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OVERSEAS DIVISION REPORT

OD/86/14

AID IN CONFIDENCE

REPORT ON A VISIT TO WESTERN SAVANNAH PROJECT (WSP),
DARFUR, SUDAN

Theo J Willcocks

January/February 1986

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

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Visit to Western Savannah Project (WSP) Darfur, Sudan

(Visit 25 January - 5 February 1986)

By Theo J Willcocks, Agricultural Engineer, OD/NIAE

1 Introduction/Objectives

The primary purpose of this visit was to:

i) see the Naga'a (bare) soils in Western Savannah and make proposals for the research and development of improved techniques to exploit the crop production potential of this virtually unused resource (approx 1500 km²).

ii) consider other Agricultural Engineering aspects of the Western Savannah Project (WSP) these included: animal traction for cultivations and general workshop and support facilities for agricultural machinery.

The visit was timed to coincide with that of the BDDEA team comprising Messrs P Weare (Natural Resources Adviser), P W D H Roberts (Engineering [Civil] Adviser) and E Hawthorn (Economics Adviser). We were accompanied throughout the trip to Darfur by Mr Mohamed Abdullah Rahman the Director General of Western Savannah Development Co-poration and Mr B Eastwood, Councillor of the British Embassy. Mr Weare's Summary Report on BDDEA visit to Sudan can be seen in Appendix A.

Whilst in Khartoum it was possible to follow up the proposals made in Nov/Dec 85 for NIAE involvement at Qal en Nahal with Euro Action Accord (ref TJW OD/NIAE Report No OD/85/21) and other contacts.

Details of Itinerary and Contacts made are at Appendices B and C.

Before leaving Khartoum, 5 Feb, a Departure Report was left with the British Embassy, extract at Appendix A5.

2 Background, WSP

The total project cost for the Western Savannah Project Phase II (5 yr) has been estimated at M\$ 43.8 by the International Development Administration (IDA) of the World Bank.

<u>Contributor</u>	<u>M\$</u>
IDA	10.6
IFAD (International Fund for Agricultural Development)	10.0
ODA (IDA estimates: M\$ 10.7)	
BDDEA Sept 85 estimate	12.7
(This includes M£0.65 for local costs and M£0.94 for TC)	
Government of Sudan	<u>12.6</u>
Total	M\$46 (approx)

Details of the proposals for WSP II can be seen in the ODA Projects and Evaluation Committee Submission, Sudan: WSP II. Report No PEC(85)47. The main project objectives and the ODA funded components are listed at Appendix A6 from PEC(85)47 para 3 pp 9 and 10.

Background Fact Sheets of the Western Savannah Development Co-operation (WSDC) are available as listed at App D. Sheets relevant to the Naga'a soils and Animal Traction are also at App D. Some background references are listed at the end of this report and a map is given on the back page.

3 Naga'a Soils, S. Darfur3.1 General Observations

The Naga'a soils represent a valuable resource for food production in South Darfur but they need to be exploited carefully.

The term Naga'a describes a soil surface that has a hard smooth cap and these soils usually occur in large virtually flat areas with little vegetative growth. (Naga'a blocks seen during this visit were generally in the 10-50 hectare range). It is estimated that there are about 120,000 ha of these soils within the Baggara Alluvium in the western area of the Western Savannah Project (Kerr, 1984). See maps at rear of report.

Traditionally the hardness of these soils has prevented their cultivation by hand or animal draught methods. Vegetative growth is sparse because run-off is high and little water infiltrates through the soil profile. Naga'a soils are much more fertile than the surrounding Qoz (sand) soils (Kerr, 1984) and observation trials with tractor drawn chisel ploughs have produced good crop yields (2-3t/ha or 9-14 x 90 kg bags/feddan) when rainfall has been reasonable (about 500 mm). In 1983, however, rainfall at Jumeiza was only 320 mm and many of the crops on Naga'a soils were a total failure.

Some tillage trials have been conducted at Jumieza to compare various types and depths of tillage. Much good work has gone in to this but unfortunately the design of these experiments involved a complete re-randomization of treatments each season which will have virtually obliterated any valid comparison of tillage depths. However, the use of chisel ploughs on these capped soils to enhance infiltration of scarce rain water is supported.

Kerr (1984) estimates that there are about 50,000 ha (120,000 feddans) of soil suitable for ploughing within a 25 km radius of Buram. During this visit the WSDC Naga'a ploughing team was seen operating near Tullus. The present fleet of five tractors with chisel ploughs were operating well, but improved field management would increase output significantly (see 3.3 below). Maintenance support facilities for these tractors were poor and these must be improved if this important development work is to continue. (Johnson et al, 1979)

Several crop root growth inspection holes were dug into Naga'a during this visit. Unlike the cap, soil cracking was evident in some holes below the surface, indicating a greater clay content. This observation means that the adverse physical properties of the soil surface may be improved by mixing with the finer soil below. The presence of such a stratification could have been developed when the Naga'a was covered in sand since uninhibited infiltration through the sand and into the Naga'a could have leached the finer clay particles out of the Naga'a surface. This would partly explain why the resultant Naga'a surface would be prone to capping where stratification occurs.

3.2 The Naga'a Problem

The main problems with these soils are:

- i) too hard to cultivate by hand,
- ii) virtually no infiltration of rain water in the untilled state (hence a bare soil that reveals little evidence of its crop production potential),
- iii) crop failure when rainfall below average,
- iv) remote location making mechanized tillage logistically difficult.

3.3 Possible Solutions, Short Term

The interim period between WSP I and WSP II (ie until 30 June 1986).

The use of tractor drawn chisel ploughs to break open the soil surface to enhance infiltration should continue but the inputs of the tractor hire scheme need to be accurately recorded. Immediate steps should be taken to ensure that all cultivation runs are above 200 m in length, below this operational costs rise exponentially (Willcocks, 1981). At present the WSDC Naga'a ploughing service is using relatively new tractors. Older equipment is more prone to breakdown and urgent attention must be given now to the provision of a more effective maintenance and repair service for this equipment so that a reliable and an economically viable service can be provided. (Fieldson et al, 1986).

Some attention should be given to reduced input strip tillage, across the slope in a micro-catchment format, as an insurance against low rainfall. Strip tillage at implement width intervals should be applied across the contour, more intensive cropping should then be conducted on these strips thereby reducing inputs for tillage, planting and weeding. (This was discussed with the HTS Agricultural Engineer before he went to WSP in Feb 86). Information from the previous tillage trials will regrettably be limited and the improvement and effective continuation of this work will require an

Agricultural Engineer and an Agronomist/Agriculturalist on the WSP team with semi-arid crop production and dry land farming tillage experience.

Greater attention needs to be given to the quantification of the Naga'a resource in terms of area, type and availability for cropping.

3.4 Long Term Development of Naga'a (WSP II)

3.4.1 Approach

Priority should be given to reducing the risks of cropping by developing:

- water catchment cultural practices with
- reduced tillage inputs.

This is technically feasible but mechanisation in this remote region will be logistically difficult. Specialist agricultural engineering inputs will be necessary to guide and support the programme so that objective trials can be drawn up to evaluate soil/water regimes/requirements of these soils with a view to implementing a lower input system designed for more reliable cropping.

In addition to this the potential resource of the Naga'a for reliable crop production needs to be assessed by:

- mapping the area of these soils available for crop production and further classifying them into 'tough' (probably 20% of the soils), 'medium' and 'friable' categories.
- analysing rainfall patterns to estimate probabilities of below and above average rainfall.

3.4.2 Investigations

Diagnostic applied studies are urgently required to:

- i) Evaluate simple forms of low input strip tillage systems that conserve water through microcatchment techniques.
- ii) Investigate the composition of soil profiles and monitor the residual effect of soil cap busting with a view to reducing tillage inputs in ensuing years.
- iii) Assess the need for deeper tillage in terms of increased inputs relative to improvement in soil porosity, water conservation, root growth and crop yields, ie compare shallow (0.1 m) with deep (0.3 m) tillage.
- iv) Develop effective measures for weed control.
- v) Evaluate the social and economic advantages of using reduced strip catchment tillage practices, as well as zero and overall tillage options, with a view to promoting private sector tractor tillage for Naga's crop production.

In i), ii) and iii) the physical properties of the soil need to be measured before the commencement of any trial and consistently monitored throughout the investigations (consult OD/NIAE for details).

3.4.3 Staff

To achieve the above the full time inputs of two Agricultural Engineers will be necessary:

- a) The Senior Officer should have had experience of semi-arid rainfed agriculture and tillage or soil/water research. He will be responsible for the tillage development programme in conjunction with the WSP team Agronomist and Land Use Planner; short term inputs will also be required by an Agricultural Economist, ref 3.4.2 v above.
- b) The second Agricultural Engineer should have had experience in tractor fleet operations and be capable of organising extension/training programmes in the use of tractor and animal drawn equipment. His duties will include responsibilities for the implementation of an improved

(reduced input) tractor hire scheme for the Naga'a soils. His services will also be needed in the introduction of light animal drawn implements on the Qoz soils. (See 4.1. below).

In view of the specialist nature of the work these agricultural engineers will need support and direction from engineers/scientists and the agricultural economist of the Overseas Division of NIAE. Suggested Terms of Reference for these (TCO) posts are given at Appendix E. Local support staff will be essential in this work in the form of counterparts, mechanics and agricultural demonstrators/extension workers.

3.4.4 Equipment

Outline specification recommendations:

a) For Tillage Evaluation and Development Work:

- | | |
|---|--|
| i) Tractor: | 50-60 kW (67-80 hp) |
| ii) Tined implements: | for shallow (cultivator),
medium (chisel plough) and deep
(winged subsoiler) cultivations. |
| iii) Alternative soil
moving implements: | e.g. progressive depth cultivator. |
| iv) Weeding equipment: | sweeps, sprayers etc |
| v) Trailer: | for tractor fitted with
manually operated crane. |
| vi) Scientific equipment: | for soil analysis, tillage
input measurement and crop
yield assessment. |
| vii) Surveying equipment: | level, staff, measuring
wheel etc. |
| viii) Engineering tools: | for equipment maintenance
and modification. |
| ix) Transport: | Land Rover long wheel base. |
| x) Trailer: | for Land Rover (LR). |

b) Equipment For Naga'a Cultivation Extension Work:

- i) Tractors: 50-60 kW, 2 wheel drive.
- ii) Chisel ploughs: depth of work: 0.1-0.25 m;
(1 per tractor) w. depth wheels,
width approx 3 m (7 tines)
- iii) Cultivators: depth of work: 0.07-0.15 m,
(1 per 2 tractors) w. depth wheels,
width approx. 3.3m (15 tines).
- iv) Surveying equipment: to ascertain direction of slope
for water catchment and field
size measurements.
- v) Transport: LR 110 pick-up truck.
- vi) Workshop trailer: c/w electrical generator,
welder, drill, hand tools
etc. 500 kg capacity.
- vii) Transport: 7t truck
- viii) Bowser: for fuel and lubricants

Detailed specifications and costing for a) and b) can be provided by OD/NIAE. (Metianu, 1979 and Wainwright, 1982).

4 Other Ag. Eng. Topics at WSDC

4.1. Animal traction Experience in much of Africa indicates that the use of animal draught for tillage is most unlikely to succeed where farmers are not already using animals for other purposes. Therefore the probability of farmers adopting work oxen for difficult Naga'a tillage is very low. On the other hand, the commonly available donkey may well prove a popular draught source for the light Qoz soils providing simple low cost implements are available.

The development of the light donkey plow/weeder seen at Tullus is commendable and the use of locally available materials must be encouraged. The present design could easily be improved from an engineering standpoint but for the present priority attention should be given to measuring farmer acceptability of the concept of using donkey draught. The proposal to manufacture about 50 implements for such an

evaluation is supported but it is recommended that with available supervision and management the best results will be achieved by limiting the study to about 5 test areas.

Results from the studies should be reviewed by an animal draught specialist later on in 1986. The design of light low draught implements for donkeys will require careful matching of resources. It is recommended that the Animal Traction and Small Equipment Section of OD/NIAE (Kemp, 1985) should assist in the development of the programme during 1987.

4.2 Wateryard pumps The rehabilitation and maintenance of water pumps is a major component of the ODA contribution to WSP II. Centrally based mobile repair and renovation teams are urgently needed but in the long run greater attention should be given to the training of pump attendants. During this visit several pump stations were visited and every rig inspected was in need of simple maintenance. For example mounting bolts were broken on two pumps and the resultant flexing of the pump body will lead to serious breakages and major repair if these bolts are not replaced promptly. Training and equipping of pump attendants, in routine checking and simple maintenance will lead to a more sustainable project.

4.3 Workshop Facilities The presence of drought relief NGOs in Nyala has created serious man power shortages particularly for mechanics. Organisations are now having to pay realistic wages (i.e. considerably above low government rates) for workshop staff which has resulted in the virtual exodus of senior staff and mechanics from the WSDC workshop. Clearly this will have serious repercussions for the whole of the transport dependent operations of WSDC and the related uncosted price of this would be totally unacceptable. Alleviation of this problem must be achieved promptly and could be aided by making the recruitment of experienced workshop staff on revised pay scales a conditionality of WSP II.

Without an efficient central workshop it is obvious that the WSP II Naga'a ploughing and extension programmes will be severely limited (Fieldson et al, 1986). This also highlights the importance of developing sustainable systems of agriculture in the region.

5 Ag. Eng. Issues in E. Sudan

5.1 Qual en Nahal (QEN) Discussions were held with Mr I Macdonald of Euro Action Acord (EAA) regarding the development of sustainable cultural practices for cropping on Vertisols at QEN. Mr J Meredith an OD/NIAE Agricultural Engineer will visit QEN to implement these studies May - Jul. 1986 (Ref. TJW Report no. OD/85/21).

5.2 Gezira Vertisols In an endeavour to obtain funds to conduct "tillage research" at Gezira, scientists have been co-operating with a local agent in the use of high power crawler tractors for cultivations (ref. El Amin 1985 and Sayer & Colley, 1985). Deep tined tillage has been conducted on self mulching Vertisol soils on the Rahad (200 feddan subsoiled) and Blue Nile Schemes. The treatment entails subsoiling 0.4 - 0.5 m depth followed by discing (74 kg/disc) at 0.1 m depth, fertilizer application and planting of cotton. Vertisols generally only require a low draught weeding cultivation for seed bed preparation (Willcocks 1984 and 1985). It is conceivable that high energy deep subsoil tillage could enhance soil cracking, subsequent infiltration of water and possibly crop yield but at an unacceptably high cost. During a brief visit to the ARS Wad Medani discussions were held with the scientists and the local agent. The results of the initial deep tillage trials (Salih, 1986) were found to be statistically insignificant and the whole concept of deep ploughing for Vertisols was challenged. However, since the crawler tractors were being offered at low hire rates (approx. SL 100/h) their use could be profitable providing wide shallow tillage equipment was available so that high work rates could be achieved.

Clearly the Gezira Board need to adopt a more objective research programme so that ^{an} economic tillage system will evolve. Specialist inputs would however be necessary to achieve this and it is recommended that the British Embassy check and advise on whether any aid inputs are in the "pipe-line" through other donors for this type of development work at Gezira. It is hoped that Mr Meredith of OD/NIAE will be able to call in at the ARC station at Gezira on route from QEN before he leaves Sudan in July 1986.

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SUMMARY REPORT ON BDDEA VISIT TO SUDAN

22 January - 5 February 1986

1. PURPOSE

1.1 A team of BDDEA Advisers visited Sudan from 22 January - 5 February 1986. The team included P R Weare (Natural Resources Adviser); P Roberts (Engineering Adviser) and E Hawthorn (Economic Adviser). The team was joined in Khartoum by Dr T Willcocks (Overseas Department, NIAE) and in Nyala/El Fasher by Messrs Jarrold and Woodroffe (MASDAR Consultants). The main objectives of the visit were as follows:-

- i. review WSDC Work Plans for the remainder of WSP1 (i.e until 30 June 1986);
- ii. review progress made by WSDC with preparation of Work Plans for 1986/87;
- iii. review progress in field, of WSP1;
- iv. introduce MASDAR team to RG Darfur and discuss liaison/coordination arrangements between team and UNDP;
- v. review and assist with two specialist consultancies commissioned by ODA:
 - (a) Pesticide Research Consultancy (TDRI);
 - (b) Livestock Research consultancy (Burt Consultants);
- vi. up-date BDDEA on the current food supply situation and 1985/86 harvest prospects (with particular reference to Western Sudan).

1.2 Dr Willcocks was particularly concerned with the applied research programme and pilot field programme related to the naga'a soils in South Darfur.

1.3 Dr Jarrold (Marketing Director, MASDAR) and Mr R Woodroffe (Team Leader, RG Advisory Planning Team, Darfur) joined the BDDEA mission in Nyala in order to make a reconnaissance visit to El Fasher, prior to mobilisation of the 3 man team funded by ODA.

1.4 Mr B Eastwood (Councillor, British Embassy) accompanied the BDDEA team in Darfur.

1.5 The Engineering Adviser (Mr P Roberts) and Dr Willocks will report separately.

2. PROGRAMME

2.1 A summarised programme for the visit is attached at Appendix 1. A list of persons met is attached at Appendix 2.

3. MAIN CONCLUSIONS AND RECOMMENDATIONS

WSDC Work Plans for WSP1

3.1 Satisfactory progress has been made with the preparation of Work Plans for the Agricultural Services Division for the remaining period of WSP1. Work Plans for the Engineering Services Division have still to be drafted. Substantial progress has also been made with preparing the Indicative Land Use Plan for South Darfur. It is anticipated that the Plan will be available for distribution in August 1986. BDDEA Advisers informed the D-G of WSDC that sympathetic consideration would be given to a request for additional short-term specialist assistance to assist with this task so that the routine work of the Land Use Planner is not disrupted.

3.2 The post of Senior Agronomist has been vacant since the departure of Mr Ogburn in December 1985. A replacement put forward by HTS was considered unsuitable by D-G WSDC on the grounds of youth (age 32 years) and inappropriate experience (humid tropics). This decision is strongly supported. HTS have been requested to provide the CV of an alternative candidate within ten days. If they are unable to do so, ODA Advisers should consider what contingency arrangements could be made to fill this important post in order to ensure timely preparation of the agronomy component of the 1986/87 Work Plans (possibly drawing on Corps of Specialists or LRDC).

1986/87 Work Plans

3.3 The general format and presentation of the 1986//87 Work Plans (i.e PY1) were discussed at some length with WSDC staff. It was agreed that further attention would be paid to (i) the identification of realistic targets, and (ii) identification of target groups and the numbers of likely beneficiaries, for incorporation in the work Plans. It was also agreed that WSDC would prepare a Discussion Paper on the Settlement component, to accompany the draft Work Plans. The Paper would review and evaluate progress made to date with the settlement programme and would redefine settlement objectives and criteria for both controlled and communal settlements. Particular attention would be paid to comparing the option for settling and rehabilitating down-graded land with the settlement of previously unexploited land areas. The preparation of this Paper will, in part, meet the expressed concern of the PEC on this component.

3.4 It was agreed that every attempt would be made to prepare draft plans by mid-March for circulation to donors, prior to joint WSDC/donor discussion in April 1986 at which the Plans would be reviewed and agreed prior to submission to GOS for inclusion in the 1986/87 budget.

Naga'a Soils/Animal Drawn Implements

3.5 Dr Willcocks to report separately.
See extract from Kharbun Departure Report at App. A5.
Food Supply and Harvest Prospects 1985/86

3.6 Mr J Goodwin (USAID) provided the latest estimates for the 1985/86 harvest. These estimates are based on the USAID crop survey undertaken in November/December 1985 utilising satellite imagery with ground truthing undertaken by the Environmental Resource Institute Michigan (ERIM) for west of Nile and USDA east Nile. Data provided by the Ministry of Agriculture were also taken into account (e.g for yields per unit area west of Nile). The latest national estimates are:

Ministry of Agriculture: 4.3 MT sorghum/millet;

USAID: 5.2 MT sorghum/millet

Domestic consumption is estimated to require 2.5 MT with a further 1 MT required for seed and domestic storage. USAID therefore estimate a national surplus of about 1.7 MT (the Ministry of Agriculture estimate a national surplus of 0.8 MT). There are considerable differences in estimates of Regional production made by USAID and the Ministry of Agriculture, particularly with regard to western Sudan. The gross production figures should be treated with some caution.

4. RG (DARFUR) ADVISORY PLANNING TEAM

4.1 Dr R Jarrold (Marketing Director MASDAR) and R Woodroffe (Land Use Planner and Team Leader designate) accompanied the BDDEA team to El Fasher. This was a reconnaissance visit prior to mobilisation of the Team in El Fasher in mid-March. A constructive meeting was held with the Military Governor of Darfur and representatives of the major Regional ministries involved with the post drought rehabilitation programme (see Appendix 2; List of People met). MASDAR was requested to make every effort to ensure that the proposed timetable for mobilisation did not slip. The RG representatives were urged to make full use of the Advisers once they were in post. Useful contacts were made with multilateral agencies and NGOs resident in El Fasher.

Specialist Consultancies

i. Pesticide Research Project

The BDDEA Natural Resources Adviser discussed the Interim Report prepared by TDRI with the Team Leader (Mr D Haydon) and Dr J Tunstall (Consultant). The technical proposals appear to be sound but the team was requested to prepare full job descriptions for the proposed Sudanese professional staff and full job descriptions and TOR for the proposed TCO input, in order to strengthen the case for the level of staffing proposed. It was agreed that the linkage between the proposed project and the research component of the IBRD "Research, Extension and Training Project for irrigated Agriculture" should be clarified. To this end arrangements were made for Mr Haydon and Dr Tunstall to meet visiting IBRD staff concerned with this project, either in Wad Medani or Khartoum. The team was requested to look further into the justification for constructing staff houses at the Gezira Research Station rather than leasing accomodation in Wad Medani. It was agreed that the Interim Report should be given to Research Advisers in ODA for consideration, as soon as possible.

ii. Livestock Research Project

Dr Burt's team (4) assembled in Khartoum at the start of the BDDEA visit. The BDDEA Natural Resources Adviser accompanied Dr Burt to initial meetings with the Director of APRA and the Under Secretary of APA. Further discussions were held with Dr Burt's team towards the end of the MDDEA mission. The team's preliminary findings indicate that livestock research in Sudan is in total disarray, with up to 99% of budgets allocated to staff salaries and allowances. In order for any livestock research project to be viable, considerable injections of recurrent expenditure will be required and provision will need to be made to ensure significant improvement in the level of research management.

P R WEARE
BDDEA
6 February 1986

Naga'a Soils (Dr Willcocks)

- 3.5 The Naga'a Soils represent a valuable resource for food production but they need to be exploited carefully. Priority should be given to reducing the risks of cropping by reducing inputs and developing water catchment cultural priorities. This is technically feasible but mechanisation in this remote area will be logistically difficult - specialist agricultural engineering inputs will be necessary to guide and support the programme
- 3.6 In the Interim period (ie. until 30 June 1986) the present approach to scale is acceptable but greater attention needs to be given to qualify the Naga'a resource. Information from the current tillage trials will regrettably be inadequate and this will be discussed with the departed HTS staff in UK. The effective coordination of this work will require an Agronomist/Agriculturalist with semi-aid experience. The use of Chisel ploughs on these capped soils to enhance infiltration of scarce rain water is supported, the use of shallow wide level discs on cracking clays should also be explored.
- 3.7 For Phase II the Naga'a resource will need further clarification to quantification ie. area, type, potential production etc. Specialist Agronomist Engineers (NIAE) input will be essential to draw up objective forces to evaluate soil/water regions/requirements of these soils with a view to implementing a lower input system designed for more reliable cropping.

Animal Drawn Implements (Dr Willcocks)

- 3.8 Progress with this aspect of the work is encouraging and the local production of prototype donkey ploughs is supported. Former acceptability testing will require thorough support to careful monitoring from agricultural engineering to agronomy aspects. There is room for improvement of the design in Phase II but the prototype is adequate to test the concept of animal drawn tillage in South Darfur.

Objectives

Extract from PEC(85)47

3.01 The main objectives of the IDA/IFAD/ODA/GOS Western Savannah Project Phase II (WSP-2) as a whole as stated by IDA, are to:

- (a) increase small farmer incomes through higher production of grain and pulses by extending technology developed during WSP-1 and making available inputs needed to use this technology;
- (b) increase output from livestock by creating an effective veterinary service and assisting sedentary and nomadic communities to control and conserve range and develop pasture; and
- (c) enable individuals and communities to adapt their farming systems to arrest the ongoing degradation of soil and range by introduction of land tenure, by extension and improvement to water supplies and by adoption of new technology either identified under WSP-I or to be developed by concentration of resources on research and development under WSP-1.

3.02 The objectives of the ODA-funded components of WSP-2 are

- (i) rehabilitation of 54 wateryards;
- (ii) establishment of a routine maintenance and operation system for 230 wateryards under the responsibility of the National Water Corporation (NWC);
- (iii) installation of 11 new wateryards each serving a new settlement accommodating about 450 farm families. Two different settlement models would be adopted in order to help identify the least cost way of assisting settlement and of making institutional (including land tenure) arrangements which encourage land use patterns that can be sustained in the long term;
- (iv) continuation of applied/adaptive agricultural research and on-farm trials at WSDC's three Development Centres;
- (v) establishment of an agricultural extension programme implemented through WSDC and the provincial government's Agricultural Extension Department;
- (vi) provision of seed dressing and phosphate fertiliser for distribution by WSDC as part of the extension programme;
- (vii) continuation of adaptive research and tractor hire services on the previously unexploited naga'a soils;
- (viii) provision of Land Rovers and trucks for other WSP-2 components;
- (ix) provision of TC in key areas.

INTINERARY, Sudan

<u>Date 86</u>	<u>Activity</u>
FRI 24 JAN	Flt BA153 LHR-KRT
SAT 25	Meet BDDEA team Messrs P R Weare, W D H Roberts and E Hawthorn
SUN 26	am Meet Mr Mohamed Abdullah Rahman Director General WSDC and Mr B Eastwood of BE Fly to NYALA (WSDC charter) pm Meet Messrs Bholar, Calderbank, Kerr etc
MON 27	am Meeting with WSDC staff chaired by Moh'd Rahman pm Visit workshops in Nyala with PWDHR and EH Met A Ali at WSP, G Fenton at SCF and Moh'd Abdul Sabed and Syd Yusif at NWC workshop Visit local blacksmith in Suq eve Discussions with: - Brian Kerr ref soils etc - Ann Clift-Hill (PTAS) and David Hughes of Jebel Mara Project - Peter Williams ref donkey 'plow'
TUE 28	Travel south to JUMEIZA with Moh'd Rahman and colleagues, BDDEA team and Mr B Eastwood Saw NAGA'A soils, tillage plots and animal drawn cultivator also saw several water pumps on route Night at BURAM (136 km) 85 mi journey from Nyala
WED 29	am Travel west dug soil/root inspection pit 21 km west of Buram Visit Ragag market and veg plots (217 LR log) 1345 Arrive DIMSU Dev Centre (236 km) pm Visit NAKHARA settlement (258 km)
THU 30	am See donkey plow/weeder Travel north Inspect crop roots in alluvium on sand Inspect Naga'a soils, crop root growth and tractor chisel ploughing at TULLUS

1740 Arr NYALA (439 km)

pm Discussions with team at WSP Rest House. NYALA

FRI 31 0800 Land Use Planning meeting with PRW, BK etc

0900 Meeting with BDDEA team

1015 Round up meeting with WSDC staff

1230 Discussions with BK

pm Drive to EL FASHER with Moh'd Rahman BDDEA AND MASDAR team

SAT 1 FEB 0830 Meet Director of Agriculture Ahmed Ibrahim with Moh'd Rahman and PRW

1100 Meeting with Major General Abu El Gasim Yousif Adlan the Governor of Dafur and officials

pm Fly to KRT with USAID team and BE

Discussion with Mr I Macdonald at EAA office.

SUN 2 FEB Visit BE

Contact: Kamal El Tom, Agri Proj Agent
A Marshall of MF
I Macdonald, EAA
A Binnie, Sudan Tractors

P Desmond, Ag Eng, FAO

Discussions with PRW

MON 13 0730 Meet PRW and PWDHR

0800 Meeting at BE with I Hawkes and MASDAR

0900 Meeting with Winston Prattley UNDP office

1100 Visit FAO office

1130 BE

1200+ Accomi PRW to Joe Coodwin USAID

1420 Meeting with I Macdonald EAA with PRW (Met HTS management)

1600 Discussion with A Marshall of MF

TUE 4 0730 Travel to Gezeira Board Ag Res Station with A Binnie

Visit local Cat Agent

Meeting with Ag Eng and Soil Research staff at ARS

eve Complete KRT departure report

WED 5 Fly to London

CONTACTS

Major General Abu El Gasim Yousif ADLAN	Governor, Darfur
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Dr Asman AGEEB	Assist Gen Manager, ARC Station, Wad Medani
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Mohamed Abdul SABEEL	Nyala
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Peter R WEARE	Natural Resources Adviser, ODA, BDDEA, British High Commission, PO Box 30465, Nairobi, Kenya
Peter WILLIAMS	Appropriate Technology Officer, VSO, WSP I
R B WOODROOFE, OBE	MASDAR, designate TL for El Fashir Project
Adam YAHIA	Officer i/c of Naga'a Tractor Ploughing Unit, WSDC
Mr YUSEF	Sec Gen to Reg Governor, Darfur
Syd YUSEPH	Natl Water Corp (NWC) Nyala

Western Savannah Development Co-operation
(WSDC) FACT SHEETS

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- 2 Project Components
- 3 The WSP Strategy
- 4 Geographic Background
- 5 Rainfall and Drought
- 6 Historical Background
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- 15 Range Management:
- 16 Settlement
- 17 Track Improvement
- 18 Wateryard Rehabilitation
- 19 Additional Activities:
 - Project Monitoring and Evaluation (PMEU)
 - Training
 - Co-operation with Other Agencies
 - Land Use and Sociology
 - Meteorology Recording
- 20 Maps of Project Area

W.S.D.C. FACT SHEETTHE WSP STRATEGY

Relatively high rainfall and extensive soils suitable for cropping have attracted a steady influx of migrants to the Project Area for at least two decades. Initially the profitability of cropping in the area attracted settlers and subsequently the drought of the late 1960's and poor rainfall have driven more people southwards. The 1982/3/4 drought can only accelerate this trend.

The result has been a very rapid increase in pressure on the land resource. Traditional cropping and stock management systems developed at a time when there was no such pressure and hence little need to consider conservation. The continued use of these systems under changed circumstances risks a rapid decline in soil fertility and range quality. This decline has already begun in specific areas.

A principal goal of the WSP strategy is therefore to assist changing the existing pattern of land use such that the area can continue to absorb population while preserving the quality of soil and range resources. This transformation will require a shift from extensive resource exhaustive techniques to more intensive methods and to achieve this, four interdependent conditions must be met.

1. Techniques which raise the productivity of land must be developed and made available.
2. Farmers and stock keepers must be able to establish land tenure in order to protect the investments they make in the new methods.
3. The best possible distribution of land use must be arranged to spread land pressure. This could be done by opening areas currently inaccessible while ensuring they are not degraded.
4. Essential services must be reliable. No one will invest in new techniques if there is the slightest risk that a breakdown in water or veterinary services for example will endanger their livelihood.

The role of WSDC is to endeavour to ensure that all four conditions are met either by direct programmes or by implementation through existing government agencies. While it may seem ambitious to tackle all four conditions at once it must be emphasized that they are wholly interdependent. If they are not met the capacity of the area to absorb and feed those fleeing areas more seriously affected by drought will be sharply reduced and the indigenous people of South Darfur will face difficulties also.

February, 1985

W.S.D.C. FACT SHEETGEOGRAPHIC BACKGROUND

The project area of 92,000 km² is entirely within Southern Darfur Province. The following districts are included.

All of Eastern District. Headquarters at Ed Da'ein

Most of Southern District. Headquarters at Buram

A part of Western District. Headquarters at Idd El Ghanam

A small part of Central District. Headquarters at Nyala.

The project headquarters is at Nyala, the capital of Southern Darfur. Nyala has a population of 130,000* (1983) and the major government and commercial centre for Western Sudan. The town is served by a twice weekly Sudan Air flight from Khartoum and there are regular charter aircraft flights. A bush airstrip has been constructed at Tullus 130 km south of Nyala.

A surfaced road links Nyala to Zalingie, 200 km to the west but there are no surfaced roads within the project area.

The population of the Project Area was estimated in 1983 to be 630,000. Refugee and migrant movements contribute to a growth of 5% per year. About 15% of the population are nomadic.

Land tenure rights within the area are loosely defined and this weak tenure system reflects the fact that land at present has little value. This means that while a land reserve of uncleared bush remains it is not worth buying land or attempting to preserve rights over land which is not in use.

Virtually all farmers in the area depend on the cultivation of millet on sandy infertile Qoz soils. This is entirely rainfed agriculture and irrigation from shallow wells is confined to narrow strips of alluvium along major wadis where high value crops such as vegetables are grown. The project has initiated the ploughing of heavy alluvial soils by tractor and good yields of sorghum have been obtained from these soils in non-drought years. Groundnuts are the main cash crop.

Livestock are a vital part of the area economy and 1983 numbers were estimated to be:

Cattle	2.0 million
Sheep	0.4 million
Goats	0.7 million

It is clear that a major constraint on development is the isolation of the area. The railway link to Eastern Sudan is inadequate and road transport takes up to 5 days.

There is difficulty attracting staff to work in such remote an area and WSDC pay a premium to recruit for key positions.

* Nyala population now estimated at 200,000 (1985).

February, 1985

WSDC FACT SHEETRAINFALL and DROUGHT:

The 1985 rainfall within the Project Area was an improvement on the previous four years but still showed a downward trend over a longer time period.

The figures for Nyala (Sudan Meteorology Service) are:

1980	533
1981	320
1982	272
1983	327
1984	198
1985	347

Rainfall recording at Nyala began in 1920 and mean values are as follows:

1920 - 85	462mm
1955 - 85	407
1965 - 85	376
1975 - 85	350

Province recorded droughts have been in 1940 (294mm) and (243 mm). There are reports of drought and famine in the year before records began, circa 1910.

The project stores historic rainfall records for all main recording sites within the Province and some data for Northern Darfur.

December 1985.

W.S.D.C. FACT SHEET

HISTORICAL BACKGROUND

- 1916 Darfur Sultanate incorporated into Sudan Colonial Admin.
- 1935 Rinderpest vaccines introduced
- 1936/37 Present Topographic maps surveyed
- 1944 Soil Conservation Committee report on need for action to arrest environmental decline
- 1951/53 Hafir construction programme S. Darfur
- 1956 Nyala town population 12,000
- 1959 Railway reaches Nyala
- 1964 Nyala population 27,000
- 1973 Nyala population 60,000
- 1967/75 Freedom from thirst campaign opens 340 boreholes
- 1971/73 Three years of below average rainfall
- 1971 Local Government Act. Local tribal authorities abolished
- 1972 Existing aerial photographs flown
- 1974/76 Hunting Technical Services completed a series of inventory resource surveys in the region
- 1975/76 Development Centres established
- 1978 Western Savannah Development Corporation created as a public corporation by Act of Parliament
- 1980 Reorganisation of Regional Government
- 1982 Beginning of present drought. Nyala rainfall almost half of 60 year average

-
- 1982 Year 1 of WSDC Programme
- 1983 Rinderpest Epidemic
- 1983 Census. Nyala population 115,000
- 1984 Third year of drought. Nyala rainfall 40% of average
- 1984 Project Evaluation and WSP-2 Preparation
- 1985 Completion of Phase 1 of Project, (June)

W.S.D.C. FACT SHEETNAGA'A CULTIVATION

Traditional agriculture in the area has been confined to light sandy soils which have been cultivated with hand tools. There is no history of animal traction but ploughing with a camel is now beginning to be accepted also in the sandy qoz soils. These soils are however inherently infertile. Local farmers have always recognised that the loamy alluvial soils are much more fertile but these could only be worked where flooding from wadis provided the correct moisture conditions. Away from this wadi area the soils have a very hard cap or pan which is impossible to break by hand.

This constraint on agriculture was realized by the early agricultural reports and a Development Farm was established at Jumeiza to investigate appropriate mechanized techniques for these 'naga'a soils'. By 1980 it had been confidently established that chisel ploughing as a primary cultivation was adequate to provide a seed bed for sorghum, which grows well on these medium textured soils. The yield results were so encouraging that tractor ploughing has been offered to farmers at a fee for the seasons 1980-84, as reported in the Table.

<u>Year</u>	<u>No. of Farms</u>	<u>Area (feddans)</u>	<u>Av. Yield (kg/ha)</u>
1980	4	38	2143
1981	7	55	1500
1982	23	137	1286
1983	49	570	134
1984	118	570	480

The very poor rainfall years in 1983 and 1984 caused many farmers to harvest no sorghum from the ploughed plots. It is clear that in a year of poor rains, these soils do not perform as well as the adjacent sand soils. However even in 1984 the ploughing allowed sorghum stover to be harvested and sold at a profit. There is also improved grass growth on plots previously ploughed which is valued as grazing.

Despite setbacks farmers appear to be willing to pay £5/25 per feddan for the ploughing and five tractors with full supervision and back-up facilities will be deployed for 1985. It is proposed to establish a revolving fund to allow a cost recovery system to operate.

The ploughing of naga'a soils is potentially of enormous benefit to the area. There is an estimated 0.25 million feddan suitable for ploughing and yields in a non-drought year are three times yields on sand soils.

* 105,000ha.

February, 1985

W.S.D.C. FACT SHEETANIMAL TRACTION

Mechanisation of crop production using appropriate technology permits timely (early) crop establishment giving potential yield increases to most crops of the order of 30%.

In a drought year like 1984, timely crop establishment was the only way of avoiding a complete crop failure.

Further benefits can be obtained by the reduction (up to 50%) in hand-hoeing labour needed at a time of peak demand, by interrow cultivation.

The Qoz soils of the WSDC project area are particularly favourable to animal traction cultivation. Donkeys, horses, oxen and camels are all potentially useful power sources but priority has been given to the development of donkey cultivations. By using donkeys already broken to water carrying and ridden by a small child the training period can be drastically shortened.

A novel wooden seeder/weeder/sweep has been developed for construction by local craftsmen using the simplest traditional hand tools at a minimum cost.

A well proven tinned cultivator design (the Donkey Arara) will be produced in small numbers for farmer training while the seeder/weeder/sweep design is perfected during 1985.

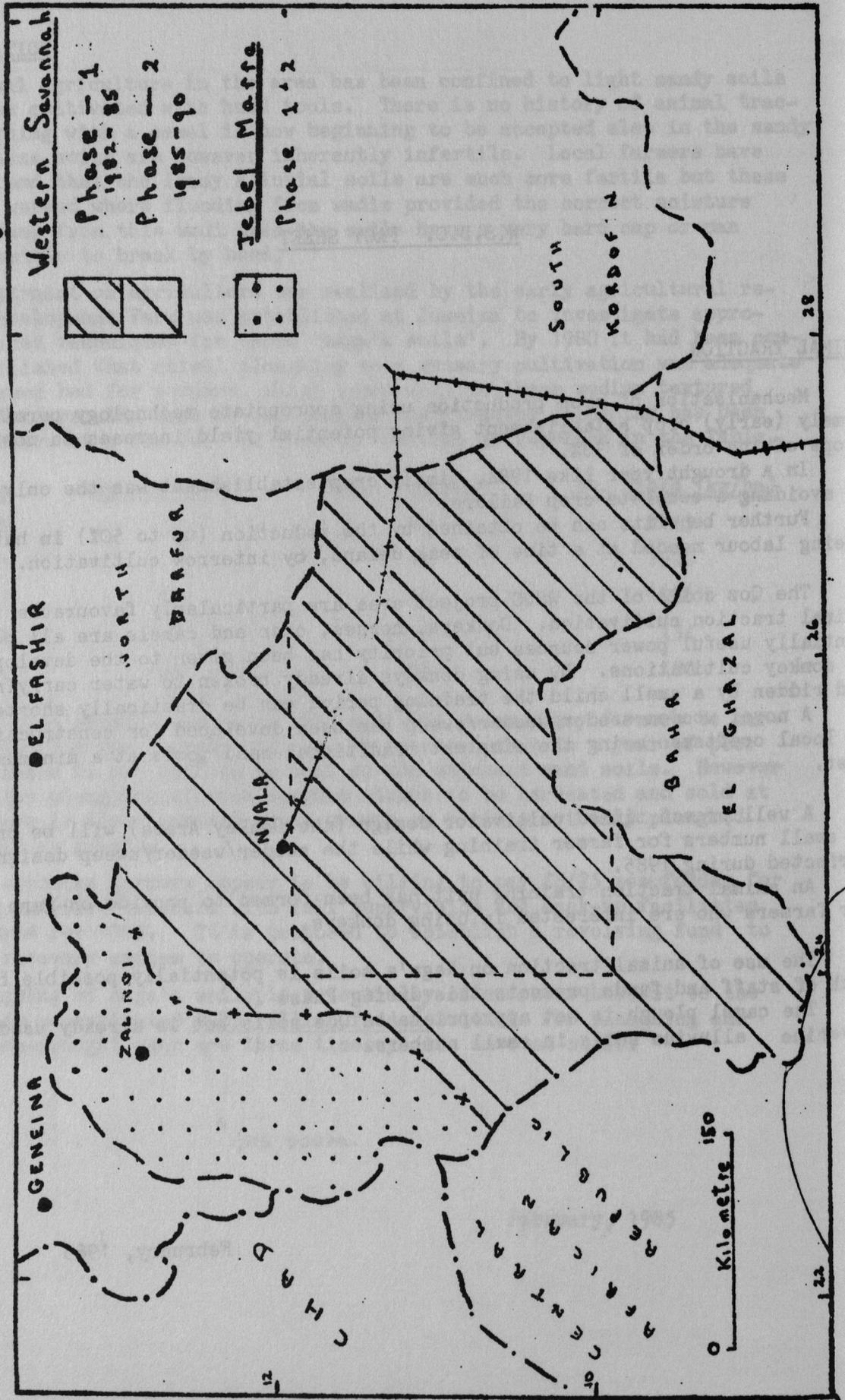
An animal traction training unit has been formed to provide on-farm support for farmers who are interested in using donkeys.

The use of animal traction on Naga'a soils is potentially possible but lack of staff and funds prevents this during Phase I.

The camel plough is not appropriate on Qoz soils but is already used on riverine alluvium soils in small numbers.

February, 1985

Southern Darfur Rural Development Programme



- a) Terms of Reference for: Agricultural Engineer (Naga'a R and D)
Western Savannah Project (WSP II)

Description

An Agricultural Engineer with experience in semi-arid rainfed agriculture and/or tillage R and D is required to work with (WSP II) based at Nyala, South Darfur, Sudan. The development of low input tillage systems for crop production on Naga'a (bare hard) soils will be the priority of the work.

Duties will include:

- i) An assessment of the cropping potential of the Naga'a (alluvium) soils.
- ii) Measurement of the physical properties of Naga'a soils so that the major limiting factors to crop growth can be quantitatively described.
- iii) The design and implementation of tillage trials with a view to developing and introducing optimum input water catchment techniques to reduce the risks of cropping.

Qualifications

First or Upper Second Class Honours or higher degree in Agricultural Engineering together with at least 2 years experience in dryland farming overseas or tillage research/soil physics studies.

- b) TORs for: Mechanization Extension Officer
Western Savannah Project (WSP II)

Description

A Mechanization Extension Officer with experience in tractor fleet management and animal drawn equipment use and development is required for the Naga'a and Qoz ploughing extension programmes of WSP II.

Duties will include:

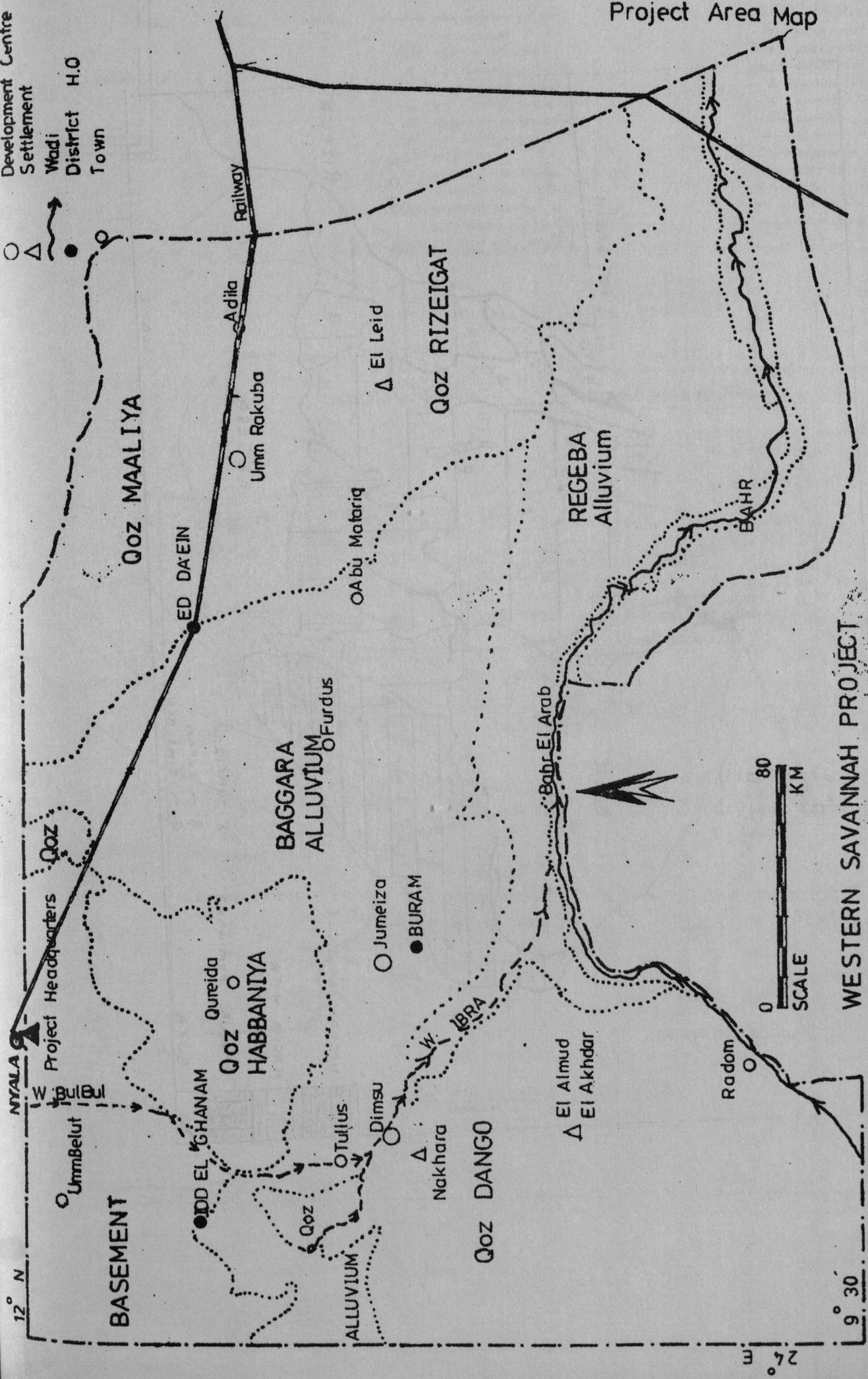
- i) The management of the Western Savannah Development Co-operation Naga'a (hard bare soil) ploughing programme using agricultural tractors.
- ii) The provision of agricultural engineering support to the evaluation and development of donkey drawn tillers/weeders on Qoz (sandy) soils.

Qualifications

A diploma or degree in agricultural mechanization together with at least 2 years experience in overseas mechanization preferably in semi-arid rainfed agriculture.

Figure 1
Project Area Map

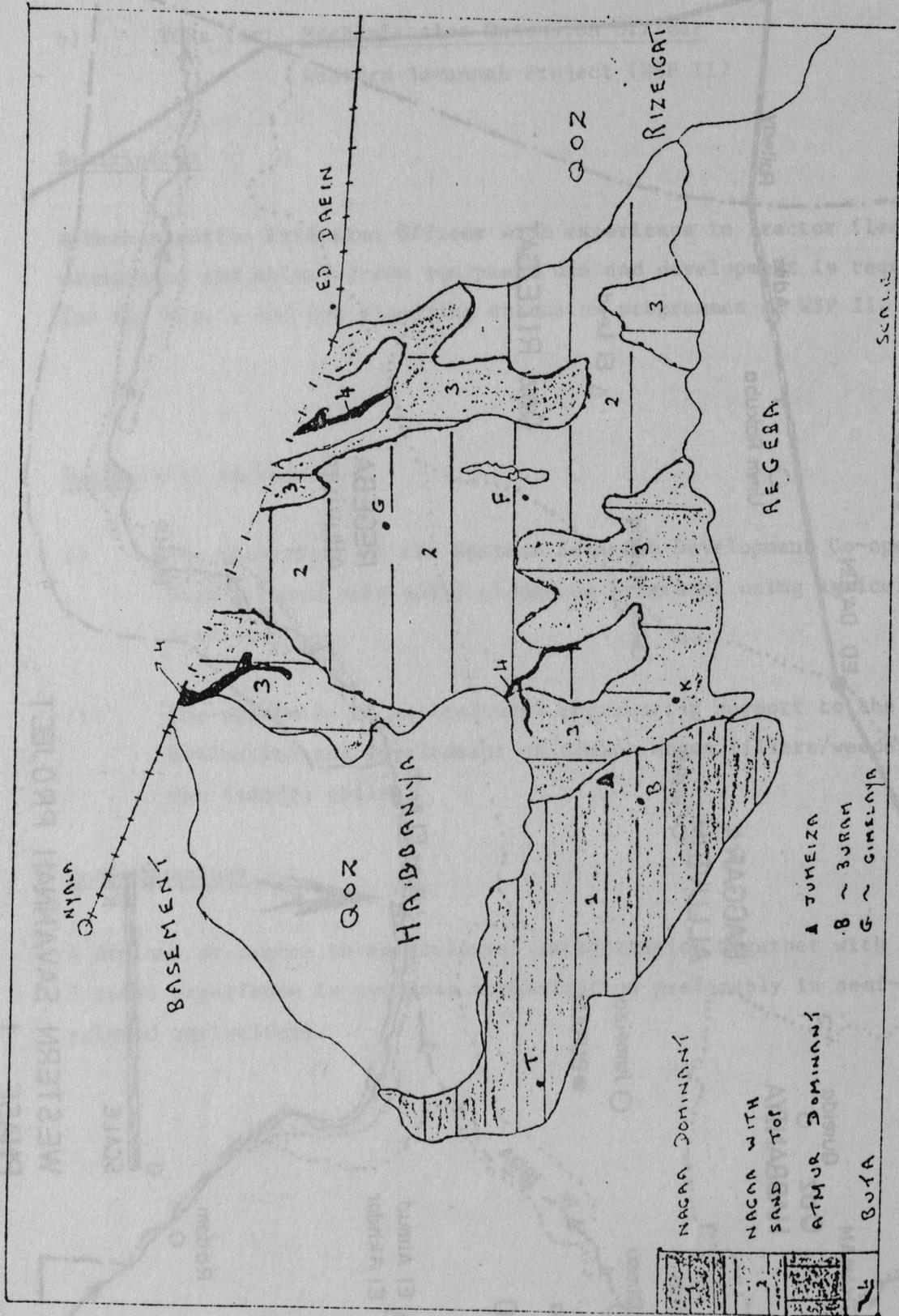
Project Boundary
Land System
Development Centre
Settlement
Wadi
District H.O
Town



WESTERN SAVANNAH PROJECT
PHASE 1

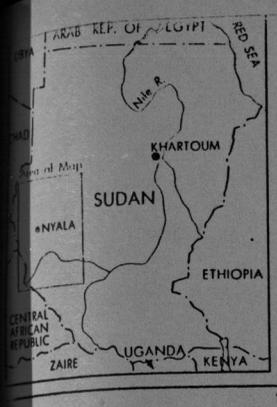
DRAWN : Hussien Babiker
May '85

FIG. 3.
SOIL GROUPS OF THE BAGGARA ALLUVIUM



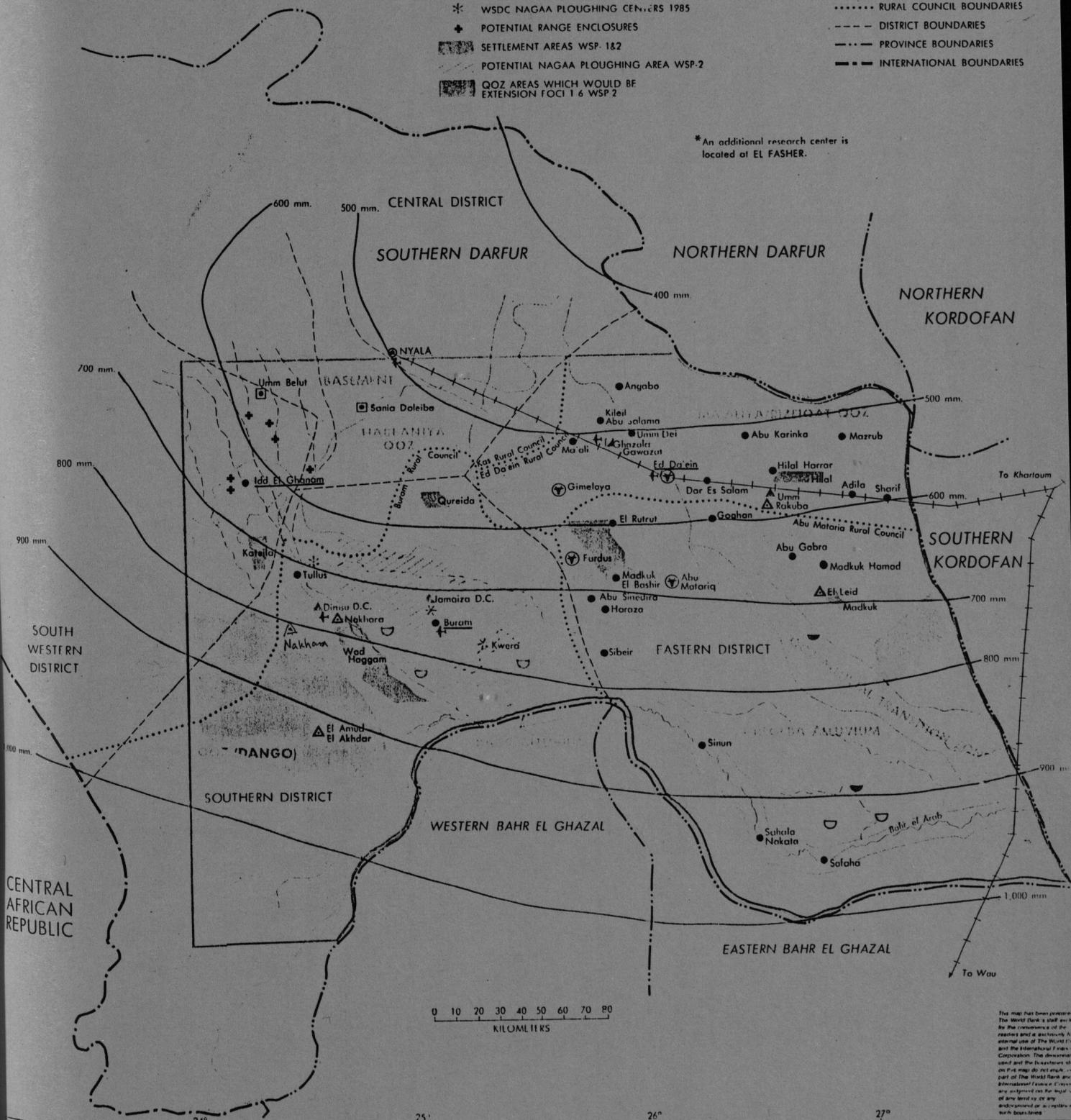
SUDAN

WESTERN SAVANNAH PROJECT PHASE II AGRICULTURAL DEVELOPMENT



- WSP-1 BOUNDARY
- WSP-2 BOUNDARY
- NYALA PROJECT HEADQUARTERS
- ▲ WSDC DEVELOPMENT CENTERS
- ▤ RESEARCH CENTERS (WSARP)*
- △ WSP-1 SETTLEMENT HEADQUARTERS
- ◻ WSP-1 RANGE SITE HEADQUARTERS
- ◐ WSP-1 HAFIR REHABILITATION I
- ◑ WSP-2 HAFIRS
- * WSDC NAGAA PLOUGHING CENTERS 1985
- ⊕ POTENTIAL RANGE ENCLOSURES
- ▨ SETTLEMENT AREAS WSP-1&2
- ▩ POTENTIAL NAGAA PLOUGHING AREA WSP-2
- ▧ GOZ AREAS WHICH WOULD BE EXTENSION FOCI 1 & WSP 2
- LAND SYSTEMS BOUNDARIES
- MAJOR MARKET TOWNS
- LESSER MARKET TOWNS
- BURUM DISTRICT HEADQUARTERS
- PROVINCE CAPITAL
- ✈ AIRSTRIPS
- RAILROADS
- ISOHYETS
- RIVERS/WADIS
- ⋯ RURAL COUNCIL BOUNDARIES
- - - DISTRICT BOUNDARIES
- - - PROVINCE BOUNDARIES
- - - INTERNATIONAL BOUNDARIES

*An additional research center is located at EL FASHER.



The map has been prepared by the cartographers of the research level and is for internal use of The World Bank and the International Finance Corporation. The development and the location shown on this map do not constitute part of The World Bank and International Finance Corporation's responsibility or any kind of or any endorsement or a reliance on such sources.