

AAID Developmental Program for the Transfer of Zero tillage Technology to the Traditional Farmers in the Rain-fed Areas of the Sudan

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Summary

In recognition of the huge agricultural potential of the rain-fed agricultural sector in Sudan, AAAID introduced Zero tillage as a new technology to address the problems of the traditional farming system; low productivity, high cost of production, and consequently high financial losses. A pilot farm was established as a fore-runner for the development of crop production under rain-fed condition.

Zero tillage is associated with the advantages of conservation of moisture, improved physical properties of the soil, increased organic matter, effective control of weeds and increased productivity.

Following the success achieved in the adoption of zero tillage in Agadi pilot farmer, it was deemed appropriate to transfer the new technology to the small traditional farmers and to partially mechanized crop production farmers.

This article gives the details of the program which was designed for the transfer of zero tillage technology to the small traditional farmers and to partially mechanized crop production farmers.

Keywords: Technology transfer; Zero tillage; Rain-fed agriculture; Agadi.

Introduction

- * The Arab Authority for Agricultural Investment and Development (AAAID) is a regional financial organization established by a number of leading Arab states to develop the agricultural resources of these states with the objective of contributing to food security in the Arab region.
- * AAAID activities include investment in all forms of agricultural production and allied fields, namely: plant production, animal production, agricultural processing, agricultural services and agricultural inputs, marketing, inter-arab trading and agricultural research.
- * AAAID has been placing particular emphasis on establishing large-scale strategic agricultural projects that can address food security issues in the Arab world.
- * AAAID has fully recognized the huge agricultural potential in the Sudan, in terms of natural resources viz. vast areas of fertile land and huge water resources from rivers, rain, and ground water.
- * AAAID with its new strategies and initiatives has introduced since 2000 Zero tillage technology for the development of the rain-fed sector in Sudan.

The rain-fed agricultural sector in Sudan

The Sudan is a vast country, 2.5 million square kilometers, extending from the desert and semi-desert environments of the north, through the savannah central clay plains, to the high rainfall areas of the south. The country is thus characterized by variable environments. Throughout the Sudan, a remarkable variety of crops are grown, under two main sectors viz:

- * Irrigated agriculture.
- * Rain-fed agriculture.

The total cultivable land is estimated at 84 million hectares, of which only 17 million hectares are utilized at present.

Rain-fed agriculture occupies 9-12 million hectares about 70% of the utilized land. The average annual rainfall in the central clay plains ranges from 450-800mm, falling from July to October.

A brief description of traditional farming systems in rain-fed areas of the Blue Nile

1. Jobraka system:

- * Implemented by very small farmers growing an area of 0.1-0.5 feddan/farmer.
- * Located in front of the house; as a house garden.
- * No mechanization or application of fertilizers and pesticides. All cultural operations including weeding are done by hand.
- * The main crops grown are : corn, sorghum, okra and tomato.
- * Sorghum productivity: estimated at 200-300 kg/fed on the average.

2. Duerta system:

- * Implemented by small farmers growing an area of 5-10 feddan/farmer.
- * Control of weeds by burning during previous season.
- * Hand weeding.
- * No mechanization or application of fertilizers and pesticides. All cultural operations including weeding are done by hand.
- * Sorghum productivity: estimated at 200-300 kg/fed on the average.

3. Small traditional and semi-mechanized system:

- * Implemented by farmers of medium-size areas; 15-200 feddans/farmer.
- * Weed control before planting by wide level disc, and later manually.
- * Land preparation is done by a wide level disc WLD (by renting).
- * No application of fertilizers and pesticides.

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- * Sorghum productivity: estimated at 300 kg/fed on the average.

4. Large mechanized crop production schemes :

- * Implemented by farmers and companies of wide areas; several hundred-thousands of feddans/farmers.
- * Weed control before planting by wide level disc.
- * Land preparation by wide level disc.
- * No application of fertilizers and pesticides.
- * Sorghum productivity estimated at an overall average of 300 kg/feddan.

5. Main features of the traditional rain-fed farming system in Sudan:

- * Limited use of agricultural machinery.
- * Lack of herbicide and fertilizer applications.
- * Lack of a proper crop rotation.
- * Deficiency of infrastructure (roads, electricity, water).
- * Poor management system.
- * Weak research and extension services.

As a result the sector has been suffering from low productivity, poor quality of produce, high cost of production, and consequently high financial losses.

AAID initiatives

AAID has been implementing various projects in different parts of the Sudan and other Arab countries. However, in recognition of the importance of the rain-fed sector in Sudan, particular emphasis was placed on a project for the development of crop production in the rainlands. The project is located at Agadi in the Southern Blue Nile State, 570 kilometers south of Khartoum and is managed by the Arab Sudanese Blue Nile Agriculture Co. (ASBANACO), an affiliate of AAID.

1. ASBANACO's traditional methods of crop production:

During the early year of its establishment ASBANACO followed the traditional methods of the mechanized crop production Schemes (MCPS') based on the use of the wide-level disc for tillage. The productivity was characterized by low yields of all crops. The yields of crops obtained under the traditional system by ASBANACO are given in Table (1).

Table 1. Yields of crops under the traditional system in ASBANACO for seasons 1987-1999 (kg/feddan)

Crop	Average	Highest yield	Lowest yield
Sorghum	177.7	295.7	66
Cotton	55.7	174.6	24.7
Sunflower	121.7	273	80

2. Selection of a new farming system:

As a result of tours to rain-fed areas in different countries (USA, Canada, Australia, South Africa and Brasil), studies, seminars, workshops, and contact with relevant international companies, AAID arrived at Zero tillage as the new farming system to be adopted and to replace the traditional tillage system. AAID contracted a south africa firm (LVA) to implement the technology.

3. The features of Zero tillage:

Also known as no-till, direct seeding, or conservation tillage, Zero tillage is based on the concept of replacement of mechanical tillage operations (plowing, harrowing, etc) by chemical weed control before, during, and after seeding. As a result of the lack of disturbance of the soil and the formation of a mulch on the surface. Zero tillage is associated with the following advantages:

- * Conservation of soil moisture.
- * Control of soil erosion.
- * Improve chemical and physical properties of the soil.
- * Increase organic matter in the soil.
- * Effective control of weeds.
- * Reduction in operational costs (labor and machinery).
- * Substantial increases in productivity.

4. Methods of implementation:

4.1. Establishment of a pilot farm: AAID established in the year 2001 a pilot farm on an area of 5000 feddans (1 feddan=1.038 acres=0.42ha.) at agadi, as an advanced phase of the research and development continuum, to serve as a fore-runner for large-scale commercial production, with the following objectives:

- * Test Zero tillage under the local conditions of Agadi area.
- * Adopt an efficient management system.
- * Collect data, based on large scale application of Zero tillage for financial analysis.

4.2. AAID initiated a new concept of large scale applied research oriented towards the new farming system: An extensive research program was designed to determine a full technological package for each crop, under the Zero tillage farming system. The program covered the various aspects pertaining to the production of crops viz. varieties, sowing dates, plant density, fertilization and weed control. The crops include cotton, sorghum, sunflower, sesame, mize and legumes.

5. Results and Achievements:

- * From the first year of the pilot farm Zero tillage proved its worth.
- * The target yields were exceeded.
- * The yields of all crops (Table 2) were superior under Zero tillage than under tillage systems.
- * Different types of machinery were tested and evaluated including:
 - Planters: Rowgrow, M.F yetter, M.F. Cross slot.

Table 2. A comparison of the yields of crops under the Zero tillage and the minimum tillage systems (season 2001).

Crop	Zero tillage*	Minim tillage
Cotton	470	329
Sorghum	1080	522
Sunflower	509	261

* kg/feddan

- Sprayers: boom sprayer, shielded sprayer
- Harvester: Picker harvester for cotton, combine harvester for sorghum and sunflower and modified combine harvester with air reel head attachment for sesame
- Mulcher-root cutter: on cotton
- * Financial analyses were carried out using different scenarios for different crop compositions.
- * The applied research program continued to determine findings on the most suitable cultural practices for Zero tillage: varieties, plant population, fertilizers, herbicides.etc.
- * Plans were made for increasing the area from 5000 to 10.000 feddans with gradual increases until the whole area of 160.000 is put under cultivation.

A developmental program for the transfer of Zero tillage technology to traditional farmers in Agadi area

1. Executing agency:

AAAID team of experts in cooperation with ASBANACO, LVA/Golder, Federal Ministry of Agriculture and Farmer Unions.

2. Objectives:

a) Specific Objectives :

- * Verify Zero tillage technology in farmer fields.
- * Improve farm management skills of farmers.

b) General Objective :

- * Increase productivity and farmer income.

3. Concept:

Following the success achieved in the adoption of Zero tillage in Agadi pilot farm, it was deemed appropriate to transfer the new technology to the farmers in Agadi area. The idea was well received by the Ministries of Agriculture and Farmer Unions. The program is composed of two projects viz.

- * **Project I:** Transfer of Zero tillage technology to small traditional farmers.
- * **Project II:** Transfer of Zero tillage technology to partially mechanized crop production farmers.

Project I:

Transfer of Zero tillage technology to small traditional farmers.

1. **Components of Project I:** The components of Project (I) showing the beneficiaries, areas, equipment, and inputs are given below :

Beneficiaries	10 small traditional farms, chosen on the following criteria: - Proximity to Agadi pilot farm. - Years of experience. - Interest and commitment to the project objectives and methodology.
Area	10 feddans for each farmer
Equipment	Knapsack sprayer. V-hoe seeding tool. To be provided by ASBANACO on loan to the farmer until the end of the season. Nine (9) feddans will be planted using 4-row planter, field sprayers and shielded sprayer.
Inputs	All inputs (seed, fertilizers, herbicides) will be provided by ASBANACO at cost, payable at the end of the season in accordance with a contract.

2. Comparison between traditional small farming system and the transferred full package Zero tillage system at Agadi; Project I: The following presentation shows the farming operations involved in the production of sorghum with a comparison between the traditional small farming system and the full package Zero tillage system.

Farming operation	Farming system	
	Traditional small farming system	Full package Zero tillage system
Sowing date	Variable	Almost at recommended date
Sowing method	Broadcasting	In rows with specific planter
Weed control before sowing	Burning or some-time harrowing	Herbicides
Weed control through growing season	Hand weeding	Selective herbicides
Pest control	None	Pesticides along pest monitoring programs
Fertilization	None	Chemical fertilization at cost-effective base
Productivity (kg/fed)	200-300 (achieved)	800-1200 (targeted)

3. Model for financial analysis of Project I: A financial analysis was conducted for project I, in which the expected cost of production, revenue, and profit for the traditional small farming systems and Zero tillage system were determined. The results are presented in Table (3).

The calculations indicate that although the cost of production of Zero tillage is higher, it is expected to result in higher productivity, higher revenue, and consequently higher profit per feddan.

Project II:

Transfer of Zero tillage technology to partially mechanized crop production farmers.

1. Components of Project II: The components of Project (II) showing the beneficiaries, areas, equipment, and inputs are given below:

Beneficiaries	Four farmers, chosen on the following criteria: - Interest and commitment to the project objectives and methodology. - Years of experience and knowledge. - Proximity to Agadi pilot farm.
Area	400 feddans for each farmer
Equipment	- 4-row Zero tillage planter. - 12-meter sprayer. - Shielded sprayer. - Harvester. - Tractor. ASBNACO will formulate a specialized unit for renting equipment to the farmers against cost.
Inputs	All inputs (seed, fertilizers, herbicides etc.) will be provided by ASBANACO to the farmers on cost; payable at the end of the season in accordance with a contract guaranteed by the Agricultural Bank.

Table 3. Financial analysis for project I traditional small farming system vs. full package Zero tillage system.

Details	Traditional (hand sowing)	Traditional mechanized (wide level disc sowing)	Hand sowing + knapsack	Zero tillage planter + knapsack
Total cost production input (US\$)/10 fed	82.97	129.9	589.4	633.4
Expected yield (sacks/fed)	1.5	2.5	8	10
Average cost/fed (US\$)	8.3	13	59	63.3
Expected revenues (10 fed)	141.5	235.85	754.72	943.4
Profit/fed	5.85	8.24	9	21.57

* Exchange rate LU\$=2560 Sudanese Pounds.
Price of sorghum \$104/ton.

2. Comparison between Partial Mechanized farming system and the transferred full package Zero tillage system at Agadi; Project II: The following presentation shows the farming operations involved in the production of sorghum with a comparison between the partial mechanized farming system and the full package Zero tillage system.

3. Model for financial analysis of Project II: A financial analysis was conducted for project II, in which the cost of production, revenue, and profit for the par-

tially mechanized system and Zero tillage system were determined. The results are presented in Table (4).

Farming operation	Farming system	
	Partial mechanized farming system	Full package Zero tillage system
Sowing date	Almost at proper date	Almost at recommended date
Sowing method	Broadcasting	In rows with specific planter
Weed control before sowing	Harrowing	Herbicides
Weed control through growing season	Hand weeding	Selective herbicides
Pest control	Pesticides none (weak to moderate application)	Pesticides along pest monitoring programs
Fertilization	None	Chemical fertilization at cost-effective base
Productivity (kg/fed)	300 (achieved)	800-1200 (targeted)

Table 4. Financial analysis for project II Partial Mechanized farming system vs. full package Zero tillage system.

Details	Traditional (wide level disc)	Modern technology (Zero tillage)
Total cost production input (US\$)/500 fed	10181	26930
Expected yield (sacks/fed)	3	10
Sack=approx.90kg		
Average cost \$/fed	20.36	53.86
Expected revenues \$ (500 fed)	14510	47170
Profit \$/fed	5.11	31.0

* Exchange rate LU\$=2560 Sudanese Pounds.
Price of sorghum \$104/ton.

The results of the financial analysis (Table 4) are in harmony with those of project I, as Zero tillage resulted in higher productivity, higher revenue and higher profit per feddan.

Technical backstopping

The farmers, in both projects, will be given full technical support based on a detailed technological package and backed-up by close follow-up from AAAID, LVA/Golder, and ASBANACO experts and technicians in cooperation with the Transfer of Technology and Extension unit of the Ministry of Agriculture. Workshops, seminars, and meetings will be held in support of the program.

Other AAAID developmental achievements associated with the project

In addition to the agricultural achievements of Agadi

pilot farm, AAAID made several contributions to the community development of Agadi area. These included:

- * Building a graded all weather gravel road from Damazin to Agadi (35) kilometers serviceable during the whole year; including the rainy season.
- * Building of hafirs and rehabilitation of wells to make drinking water available to the local people.
- * Building a mosque at Agadi village.
- * Rehabilitation of the boys intermediate school and building class rooms for the girls intermediate school at Agadi.
- * Building new houses for accommodation of project staff and rehabilitation of houses and rest house for the local staff.
- * Rehabilitation of two houses to be used as a dispensary for the villagers.

Conclusions

- * The strategies and initiatives of AAAID in introducing the zero tillage farming system for the development of the rain-fed sector in Sudan have been achieving fruitful results.
- * Establishment of Agadi pilot farm, as a fore-runner for commercial production, supported by the new concept of large-scale applied research proved to be useful means for achieving the objectives.
- * Against the background of the success achieved, the

developmental program for the transfer of Zero tillage technology to traditional farmers in Agadi area was launched, to extend the benefits to the farmers. AAAID has been receiving requests from state governors, ministries of agriculture, and farmer unions to extend its transfer of technology program to other regions of the rain-fed sector. It is anticipated that the transfer of technology program will have a substantial contribution to the development and welfare of the rural communities in Sudan.

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مضامين وآليات برنامج الهيئة العربية للاستثمار والإنماء الزراعي لنقل وتوطين نظام الزراعة بدون حرث إلى المزارعين في القطاع المطري في السودان

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الخلاصة

إيماناً من الهيئة العربية للاستثمار والإنماء الزراعي بالدور الأساسي الذي يعوّل على القطاع الزراعي المطري في تنمية وتطوير القطاع الزراعي في السودان، فقد أدخلت الهيئة العربية نظام الزراعة بدون حرث للتصدي لمشاكل القطاع الزراعي المطري التقليدي المتمثلة في تدني الإنتاجية وارتفاع تكلفة الإنتاج ومن ثم الخسائر المادية وأنشأت مزرعة رائدة في أقدي لتحقيق هذا الغرض، حيث تم إدخال نظام الزراعة بدون حرث لأول مرة في السودان. يحقق نظام الزراعة بدون حرث عدة فوائد من بينها المحافظة على رطوبة التربة وتحسين خواصها وزيادة المادة العضوية والمقاومة الفعالة للحشائش وزيادة الإنتاجية.

وفي ضوء نجاح الزراعة بدون حرث في أقدي تبنت الهيئة العربية تنفيذ برنامج لنقل ثقافة الزراعة بدون حرث إلى المزارعين في القطاع المطري. وتعد هذه المقالة بتوضيح تفاصيل البرنامج الذي صمم لنقل ثقافة الزراعة بدون حرث إلى حقول صغار المزارعين التقليديين ومزارعي القطاع المطري الآلي، بهدف نشر هذه الثقافة في القطاع المطري وتحقيق النقلة المرجوة في رفع إنتاجية هذا القطاع.

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