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Public Disclosure Authorized



CREDIT NUMBER 834 SU

Development Credit Agreement

(Agricultural Research Project)

between

THE DEMOCRATIC REPUBLIC OF THE SUDAN

and

INTERNATIONAL DEVELOPMENT ASSOCIATION

Public Disclosure Authorized

Dated July 27, 1978



DEVELOPMENT CREDIT AGREEMENT

AGREEMENT, dated July 27, 1978, between DEMOCRATIC REPUBLIC OF THE SUDAN (hereinafter called the Borrower) and INTERNATIONAL DEVELOPMENT ASSOCIATION (hereinafter called the Association.)

WHEREAS (A) the Borrower has requested the Association to assist in the financing of the Project described in Schedule 2 to this Agreement by extending the Credit as hereinafter provided;

(B) the Borrower intends to contract from the United States Agency for International Development (USAID) a grant (hereinafter called the USAID Grant) in the amount of about twenty million dollars (\$20,000,000) to assist in financing the Project on the terms and conditions set forth in an agreement (hereinafter called the USAID Grant Agreement) to be entered into between the Borrower and the USAID; and

(C) the Project will be carried out by the Agricultural Research Corporation of the Borrower (hereinafter called ARC) with the Borrower's assistance and, as part of such assistance, the Borrower will make available to ARC the proceeds of the Credit as hereinafter provided; and

WHEREAS the Association has agreed, on the basis inter alia of the foregoing, to extend the Credit to the Borrower upon the terms and conditions hereinafter set forth and in the Project Agreement of even date herewith between the Association and ARC;

NOW THEREFORE the parties hereto hereby agree as follows:

ARTICLE I

General Conditions; Definitions

Section 1.01. The parties to this Agreement accept all the provisions of the General Conditions Applicable to Development Credit Agreements of the Association, dated March 15, 1974, with the same force and effect as if they were fully set forth herein (said General Conditions Applicable to Development Credit Agreements of the Association being hereinafter called the General Conditions).

Section 1.02. Wherever used in this Agreement, unless the context otherwise requires, the several terms defined in the General Conditions and in the Preamble to this Agreement have the respective meanings therein set forth and the following additional terms have the following meanings:

(a) "Project Agreement" means the agreement between the Association and ARC of even date herewith, as the same may be amended from time to time, and such term includes all schedules to the Project Agreement and all agreements supplemental to the Project Agreement;

(b) "MAFNR" means the Ministry of Agriculture, Food and Natural Resources of the Borrower;

(c) "WSDC" means the Western Savannah Development Corporation of the Borrower, a body corporate established under the Borrower's Laws;

(d) "Previous Development Credit Agreement" means the Development Credit Agreement concluded between the Borrower and the Association on June 24, 1977, for the Savannah Development Project;

(e) "MPW" means the Ministry of Public Works of the Borrower;

(f) "Project Center" means the center, to be established at Nyala under Part A.1 of the Project, to operate as ARC's regional and Project headquarters; and

(g) "Sudanese Pounds" means the currency of the Borrower.

ARTICLE II

The Credit

Section 2.01. The Association agrees to lend to the Borrower, on the terms and conditions in the Development Credit Agreement set forth or referred to, an amount in various currencies equivalent to fifteen million dollars (\$15,000,000).

Section 2.02. The amount of the Credit may be withdrawn from the Credit Account in accordance with the provisions of Schedule 1 to this Agreement, as such Schedule may be amended from time to

time by agreement between the Borrower and the Association, for expenditures made (or, if the Association shall so agree, to be made) in respect of the reasonable cost of goods and services required for the Project and to be financed out of the proceeds of the Credit.

Section 2.03. Except as the Association shall otherwise agree, procurement of the goods and civil works to be financed out of the proceeds of the Credit shall be governed by the provisions set forth or referred to in Section 2.13 of the Project Agreement.

Section 2.04. The Closing Date shall be June 30, 1985 or such later date as the Association shall establish. The Association shall promptly notify the Borrower of such later date.

Section 2.05. The Borrower shall pay to the Association a service charge at the rate of three-fourths of one per cent ($3/4$ of 1%) per annum on the principal amount of the Credit withdrawn and outstanding from time to time.

Section 2.06. Service charges shall be payable semiannually on March 15 and September 15 in each year.

Section 2.07. The Borrower shall repay the principal amount of the Credit in semiannual installments payable on each March 15 and September 15 commencing September 15, 1988, and ending March 15, 2028, each installment to and including the installment payable on March 15, 1998, to be one-half of one per cent ($1/2$ of 1%) of such principal amount, and each installment thereafter to be one and one-half per cent ($1-1/2\%$) of such principal amount.

Section 2.08. The currency of the United States of America is hereby specified for the purposes of Section 4.02 of the General Conditions.

Section 2.09. The Director General of ARC or such other person or persons as he shall designate in writing are designated as representatives of the Borrower for the purposes of taking any action required or permitted to be taken under the provisions of Section 2.02 of this Agreement and Article V of the General Conditions.

ARTICLE III

Execution of the Project

Section 3.01. (a) Without any limitation or restriction upon any of its other obligations under the Development Credit Agreement, the Borrower shall cause ARC to perform in accordance with the provisions of the Project Agreement all the obligations therein set forth, shall take and cause to be taken all action, including the provision of funds, facilities, services and other resources, necessary or appropriate to enable ARC to perform such obligations, and shall not take or permit to be taken any action which would prevent or interfere with such performance.

(b) The Borrower shall make the proceeds of the Credit, together with the proceeds of the USAID Grant and the funds provided by the Borrower for the execution of the Project, available to ARC on a grant basis.

(c) In order to enable ARC to operate effectively and to carry out its obligations under the Project, the Borrower shall: (i) promptly deposit in the Project account, to be established by ARC pursuant to Section 2.06 of the Project Agreement, an amount of not less than 200,000 Sudanese Pounds; and (ii) provide ARC with funds sufficient to maintain said account at the level referred to under Section 2.06 (b) of the Project Agreement.

Section 3.02. In recognition of ARC's general responsibility for agricultural research in Sudan, the Borrower shall: (a) cause WSDC to transfer to ARC all of WSDC's research facilities in west Sudan, including those provided under the Previous Development Credit Agreement, in accordance with a schedule to be prepared by the Borrower and reviewed as provided in Section 3.04 of this Agreement and shall, until the completion of such transfer, ensure effective technical cooperation between ARC and WSDC; (b) ensure that the Saudi Fund, the Co-Financier in the Previous Development Credit Agreement, and all other external financiers assisting in WSDC's research programs in west Sudan, will be given a reasonable opportunity to comment on the measures proposed for effecting such transfer; and (c) cause MAFNR to integrate fully all agricultural and animal production research.

Section 3.03. (a) the Borrower shall take all action necessary for the transfer to ARC of all such land and rights in respect of land as shall be required for the establishment and

proper operation of the research center and stations specified under Part A.1 (a) and (b) of the Project. Such land shall be selected in consultation with the executive architects referred to in Section 2.02 of the Project Agreement and shall be suitable for such facilities.

(b) the Borrower shall cause its ministries, agencies or departments in charge of public utilities to extend, when needed for the operation of the Project facilities and to the extent practicable, electrical, water and telephone services to ARC's research stations and other sites of Project operation.

(c) the Borrower shall cause MPW to provide qualified personnel in numbers adequate to assist the executive architects, referred to in Section 2.02 of the Project Agreement in supervising the construction of civil works under the Project.

Section 3.04. Upon the preparation of the detailed research plan pursuant to Section 2.07 (b) (iii) of the Project Agreement, the Borrower shall cause MAFNR to form a committee composed of three internationally reputed scientists, selected in consultation with the Association, and representatives from the Association and the USAID. Such committee shall review said plan, together with the recommended procedures and schedule for the transfer of research activities in west Sudan from WSDC to ARC pursuant to Section 3.02 of this Agreement. Such schedule shall provide for the completion of this transfer not later than the fifth anniversary of the Effective Date.

Section 3.05. During the preparation of the detailed research plan referred to under Section 3.04 of this Agreement, the Borrower shall make a study on possible means of financing future agricultural research from sources other than budgetary allocation. Such study shall investigate, inter alia: (i) possible financial contributions to agricultural research by corporations and farmers benefitting from the higher agricultural productivity brought through research; and (ii) possible means for including such assistance in the prices of, or fees or taxes on, agricultural services and goods.

ARTICLE IV

Remedies of the Association

Section 4.01. For the purposes of Section 6.02 of the General Conditions the following additional events are specified pursuant to paragraph (h) thereof:

(a) ARC shall have failed to perform any covenant, agreement or obligation of ARC under the Project Agreement;

(b) an extraordinary situation shall have arisen which shall make it improbable that ARC will be able to perform its obligations under the Project Agreement;

(c) the Borrower's Act No. 44 of the year 1977 establishing ARC, shall have been amended, suspended, abrogated, repealed or waived in such a way as to materially and adversely affect the ability of ARC to carry out the covenants, agreements and obligations set forth in the Project Agreement;

(d) the Borrower or any other authority having jurisdiction shall have taken any action for the dissolution or disestablishment of ARC or for the suspension of its operations; and

(e) (i) subject to subparagraph (ii) of this paragraph: the right of the Borrower to utilize the proceeds of the USAID Grant shall have been suspended, cancelled or terminated in whole or in part, pursuant to the terms of such Grant.

(ii) subparagraph (i) of this paragraph shall not apply if:

(A) such suspension, cancellation or termination is not caused by the failure of the Borrower to perform any of its obligations under such agreement, and

(B) adequate funds for the Project are available to the Borrower on terms and conditions consistent with the obligations of the Borrower under this Agreement.

Section 4.02. For the purposes of Section 7.01 of the General Conditions, the following additional events are specified pursuant to paragraph (d) thereof:

(a) the event specified in paragraph (a) of Section 4.01 of this Agreement shall occur and shall continue for a period of 60 days after notice thereof shall have been given by the Association to the Borrower; and

(b) any of the events specified in paragraphs (c) or (d) of Section 4.01 of this Agreement shall occur.

ARTICLE V

Effective Date; Termination

Section 5.01. The following events are specified as additional conditions to the effectiveness of the Development Credit Agreement within the meaning of Section 12.01 (b) of the General Conditions:

(a) the project director, the deputy project director and the senior research adviser referred to in Section 2.03 of the Project Agreement have been appointed;

(b) all conditions precedent to the effectiveness of the USAID Grant Agreement, or the right of the Borrower to make withdrawals thereunder, except for the effectiveness of this Agreement, have been fulfilled;

(c) the Borrower has deposited in the Project account the amount referred to in Section 3.01 (c) of this Agreement; and

(d) ARC has completed a study comparing its salaries and benefits with those provided by other comparable institutions, such as the universities, employing high calibre scientific staff, and has adopted incentives for its staff to be assigned to work on the Project satisfactory to the Borrower and the Association.

Section 5.02. The following is specified as an additional matter, within the meaning of Section 12.02 (b) of the General Conditions, to be included in the opinion or opinions to be furnished to the Association, namely, that the Project Agreement has been duly authorized or ratified by, and executed and delivered on behalf of, ARC, and is legally binding upon ARC in accordance with its terms.

Section 5.03. The date November 27, 1978, is hereby specified for the purposes of Section 12.04 of the General Conditions.

Section 5.04. The obligations of the Borrower under Section 3.04 and the provisions of Section 4.02 of this Agreement shall cease and determine on the date on which the Development Credit

Agreement shall terminate or on a date fifteen years after the date of this Agreement, whichever shall be the earlier.

ARTICLE VI

Representative of the Borrower; Addresses

Section 6.01. The Minister of National Planning or the Under-secretary of the Ministry of National Planning of the Borrower is designated as representative of the Borrower for the purposes of Section 11.03 of the General Conditions.

Section 6.02. The following addresses are specified for the purpose of Section 11.01 of the General Conditions:

For the Borrower:

Ministry of National Planning
P.O. Box 2092
Khartoum
The Democratic Republic of the Sudan

Cable address:

EIMAR
Khartoum

Telex:

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For the Association:

International Development Association
1818 H Street, N.W.
Washington, D.C. 20433
United States of America

Cable address:

INDEVAS
Washington, D.C.

Telex:

440098 (ITT)
248423 (RCA) or
64145 (WUI)

IN WITNESS WHEREOF, the parties hereto, acting through their representatives thereunto duly authorized, have caused this Agreement to be signed in their respective names in the District of Columbia, United States of America, as of the day and year first above written.

THE DEMOCRATIC REPUBLIC OF THE SUDAN

By /s/ Osman Hashim Abdel-Salam
Authorized Representative

INTERNATIONAL DEVELOPMENT ASSOCIATION

By /s/ Hans Adler
Acting Regional Vice President
Eastern Africa

SCHEDULE 1

Withdrawal of the Proceeds of the Credit

1. The table below sets forth the Categories of items to be financed out of the proceeds of the Credit, the allocation of the amounts of the Credit to each Category and the percentage of expenditures for items so to be financed in each Category:

<u>Category</u>	<u>Amount of the Credit Allocated (Expressed in Dollar Equivalent)</u>	<u>% of Expenditures to be Financed</u>
(1) Civil works (building construction)	9,900,000	100% of foreign expenditures
(2) Aircraft	300,000	100% of foreign expenditures
(3) Aircraft operating expenses		
(a) imported spares and services	50,000	100% of foreign expenditures
(b) locally procured goods and services	250,000	60%
(4) Unallocated	4,500,000	
	<hr/>	
	TOTAL	
	15,000,000	
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2. For the purposes of this Schedule, "foreign expenditures" means expenditures in the currency of any country other than the Borrower and for goods and services supplied from the territory of any country other than the Borrower.

3. The disbursement percentages have been calculated in compliance with the policy of the Association that no proceeds of the Credit shall be disbursed on account of payments for taxes levied by, or in the territory of, the Borrower on goods or services, or

on the importation, manufacture, procurement or supply thereof; to that end, if the amount of any such taxes levied on or in respect of any item to be financed out of the proceeds of the Credit decreases or increases, the Association may, by notice to the Borrower, increase or decrease the disbursement percentage then applicable to such item as required to be consistent with the aforementioned policy of the Association.

4. Notwithstanding the provisions of paragraph 1 above, no withdrawals shall be made in respect of payments made for: (i) expenditures prior to the date of this Agreement; and (ii) expenditures under Category (1) until the Borrower shall have implemented the provisions of Section 3.03 (a) of this Agreement.

5. Notwithstanding the allocation of an amount of the Credit or the disbursement percentages set forth in the table in paragraph 1 above, if the Association has reasonably estimated that the amount of the Credit then allocated to any Category will be insufficient to finance the agreed percentage of all expenditures in that Category, the Association may, by notice to the Borrower: (i) reallocate to such Category, to the extent required to meet the estimated shortfall, proceeds of the Credit which are then allocated to another Category and which in the opinion of the Association are not needed to meet other expenditures, and (ii) if such reallocation cannot fully meet the estimated shortfall, reduce the disbursement percentage then applicable to such expenditures in order that further withdrawals under such Category may continue until all expenditures thereunder shall have been made.

6. If the Association shall have reasonably determined that the procurement of any item in any Category is inconsistent with the procedures set forth or referred to in this Agreement, no expenditures for such item shall be financed out of the proceeds of the Credit and the Association may, without in any way restricting or limiting any other right, power or remedy of the Association under the Development Credit Agreement, by notice to the Borrower, cancel such amount of the Credit as, in the Association's reasonable opinion, represents the amount of such expenditures which would otherwise have been eligible for financing out of the proceeds of the Credit.

SCHEDULE 2

Description of the Project

The purposes of the Project are to develop, expand and increase the efficiency of ARC's research operations in west Sudan, and to provide supporting services and facilities for ARC's new headquarters, to be established under the Project, in Khartoum. The first three years of Project implementation will be mainly devoted to the improvement of research institutions; the actual research programs will be carried out during the next three years. Accordingly, the Project consists of the following two parts:

Part A: Institutional Development of ARC's Research Operations.

1. Research Center and Stations:
 - (a) the establishment of the Project Center at Nyala, equipped with laboratories, staff offices and houses, vehicles and other research facilities; and
 - (b) the establishment (or development) of three research stations located at El-Fasher, El-Obeid and Kadugli, respectively, and equipped with laboratories, staff offices and houses, vehicles and other research facilities.
2. Other Institutional Development:
 - (a) the provision of a headquarters building for ARC in Khartoum, provided with the necessary furniture, office equipment and vehicles; and
 - (b) the establishment of three new units, namely, the project support unit and the planning and evaluation unit at ARC's headquarters and the in-service training and extension unit at the Project Center.
3. Fellowships:

Overseas fellowships for the scientific staff of ARC to pursue studies and training and attend scientific conferences.

4. Technical Assistance and Cooperation:

The conclusion of arrangements between ARC and external research institutions for the cooperation in scientific problem solving.

Part B: Research Programs.

The Project provides for two major research programs:

1. The research program on livestock/crop production systems which shall be implemented under three sub-programs at the following places: (a) El Obeid (integrated crop/livestock on non-cracking clay soils); (b) Kadugli (integrated crop/livestock on cracking clay soils); and (c) El Fasher (livestock at the arid desert fringe). In addition, ARC will assume, pursuant to the provisions of Section 3.02 (a) of this Agreement, responsibility for agricultural research to be carried out by WSDC at Ghazala Gawazat, which would cover the two other important production systems in the Project area, namely: (i) integrated crop/livestock on stabilized sands; and (ii) livestock in the semi-arid areas. Research at these four places will have a common approach with emphasis on the environmental and production systems' aspects in each of such places, all as shown in Annex C to this Schedule.

2. Research program on water and land use management.

This program will be directed from Nyala, its major objective is to support the research programs specified under paragraph 1 above. Components of this program are provided in Annex C to this Schedule.

* * *

The Project is expected to be completed by December 31, 1984.

ANNEX A

Scientists and Senior Staff to be employed under the Project

1. Staff to be posted at the ARC headquarters in Khartoum:

(a) Project Support Unit:

- 1 Senior Research Adviser to the Director General of ARC (head of the Project Support Unit);
- 1 Project Liaison Officer;
- 1 Project Architect/Research Station Planner; and
- 1 Accountant.

(b) Planning and Evaluation Unit:

- 1 Planning and Evaluation Advisor (head of the Planning and Evaluation Unit).

2. Staff to be posted at the Nyala Research Center:

(a) Director's Office:

- 1 Project Director;
- 1 Deputy Project Director;
- 1 Station Superintendent;
- 1 Accountant; and
- 1 Communications Officer/Pilot.

(b) Production Systems Research Program:

- 1 Livestock/Crop Production Systems Specialist (Program Leader);
- 1 Sociologist (Discipline Leader);
- 1 Sociologist;

- 2 Economists;
- 1 Biometrician;
- 2 Groundnut Breeders; and
- 1 Research Liaison Officer.

(c) Water and Land Use Research Program:

- 1 Water and Land Use Specialist (Program Leader);
- 1 Water and Land Use Specialist (Deputy Program Leader);
- 1 Soil Physicist;
- 1 Soil Chemist;
- 1 Agro-Climatologist;
- 1 Agro-Climatologist (Discipline Leader);
- 1 Agro-Climatologist; and
- 1 Water Engineer.

(d) In-service Training and Extension Unit:

- 1 Training Officer (head of In-service Training and Extension Unit); and
- 1 Assistant Training Officer.

3. Staff to be posted at the El Fasher Research Station:

- 1 Range Specialist (Sub-Program Leader Arid Livestock Production);
- 1 Range Specialist;
- 1 Camel Specialist; and
- 1 Sheep and Goat Specialist.

4. Staff to be posted at the Kadugli Research Station:
 - (a) Sub-Program Livestock/Crop Production on Cracking Clay Soils:
 - 1 Plant Breeder/Agronomist (Sub-Program Leader);
 - 1 Farm Management Economist (Discipline Leader);
 - 1 Farm Management Economist;
 - 1 Agricultural Engineer;
 - 1 Sorghum Breeder;
 - 1 Livestock Specialist/Forage Agronomist; and
 - 1 Research Liaison Officer.
 - (b) Water and Land Use Research Program:
 - 1 Field Project Officer.
5. Staff to be posted at the El Obeid Research Station:
 - (a) Sub-Program Livestock/Crop Production on Non-Cracking Clay Soils:
 - 1 Systems Agronomist (Sub-Program Leader);
 - 2 Gum Arabic Specialists;
 - 1 Agricultural Engineer;
 - 1 Farm Management Economist;
 - 1 Millet Breeder;
 - 1 Kerkadeh Specialist;
 - 1 Livestock Specialist; and
 - 1 Research Liaison Officer.
 - (b) Water and Land Use Research Program:
 - 1 Field Project Officer.

ANNEX B

Technical Assistance to ARC

1. Long-Term Assignments of Internationally Recruited Staff:

Internationally recruited staff are required to fill the following positions under the Project:

- 1 Senior Research Advisor to the Director General of ARC;
- 1 Research Planning and Evaluation Adviser;
- 1 Project Architect/Research Station Planner;
- 1 Deputy Project Director;
- 1 Livestock/Crop Production Systems Specialist - Program Leader;
- 1 Sociologist - Discipline Leader;
- 1 Farm Management Economist - Discipline Leader;
- 1 Agricultural Engineer - Discipline Leader;
- 1 Water and Land Use Specialist - Program Leader; and
- 1 Agro-Climatologist - Discipline Leader.

2. Fellowships:

- (a) 6 Ph.D. level fellowships (4 years) for 1 soil physicist, 1 sociologist, 1 range specialist, 1 farm management economist, 1 gum arabic specialist and 1 subject matter specialist to be identified;
- (b) 5 M.Sc. level fellowships (2 years) for 2 economists, 1 farm management economist, 1 agricultural engineer and 1 agro-climatologist; and
- (c) 17 non-degree specialization courses (3-12 months) for 3 research liaison officers, 1 forage agronomist/livestock specialist, 1 livestock specialist, 1 sheep and goat specialist, 1 groundnut breeder, 1 millet

breeder, 1 sorghum breeder, 1 water engineer, 1 agricultural engineer, 1 gum arabic specialist, 1 kerkadeh specialist, and four subject matter specialists to be identified.

3. Short-Term Consultancies:

- (a) 20 man-months for the research programs in West Sudan;
- (b) 10 man-months for solar energy research; and
- (c) 50 man-months for the Planning and Evaluation Unit at ARC headquarters in Khartoum.

4. Building Program Technical Assistance:

- (a) Development Study and Report: to be carried out by a firm of internationally reputed architect/planners in association with agricultural scientists and supported by appropriate engineering and surveying expertise. The study would chart the magnitude and direction of growth at each station and include: soil analysis and climatic data; a definition of the functional program; preparation of detailed architectural briefs and room data sheets; a schedule of accommodation; a list of major laboratory equipment; site development plans for land and physical facilities; a building system study to compare traditional systems with modular construction and air freighting of materials; a preliminary cost estimate; and an anticipated implementation schedule for civil works construction.

- (b) Executive Architects

An internationally reputed firm of executive architects will be appointed to: establish and manage a work program for all activities during the design, construction and commissioning phases of the Project; prepare sketch designs and design development drawings for client approval; prepare contract documents, namely working drawings, specifications and bidding documents; coordinate the work of structural engineers and mechanical services engineers; with the quantity surveyors, prepare and update cost estimates throughout the Project life and prepare cash flow projections to indicate funding

requirements throughout the construction period; in cooperation with the Project Support Unit, administer bidding procedures and contracts; supervise construction, reinforced by resident clerks of works and site engineers provided by the Borrower; carry out the final inspection and acceptance of completed buildings; and prepare final accounts.

(c) Procurement Assistance:

Consultants will be employed to assist in the procurement of goods including: assembling of bid packages; supervising bidding and contract awards.

(d) Physical Facilities Development:

This includes short-term assignments of engineers to provide professional counsel to ARC.

ANNEX C

Research Programs

A. Research Center, Nyala

1. The Research Center at Nyala will comprise:

- (a) the Project Director's Office;
- (b) the headquarters of the Production Systems Research Program including socio-economic support services;
- (c) the headquarters of the Water and Land Use Research Program; and
- (d) the In-service Training and Extension Unit.

2. Capital Investments:

- 1,500 m² offices and field laboratories;
- 55 staff houses;
- 2 mobile research units;
- 7 four-wheel drive vehicles;
- 8 motor cars;
- 1 minibus;
- 1 aircraft; and
- 5 radios, one of which may be used in Khartoum.

B. Production Systems Research Program

The program will study, through the establishment and operation of interdisciplinary research teams, the five important agricultural production systems in West Sudan, namely:

- (a) arid livestock production at the desert fringe (El Fasher);

- (b) semi-arid livestock production in the south of the Project area, interspersed with crop production (Ghazala Gawazat);
 - (c) integrated crop/livestock production on stabilized sands (Ghazala Gawazat);
 - (d) integrated crop/livestock production on non-cracking clays (Kadugli);
 - (e) integrated crop/livestock production on cracking clays (El Obeid);
1. Arid Livestock Production Sub-Program based at El Fasher

(a) Research

Range condition and trend, range manipulation through different livestock species, water regimes, fire and grazing rotations; methods to stop the advance of the desert; structure and productivity of camel herds and sheep and goat flocks; effects of improved disease control, feeding of mineral supplements, and drought proofing mechanisms and strategies; human resource studies including demographic structure and trends, nutritional and health status, organizational and social context of the production unit, socio-economic value patterns, marketing processes, animal management patterns; and interpopulation pressures through competition for resources.

(b) Capital Investments:

550 m² of offices and field laboratories;

300 m² of farm buildings;

16 staff houses; furniture and equipment; minor fencing;

1 mobile research unit;

4 four-wheel drive vehicles;

1 motor car; and

2 radios.

2. Semi-arid Livestock Production Sub-Program based at Ghazala Gawazat

(a) Research:

(i) Rangeland production: the assessment of range condition and trend; its primary productivity and improvement possibilities through controlled grazing, water and fire management; the introduction of new species (particularly leguminous trees and shrubs), the strategic use of localities with better soils or water availability; and to a lesser extent, reseeding and bush control.

(ii) Livestock production: the structure and productivity of cattle herds and sheep and goat flocks; the effect of improved disease control, mineral supplements and the feeding of crop residues and by-products on herd productivity and herd productivity changes through the early extraction and fattening of young males.

(iii) Pastoral security: human resources studies including demographic structure and trends, nutritional and health status; organizational and social context of the production unit, socio-economic value patterns, and interpopulation pressures through competition for resources; and investigations of the opportunities for capital investment other than in livestock.

(iv) Pastoral systems: integration of research results into proposals for improving traditional systems of husbandry and people's lifestyles.

(b) Capital investments: to be provided under the Previous Development Credit Agreement.

3. Integrated Livestock/Crop Production Sub-Program on Stabilized Sands-Sub-Program based at Ghazala Gawazat

(a) Research

- (i) Systems' themes: Differential efficiencies and costs of crops and livestock; study of integrating factors such as risk minimization, even use of labor, utilization of unsaleable products and the effect of manure on soil fertility; evolution of crop/fodder/pasture rotations; small farm economic studies; the social structure of production units; marketing procedures and opportunities; institutional requirements in the subsistence sector, development of technology packages easily applicable by subsistence farmers; and the environmental impact of innovations.
 - (ii) Crops: the testing of food and cash crops, particularly new millet and groundnut varieties; minimum tillage and water management technology, crop protection, cultivation practices and their timing; weed control and fertilizer use.
 - (iii) Livestock: the use of draught animals; milk and meat production; nutritional values of crop by-products and residues; fertilizer values of animal wastes and comparative productive and reproductive efficiencies of local cattle, sheep and goats at low and variable feed supplies.
 - (iv) Pasture and forage: possible new species to improve range production; the impact and economics of forage crops, fertilizers and irrigation to increase feed supply at critical times; conserved fodder cut from pasture and forage crops and crop residues and grain supplements for the maintenance or survival feeding of stock during the dry season.
- (b) Capital investments: to be provided under the Previous Development Credit Agreement.

4. Integrated Livestock/Crop Production Sub-Program on non-Cracking Clays based at El Obeid

(a) Research:

The same sub-program as referred to under Section B 3 (a) of this Annex with additional emphasis on: millet, improved tillage technology including animal traction and gum arabic (Acacia senegal) studies.

The wild-growing plant kerkadeh will be studied regarding its suitability both in an integrated farming system or as a plantation crop.

(b) Capital Investments:

1,000 m² of offices and field laboratories;

1,200 m² of farm buildings;

28 staff houses, furniture and equipment;

2 mobile research units;

6 four-wheel drive vehicles;

8 motor cars;

1 tractor; and

3 radios.

5. Integrated Livestock/Crop Production Sub-Program on Cracking Clays based at Kadugli

(a) Research:

The same sub-program as referred to under Section B 3 (a) of this Annex with additional emphasis on:

(i) Crops: sorghum, sesame, cotton and soybeans suitable for reasonable rainfall conditions.

- (ii) Livestock: animal traction, milk and meat production of local and introduced breeds of cattle, sheep and goats and their crosses.
- (iii) Pasture and forage: techniques of fodder conservation in particular hay.
- (iv) Cultural techniques: examination of hand and mechanized tools for more rapid and more efficient cultivation of black cotton soils, tillage practices by hand, animal traction and varying degrees of mechanization in relation to optimal water use, root penetration and plant growth, soil erosion, timing of tillage and labor requirements and economic evaluation.

(b) Capital Investments

- 1,100 m² offices and field laboratories;
- 1,200 m² farm buildings;
- 29 staff houses;
- 2 mobile research units;
- 4 four-wheel drive vehicles;
- 9 motor cars;
- 4 tractors; and
- 3 radios.

C. Water and Land Use Research Program

This Program will support the five multi-disciplinary research sub-programs described in Part B of this Annex. The main lines of research include:

- (1) Resource potential: an inventory and the analysis of previous investigations and of existing environmental data for the Project area on meteorological records, air photographs and satellite

imagery, water balance, primary productivity, pedology, ecological trend and human and animal demography.

- (2) Water management technology: water conservation, infiltration, penetration, run-off and harvesting, surface and underground storage; evaporation; and efficient minimum use of water for crops and livestock and human populations.
- (3) Socio-economics of water management: comparative costs and benefits of the techniques of harvesting, storing and using water; social structures and economic pressures as mechanisms to control and restrict water use in order to control livestock numbers and to improve rangeland management and crop farming.