was held with livestock dealers. They appreciated the idea of buying livestock from farmers according to characteristics allowing to sell easily.
* A meeting was held with sheep producers. They appreciated the introduction of improved males to their villages, the feeding diet which was applied, and the impact of the package on producing healthy sheep that can be sold at higher price comparing to sheep produced from mating with local males.
* Three meetings were held with restaurant owners in Dhamar city. They revealed no objection of buying sheep from farmers in the target villages.
* A meeting was held with the owner of a sheep fattening farm to explore the possibility of purchasing fattened sheep from the three villages. The owner showed a serious willingness to communicate with farmers and to buy their sheep production.
* Meetings were held to discuss the overall understanding of research to business concept. Participants were the project team, concerned researchers in the Central Highlands Research Station and extension agents from the Ministry of Agriculture and Irrigation Office/Dhamar governorate including the DG. The purpose of the meetings was to clarify the concept to other partners and explain the experience on conducting this activity with sheep. All attendance appreciated the concept and even discussions about testing the concept on other commodities took place.
* A meeting was held with the owner of the fattening farm concerning buying lambs from farmers and the suggested mechanism by farmers to assign the local extension agent to be the one who could coordinate between farmers and the fattening farm. It should be mentioned that the fattening farm prefers lambs just after or during weaning.

In general, the research to business model has somehow crystallized as follows:

* Farmers are accepting the technology of using improved lamb and feeding menu to improve their sheep production. Farmers agreed to sell their sheep (lambs) to the fattening farm and livestock whole sellers with the coordination of the local extension agent as a focal point.
* The focal point will contact and coordinate with buyers when there are a sufficient number of lambs for selling.
* Buyers (fattening farm and livestock whole sellers) will coordinate with the focal point in the village to determine the selling seasons.

**Table 14: Farmers’ opinion regarding some characteristics of sheep produced from mating with improved males in comparison to local males**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Factor/Characteristics | Comparison in % (sample size = 32 farmers) | | | |
|  | Improved sheep is better | Local sheep is better | No difference | No Idea |
| 1 | Size at birth and growth rate | 100 | 0 | 0 | 0 |
| 2 | Tolerance to stress | 23 | 0 | 11 | 63 |
| 3 | Tolerance to hunger | 0 | 0 | 22 | 78 |
| 4 | Eating all types of fodder | 100 | 0 | 0 | 0 |
| 5 | Tolerance to diseases | 41 | 0 | 35 | 24 |
| 6 | Decrease in death rate | 88 | 0 | 12 | 0 |
| 7 | Increase in fertility rate | 44 | 0 | 0 | 56 |
| 8 | Twins production | 56 | 11 | 33 | - |
| 10 | Market demand | 100 | 0 | 0 | 0 |
| 11 | Price | 100 | 0 | 0 | 0 |
| 12 | Shape | 100 | 0 | 0 | 0 |

**Table 15: Price comparison**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Sheep born from mating with improved male | Sheep born from mating with local male | Sheep born - first generation of improved male |
| Average selling price | 23111 | 18000 | 19250 |
| Sheep age at selling (in month) | 6 | 8 | 8 |
| Average selling price + forage saving | 30311 | 18000 | 19250 |

**Progress made against the annual work plan:**

The planned physical interventions and the expected elements of the research-to-business model outlined in the approved annual work plan are summarized in the table below.

The military operations in Yemen which started in March 2015 affected the implementation of the work plan.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Physical interventions in Phase I**  (tested and proven technically at farm level) | **Physical interventions in Phase II**  (with a focus on the economic analysis) | **Elements of the research-to-business model** |
| **Yemen** | Improving crop productivity:  (Introduction of newly released wheat and lentil varieties, fertilization, seed rate and irrigation recommendations were the main interventions to improve crop productivity)  Improving livestock productivity:  (Introduction of pure breed of sheep, of feeding diets and of new cereal forage crops were the main interventions to improve livestock productivity) | Establishment of innovation platforms for improved livestock (sheep) and crop (wheat and lentil) productivity. | Identification of marketing mechanisms and potential establishment of marketing channels for wheat and lentil. |

# ANNEX 1: ETHIOPIA

**Value Chain and SWOT Analysis (component II of the project)**

A study has been undertaken at Boku Wolda village with the members of Gadamso Irrigation Development Cooperative. The effort here is to grasp on the major market constraints the group is facing, what the cooperative is doing in this regard, identifying potential partners and linkages needed to improve the current situations. Comprehensive appraisal of the value chain will be conducted as per the schedule.

So far Gedemso cooperative has a total capital of only 265,000 birr. The members in total size about 195 of which about 45 are females. The cooperative also has store with a capacity of 1000 quintals (100 tons). The group did not start buying and selling of grain crops. However they started marketing of onion and tomato produce. The produce was sold to Duro Langano Union (which makes up 17 primary cooperatives including Gadamso Irrigation Cooperative). The group revealed that Duro Langano Union was not able to take all the produce that is collected by the cooperative. As a result, brokers are interfering in the market and this is the major problem. There is also high transport cost to take the produce to the nearest town Arsi-Negelle, it cost about 30birr per box. The cooperative has no linkage other than this union.

**Cooperative Unions**

**Duro Langno Union**

The union owned small vegetable shop at Arsi-Negele town. They also bought a new car (midi truck- Isuzu) last year. The union constructed new store to be used for vegetables. The union is involved in marketing of vegetables, not cereals. The officers were not available during the first visit and no discussion is made for further information. There will be preliminary discussion and consecutive meetings for effective linkages as this partner is the only one involved in vegetable chain in the area.

**Duro Abaro Union**

The Union is located in Arsi-Negelle town and discussion is made with the chairman and the board member of the union. Its total capital is 2.5 million and working capital sizes about 600,000 birr. The union owns store with a capacity of 12,000 quintals. There are 17 cooperatives organized under this union. The union buys and sells wheat, barley, maize and haricot beans. Out of this, they sold 5000 quintal of wheat for unions and Ethiopian Grain Trade Enterprise (EGTE). Collection of wheat and maize was performed for two years and for haricot bean is only for one year. The constraint in trading with this partner (EGTE) is lack of flexible contract that EGTE sets fixed price. While the price on the market is much higher than the agreed price, it becomes un-attractive to the union. Thus, the union prefers to base on the going market price. The other constraint with this model is that EGTE only buys first grade grain, not the second grade or other. The union faces problems while buying grain that the collection from the beginning is not based on grades. The farmers or the cooperative do not clean the grain to this standard. This makes it difficult for the union to meet up the EGTE’s criteria.

The other partner is the Lume-Adama Cooperative Union, for whom the union sold wheat the previous two years. Uta Wayu Union is located in Shashamene (further sells grain to WFP) and local traders were also the other buyers. The effort to work with Kaliti Food processing company and industries in Hawassa did not come up with effective linkage that the industries were not interested. The union provided facilities such as analytical balance, germination test, and moisture testing. Still the union has limitations of capital and availability of market. Recently, the union also got credit of 2 million birr from Lume-Adama Union. Although Gadamso Cooperative is not member to Duro Abaro Union by subscribing shares, it could sell the produce as that of the member cooperatives. However, the union still not able to fulfill the service even for the member cooperatives.

**Potential food industries in the wheat value chain**

As one of the actors in the wheat value chain, some processing firms were contacted to establish and test the models.

**Africa PLC**

The company is located at Adama and a new plant is to be established in Addis Ababa. The company processes Pasta, Maccorroni and Packed Floor. The company gets grain from EGTE i.e. the government arrangement to stabilize market. The floor will be distributed to consumer cooperatives on quota basis. It also buys grain from traders and has 4-5 agents in Adama which could connect to the traders. They report that there is shortage of grain from April to May. The company has no experience working with farmer cooperatives but they confirmed that they are interested to work with them as far as the quality is met.

**Brothers Biscuit Factory and Ahwan Floor Factory**

These two sister companies are processing biscuit and packed floor, respectively. There is a problem of purity on the supply that some is wet and the other is not well cleaned. But they built trust and business relationships through long years of trading with partners. EGTE possess the same link with this company and delivers hard wheat to be processed to floor. For biscuit, the industries need soft wheat. The company acquires grain from traders and brokers. The traders transport the grain to the factory place.

According to the company, they prefer to get from farmers but the supply should be greater than 50 quintals. However, they are afraid of displacing traders and causes a price war with the unions. The traders would raise price and in the end the industry will get in a problem that it deteriorates their long term business relations. This also will cause a problem on consumers. Because of this, they prefer to buy from farmers with the ‘’farmer price’’ and ‘’ trader price’’ for that of the traders. On the other hand, this gives less incentive for farmers and they may not again interested to sell to the company. Even if with this challenges to come, the company agreed that the cooperative could deliver the produce beginning this time meeting up with the required quality. The other is that the company would not like to get into contracts with farmers. As private business, they prefer to continue with the previous approach, accept if quality and quantity requirement is met or reject if not. The price of purchase will also depend on the market situation. Hence, the companies would not like to have formal linkages because of the fact that the uncertainty on the delivery and lack of experience with cooperatives. It might be so feasible after repeated and successful trade partnership with the groups. It is necessary to have consultation meeting with the involvement of all the actors and arrive on the most likely arrangement and commitments.

Other partners to be contacted ahead:

1. Ethiopian Grain Trade Enterprise
2. Duro Langno Union
3. Food processors at Shashamene (nearby city)
4. Lume Adama Union

**SWOT Analysis**

Group discussion has been carried out for SWOT analysis purpose. Members of Gedamso Small Scale Irrigation Cooperative and beneficiaries of the project gave their feedback on the strength, weakness and constraints with regard to production and marketing of tomato, onion and wheat. About twelve farmers participated for the discussion of the issues of which 3 are female farmers.

The farmers were asked about the benefits they got from the project for introduction. They informed that they received tomato variety named ‘Gelila’. The same amount of onion was supplied with variety named ‘Bombay Red’. With regard to wheat, they received 33.3 kg for Deqeba variety. This variety is targeted for stress tolerance and farmers said it is early maturing as its name. It yields 32 quintal /ha and they prefer it. They also got fertilizer 30kg/ DAP per farmer and urea the same amount. Earlier, they were also provided maize 540 variety with 12.5 kg per farmer. In addition 2 chicken for two farmers and sheep for 3 farmers were given. Potato, Teff, and faba bean were are also delivered during the starting time.

|  |  |
| --- | --- |
| **Strengths** | **Weaknesses** |
| * Good access to irrigation water in the kebele * Provision of small seed, inputs and other support * Provision suitable variety of wheat * Most farmers plow more than 2 Qert (0.5 ha) and possibility to increase productions * Improvement in production of wheat with supplemental irrigation * Capacity building from seedbed preparation till the end of harvest * Expand production and activities * Visit by experts from the research * Supply of inputs and varieties by the cooperative * Contact stakeholders for training and solving water related problems by the group * Conducting discussion with members * Having own budget, and ability to maintain store and office | * Provision of improved varieties and inputs not performed on time and expected quantity * Delivery of chemicals was promised and farmers did not get it * Supply of improved breeds and AI service was not pragmatic * Capacity building not conducted, adequate tools and equipment not provided for bee keeping. Capacity building related to horticulture is also inadequate * The project only gives support but not do monitoring and follow up. * Selected farmers may not receive the inputs and seeds * Lack of transparent transfer of assets * Project lacks planning. The capacity of the project and the number of farmers to support is not clear * Farmers lack diversification on production to come up with market problems * Absence of clustering of farmers that helps to meet up with the market demand * Cooperative lacks capital to purchase chemicals or to market produce. It has made no effort to secure credit for acquiring it. * The cooperative do not have adequate storage and facilities * The union could not achieve market power against traders * Farmers and the cooperative have capacity gaps related to business * Problems of water loss due to breakage of the irrigation canal * Lack of cleaning the canal * Livestock movement across the canal * Water utilization problem due to allocation and management * Siltation problem of the canal * Design problem of the canal caused breakage and siltation * Reduced reservoir due to siltation. Difficulty of cleaning it using labor |
| **Opportunities** | **Threats** |
| * High potential for growing onion and tomato vegetables and rolling cabbage * High demand on the market for rolling cabbage * Production of the seed of onion * Good market for produced seed with attractive price * Nearness to horticulture corridors, Ziway and Meki. Possible to get seed and other inputs * Potential for production of wheat * Existence of unions to support involved in both vegetable and cereal marketing. | * Lack of better market for the produce and reason for failure of paying credit * The fluctuation of price of horticulture * Potential area (Meki) cause for low price * Transport problem, high transport fare raising from season to season and absence of competition * Challenge of seed quality problem (germination and purity) mainly tomato and onion * The seed for horticulture is bought from traders (Meki and Ziway) unknown sources * Availability of chemical for controlling insects and its high cost * High interest rate (10 %), plus high service fee and penalty * No strategy to provide credit for farmers depending on time and seasons * Lack of focus by different stakeholders at Woreda level * Union fail to negotiate on market and lack of market power |

# Strengths

The project has provided different packages and of these the new variety of wheat named ‘’Deqeba’’ fits well for the area. The variety is early maturing and so it is suitable for our climate. Most farmers plow more than 2 Qert (0.5 ha) and possible to increase productions. Good access to irrigation water is the other strength in the kebeles. Providing support for irrigation users and non-users class and provision of assistance is good approach. Provision of small seed and other support is its strength. Capacity building has been performed about crop varieties, spacing, seedbed type during dry and wet seasons, depth of planting of tomato and onion crops, and row planting for teff and wheat. Only 4 kg/ha of seed is needed to plant before we use large mas of bulb. In general, it is from seedbed preparation till the end of harvest. Training has been provided though only for 6 persons and this enables to manage seed production. Currently two men farmers are involved in onion seed production. For tomato, some farmers have the skill but it is not very significant.

The project enabled us to expand our production with the provision of technologies and inputs. There is change on the livelihood of farmers. It allowed us to involve in the activities for example, some farmers work by sharing land with other farmers before. The visit made by many experts of the research center from farm distance is appreciable. The effort of doing this discussion at this moment and asking us about our problems is also strength. Production of wheat with supplemental irrigation enhanced the height and the stand, adjustment for optimal seed rate.

From the cooperative side, it is doing well though provided small seed and input. Some efforts of contacting stakeholders for training and solving water related problems were performed. Increased gain in membership of the cooperative is also one of the positive sides. Conducting discussion with members with regular and annual meeting, having own budget, and ability to maintain store and office has been mentioned.

# Weaknesses

The provision of improved varieties (0.5gm onion and tomato) and inputs (fertilizer) has not been performed on time and expected quantity was not delivered as planned and promised. Even, only Urea was obtained this year. Farmers were waiting for long after preparation of their plots. Delivery of chemicals was promised and farmers did not get it at all this year. For wheat they needed Palace and Topic chemicals. In the direction to livestock, supply of improved breeds and AI service was considered however was not pragmatic. Earlier, beehive is given to farmers but not training as planned with regard to the general management, processing of honey and use of clothes. The lack of capacity building and provision of inadequate tools and equipment for bee keeping constrained the involvement of the farmer. The farmers put their effort with limited skills on it. Capacity building related to horticulture production is also inadequate. Lack of capacity building is the main weakness in this project.

Follow up was good during the earlier period of the project but weak afterwards. This year also we did not get chemicals. Due to lack of follow up the selected farmers may not get the inputs and seeds. There is lack of transparent transfer of assets, the capacity of the project what it can and cannot, and the amount it could support (how much in each commodity). The number of farmers to support is not known and it lacks planning in general. Whereas, the project is only giving support but not have monitoring and evaluation component. On the farmers’ side, there is lack of diversification on production that all farmers produce the same crop, eventually oversupply on the market has led to down serge on the price. The development agent explains that when more is supplied, produce lacks market while when there is more demand on the market our supply will not meet the demand, it is a challenge. So lack of clustering is one weakness affecting negatively and so clustering of farmers helps to meet up with the market demand. With this arrangement, the produce of all the farmers gets harvested at the same time which is good for economy of scale. It will also be very convenient to arrange transport or attract buyers. Besides, the farmers could supply uniform quality which again creates incentive for traders to take all the produce.

There is shortage of capital from the cooperative side to purchase and supply chemicals or marketing of produce as well. However, it has made no effort in this regard to secure credit for acquiring chemicals. Default on credit also the other obstacle for the cooperative. They do not have adequate storage and facilities. The cooperative is member to Duro Langano union located at Arsi-Negelle town and established focusing towards horticulture marketing. The union first informed us to supply the produce but in the end the union could not find market for it and failed to buy from us. The farmers then took the tomato produce to open market which they incurred transport cost and forced them to sell at very depressed price. The farmers get back to traders the usual business due to such a war on the market. The union could not achieve market power since traders make cooperation to discourage it and make it out of the game.

Farmers and the cooperative also lack knowledge with regard to business, and business plan in doing operations or while taking credit. The cooperative lacks information exchange among farmers. The basis for the establishment of our cooperative association is irrigation water. Currently it faces the problems of water loss due to breakage of the irrigation canal. Lack of cleaning the canal due to difficulty of doing manually using human labor. Livestock movement across the canal is one of the causes for breakage and it is our weakness that we can prevent from such a damage. There is water utilization problem related to allocation and management, for instance slope matters that on the upper side of the canal there is more access. Siltation problem of the canal is the challenge with our group. Farmers mentioned design problem and need for concrete lined canal to avoid breakage and siltation, which requires huge capital. Currently there is problem of reduced reservoir due to siltation, however it is very difficult to clean it using our labor since it was machine dug from the beginning.

# Opportunities

The area has high potential due to the suitable agro-ecology for growing onion and tomato vegetables. Rolling cabbage also performs well provided that insect pests affecting its production are effectively controlled. There is high demand on the market and fetches good profits. Ziway and Meki are horticulture corridors, as we are near to these areas seed and other inputs could be obtained. Production and marketing of the seed of onion is the other opportunity to be mentioned. Produced seed could be sold to nearby areas with its attractive price (500/kilogram for onion). Potato also performs well in the area but water shortage affects the involvement. Wheat is also the best performing crop among cereals and there is high potential to supply more both of the hard and soft wheat types.

The presence of Duro Langano union to support vegetable marketing is good opportunity as far it could be supported to be vibrant association. Currently it has constricted store and shop for selling the produce. It also acquired Isuzu track car for transporting produce. With regard, to cereals, Duro Abaro union located at Arsi Negelle collects grains and markets to other partners. The union buys from the member and non-member farmers depending on its capacity.

# 

# Threats

Lack of market for the produce is one of the constraints raised by the groups. Low market price causes a loss for farmers in connection to high production cost of vegetables and main reason led to default on credit. High input is applied but yield may be lost. The fluctuation of price is also common issue in horticulture produce in the area. A number of middle men involved and offer only 100 birr for us when the market is 150 or more. As Meki area is potential in vegetable the produce gets so cheap (60-70 birr/box for tomato) and always causes price reduction in our area to be considered as threat. There is lack of transport, high transport fare, 12 birr per quintal for onion and 6 birr per box for tomato. It is also raising from season to season and no competition among them.

With regard to wheat, the price gets low (500 birr/quintal) after immediate harvest. Some farmers may need money and sell the produce with such a price. Farmers told that some is explained by the weakness on the farmers’ side but if it will be stored until summer, it could be sold 900-1000 birr. There is lack of credit and mechanism for this kind of challenges.

On the supply of seed on the market, there is a challenge of seed quality problem mainly tomato and onion. The seed for horticulture is bought from traders in Meki and Ziway from unknown markets Sources. The seed fails to germinate or mixed fruit of tomato is germinating. The availability of chemical for controlling insects and worm is one of the challenges. Besides, the high cost or expensiveness of the chemicals raises the cost of production. High interest rate (10%) plus high service fee 500 birr out of 6000 credit constrain asking credit. After the deadline of payment time 50 birr/day (WALQO) is to be paid. Busa Gonofa MFI is lowest interest in giving credit but not available in here. No strategy to provide credit for farmers depending on time and seasons. There is lack of focus by different stakeholders, Woreda Administration Office, Woreda Cooperative Association, Bureau of Agriculture and etc… The attention given is very negligible and less commitment of this woreda.

# ANNEX 2: SUDAN

**Activity 1:** On-Farm Demonstration, Training and Dissemination of Improved Production Technologies of Wheat and Winter Grain Legumes (Faba Bean, Chickpea and Common Bean) in Lower Atbara Area

**Scientist:** Dr**.** Omer H. Ibrahim

**INTRODUCTION**

The on-farm activities during the crop season 2014/2015 were carried out at four testing sites (villages) namely, Albiara-1, Albiara-2, Gangari and Algilaia in Lower Atbara Area. In each village a demonstration model was executed in a way that the four targeted crops namely, wheat, faba bean, common bean and chickpea were demonstrated to farmers at each site. In addition, farmers’ field days were carried out in collaboration with IFAD team at both on-farm (Albiara-1) and research (Hudeiba Research Farm) levels.

Generally, the on-farm activities in Lower Atbara area were carried out with following objectives:

1. To expose and train many farmers in Lower Atbara Area on improved production technologies of the specified winter season crops.
2. To quantify yield gaps between research, demonstration plots and farmers’ plots in Lower Atbara area.
3. To enhance dissemination and scaling up processes of improved technologies by distribution of improved seeds to all trained farmers.
4. To improve farmers' income and livelihood by adopting improved technologies and by introducing new highly rewarding cash crops such as chickpea and common bean.

**(1)Wheat Demonstration Plots in Lower Atbara Area**

**Materials and Methods:**

Two contrasting improved wheat varieties namely, Nebta (early maturing) and Debeira (medium to late maturing) were planted in collaboration with four farmers in Lower Atbara area. Each variety was planted in an area of about 500 m2 at each testing site. Two neighboring wheat farmer’s plot was monitored for comparison purposes. Concurrently the two demonstrated wheat varieties were planted in a research-managed plot (750 m2 per variety) at Hudeiba Research Farm as a reference site. In addition to the improved variety, the wheat improved production package consisted of:

1. Optimum planting date (during November).
2. Seeding rate of 140 kg/ha.
3. Fertilizer-N at a rate of 86 kg N/ha for Nebta and a fertilizer-N rate of 129kgN/ha for Debeira.
4. Fertilizer-P at a rate 43 kg P2O5 at the farm and on-station levels.
5. Frequent watering.
6. Weed management.

The crop management practices adopted in demonstration plots and neighboring farmers’ plots in Lower Atbara; and in the reference site at Hudeiba Research Farm are presented in Table 1. In comparison to improved technology, the farmer's practice was generally characterized by absence of both phosphorous application and weed management, use of mixed crop varieties; comparatively delayed planting and use of low seed rates; and suboptimal application of irrigation water and fertilizer-N.

**Results and Discussion:**

The wheat crop grain yield performance in demonstration and neighboring farmers’ plots in Lower Atbara Area as well as in the researcher-managed plot at Hudeiba Research Farm is presented in Table 1. The mean wheat crops yields ranged from a low of 1434kg/ha in the neighboring farmers’ plots to a high of 3707kg/ha at farm level and a high of 3923kg/ha at the researcher-managed plots. The improved medium maturing variety Debeira gave the highest grain yields at both on-farm (3817kg/ha) and on-station (4097kg/ha) levels. Averaged over all varieties, the improved wheat production technology increased farmer’s yield by 159% at the farm level and 174% at the researcher-managed plots level. These remarkable yield gaps were mainly attributed to use of mixed crop varieties; suboptimal application of irrigation water and fertilizers; absence of weed management; and comparatively delayed planting and in the neighboring farmers’ plots (Table 1). To bridge these large yield gaps appreciable extension efforts are highly stressed.

**Economic Evaluation:**

The partial budget analysis technique was used for economic evaluation of improved wheat production technology (Table 2). The total wheat production costs were increased (82% at the farm level and 108% at the station level) by use of the improved technology (Table 2). However, the higher grain yields obtained with the adoption of improved technology had dramatically increased the net benefits over farmers’ practice at both on-farm and on-station levels. Averaged over varieties, the farmer’s net benefits were more than four-folds (410%) at the farm level, and were about four-folds (388%) when compared to the researcher-managed plots. Therefore the high costs associated with adoption of improved technology were more than compensated for by the high increments in grain yields obtained in response to adoption of improved technology. The evaluated improved wheat production technologies were highly profitable at both on-farm and on-station levels. The marginal rate of returns (MRR) ranged from a low of 99% (Nebta at reference site) to a high of 152% (Nebta and Debeira at the farm level) with an overall mean MRR of 152% at the farm level and 109% at the station level. Based on grain yield performance and economic evaluation, at both on-farm and on-station levels, the medium maturing variety Debeira tended to be comparatively superior.

**(2) Faba Bean Demonstration Plots in Lower Atbara Area**

**Materials and Methods:**

The improved faba bean varieties Ed Damer and Hudeiba93 were planted in collaboration with four faba bean growers in Lower Atbara area. Each variety was planted in an area of about 500 m2 at each testing site. One neighboring farmer’s plot was monitored for comparison purposes. Concurrently the two investigated faba bean varieties were planted in a research-managed plot (500 m2 per variety) at Hudeiba Research Farm as a reference site. In addition to the improved variety, the faba bean improved production technology comprized:

1. Optimum planting date (during November).
2. Seeding rate of 119 kg/ha.
3. Chemical weed control (Pursuit + Stomp).
4. Frequent watering.

The crop management practices followed in participating farmers’ plots (PF), neighboring farmers’ plots (NF) and reference site at Hudeiba Research Farm are presented in Table 3. The farmer's practice was generally characterized by use of local low yielding land race, absence of weed management and application of less irrigation water.

**Results and Discussion:**

The grain yield performance of faba bean crops in neighboring and participating farmers’ plots in Lower Atbara Area, as well as in the reference site at Hudeiba Research Farm are displayed in Table 3. Mean faba bean grain yields ranged from a low of 1337 kg/ha in neighboring farmer’s plot to a maximum of 1640 kg/ha in participating farmers’ plots and a maximum of 1826 kg/ha in the reference site at Hudeiba Research Farm. Averaged over varieties, use of improved technology had increased farmer’s yield by 23% at the farm level and by 37% as compared to the researcher-managed plot (Table 3). The grain yields of the two demonstrated faba bean varieties were similar at the farm level. However, at the station level, the improved variety Ed Damer outyielded Hudeiba93 by 27%. Use of a low yielding land race, absence of weed management and application of less irrigation water were the major factors underlying the low faba bean yields in farmer’s field. Again more extension efforts are needed to boost faba bean yields in Lower Atbara Area.

**Economic Evaluation:**

The partial budget analysis technique was used for economical evaluation of the improved faba bean production package in Lower Atbara Area (Table 4). Averaged over the two investigated varieties, use of improved technology had increased total farmer’s costs by 25% at the farm level and 43% at the station level. However, the higher grain yields obtained with the use of improved technology had appreciably increased the net benefits over farmers’ practice at both on-farm and on-station levels. Averaged over varieties, the farmer’s net benefits were increased by 21% and 32% at the farm and station levels, respectively. This implies that the high costs incurred by using improved technology were more than compensated for by the high increments in grain yields obtained in response to adoption of improved technology. The investigated faba bean varieities proved to be profitable at both on-farm and on-station levels. Averaged over varieties, the MRR was 124% at the farm level and 109% at the on-station level. However, the improved variety Ed Damer proved to be economically superior at both on-farm and on-station levels. Based on grain yield performance and economic evaluation, the improved variety Ed Damer proved to be superior at both on-farm and on-station levels.

**(3) Common Bean Demonstration Plots in Lower Atbara Area**

**Materials and Methods:**

Two improved common bean varieties namely, Ibberria (erect and large-seeded type) and RO/2/1 (prostrate and small-seeded type) were planted in collaboration with four farmers in Lower Atbara area. Each variety was planted in an area of about 500 m2 at each testing site. Concurrently the two evaluated common bean varieties were planted in a research-managed plot (500 m2 per variety) at Hudeiba Research Farm as a reference site. In addition to the improved variety, the common bean improved production technology included:

1. Optimum planting date (early November).
2. Seeding rate of 60 kg/ha for RO/2/1 and 80kg/ha for Ibberria.
3. Chemical weed control (Pursuit + Stomp).
4. Frequent watering.

The cultural practices adopted in at the on-farm and on-station levels are presented in Table 5. The low number of irrigations applied at the station level was mainly related to use of long-furrow irrigation (i.e. addition of more irrigation water).

**Results and Discussion:**

The grain yield performance of common bean crops in participating farmers’ plots in Lower Atbara Area, as well as in the researcher-managed plots at Hudeiba Research Farm is shown in Table 5. The mean common bean yields ranged from a low of 1951 kg/ha (Ibberria at the farm level) to a maximum of 2647 kg/ha (RO/2/1 at the station level). Averaged over all varieties, the researcher-managed plots outyielded participating farmers’ plots by 21%. This yield gap was mainly related to better crop establishment and proper weed management in the researcher-managed plots at Hudeiba. The indeterminate, prostrate and small-seeded type variety (RO/2/1) proved to be superior at both on-farm and on-station levels. RO/2/1 outyielded Ibberria by 13% and 10% at the farm and station levels, respectively (Table 5).

**Economic Evaluation:**

The total production costs and net benefits were calculated for the two demonstrated common bean varieties (Ibberria and RO/2/1) at the farm (Lower Atbara Area) and research (Hudeiba Research Farm) levels (Table 6). The two demonstrated common bean varieties proved to be highly profitable at both the on-farm and on-station levels. The net returns ranged from a low of 14080 Ls/ha (Ibberria in Lower Atbara Area) to a maximum of 20247 Ls/ha at Hudeiba Research Farm. The improved variety RO/2/1 proved to be economically superior at both on-farm and on-station levels as evident in the calculated net benefits (Table 6). Based on economic evaluation and grain yield performance, the improved variety RO/2/1 proved to have high potential as a winter season cash crop in Lower Atbara Area.

**(4) Introduction of chickpea crop into Lower Atbara Area**

**Materials and Methods:**

Two contrasting improved chickpea varieties namely, Wad Hamid (early maturing) and Borgeig (late maturing) were planted in collaboration with four farmers in Lower Atbara Area. Each variety was planted in an area of about 500 m2. Concurrently the same varieties were planted in researcher-managed plots (500m2) at Hudeiba Research Farm. In addition to improved variety, the chickpea improved production package consisted of:

1. Optimum planting date (mid November).
2. Seeding rate of 80 kg/ha (Wad Hamid) and 70 kg/ha (Borgeig).
3. N-fertilizer at a rate of 86 kgN/ha.
4. Pest management.

The crop management practices adopted in demonstration plots in Lower Atbara Area and in the researcher-managed plot at Hudeiba Research Farm are presented in Table 7.

**Results and Discussion:**

The chickpea grain yields obtained in the participating farmers’ plots in Lower Atbara and in the reference site at Hudeiba Research Farm are presented in Table 7. The mean chickpea yields ranged from a low of 1990 kg/ha (Borgeig at the farm level) to a maximum of 3313 kg/ha (Wad Hamid at the station level). Averaged over all varieties, the researcher-managed plots outyielded participating farmers’ plots by 31%. This yield gap was mainly related to better crop establishment and proper weed management in the researcher-managed plots at Hudeiba. The early maturing variety Wad Hamid outyielded the late maturing one Borgeig at both on-farm (14%) and on-station (45%) levels (Table 7).

**Economic Evaluation:**

The total production costs and net benefits were calculated for the two demonstrated chickpea varieties Wad Hamid and Borgeig at the farm (Lower Atbara Area) and research (Hudeiba Research Farm) levels (Table 8). The two demonstrated chickpea varieties proved to be economically profitable at both the on-farm and on-station levels. The net returns ranged from a low of 2756 Ls/ha (Borgeig in Lower Atbara Area) to a maximum of 6373 Ls/ha at Hudeiba Research Farm. The improved early maturing variety Wad Hamid proved to be economically superior at both on-farm and on-station levels as evident in the calculated net benefits (Table 6). Based on economic evaluation and grain yield performance, the improved variety Wad Hamid tended to have high potential as a winter season cash crop in Lower Atbara Area.

**(5) Farmers’ Field Days:**

Farmers in vicinity of testing sites as well as those distant from testing sites, but under IFAD mandate, were exposed to improved technologies during field days activities at both on-farm and on-station levels. Two farmers’ Field days were organized in close collaboration with IFAD team in Lower Atbara Area. About 70 farmers participated in the field day activities. Participants were exposed and introduced to the different components of the improved production technology for each of the specified four crops. Concurrently extension pamphlets were distributed to participating farmers as well as other interested participants. Field days were also attended by IFAD team, extension officers and research scientists. For scaling-up purposes small seed lots (8 to 15 kg) from the reference site (intended to plant an area of 1000m2 for each crop) were packed and stored at Hudeiba. These seed lots are planned to be distributed by IFAD team (at planting time) to 60 trained farmers. Seeds to be distributed cover all demonstrated varieties of the four specified crops. Detailed extension pamphlets will distributed to participating farmers. The fate of seeds distributed to farmers will be monitored in collaboration with IFAD team in Lower Atbara Area.

Table (1): Grain yield and agronomic practices of wheat crops adopted at the farm (Lower Atbara) and the on-station (Hudeib Research Farm) levels during 2014/15 crop season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Farmer’s  No. | Variety | Plot  area  (m2) | Planting  date | Seed  rate  (kg/ha) | Weed Control | Fertilizer  kgN/ha  (kgP2O5) | No. of  Irrigations | Grain  Yield  (kg/ha) |
| 1. **Neighboring Farmers’ Plots (Lower Atbara)** | | | | | | | | |
| **Mean**  *(2 farmers)* | Mixed | **9800** | **21 Nov.** | **107** | **0** | **70(0)** | **7** | **1434** |
| 1. **Participating Farmers’ Plots (Lower Atbara)** | | | | | | | | |
| Albiara-I | Nebta | 500 | 17Nov. | 140 | T+24D(1S) | 107.5(43) | 10 | 4072 |
| Albiara-II | Nebta | 500 | 15 Nov. | 140 | 0 | 107.5(43) | 11 | 3600 |
| Gangari | Nebta | 500 | 17 Nov. | 140 | T+24D(1S) | 107.5(43) | 11 | 3183 |
| Algilaia | Nebta | 500 | 15 Nov. | 140 | T+24D(1S) | 107.5(43) | 10 | 3533 |
| **Mean** |  | **500** | **16 Nov.** | **140** | **T+24D(0.75S)** | **107.5(43)** | **10.5** | **3597** |
| Albiara-I | Debeira | 500 | 17Nov. | 140 | T+24D(1S) | 129(43) | 10 | 4221 |
| Albiara-II | Debeira | 500 | 15 Nov. | 140 | 0 | 129(43) | 11 | 3879 |
| Gangari | Debeira | 500 | 17 Nov. | 140 | T+24D(1S) | 129(43) | 11 | 4413 |
| Algilaia | Debeira | 500 | 15 Nov. | 140 | T+24D(1S) | 129(43) | 10 | 2754 |
| **Mean** |  | **500** | **16 Nov.** | **140** | **T+24D(0.75S)** | **129(43)** | **10.5** | **3817** |
|  |  |  |  |  |  |  |  |  |
| **Grand Mean** | | **500** | **16 Nov.** | **140** | **T+24D(0.75S)** | **118.2(43)** | **10.5** | **3707** |
| 1. **Reference Site (Hudeiba Research Farm)** | | | | | | | | |
| On-Station | Nebta | 750 | 13 Nov. | 140 | T+24D(1S) | 129(43) | 9 | 3749 |
| On-Station | Debeira | 750 | 13 Nov. | 140 | T+24D(1S) | 129(43) | 10 | 4097 |
| **Mean** |  | **750** | **13 Nov.** | **140** | **T+24D(1S)** | **129(43)** | **9.5** | **3923** |

*Notice: T = Traxos, 24D = Post emergence application of Dialine Super (2-4-D) and S = Spray.*

Table (2): Partial budget analysis for wheat demonstration plots in Lower Atbara Area 2013/2014 season.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Reference Site (Hudeiba)** | | | | | **PF Plots (Lower Atbara)** | | | **NF Plots** | |
|  |  |  | | |  | | |  | |  |
| Variety | Nebta | | Debeira | **Mean** | | Nebta | Debeira | **Mean** | Mixed | |
| Yield (kg/ha) | 3749 | | 4097 | **3923** | | 3597 | 3817 | **3707** | 1434 | |
| Price (Ls/kg) | 3.5 | | 3.5 | **3.5** | | 3.5 | 3.5 | **3.5** | 3.5 | |
| **Total Benefit (Ls/ha)** | **13122** | | **14340** | **13731** | | **12590** | **13360** | **12975** | **5019** | |
| **Production Costs (Ls/ha):** | | | | | | | | | | |
| Land Preparation | 1071 | | 1071 | **1071** | | 905 | 905 | **905** | 905 | |
| Seeds | 840 | | 840 | **840** | | 840 | 840 | **840** | 492 | |
| Fertilizers | 1817 | | 1817 | **1817** | | 1598 | 1817 | **1708** | 724 | |
| Irrigation | 563 | | 625 | **594** | | 656 | 656 | **656** | 438 | |
| Weed Control | 928 | | 928 | **928** | | 697 | 697 | **697** | 0 | |
| Harvest | 2690 | | 2829 | **2760** | | 2153 | 2241 | **2197** | 1288 | |
| **Total Cost (Ls/ha)** | **7909** | | **8110** | **8010** | | **6849** | **7156** | **7002** | **3847** | |
| **Net Benefit (Ls/ha)** | **5213** | | **6230** | **5721** | | **5741** | **6204** | **5973** | **1172** | |
| **MRR (%)** | **99** | | **119** | **109** | | **152** | **152** | **152** |  | |

*Notice: PF = Participating farmers’ plots and NF = Neighboring farmers’ plots.*

Table (3): Grain yield and cultural practices of faba bean crops adopted at the farm (Lower Atbara) and the on-station (Hudeib Research Farm) levels during 2014/15 crop season.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Farmer’s  No. | Variety | Plot  area  (m2) | Planting  date | Seed  rate  (kg/ha) | Weed Control | No. of  Irrigations | Grain  Yield  (kg/ha) |
| 1. **Neighboring Farmers’ Plots (Lower Atbara)** | | | | | | | |
| *(1 farmer)* | local | **6300** | **9 Nov.** | **143** | **0** | **6** | **1337** |
| 1. **Participating Farmers’ Plots (Lower Atbara)** | | | | | | | |
| Albiara-I | Ed Damer | 500 | 3Nov. | 119 | P+Stomp (1S) | 10 | 1701 |
| Albiara-II | Ed Damer | 500 | 3Nov. | 119 | P+Stomp (1S) | 10 | 1781 |
| Gangari | Ed Damer | 500 | 3 Nov. | 119 | P+Stomp (1S) | 10 | 1142 |
| Algilaia | Ed Damer | 500 | 8 Nov. | 119 | P+Stomp (1S) | 10 | 2051 |
| **Mean** |  | **500** | **4Nov.** | **119** | **P+Stomp (1S)** | **10** | **1669** |
| Albiara-I | Hudeiba93 | 500 | 3Nov. | 119 | P+Stomp (1S) | 10 | 1789 |
| Albiara-II | Hudeiba93 | 500 | 3Nov. | 119 | P+Stomp (1S) | 10 | 1744 |
| Gangari | Hudeiba93 | 500 | 3 Nov. | 119 | P+Stomp (1S) | 10 | 1050 |
| Algilaia | Hudeiba93 | 500 | 8 Nov. | 119 | P+Stomp (1S) | 10 | 1862 |
| **Mean** |  | **500** | **4Nov.** | **119** | **P+Stomp (1S)** | **10** | **1611** |
|  |  |  |  |  |  |  |  |
| **Grand Mean** | | **500** | **4Nov.** | **119** | **P+Stomp (1S)** | **10** | **1640** |
| 1. **Reference Site (Hudeiba Research Farm)** | | | | | | | |
| On-Station | Ed Damer | 500 | 31 Oct. | 119 | P+Stomp (1S) | 9 | 2041 |
| On-Station | Hudeiba93 | 500 | 31 Oct. | 119 | P+Stomp (1S) | 9 | 1610 |
| **Mean** |  | **500** | **31 Oct.** | **119** | **P+Stomp (1S)** | **9** | **1826** |

*Notice: P+Stomp = Pre-emergence application of in-tank mixture of Pursuit and Stomp and S = Spray.*

Table (4): Partial budget analysis for faba bean demonstration plots in Lower Atbara Area 2014/2015 season.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Reference Site (Hudeiba)** | | | | **PF Plots (Lower Atbara)** | | | | **NF Plots** |
|  |  |  | |  | | |  |  | |
| Variety | Ed Damer | | Hudeiba93 | **Mean** | Ed Damer | Hudeiba93 | **Mean** | | Local |
| Yield (kg/ha) | 2041 | | 1610 | **1826** | 1669 | 1611 | **1640** | | 1337 |
| Price (Ls/kg) | 7 | | 7 | **7** | 7 | 7 | **7** | | 7 |
| **Total Benefit (Ls/ha)** | **14287** | | **11270** | **12778** | **11683** | **11277** | **11480** | | **9359** |
| **Production Costs (Ls/ha):** | | | | | | | | | |
| Land Preparation | 1071 | | 1071 | 1071 | 905 | 905 | 905 | | 905 |
| Seeds | 1190 | | 1190 | 1190 | 1190 | 1190 | 1190 | | 1215 |
| Irrigation | 563 | | 563 | 563 | 625 | 625 | 625 | | 375 |
| Weed Control | 600 | | 600 | 600 | 600 | 600 | 600 | | 0 |
| Harvest | 2006 | | 1834 | 1920 | 1382 | 1358 | 1370 | | 1249 |
| **Total Cost (Ls/ha)** | **5430** | | **5258** | **5344** | **4702** | **4678** | **4690** | | **3744** |
| **Net Benefit (Ls/ha)** | **8857** | | **6012** | **7434** | **6981** | **6599** | **6790** | | **5615** |
| **MRR (%)** | **192** | | **26** | **109** | **143** | **105** | **124** | |  |

*Notice: PF = Participating farmers’ plots and NF = Neighboring farmer’s plot.*

Table (5): Grain yield and cultural practices of common bean crops adopted at the farm (Lower Atbara) and the on-station (Hudeib Research Farm) levels during 2014/15 crop season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Farmer’s  No. | Variety | Plot  area  (m2) | Planting  date | Seed  rate  (kg/ha) | Weed Control | No. of  Irrigations | Fertilizer  (kgN/ha) | Grain  Yield  (kg/ha) |
| 1. **Participating Farmers’ Plots (Lower Atbara)** | | | | | | | | |
| Albiara-I | Ibberria | 500 | 3 Nov. | 80 | P+St(1S) | 10 | 86 | 1645 |
| Albiara-II | Ibberria | 500 | 3 Nov. | 80 | P+St(1S) | 11 | 86 | 2251 |
| Gangari | Ibberria | 500 | 3 Nov. | 80 | P+St(1S) | 10 | 86 | 1515 |
| Algilaia | Ibberria | 500 | 8 Nov. | 80 | P+St(1S) | 10 | 86 | 2394 |
| **Mean** |  | **500** | **4 Nov.** | **80** | **P+St(1S)** | **10.25** | **86** | **1951** |
| Albiara-I | RO/2/1 | 500 | 3 Nov. | 60 | P+St(1S) | 10 | 86 | 2488 |
| Albiara-II | RO/2/1 | 500 | 3 Nov. | 60 | P+St(1S) | 11 | 86 | 1796 |
| Gangari | RO/2/1 | 500 | 3 Nov. | 60 | P+St(1S) | 10 | 86 | 1959 |
| Algilaia | RO/2/1 | 500 | 8 Nov. | 60 | P+St(1S) | 10 | 86 | 2611 |
| **Mean** |  | **500** | **4 Nov.** | **60** | **P+St(1S)** | **10.25** | **86** | **2213** |
|  |  |  |  |  |  |  |  |  |
| **Grand Mean** | | **500** | **4Nov.** | **70** | **P+St(1S)** | **10.25** | **86** | **2082** |
| 1. **Reference Site (Hudeiba Research Farm)** | | | | | | | | |
| On-Station | Ibberria | 500 | 1 Nov. | 80 | P+St(1S) + 1HW | 8 | 86 | 2411 |
| On-Station | RO/2/1 | 500 | 1 Nov. | 60 | P+St(1S) + 1HW | 8 | 86 | 2647 |
| **Mean** |  | **500** | **1 Nov.** | **70** | **P+St(1S) + 1HW** | **8** | **86** | **2529** |

*Notice: P+St = Pre-emergence application of in-tank mixture of Pursuit and Stomp, S = Spray and HW = Hand weeding.*

Table (6): Production costs and benefits of common bean crops, demonstrated at the farm (Lower Atbara) and on-station (Hudeiba) levels during 2014/2015 crop season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Reference Site (Hudeiba)** | | | | **PF Plots (Lower Atbara)** | | | |
|  |  |  | |  | | |  |  |
| Variety | Ibberria | | RO/2/1 | **Mean** | Ibberria | RO/2/1 | **Mean** | |
| Yield (kg/ha) | 2411 | | 2647 | **2529** | 1951 | 2213 | **2082** | |
| Price (Ls/kg) | 10 | | 10 | **10** | 10 | 10 | **10** | |
| **Total Benefit (Ls/ha)** | **24110** | | **26470** | **25290** | **19510** | **22130** | **20820** | |
| **Production Costs (Ls/ha):** | | | | | | | | |
| Land Preparation | 1071 | | 1071 | **1071** | 905 | 905 | **905** | |
| Seeds | 900 | | 675 | **788** | 900 | 675 | **788** | |
| Fertilizers | 890 | | 890 | **890** | 890 | 890 | **890** | |
| Irrigation | 500 | | 500 | **500** | 641 | 641 | **641** | |
| Weed Control | 838 | | 838 | **838** | 600 | 600 | **600** | |
| Harvest | 2154 | | 2249 | **2202** | 1494 | 1599 | **1546** | |
| **Total Cost (Ls/ha)** | **6354** | | **6223** | **6288** | **5430** | **5310** | **5370** | |
| **Net Benefit (Ls/ha)** | **17756** | | **20247** | **19002** | **14080** | **16820** | **15450** | |

*Notice: PF = Participating farmers’ plots.*

Table (7): Grain yield and cultural practices of chickpea crops adopted at the farm (Lower Atbara) and the on-station (Hudeib Research Farm) levels during 2014/15 crop season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Farmer’s  No. | Variety | Plot  area  (m2) | Planting  date | Seed  rate  (kg/ha) | Weed Control | No. of  Irrigations | Fertilizer  (kgN/ha) | Grain  Yield  (kg/ha) |
| 1. **Participating Farmers’ Plots (Lower Atbara)** | | | | | | | | |
| Albiara-I | Wad hamid | 500 | 11 Nov. | 80 | Goal (1S) | 10 | 86 | 2899 |
| Albiara-II | Wad hamid | 500 | 14 Nov. | 80 | Goal (1S) | 10 | 86 | 3734 |
| Gangari | Wad hamid | 500 | 11 Nov. | 80 | Goal (1S) | 10 | 86 | 555 |
| Algilaia | Wad hamid | 500 | 15Nov. | 80 | Goal (1S) | 10 | 86 | 1916 |
| **Mean** |  | **500** | **13 Nov.** | **80** | **Goal (1S)** | **10** | **86** | **2276** |
| Albiara-I | Borgeig | 500 | 11 Nov. | 70 | Goal (1S) | 10 | 86 | 2363 |
| Albiara-II | Borgeig | 500 | 14 Nov. | 70 | Goal (1S) | 10 | 86 | 1692 |
| Gangari | Borgeig | 500 | 11 Nov. | 70 | Goal (1S) | 10 | 86 | 1371 |
| Algilaia | Borgeig | 500 | 15Nov. | 70 | Goal (1S) | 10 | 86 | 2534 |
| **Mean** |  | **500** | **13 Nov.** | **70** | **Goal (1S)** | **10** | **86** | **1990** |
|  |  |  |  |  |  |  |  |  |
| **Grand Mean** | | **500** | **13 Nov.** | **75** | **Goal (1S)** | **10** | **86** | **2133** |
| 1. **Reference Site (Hudeiba Research Farm)** | | | | | | | | |
| On-Station | Wad hamid | 500 | 15 Nov. | 80 | Goal (1S) + 1HW | 8 | 86 | 3313 |
| On-Station | Borgeig | 500 | 15 Nov. | 70 | Goal (1S) + 1HW | 9 | 86 | 2283 |
| **Mean** |  | **500** | **15 Nov.** | **75** | **Goal (1S) + 1HW** | **8.5** | **86** | **2798** |

*Notice: S = Spray and HW = Hand weeding.*

Table (8): Production costs and benefits of chickpea crops, demonstrated at the farm (Lower Atbara) and on-station (Hudeiba) levels during 2014/2015 crop season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Reference Site (Hudeiba)** | | | | **PF Plots (Lower Atbara)** | | | |
|  |  |  | |  | | |  |  |
| Variety | Wad Hamid | | Borgeig | **Mean** | Wad Hamid | Borgeig | **Mean** | |
| Yield (kg/ha) | 3313 | | 2283 | **2798** | 2276 | 1990 | **2133** | |
| Price (Ls/kg) | 3.75 | | 3.75 | **3.75** | 3.75 | 3.75 | **3.75** | |
| **Total Benefit (Ls/ha)** | **12424** | | **8561** | **10492** | **8535** | **7463** | **7999** | |
| **Production Costs (Ls/ha):** | | | | | | | | |
| Land Preparation | 1071 | | 1071 | **1071** | 905 | 905 | **905** | |
| Seeds | 480 | | 420 | **450** | 480 | 420 | **450** | |
| Fertilizers | 890 | | 890 | **890** | 890 | 890 | **890** | |
| Irrigation | 500 | | 563 | **532** | 625 | 625 | **625** | |
| Weed Control | 595 | | 595 | **595** | 357 | 357 | **357** | |
| Harvest | 2515 | | 2103 | **2309** | 1624 | 1510 | **1567** | |
| **Total Cost (Ls/ha)** | **6051** | | **5642** | **5846** | **4881** | **4707** | **4794** | |
| **Net Benefit (Ls/ha)** | **6373** | | **2919** | **4646** | **3654** | **2756** | **3205** | |

*Notice: PF = Participating farmers’ plots.*

**ANNEX 2: SUDAN**

**Activity 2:** Water saving technologies (pipe conveyance system)

**Scientists:** Prof. Mekki Abdelateef and Dr. Waleed Mohamed Alamin

**Introduction:**

Preceding to field test and verification of four irrigation systems demos (drip, bubbler, pipe conveyance and sprinkler) at Lower Atbara, and evaluation; pipe conveyance system emerged to be the most likely desired by producers. It is cheap, simple and easy to install and operate. On the basis of such outcomes a joint meeting of the project staff, DG of ARC and ICARDA back stopping team on September 2014 has recommended installing 6 more units of pipe conveyance for promotion and up-scaling of the system within the IFAD – Butana Integrated Rural Development Project (BIRDP) supported communities. Accordingly, the Water Harvesting Research Institute (WHRI) and IFAD coordination office at EdDamar were requested to perform field survey and communities sensitization for selection of appropriate sites and interested farmers for installation of the 6 units, each covering one feddan area. Table 1 below shows the selected participating farmers in two communities with cropping pattern for the demo’s activities.

**Table 1: Farmers selected for promotion of pipe conveyance system in AlAbaar and Gangari communities**

|  |  |  |
| --- | --- | --- |
| **Village/ community** | **Participating Farmer** | **Cropping pattern** |
| AlAbaar | Rahmitalla | Okra |
| “ “ | Elhadi | Okra |
|  | Yassin | Alfa alfa |
| “ “ | Marighani Musa | Wheat/okra |
| Gangari | Shwagi | Okra |
| “ “ | AbassElbaih | Wheat |

**Objective of demo farm interventions**

To introduce pipe conveyance system to new farmers to witness economic, irrigation water savings and crop yield improvement and enhancing adoption.

**Monitoring and data collection:**

The WHRI engineers have conducted regular visits for follow up and check for repair and maintenance needs and operation and management (O&M) issues. On-farm training to producers on O&M has been exercised and implemented. Likewise regularly monitoring and follow up of field measurement and data collection pertaining to performance indicators was collectively performed by the BIRDP extension agents the institute technicians. The indicators of concern to the technology performance are the following:

* Fuel consumption or electricity use and cost recording
* Irrigation water use
* Irrigation labor and weeding labor (man days and cost)
* Irrigation time of pumping unit (hr)
* Crop yield

**Result and Discussion:**

**Water savings and other benefits:**

Analysis of demo farms water savings data (table 2) indicates that the pipes conveyance (PC) produced 14 – 30 % water savings over the traditional open channel and flood irrigation practices under vegetables (okra) and field crop (wheat). The tables also indicate that the savings did vary for the improved pipes conveyance plots, depending on the seepage losses from the unlined open channels. In addition, to the irrigation water savings, also benefits in fuel, pumping hours and labor savings and increase in crop yields were observed. The percentage increase figures under the improved pipes conveyance are 14 - 30 % for fuel, 14.5 - 30 % for the pump irrigation time and 30 - 71 % labor savings. The water savings may be attributed to reducing seepage losses from the unlined open channels.

The variation in the obtained results may probably reflects the effect of soils, cropping patterns, length of growing season and farmers experience as well as to that soils variability between areas close to the river and those in the upper-terrace, which is generally light. The labor requirements on this table are the labor working hours used in the irrigation operation. It consists of labor time used in operating and closing of the pump units and control valves, weeding and trimming of grasses in irrigation channels, in comparison to manual intensive labour requirements under the traditional practices such as digging and removal of soil during follow of irrigation process in general.

**Table 2: Water savings and other benefits in demo farms**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name of the Participating Farmer** | **Community** | **Crop** | **Percent savings (%)** | | | |
| **Water** | **Fuel** | **Pump operation time** | **Labor** |
| Shawgi Eltayb Babikr | Gangari | Okra | 14 | 14 | 25 | 30 |
| Margani Musa | AlAbaar | Wheat | 17 | 17 | 23 | 23 |
| Rahmtalla Ahmed Elbasher | AlAbaar | Okra | 14 | 14 | 14.5 | 92 |
| Abas Fadlalla | Gangari | Wheat | 30 | 30 | 30 | 71 |
| **Average** |  |  | **19** | **19** | **23** | **54** |

**Crop yield:**

Table 3 shows the results of crop productivity under the improved pipe conveyance of the demo farms compared with traditional practice with open channels. Generally, the demo farms with improved pipe conveyance system out-yielded the traditional irrigation system by about 20%. Crop yield data for wheat showed slight increase above the average, whereas the okra yield increased by 21 % for two farmers.

**Table 3: Crop yield under pipe conveyance and traditional irrigation systems**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name of the Participating Farmer .** | **Crop** | **Yield (ton/fed)** | | **% increase** |
| **Pipe conveyance** | **Traditional** |
| Shawgi Eltayb Babikr | Okra | 3.37 | 2.68 | 21 |
| Margani Musa | Wheat | 0. 8 | 0.65 | 23 |
| Rahmtalla Ahmed Elbasher | Okra | 2.13 | 1.91 | 12 |
| Abas Fadlalla | Wheat | 1.15 | 0.95 | 21 |

**Way forward:**

The up scaling of the pipe conveyance system among the project beneficiaries depends on access to credit and communities interest. Meeting at the Federal level with the Sudan Rural Development Company indicates availability of credit and arrangements are necessary for conducting field surveys for assessment of community response and volume of credit. Primary the company agreed to undertake 3 communities for survey work and assessment during August 2015.

**ANNEX 2: SUDAN**

**Activity 3:** Livestock production

**Scientist:** Dr. Faisal M El-Hag

1. **General Introduction**

The project “Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry land Areas” targets the poor and vulnerable populations of the dry areas and aims at developing technology, policy and institutional innovations to improve livelihoods, using an integrated systems approach. In Sudan, the project activities are implemented at Lower Atbara region in the River Nile State, that has been identified by the Sudan National Adaptation Program of Action (NAPA, 2007) as one of the main areas in the country as particularly vulnerable to climate change. The area falls with a semi desert zone, characterized by increased temperature and accelerated desert encouragement with increased land degradation. Some of the impact could be seen in deficiency in major elements (particularly P, Ca and Iodine) (El-Hag *et al*. 2011) as reflected in reduced crop yields and low livestock productivity. Previous ICARD activities in the area under the phase I project; “Improving the livelihoods of rural communities in the Nile Valley and Sub Saharan African Region: Sustainable crop and livestock management”, has identified water conveyance as a platform for technological innovations under the smallholder integrated farming systems in the area. This platform could be scaled-up to improve productivity, and enhance rural communities’ resilience and build their capacity to adapt to climate change, hence managing risk and improving productivity.

Livestock raised under these smallholder integrated traditional production systems depends mainly on crop residues and to a limited extent on meager rangelands resources in Lowe Atbara region. The impact of climate change on livestock productivity could be seen in reduced milk yields, low fertility and reduced reproductive rates (El-Hag et al., 2001) and high mortality in both young and adult animals. Livestock activities focused on utilization forages and crop residues produced under water conveyance platform together with necessary supplements to improve productivity and milk yields for smallholder animals particularly during the dry season.

The project activities started in early February 2015 for lactating goats and cows, and for breeding sheep flocks. Project activities covered two villages. Activities conducted were:

* Concentrates and saltlick blocks for lactating animals (goats, cows) to improve milk yields and household food security
* Supplementary feeding activities for lactating goats targeted women farmers in the area whereas those for lactating cows and breeding sheep covered two villages. Feed resources produced under water conveyance platform used included forage legumes clitoria or Berseem hay on a basal diet of sorghum and wheat straw. Other feed resources used included oilseed cakes and saltlick blocks.
* Strategic supplementary feeding for breeding ewes for improving reproductive performance.

1. **Supplementation to Lactating Animals**

**Introduction:** Protein concentrates and mineral supplementation trials for lactating goats were conducted at two villages (El Abar and El Goba) at lower Atbara. For lactating cows, groundnut seed cake (GNSC) and saltlick were used. However, for lactating cows there were only 17 lactating cows at the two villages. Only 14 cows were included into this activity, nine supplemented and five were used as a control and their data were analyzed collectively as a RCBD. Range plants and crops residues in the area are deficient in major mineral elements, particularly phosphorus and calcium. The objectives were to improve milk yield at these areas in order to improve supply of milk for the inhabitants particularly children and women, and other objectives was to improve goats and cows fertility.

**Methodology**

**Lactating goats’ trials:** The trials were conducted during the dry summer season (March-June) of 2015. Lactating goats at the two villages at lower Atbara (El Abar and El Goba Villages) were included in these trials. A total number of 120 lactating goats (2-4 years old), belonging to 25 women farmers were used in these trials (Table 1). Goats in lower Atbara are a mixture of Desert and Nubian goat subtypes. Desert goats are characterized with low milk yields and lower body weight, but are prolific with a twining rate of about 30.0% whereas Nubian goats are known for their high milk yields ranging from 2.5-3.5 litre/day. At each village, goats belonging to each farmer were randomly either supplemented (legume hay + Saltlick) or left as control (Ivomec Injection only).

The legume hay quantity provided for each goat was 400 g daily, while a saltlick block was hanged at goats barns. All goat groups, including control goats, were initially injected with Ivomec (IvomectinR) as a prophylactic treatment against internal and external parasites administered at 0.5 cc s/c, and repeated two weeks later. The trials lasted for 6 weeks (42 days).

**Lactating cows’ trials:** The second trial utilized fourteen (14) lactating cows at the two villages (Table 1). The cows at lower Atbara belong to Butana breed; a *Bos indicus* (Zebu) cattle reputed for their milk yields (10-15 litre/cow/day). All cows were 8-10 years old, belonging to 14 farmers. Nine cows were randomly assigned to the supplementary feeding treatment while the other five were left as a control, same as goats, but for lactating cows GNSC was used instead of the legume hay. GNSC quantity provided for each cow was 250 g daily and the Ivomec was injected at 5.0 cc s/c per cow repeated after two weeks. Mineral supplementation for lactating cows was done through hanging a brick of saltlick at the animal barns throughout the trial period. Cows were at the 2nd month of their lactation period. The basal diet was wheat and Abu 70 straws mixed on equal proportions and provided *ad libitum*. The trials lasted for 6 weeks (42 days) during the period March-June 2015.

All animals (cows or goats) were first allowed an adaptation period of one week before the full provision of the allotted supplement quantity. Data recorded was mainly daily milk yields and the animals were observed for services and conception. The farmers (men and women) were provided with notebooks and pens to keep the daily milk yield records of their animals.

**Strategic supplementary feeding of breeding ewes:** A total of 40 ewes were used in this trial, 20 at each of the village (El Abar and El Goba). The ewes were 4-5 years old. At each village the ewes were divided into two groups, one received 400 g/ewe/day for one month at breeding time and a month prior to lambing while the other was left as a control (farmer practice), with saltlick provided as mineral blocks hanged at resting areas. Breeding rams were also supplemented with the same forage legume hay during the mating time. All ewes and rams received a prophylactic treatment against internal and external parasites.

**Economic analyses:** Costs of supplements (legume hay, GNSC and saltlick) were given. Cost-benefit analysis was also carried out to delineate cost per liter of milk produced for both lactating goats and lactating cows. A partial budgeting was done for the economic analysis of breeding ewes performance.

Table 1. Participants farmers by gender, total animals and lactating animals included in trials.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Village** | **Animals** | **Women** | **Men** | **Total** |
| Supplementary feeding of lactating goats | Al Abar | 60 | 12 | 0 | 12 |
|  | El Goba | 60 | 13 | 0 | 13 |
| Supplementary feeding of lactating cows | Al Abar | 9 | 0 | 7 | 7 |
| Strategic supplementary feeding of breeding ewes | El Abar | 20 | 0 | 1 | 1 |
|  | El Goba | 20 | 2 | 2 | 4 |
| **Participant farmers:** |  |  |  |  |  |
| Women | 27 |  |  |  |  |
| Men | 10 |  |  |  |  |
| **Animals:** |  |  |  |  |  |
| Lactating Goats | 120 |  |  |  |  |
| Breeding Ewes | 40 |  |  |  |  |
| Lactating Cows | 9 |  |  |  |  |

**Results**

**Lactating goats:** Supplementary feeding of lactating goats with legume hay and saltlick blocks had increased (P<0.001) total and daily milk yields (Table 2). The percentage increases in average daily milk yield of supplemented goats over the controls was 58.6%. The economic analysis for lactating goats resulted in higher returns compared with un-supplemented controls (Table 3). Percentage increase in returns from milk of supplemented goats over that of the controls was 55.7%. The marginal rate of return (MRR) was derived as the ratio of marginal net benefit to the related marginal cost of the supplemented (treated) goats and was calculated as 622% (Table 4). This result meant that every monetary unit (1 SDG) invested would be returned, plus earning an additional amount of 6 SDG This implied that goats at Lower Atbara villages could be supplemented with forage legumes + saltlick blocks.

Table 2. Effect of mineral and concentrate supplementation on milk yield of lactating goats at Lower Atbara villages

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Legume Hay + Saltlick** | **Control** | **SE±** |
| **Lactating Goats:** |  |  |  |
| No. of goats | 120 | 40 |  |
| Weeks on test | 7 | 7 |  |
| Average total goat milk yield (litre) | 88.50 | 53.75 | 3.507\*\* |
| Average daily milk yield/goat (litre) | 2.11 | 1.33 | 0.081\*\* |
| %Increase over control goats | 58.6% |  |  |

\*\*\* = very highly significant (P<0.001).

Table 3. Lactating goat feed supplement quantities (kg), costs and returns from milk yield (sdg\*)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Concentrate + Saltlick** | **Control** |
| No. of goats | 120 | 40 |
| Days on test | 42 | 42 |
| **Supplements per goat:** |  |  |
| Legume hay (g/goat/day) | 400.0 | 0 |
| Legume had (kg/goat/42 days) | 16.8 | 0 |
| Legume hay for the whole group (kg) | 2,016 | 0 |
| Legume hay cost (sdg/kg) | 1.4 | 0 |
| **Legume hay total cost per flock (sdg)** | **2,822.4** | **0** |
| **Legume hay total cost per goat (sdg)** | **23.52** |  |
| Saltlick block (g/goat/day) | 5.0 | 0 |
| Saltlick total consumption (kg) | 2.52 | 0 |
| Saltlick unit cost (sdg/kg) | 5 | 0 |
| Saltlick total cost (sdg) | 12.6 | 0 |
| **Total costs per goat (sdg)** | **36.12** | **0** |
| **Benefits:** |  |  |
| Av. total Milk yield per goat (litre) | 88.50 | 53.75 |
| Milk price (sdg/litre) | 7.50 | 7.50 |
| **Total milk revenue (sdg)** | **663.75** | **403.125** |
| **Returns (Revenue-Costs) (sdg)** | **627.63** | **403.125** |
| **Increase in returns over controls (%)** | **55.7** |  |
| **MRR (%)** | **622** |  |

* Sudanese Pound

**Lactating cows:** Supplementary feeding of lactating cows with concentrates and saltlick blocks had, also, increased (P<0.001) their total and daily milk yields (Table 4). The percentage increase in average daily milk yield of lactating cows supplemented with concentrates + saltlick over that of the control cows was 40.9%. The highest returns were recorded for lactating cows supplemented with GNSC + Saltlick and the lowest were for the controls. Percentage increase in returns from milk of supplemented cows over that of the controls was 23.8%. The treatment was highly profitable as shown by the high MRR (1547%), which meant that every monetary unit (1 SDG) invested in the supplementary feeding of lactating cows, would be recovered plus earning an additional amount of about 15 SDG (Table 5).

Table 4. Effect of mineral and concentrate supplementation on milk yield of lactating cows at Lower Atbara villages

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Concentrate + Saltlick** | **Control** | **SE±** |
| **Lactating Cows:** |  |  |  |
| No. of cows | 9 | 5 |  |
| Weeks on test | 6 | 6 |  |
| Milk Yield (litre/cow): |  |  |  |
| Average total cow milk yield | 515.088 | 304.500 | 22.237\*\*\* |
| Average daily milk yield/cow | 12.264 | 7.25 | 0.765\*\* |
| %Increase over control cows | 40.9% | -- |  |

\*\*\* = very highly significant (P<0.001).

Table 5. Lactating cow feed supplement quantities (kg), costs and returns from milk yield (sdg)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Conc.+Saltlick** | **Control** |
| No. of cows | 9 | 5 |
| Days on test | 42 | 42 |
| Supplements: |  |  |
| GNSC (g/cow/day) | 250 | 0 |
| GNSC (g/cow/42 days) (kg) | 10.5 | 0 |
| GNSC for the whole group (kg) | 94.50 | 0 |
| GNSC unit cost (sdg) | 1.75 |  |
| GNSC total cost per cow (sdg) | 18.375 | 0 |
| Saltlick block (g/cow/day) | 80 | 0 |
| Saltlick total consumption (kg/group) | 30.24 | 0 |
| Saltlick consumption per cow (kg) | 3.36 |  |
| Saltlick unit cost (sdg/kg) | 5 | 0 |
| Saltlick total costs per cow (sdg) | 16.8 | 0 |
| **Total supplements costs per cow (sdg)** | **35.175** | **0** |
| **Benefits:** |  |  |
| Total Milk yield (litre) | 515.088 | 304.500 |
| Milk price (sdg/litre) | 7.50 | 7.50 |
| **Total milk revenue (sdg)** | **3,863.16** | **2,283.75** |
| **Returns (Revenue-Costs) (sdg)** | 2,828.01 | 2,283.75 |
| **Increase in returns over controls (%)** | 23.8% |  |
| **MRR (%)** | 1547 |  |

1. **Strategic supplementary feeding of breeding ewes**

Introduction: At Lower Atbara, sheep production is practiced under traditional smallholder farming systems characterized by low inputs and extensive mode of production. Sheep breeding (mating) is controlled to be done at February-March to coincide lambing with July-August to match lambing with rainy season and availability of feed resources. This practice subjects breeding stock to nutritional stress and results in low conception and lambing rates, and high abortion and ewe and lamb mortality rates (El-Hag et al., 2001). The objective was to improve desert sheep reproductive performance in order to increase smallholder farmer income.

Materials and Methods: This trial was conducted at two villages. Forty ewes (3-4 years old), twenty at each village, were used. At each village, the ewes were divided in two equal groups of 10 heads each. One group was randomly assigned to forage legume + saltlick supplementation while the other was left as a control. Forage legume hay (clitoria + berseem) was supplemented at 400 g/head/day. Ewes in both groups had free access to saltlick at resting areas. The ewes were offered the supplement in small groups during the watering time (every three days). Supplementation for one month before mating time, then stopped and resumed again at the last trimester of the gestation period (one month before lambing). Breeding rams (2 desert rams, 5 years old) were offered a supplement of forage legume hay only at mating time and were rotated between the two ewe groups to eliminate ram-to-ram effect. Ewes were monitored for behavioral estrous signs and were serviced accordingly. Data collected included number of ewes serviced, abortions, mortality, lambing, and lamb type of birth.

Results: Conception rates ranged from 90.0% for forage legume supplemented ewes to 50.0% for the control group. No abortions or mortalities were recorded for both groups (Table 6). From these results, it appeared that forage legumes (clitoria, berseem hay) could be used to supplement desert ewes to improve their productivity. Partial budgeting showed that increase of return of supplemented ewes over the control was about 101% and the increase in cost was only about 11%. The strategic supplementary feeding of breeding ewes with forage legumes was highly profitable as indicated by the high MRR of about 1060% (Table 6).

Table 6. Desert sheep reproductive performance at lower Atbara in response to strategic supplementary feeding together with partial budget for strategically supplemented and control ewes (prices in sdg)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Cowpea Group** | **Control group** |
| No. ewes | 20 | 20 |
| No. conceived | 18 (90.0%) | 10 (50.0%) |
| Not conceived | 2 (20.0%) | 10 (50.0%) |
| No. lambed | 18 (90.0%) | 10 (50.0%) |
| **Type of birth:** |  |  |
| Single births | 10 | 7 |
| Twin births | 8 | 3 |
| Total number of lambs | 26 | 13 |
| Ewe costs (sdg) | 6,000.00 | 6,000.00 |
| Forage legume costs (sdg) | 672.00 | 0.00 |
| **Total costs (sdg)** | **6,672.00** | **6,000.00** |
| Ewe returns | 5,250.00 | 5,250.00 |
| Lambs returns | 15,600.00 | 7,800.00 |
| **Total returns** | **20,850.00** | **13,050.00** |
| **Partial budget:**  Net benefits  Increase in return over control  MRR (%) | 14178  101%  1060 | 7050 |

1. **Conclusions and Recommendations:** These activities clearly indicated that:

* Livestock technological innovations based on pipe conveyance irrigation systems are highly viable and economically sound and should be scaled-up in the area.
* Other technological packages in areas of rural dairy processing and sheep fattening need to be also disseminated for rural women at Lower Atbara region. Previous efforts, through phase I project, clearly showed that rural women capacities should be built and links with private sector be facilitated and strengthened.

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**ANNEX 2: SUDAN**

**Activity 4:** Socioeconomics studies

**Scientist:** Prof. Abdelmoneim Taha

**Background**

The area of lower Atbara falls within the arid zone which characterized by meager resources of rainfall and seasonal flow of Atbara River. The rainfall is highly erratic with annual mean less than 100 mm and chances of rain-fed farming are limited. Atbara River flows only during flood season from July to October and thereafter its flow is restricted by blocking of Khashim AlGirba dam. Irrigated agriculture is practiced during flood season through cultivation of flood receding in the low lying riverine areas where floodwater is naturally overtopping the river banks, by direct pumping from the river for high contour areas, and by pumping from shallow wells, known as “matara”. On drought years flooding is hardly occurred or the flooded areas are limited or not existing. However, due to the new development of constructing the twin dams – Setiet and Upper Atbara dams on the upper eastern end of the river, a more stable and bigger flow of water is expected; this will make the river water available all the year around; will also improves the recharge of underground water and the water level.

The agricultural production that will be addressed here is irrigated farming by pumping irrigation water either, directly from the river, or from shallow wells, known as “matara”. Rearing of animals is also a common practice; animals are mainly for household consumption but can also be a source of income. Generally, productivity is low but there are good potentials to improve productivity and profitability of both crops and animals. This has been shown by the results of the on-farm demonstrations of improved technologies conducted by this project with farmers / producers, which is highlighted below.

* ***Technically feasible and economically viable improved production technology:*** on farm demonstrations on wheat, faba beans, chick pea and common beans – improved varieties plus improved production package of: optimum planting date; seeding rate; N fertilizer (for wheat); frequent watering; and pest management. The improved technology for all crops resulted in significant yield improvement of between 70% - 94% over prevailing traditional practices. They also gave high monetary returns reflected in high marginal rates of returns (MRR) to investment in the improved technology. (*see, reports of the On-Farm Demonstration and Yield Maximization Plots of Wheat and Winter Grain Legumes in Lower Atbara Area (reports for 2012 -2015).*
* ***Improved animal nutrition / feed supplementation:*** by using concentrates plus saltlick. The improved animal nutrition resulted in significant increase in milk production, and gave high monetary returns for both goats and cows. For example, in season 2014/2015, the improved nutrition regime resulted in 60% and 41% increase in milk production for goats and cows, respectively. The increase in cost of the improved nutrition regime is more than compensated for by the monetary returns to the productivity increase, and this is reflected in high rates of returns to investment in the improved nutrition regime, *(Range and livestock annual technical report, 2015).*
* ***Improved irrigation system:*** a pipe conveyance irrigation system has been introduced and demonstrated in farmers’ field, and it proves to be highly viable and economically feasible. The advantages of the new system: saves water; better control of irrigation water and improves the efficiency of irrigation; reduces the time needed for irrigation and labor time required; and reduces the cost of irrigation, *(Water saving technologies (pipe conveyance system) report).*

It is evident that from the previous efforts through phase I of the project, and the efforts of phase II, that the improved technologies and innovations introduced and demonstrated in farmers fields provide very viable options for improvement of productivity, enhancing food security and alleviating poverty in Lower Atbara area. However, these could only be realized if these technologies and innovations are adopted by the community. Key pre-requisites for farmers’ adoption of technologies and innovations, is a supportive and enabling policy and institutional environment, which promote, encourage and facilitates clients’ access to these technologies. The supportive and enabling policy and institutional environment will the subject of this study.

**Objectives of the Study**

The overall objective of this study is to review and analyze the institutional and policy environment of value chains of the farming systems in Lower Atbara area, and to assess how supportive is it to technology use by farmers / producers.

**Specific Objectives**

1. Identifying and analyzing formal and informal institutions within the value chain of the farming systems in the area;
2. Mapping of the farming systems value chains components; functions undertaken along the chains, as well as the stakeholders / institutions undertaking these functions.
3. Analyzing segments of the chains and how the value chains partners cooperate and collaborate.
4. Draw recommendations on how to improve the linkages among value chain components, and effectiveness of the system

**Activities Conducted**

1. Diagnostic appraisal: reviewed background information; visited project domain, observations, informal consultations, ..etc) to understand the context, issues along the VC - agricultural systems: farming / production systems; input and output markets; formal and informal institutions of service providers, research, extension / advisory services; farmers’ groups.
2. Identified the main value chain components or sub-systems of the farming ststem(s), functions undertaken along the chains and the key stakeholders and business partners
3. Conducted situation analyses of the key stakeholders and institutions to analyze internal and external business environments, as well as the quality of linkages and coordination between business partners in the VC.

**Results and Discussion**

**Value Chains: Conceptual Framework**

*Definition of Value Chains:* The Value Chain (VC) is defined as the chain of activities, which transform raw materials into products that can be purchased by a final consumer.

The Value Chain (VC) is characterised by the sequence of production processes from the provision of inputs to primary production, to intermediary trade, to processing, to marketing and up to final consumption; and the quality of linkages and coordination between business partners in the VC.

The value chain system is composed of three sub-systems – micro, meso and macro (Figure below).



For the purpose of this study, the value chain components that will be addressed and analyzed are the formal and informal institutions in the three VC sub-systems of the farming systems in Lower Atbara area. The components of the VC system and the respective functions they undertake are:

***The Micro sub-system:*** these are called operators; will be confined to the producers or practitioners of agricultural and animal production and their institutions; the main functions they undertake are production practices including pre and post harvest functions.

***The meso sub-system:*** these are service providers, development partners, technical agencies, research and extension, and groups / associations and organizations. They do support the operators and their functions include:

* Avail and facilitate access to production inputs
* Advisory, extension and training services
* Research and development
* Credit and financial services
* Marketing information, market linkages
* Organizational development farmer groups

***The macro sub-system:*** the main stakeholders here are: local governments, providers of utilities / infrastructure, national government and public administration. They are called enablers and are expected to create an enabling environment for both operators and supporters. Functions undertaken by the enablers include:

* Macroeconomic policy (exchange rate, inflation, etc)
* Financial policy (taxes, tarrifs, levies, etc)
* Legal framework (land tenure, standards, etc)
* Economic infrastructure (road network, markets, etc)
* Social infrastructure (education, health, etc)
* Administration (business establishment, enforcement, etc)

**Value chain Institutions**

Value chain stakeholders / institutions identified and surveyed and interviewed are:

* Producers: scheme owners and sharecroppers
* Service providers – credit institutions, input-output markets
* Research stations, Extension services
* Formal public institutions – ministry of agriculture / various departments
* Community – based organizations and farmers’ groups

**Production Institutions**

A field survey was conducted by direct interviewing of 12 scheme owners and 45 farmers in 4 villages in the project domain; 58% are under matara irrigation system and 42% are under direct pumping from the river; 93% of farmers interviewed are male and 7% are females. At the farmers’ community, institutions are based on resources (land, irrigation pump) ownership. In this respect, one can distinguish between two categories of institutions:

1. Scheme owner: this is the one who owns the irrigation pump; the pump owner can own the whole irrigated land (the scheme) or part of it.
2. Farmer or sharecropper: here the farmer can own the land or can be a sharecropper who does not own the land.

The main features of the production system(s) in Lower Atbara area are:

1. *Production relations:* are based on resource participation and can be highlighted in the following:

* The responsibilities of the pump / scheme owner are: irrigation by operating the irrigation pump and availing water for farmers; land preparation by contracting for machinery services; and supply of purchased input particularly fertilizers and pesticides.
* The farmer is responsible for all management / cultural practices by providing his/her labor to undertake manual field management practices.
* The produce is shared equally between the two, after subtracting all the cost of purchased inputs, except spare parts and fuel.

1. *Decision making:* decisions related to production can be highlighted as:

* Crops to be cultivated, mostly agreed on between the scheme owner and farmers.
* Land preparation: mostly taken by the scheme owner since he is the one responsible for it.
* Purchased inputs: fertilizers and pesticides, mainly taken by the scheme owner.
* Irrigation: mainly decided on by the scheme owner since he is the one responsible for running the irrigation pump.

1. *Animal ownership:*

* Two thirds of respondents own animals, mainly for household’s consumption but some may have commercial numbers specially sheep. Even for those household animals, they can also contribute to income and contribute to the needs in social occasions.
* Abu70 and sorghum are the main crops grown as fodder; there is also some who grow alfa Alfa for fodder. However, in the off-season farmers can resort to purchase of fodders whether it is abu70, alfa alfa and concentrates.

1. *Constraints:*

The main constraints reported by respondents are: availability and high cost of inputs – seeds; machinery services; fertilizers; pesticides; fuel and spare parts.

**State Ministry of Agriculture, Animal Resources and Forests**

Located at the state capital city ELdamer; it has five directorates: horticulture, crop protection, extension (agricultural and veterinary extension); seeds; and field and localities affairs. The head offices of Directorates are located in the state capital and there are branches in each of the seven localities. The lower Atbara area administratively belongs to Eldamer locality; it has two administrative units in Ela’tbarawi and Seiedon.

* The prime mandate of the Ministry of Agriculture is to support all farmers by provision of extension services through field demonstrations of improved production technology, and training through farmers’ field schools which cover crop, animal production and forestry.
* The level of support provided to Lower Atrba area is by the various departments of the MOA is rated as poor and far below the actual need of clients and the area. This is attributed to the fact that the area is large and the weak capacity of the ministry to reach out to the rural communities of the area.
* SWOT analysis
* ***Strengths:*** qualified human resources; availability of technical support provided by Hudeiba research station and Wadi Elnneil University, which are located in the state;
* ***Weaknesses:*** inadequate transportation facilities to reach out for farmers and agro-pastoralists in rural areas; inadequate operational budgets to conduct extension and training activities; delays in provision of inputs and credit negatively affect timeliness of the calendar of agricultural operations and the technical support to be extended to farmers.
* ***Opportunities:*** adequate political support and commitment at federal and state levels to agricultural development; this is reflected in the technology transfer Fund which supports availing of agricultural machinery; and improvement in credit and micro-finance support to small farmers; improvement in paved roads to rural areas which improve input / output trade and interaction between production and consumption centers; improvement in level of rain fall in the state; presence of externally funded projects and initiatives in climate change, water harvesting and rural development
* ***Threats:*** federal and state level agricultural policies are not stable; increase in the rate of desertification threatens agricultural land;

**Credit institutions**

In an attempt to improve farmers’ use of improved production technology, the government has undertaken good efforts to encourage credit institutions to increase its financing of small farmers. These efforts reflected in:

* Increasing the capital of the Agricultural Bank of Sudan, increasing our branches in production areas, and adopting flexible financing policies with small producers.
* Establishing a micro-finance unit within the central Bank of Sudan; with the intension to target small businesses including small farmers and agro-pastoralists.
* Encouraging State Governments to establish state level micro-finance units and agriculture development funds targeting small producers.

The main credit institutions operating in the River Nile State are: the Agricultural Bank of Sudan, the Farmer’s Commercial Bank, and the River Nile Organization for micro-finance.

**The Agricultural Bank of Sudan (ABS)**

The Agricultural Bank of Sudan (ABS) is the main public credit institution mandated with providing short and medium term credit to farmers in all production systems. The ABS has three types of credit systems:

1. Financing individual farmers who have bank accounts with the bank;
2. Financing individual farmers on their own collateral whether it is the land or a personal cheque;
3. Financing group of farmers against group collateral.

**Farmer’s Commercial Bank**

The Farmer’s Bank credit policy is similar to that of the ABS. The main limitation as far as Lower Atbara area is that none of these credit institutions has branch(s) in the area. Credit seekers

**River Nile Organization for Micro-finance**

A public micro finance system which provides credit to individual farmers against their own collateral, or to a group of farmers against the group’s collateral. The source of finance is from speculations with the central bank, other commercial banks and social security funds.

**Credit institutions: SWOT analysis**

* **Strengths:** generally, existence of qualified staff; improvement in the level of finance allocated to agriculture and small producers; improved engagement with key stakeholders such as input providers and producers’ groups.
* **Weaknesses:** services are confined to cities and big towns where branches are found i.e. limited expansion of the service into rural areas where actual demand is there; bureaucracy and inadequate work aids and modern technology specially in branches;
* **Opportunities:** political commitment at federal and state levels towards support of small producers; development of a national policy towards support and development of micro-finance; expansion in agricultural investments and increasing demand for credit services; rise of the notion of establishment of grassroots and producers’ groups which provide collateral to individual clients.
* **Threats:** the free market policy and higher rates of inflation; low clients’ awareness and culture towards credit and micro-finance; high risk of agricultural production; low repayment and default by clients; taxes and levies on producers by state and local government.

**Contractual arrangement**

Following the recent move and improvement in providing credit to small producers, and in view of the fact that improving productivity necessitate clients’ use of improved production technology,

* The business deals between newly established credit and micro-finance institutions from one side and the central bank and commercial banks on the other side, where the latter finance the former credit \*\*\*\*\*
* The contractual agreements between credit institutions and other service providers (seed companies, machinery service providers, fertilizer dealers, ..etc) who provide their respective inputs / services to the final users through the credit institutions
* Announcement of the crop floor price by the government before planting, and the commitment to procure the produce, is a form of agreement between the government and producers.
* The credit deal between the credit institution and producers and their groups, in which the credit institution provides credit to the clients, under agreed upon terms.

**Development projects**

Compared to other areas along the main Nile, Lower Atbara area has not received much public support with respect to infrastructure and basic services. However, in recent years there have been few externally funded community and rural development projects operating in the area. Of these, is the Butana Integrated Rural Development Project which has been working since 2009. The main objectives of the project are: sustainable improvement of livelihoods and drought resilient communities; ensuring communities access to land and water resources; empowering of women and men and improve their negotiation capacity in marketing of their crops and animals; and improve the capacity of community –based organizations and their participation in community development.

The implementation approach of the Butana project featured: participation of grass root communities; bottom up approach in planning and implementation which ensures realization of community needs and engagement; service provision, capacity building of local communities and facilitate partnerships with service providers through agreements. The project uses a revolving fund scheme to fund its activities which are rotated to cover a large number of clients and communities.

The Butana Project is a good model for development projects that can be used to facilitate scaling out of improved production technology promoted by the ARC/ICARDA/IFAD project. The approach and the community based structures build would catalyze building strong and well organized demand which secures and ensures effective engagement in community development efforts.

**Community-Based Organizations**

One of the main factors contributing to the efficiency and effectiveness of technology transfer efforts is organization of beneficiaries (demand); a well organized and well engaged demand, is more likely to contribute to successful technology transfer efforts. The role of civil society and community base organization is very central to the success of project working towards improving livelihoods of rural communities. They can help mobilize community and ensure their engagement in planning and implementation of activities. In the last decade, policies and legal frameworks have been developed by the government to guide formulation and operation of beneficiaries groups which take different forms – development committees, agricultural / animal production societies / groups, women development groups, ..etc. Examples of groups exist in the area are: Azza Society for Agricultural and Animal production; Alabar Voluntary Society for Development; Elnahda Society for animal production. These are village based group of farmers; each has an elected president and an executive office. The key objective of the society is to improve productivity, production and farm income through facilitating members’ access to improved production technology and improving members bargaining power. The group provides collateral for its members, and deals with credit institutions and service providers to get the necessary credit or inputs; mobilize members and organize promotion and training activities with extension and other technical organs; and facilitate collective marketing or engage with crop buyers to obtain good prices.

**Conclusions**

The agricultural production in Lower Atbara area is characterized by good soils and adequate water for irrigation which will improve after completion of the Atbara and Setait dams. The area is characterized by production of many crops ranging from cool season food legumes, vegetables and fodders. Generally, productivity is low but there are good potentials to improve productivity and profitability of both crops and animals. This has been shown by the results of the on-farm demonstrations of improved technologies conducted by this project with farmers / producers in the area. Also an improved pipe conveyance irrigation system has been tested and demonstrated with farmers in the area; it has proven its superiority over traditional systems with respect technical and economical efficiency. The area has not received the due attention from public institutions and the level of support is poor and far below the actual need of clients and the area. This is attributed to the fact that the area is large and the weak capacity of the MOA to reach out to the rural communities of the area. On the other hand, the institutional set up of formal and informal institutions and its interaction among themselves and their engagement with the community is weak. It is therefore, necessary for formal institutions, service providers and community based organizations, to reach out for rural communities and enhance their engagement with producers and other stakeholders within the value chains of the production systems in the area.

1. Based on draft progress reports submitted by national coordinators and on the outcomes of field visits undertaken

   by ICARDA’s project leader. [↑](#footnote-ref-1)