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NARO/DFID Client-Oriented Agricultural Research and Dissemination Project

Soil Fertility and Soil Management in Teso and Lango

Peter Brinn
Godfrey Kayobyo
Nathan Nagoti

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1. Executive Summary

1.1. Introduction

The NARO/DFID Client-Oriented Agricultural Research and Dissemination (COARD) Project is supporting demand-driven agricultural research and technology dissemination in the Teso and Lango farming systems of Eastern Uganda through the development of competitive agricultural technology funding systems.

Participatory needs assessment studies have identified soil fertility as a concern in the Teso and Lango regions. However, a comprehensive understanding of these concerns and what interventions might be appropriate to address them was lacking. This study was carried out during 2001 to review existing information and undertake selected field studies in order to develop guidelines and recommendations for co-ordinated support to improved soil productivity in the Teso and Lango farming systems.

The purpose of the study was to provide recommendations and guidelines for the development of improved soil management practices in E & N Uganda, informed by a review of current Government and non-Government interventions, and a field study of the farmers' current soil management practices and constraints, and how institutions influence these.

A recent agro-ecological zonation classed the majority of the study area as Zone 3 (Northern Moist Farmlands), with a well distributed rainfall (MAR 1260 mm) and MAT of 24° C. The two farming systems concerned are the Teso (annual cropping and cattle system) and Lango (a sub-system of the annual cropping and cattle Northern system).

1.2. Activities

As a foundation for the study a range of representative stakeholders were consulted regarding soil management practices and soil fertility in the region. Current and previous Governmental and non-Governmental soil management interventions were identified and assessed.

Needs assessments co-ordinated by NARO in 1999 identified specific areas in the region where farmers had particular concerns over soil fertility. These assessments were used to select three villages in Kumi (Adokar) Katakwi (Aterai) and Lira (Baralegi) Districts for detailed study.

In each selected village the elected Local Council representatives were asked to classify the residents into three groups according to their perception of relative "wealth". This wealth ranking was important to capture within-village differences in access to resources and influences in order to improve targeting of strategies.

For each wealth rank three farming systems based participatory assessments were undertaken, facilitated by a multidisciplinary team, they included :

- Institutional influence mapping, which identified and prioritised institutions influencing natural resource management practices.
- Resource flow diagrams of a representative farm, to record the quantity and quality of resources available and the flows.

- Land characterisation, including site and soil characterisation supported by soil analysis.

The stakeholder consultations and field studies were used to develop guidelines for potential applicant for COARD funding. These were presented and reviewed at a workshop held at SAARI.

The findings of the study were assessed in relation to other projects supported by COARD, NARO, NAADS and others.

1.3. Results

In the course of the study a considerable amount of detailed information was collected, analysed, presented and discussed at various fora. The details are available in the main report and appendices. The following section highlights the main findings of the study :

1 There is a wide range of understanding and articulation of soil fertility concepts in Uganda .

2 Concern over soil fertility decline in Uganda is relatively recent. Until the mid 90's Uganda's soils were considered "fertile" by both politicians and NARO. Consequently, the debate and consensus on the way forward is still in flux.

3 Soil fertility is often assumed to be the cause of productivity declines. In some cases productivity declines could result from the complex interaction of a variety of factors (including soil fertility).

4 Comparatively little recent or current soil fertility research has been/is undertaken in the Teso / Lango area.

5 NAROs' regional (Teso/Lango) capability to carry out soil fertility research is currently extremely limited and national capability is stretched. It is important that steps are taken to reverse this situation as the demand for soil fertility expertise will increase in the future.

6 Historic, but useful information on soil properties and distribution in Teso / Lango area exists but it is not readily available. Efforts should be made to improve availability.

7 In comparison with the soil resources of the majority of the African continent, the soils of Teso / Lango cannot be considered to have major soil fertility problems. Nevertheless, if current practices continue without interventions the trend will be one of production decline because there are larger losses from the systems than there are gains. This trend is more apparent in some areas than in others.

8 The subdued relief of much of the area, combined with vegetative cover reduces the occurrence and risk of significant accelerated soil erosion.

9 The fertility status of the soils of Teso/Lango can be attributed to the individual effects and interactions of :

   a) Climatic influence, principally rainfall distribution and temperature which permit plant growth, (both crop and re-growth) through-out the

year. These condition provide a source of organic materials, which maintain the organic matter status of the soil surface at relatively high levels.

b) The wide range of relatively undemanding crops grown, including legumes that are rotated and interplanted (intentionally or unintentionally) in both Teso and Lango farming systems. Conversely, there is limited mono-cropping of gross-feeding crops such as maize.

c) The relatively low population pressure and consequently relatively large individual holdings, which permit fallowing to be practised. The fallows are generally effective in providing a net contribution to levels of organic matter because a good cover of vegetation re-growth is established.

d) Relatively limited burning of crop residues and limited use of burning in land preparation.

e) Parent materials that give rise to soils with predominantly medium to fine textures.

Changes in soil fertility are likely to occur as factors b. c. and d. above change. Any reduction in rotation and or fallow and or increase in burning will inevitably contribute to a trajectory of declining productivity.

10 Important differences exist within communities with respect to access to resources, particularly area of land and livestock. Such differences need to be taken into account when designing soil management intervention strategies.

11 The resource flow analysis showed differences between the study areas and between the wealth ranked groups within the villages. Farm sizes are smallest in Kumi and largest in Lira. The least wealthy group in Kumi have insufficient land to fallow, which limits their options for fertility management. The poorer groups have few or limited livestock which again limits their options. Some households may have access to manure but do not apply it to crops, indicating that there are opportunities to improve resource use. Crop rotation is practiced to a greater or lesser extent in all areas and by all wealth groups. Cassava, millet and sorghum are grown by all farmers and maize by nearly all. Sweet potato is important in the Teso sample but not Lango, while pigeon pea is important in Lango and also some simsim and cotton.

12 Study findings reveal that across all study sites and all farmer categories; Familial, communal and governance institutions are the most important type of institutions influencing the way farmers manage their soils. Parents and other family members are the key familial institutions while elders are the key communal institution influencing the soil management practices of farmers of all wealth categories. Extension featured as the most influential governance institution across all districts, with the exception of the better off farmers in Katakwi and the least well off farmers in Lira. Results show that NGOs and radio were more important to the wealthier group than to the others in influencing their soil management practices. Radio was not cited by the least well off farmers in any of the districts.

13 The wealthier categories of farmers in all areas had access to the largest areas of land, livestock as well as having better access to information sources. Farmers in the wealthier categories also often had non-farm income sources. Information and options available to wealthier farmers are not available to the poorer neighbours who make up the majority of the communities studied.

14 Knowledge of sustainable land husbandry practices is well established at community level and generally common to all types of farmers. However, the translation of this knowledge into practice is constrained. Consequently initiatives that aim to increase farmer knowledge of soil management without examining the constraints to using the knowledge are likely to have limited impact.

15 Where individual holdings are small, due to relatively high population density, the opportunity for fallows and crop rotations decline, continuous cassava tends to dominate the cropping cycle. When this situation occurs on coarser textured soils the loss of organic matter is more rapid.

16 The problems of soil fertility decline are exacerbated by, limited smallholding size; coarse soil textures; and very limited affordable opportunities for increasing soil nutrient status.

17 Opportunities also exist to develop new ways of working with different types of farmers. These should aim to identify different soil management strategies appropriate to farmer circumstances, which will contribute to the productivity and sustainability of the farming systems.

18 Possible soil management interventions appropriate for Teso and Lango include those identified by the national Soil Fertility Initiative team. These interventions include : conservation tillage; organic mulch management; retention and incorporation of crop residues; accelerated and tree fallows and the promotion of the use of locally available low cost organic materials. Promotion the use of low level mineral fertilizer applications integrated with appropriate organic matter management particularly for cash crops where the economic benefits are clear is recommended.

19 Farmer support for improvement of soil management could be effectively delivered through the NAADS framework. The NAADS emphasis on de-centralised, farmer-demand led services provides the mechanism to ensure that the support will deliver what farmers want to address their perceived problems and hence increase and sustain impact.

20 At the Workshop held at SAARI in Oct 2001 to obtain feedback on the soils study the following key issues were endorsed by a range of stakeholders:

a. Resource endowments must be taken into account when designing interventions (and priority given to technologies for poorer groups).
b. Gender labour implications must be taken into account when designing interventions.
c. Financial cost & availability of technologies must be taken into account when designing interventions
d. COARD should promote projects on:

- Testing & disseminating *technical* information/ guidelines in a variety of media.
- Procedures/methods for helping farmers learn.
- Community mobilisation for soil/ land management.

e. NARO & COARD have important role in promoting awareness of "new" soil/land management technologies, through farmer-managed technologies.

f. Project teams must demonstrate their capacity to carry out interventions.

2. Guidelines for formulation and review of proposals for soil productivity management projects in Teso and Lango

The guidelines and are designed to assist potential applicants who apply to the Agricultural Funds Management Committee with proposals related to soil productivity. The recommendations are intended to assist the Agricultural Funds Management Committee and NARO in strategic decision making. The findings are based on interviews with a range of stakeholders in Uganda and field work undertaken with farmers in the Lango and Teso farming systems.

The guidelines have been formulated as a result of :

a. A review of the available literature.
b. Field studies in selected locations.
c. Consultation with a broad range of regional stakeholders.
d. Suggestions arising from a national workshop (anticipated).

They have also been prepared in a style consistent with the general guidelines prepared by CORSU with a target audience of research workers.

The guidelines are presented in two sections, the first, **General Guidelines** are probably applicable to a wide range of proposals as well as soil productivity as they include a range of cross-cutting issues. The second section, **Specific Guidelines** deal more specifically with soil productivity issues. Where appropriate the specific guidelines are supported by reference to the field studies.

2.1. General Guidelines for applicants[1]

1. Have you identified a clear problem, supported by independent evidence to justify the soil productivity management intervention proposed ?

Rationale Unless the target group acknowledge that they have a soil productivity problem that justifies intervention their active participation is likely to be limited or short-lived. Individual researchers may not be completely unbiased with respect to specific problems. If evidence can be obtained from several sources, which confirm the problem to be addressed this will strengthen the proposal.

2. Does the proposal clearly define and describe the target group at which the SPMI is aimed ?

Rationale Field studies in Teso and Lango clearly demonstrated that within a particular village, individual households have access to very different qualities and quantities of resources. In particular, the area of land and ownership of livestock varied considerably. Consequently, an intervention suited to a resource rich household is unlikely to be appropriate for a resource poor household. In designing a

[1] **Abbreviations**

CORSU -	Client Orientated Research Support Unit
SPMI	- Soil Productivity Management Intervention
SFMI	- Soil Fertility Management Intervention
SPMT	- Soil Productivity Management Technology
IIM	- Institutional Influence Mapping
RFD	- Resource Flow Diagram

possible intervention strategy a clear understanding of resource distribution and availability is essential.

Field studies on the assessment of the influence of different institutions on soil management practices showed variations in relation to the "wealth" of the group consulted. In designing a promotional or dissemination strategy it is important to appreciate what institutions are considered most influential by the particular target group.

3. Is there clear evidence of a demand from the target group for the proposed intervention?

Rationale Unless the target group considers a particular problem a priority, it is unlikely that they will regard its solution a priority. Changes in soil fertility, both positive and negative are likely to be slow processes and are very different in nature to the immediate problem caused by for example a major crop pest. A proposal will be considerably strengthened where a needs assessment has been carried out with representatives of the target group. Such a needs assessment may be eligible for funding through a Project Preparation Grant.

4. Are the gender implications of the intervention understood and clearly addressed in the proposal ?

Rationale Proposers should be aware of existing gender specific tasks and practices that might effect the potential uptake of a particular intervention. For example women are frequently responsible for transporting manure and other bulky materials.

5. Can you clearly demonstrate how the interactive participation of the target group is going to be addressed / attained.

Rationale Participation by the target group in problem identification and solution is likely to be essential to the success of the initiative. Participation cannot be assumed. The proposal should include details of the mechanisms employed to achieve participation.

6. Have you considered the labour demands of the proposed soil productivity management interventions, particularly with respect to gender ?

Rationale Soil fertility management interventions frequently include the movement of large quantities of bulky materials, with a high labour demand. The proposal should assess if any additional labour requirements can be met by the beneficiaries and opportunities to reduce labour where possible should be considered. Labour demands may also have a gender bias and these should be understood and addressed.

7. Have you considered the financial cost in relation to the soil fertility management intervention proposed ?

Rationale A large number of interventions exist with the potential to improve soil fertility. Despite this, an effective intervention will not be adopted if it is too expensive for the target group to afford. If items of specialised equipment and mineral fertilizer are included in the proposal it must be clearly explained how the target group will finance their purchase.

2.2. Specific Guidelines

8. Proposals should reflect that in Teso and Lango, soil fertility problems are more a more widespread concern than physical degradation.

Rationale Because of the low relief in the area combined with generally good cover of the soil surface and physical conservation measures, accelerated soil erosion is less of a problem than in other parts of Uganda.

9. Does the proposal include an evaluation of the availability of the SPMT (or its critical components) ?

Rationale Linked to the issue of financial cost is availability. The proposed intervention may require an external input that could be affordable but not available. For example, the availability of mineral fertilizer is currently limited in Teso and Lango, how would this be addressed? or would it critically undermine the impact of the intervention ?

10. Have you looked at the direct and indirect environmental impact of the SPMI proposed ?

Rationale If the proposed intervention involves the use of agrochemicals the potential impact on the environment should be evaluated. As well as the direct impact at the site of application, the effects of prolonged use, movement and concentration should be considered in relation to the anticipated quantities used. Human health risks, correct use and storage of these materials should be addressed by an appropriate training programme.

Soil fertility management interventions frequently involve the concentration of organic materials, for example in compost production. The impact of removal of materials is unlikely to be a major cause of concern, but the implications of large-scale removal should be addressed.

11. How will stakeholders be made aware of the implications of positive productivity gains arising from the SPMI e.g. storage and marketing of additional production ?

Rationale If the proposed intervention is successful, storage, transport and marketing of additional production are likely to be important issues. Although the proposed project cannot be expected to manage all subsequent, consequences of the SPMI, the proposal should include consideration of the implications and how key stakeholders are kept informed.

12. Have you shown how the SPMI proposed sustainably enhances soil productivity ?

Rationale It is possible to have a SPMI that has a positive impact on productivity but is not sustainable. For example this may be due to excessive reliance on external support which render the initiative vulnerable after its withdrawal. Initiatives may only reduce the rate of decline, rather than neutralise or reverse it. Based on these concerns proposals should demonstrate a clear assessment of the sustainability of the initiative. It is important to appreciate that issues of sustainability are concerned with both the social and natural resource capital of the target group.

13. Have you identified and consulted available information relevant to the issue?

Rationale Information on the distribution and properties of soils in Teso and Lango is difficult to find, but it does exist and efforts are being made to improve its accessibility. Research results from relevant experimental work as well as published articles should be consulted. It may be relevant to relate a particular technology to a particular soil type, in which case soil maps can be used to show the extent of that soil type and hence its regional significance.

14. Is/are the project location(s) clearly identified ?

Rationale Because soil conditions vary according to differences in parent material, slope position and climatic variables it is important that the location of the proposed intervention is known. An intervention appropriate in one area may not be appropriate in another.

15. Does the proposal include the collection of baseline information and a monitoring procedure ?

Rationale Unless baseline information is collected or obtained from another source at the start of the intervention it will be difficult to measure impact. The effort expended on this should not be out of proportion to the actual intervention. Resource flow diagrams and rapid soil characterisation techniques could be used to provide this information. Most soil productivity proposals will require soil analysis which can be carried out at KARI or Makerere University. The proposal should include a simple and focused monitoring of the intended impact led by the target beneficiaries.

16. Is the proposed intervention of sufficient duration to demonstrate an impact ?

Rationale The production benefits from increasing soil organic matter levels can take several seasons before they are expressed. If the project cycle is too short the benefits may not be fully recognised. Long-term soil fertility trials conducted at SAARI last century showed that only after three years of application did animal manure result in substantial yield increases, however the yield benefits did last for several years after the applications ceased.

17. Does the proposal consider opportunities for minimising nutrient losses from existing resource flows within the target farming system ?

Rationale Participatory examination of representative small-holder enterprises resource flows provide a clear "snap-shot" of the dynamics of nutrient sources, flows and sinks. From this information it may be possible to identify opportunities reduce losses or redirect nutrients to more productive use within the farming system.

18. In designing a proposal be aware that providing farmers with training on soil fertility management may not be sufficient to ensure an impact.

Rationale Field studies showed that all wealth categories have considerable knowledge of soil fertility management "best practice". However, this knowledge is not always applied. Proposals should address the issue of how farmers can apply information in addition to providing it.

19. When preparing a proposal be aware of limited uptake of agro-forestry technologies.

Rationale In Soroti District SOCADIDO's experience with the uptake of agro-forestry interventions aimed at improving soil fertility have been limited, despite active promotion and a network of nurseries. Proposals advocating agro-forestry should investigate SOCADIDO's experience.

20. Examine options for the promotion of compost, particularly on high value crops.

Rationale We found little evidence of compost production in the area, except where a particular project had promoted the practice. Opportunities exist for greater production and use of compost, but this is best applied over a limited area and on high-value crops. There is also a possibility of developing municipal composting schemes from the larger urban centres.

21. Poverty assessments, access to resources and quality of resources are a greater concern in Kumi than Katakwi or Lira Districts.

Rationale According to NAADS data Kumi District is the second poorest in Uganda. The assessment used to determine this is open to debate, but it probably indicates the relative wealth of Kumi compared to Katakwi and Lira. Our field studies showed that a high proportion of Kumi households in the study community have access to limited resources and the general soil fertility status is lower than that found in the study sites in Katakwi or Lira Districts. This information could help to focus the geographic location of a proposal.

22. Interventions that raise the level of organic matter in the soil should be given priority.

Rationale Studies have shown that the levels of organic matter in soil is closely related to potential productivity. Increasing soil organic matter levels, or reducing their decline through a variety of possible management interventions is an desirable objective.

23. The phosphorus and organic matter content of soils are likely to be the most limiting factors influencing soil fertility in Teso and Lango.

Rationale Field studies show that pH, potassium and calcium levels confirm national study conclusions that these components are less likely to be limiting than phosphorus and organic matter levels.

2.3. Guidelines for CORSU and the Agricultural Technology Funds Management Committee

Assuming that the Guidelines for potential applicants are accepted and made available to applicants an initial task of the Committee is to check that they have been adhered to. The following checklist can be used to assist this process (the numbering is the same as for the Proposal Guidelines)

ATFsMC Proposal Checklist

1. Has the proposal identified a clear problem, supported by independent evidence to justify the soil productivity management intervention ?
2. Does the proposal clearly define and describe the target group at which the SPMI is aimed ?
3. Does the proposal show clear evidence of a demand from the target group for the intervention?
4. Are the gender implications of the intervention understood and clearly addressed in the proposal ?
5. Does the proposal clearly demonstrate how the interactive participation of the target group is going to be addressed / attained ?
6. Are the labour demands of the soil productivity management interventions adequately addressed, particularly with respect to gender ?
7. Have the financial costs of the soil fertility management intervention been considered ?
8. How are stakeholders to be made aware of the implications of positive productivity gains arising from the SPMI e.g. storage and marketing of additional production ?
9. Does the proposal include the collection of baseline information and a monitoring procedure ?
10. **Proposals that address soil fertility issues should be given higher priority than those that are concerned with physical degradation.**
11. Does the proposal include an evaluation of the availability of the SPMT (or its critical components) ?
12. Has the proposal addressed the direct and indirect environmental impact of the SPMI proposed ?
13. Does the SPMI proposed sustainably enhance soil productivity ?
14. Does the proposal include evidence that available soils information has been consulted ?
15. Is/are the project location(s) clearly identified ?
16. Is the proposed intervention of sufficient duration to demonstrate an impact ?
17. Does the proposal consider opportunities for minimising nutrient losses from existing resource flows within the target farming system ?
18. Be aware that proposals that only provide farmers with training on soil fertility management may not be sufficient to ensure an impact.
19. Be aware of the limited uptake of agroforestry technologies when assessing proposals.
20. Proposals concerned with reducing the labour inputs associated with compost making and application for high value crops should be given priority.
21. Other things being equal proposals addressing soil fertility issues in Kumi District should be given priority over Katakwi or Lira Districts.
22. Interventions that raise the level of organic matter in the soil should be given priority.
23. Proposals that address the organic matter and phosphorus content of soils should be given priority.

2.4. Thematic Call – Soil Productivity Management

Although the remit of this consultancy was to produce Guidelines for potential applicants it is understood that CORSU is considering issuing a Thematic Call addressing soil fertility. This might prove more efficient both in focusing attention on key issues and for the target implementers compared to the use of Guidelines.

At the Workshop held at SAARI on Oct 17th to obtain feedback on the soils study the following key issues were endorsed by a range of stakeholders:

1. Resource endowments must be taken into account when designing interventions (and priority given to technologies for poorer groups).
2. Gender labour implications must be taken into account when designing interventions.
3. Financial cost & availability of technologies must be taken into account when designing interventions
4. COARD should promote projects on:
   - Testing & disseminating *technical* information/ guidelines in a variety of media.
   - Procedures/methods for helping farmers learn.
   - Community mobilisation for soil/ land management.
5. NARO & COARD have important role in promoting awareness of "new" soil/land management technologies, through farmer-managed technologies.
6. Project teams must demonstrate capacity to carry out interventions.

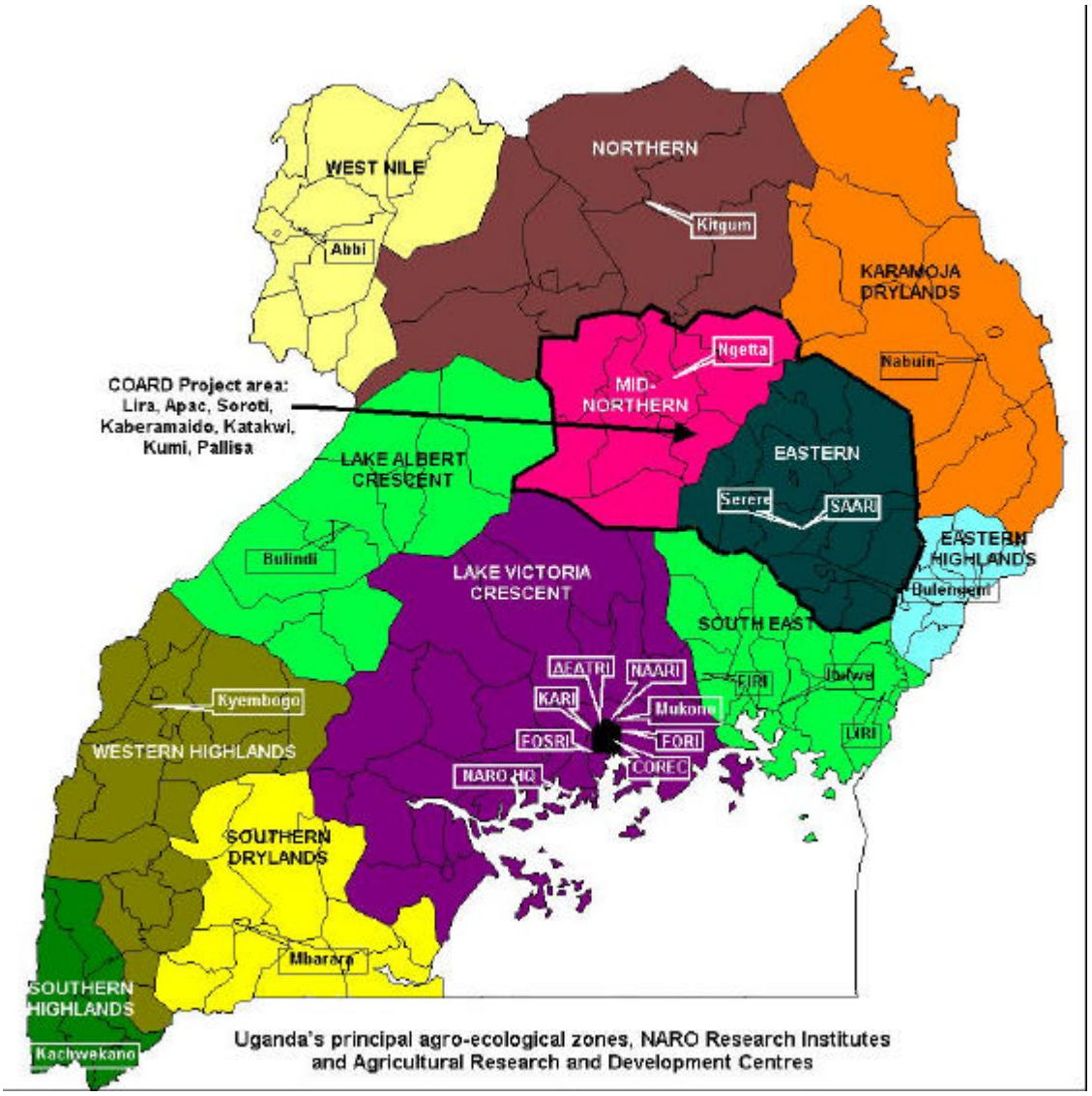
These key issues provide focus for a potential thematic call. Other areas to consider include a continuation and expansion of the partnerships already established with the villages of Adokar, Aterai and Baralegi through the needs assessment and this study. These provide the baseline information and an entry point to work with selected wealth groups to examine soil fertility management options suited to their circumstances. The approach would need to be flexible, as the agenda for activities would be developed through discussion and with between the target communities and the implementation team. The team would probably best led by local extension staff with a mechanism to "call down" specialist input as the need is identified. Initial activities could involve a joint examination of opportunities to minimise nutrient flow losses from the system, followed by a joint evaluation of opportunities to introduce soil fertility management technologies. This type of approach resembles the "action research" approach which despite being effective in a range of circumstances does need an experienced team and importantly a supportive and flexible administration. A modest programme of this type, critically monitored, evaluated and documented would provide a valuable model with relevance for elsewhere in Uganda and the region.

Another area the AFM Committee might consider is a modest study and possible piloting of municipal composting. Markets generate large quantities of organic waste, which currently constitute a public health hazard and could be composed and used as a soil amendment. As the cost and availability of mineral fertilizers currently limit their use, opportunities for developing a market for other soil amendments could be usefully examined.

3. Background to the Teso and Lango farming systems

3.1. Location

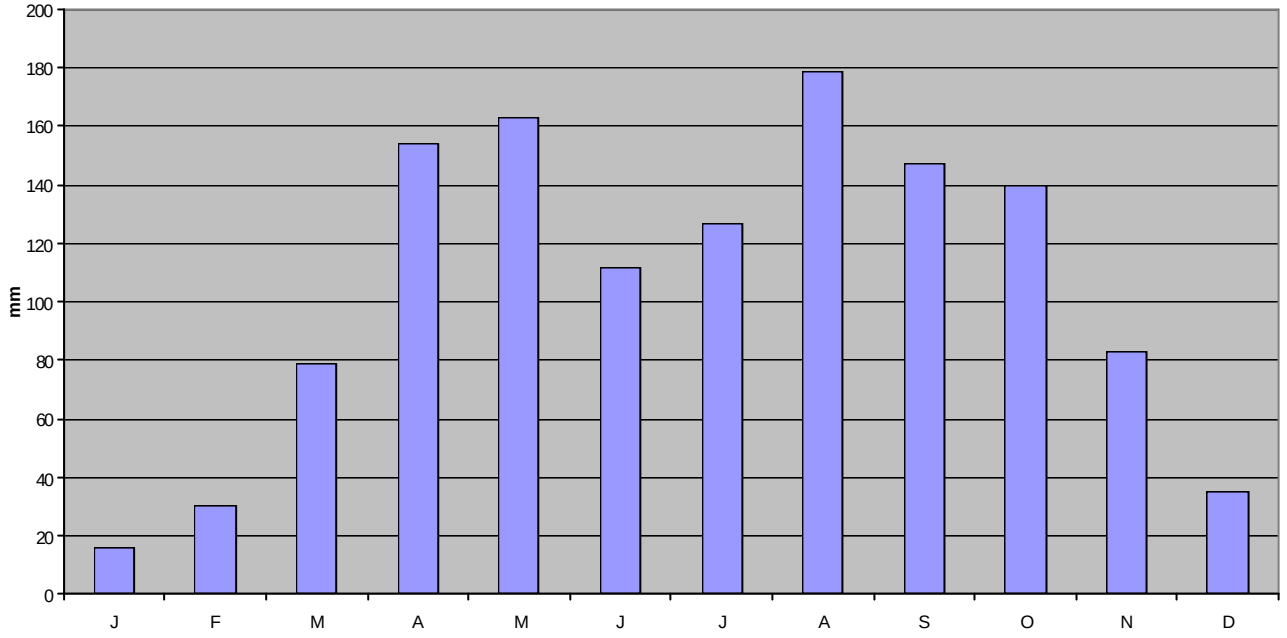
The Teso and Lango farming systems occur in eastern and northern Uganda respectively. The Teso Farming system is comprised of Soroti, Katakwi, Kumi and Pallisa Districts while the Lango Farming sub-system consists of the Districts of Apac and Lira, as shown in Figure 2.1 The Teso farming system is described as an annual cropping and cattle system and the Lango farming system as a sub-system of the annual cropping and cattle Northern system by Parsons (1960).



3.2. Climate, vegetation and population

Altitude in the two farming systems is fairly similar: the Teso system lies at an approximate altitude of between 1036m and 1127m above sea level; the Lango farming system is between 975m and 1146m above sea level. Both farming systems receive bi-modal rainfall with the first rains - often longer and more reliable - coming from February (March) to June, and the shorter second rains running from July (August) to November. The area is generally hot with temperatures over 25°C.

Although the Teso farming system is found in a modified equatorial climatic zone with both heavy rainfall and high temperature, statistics show that the Lango farming system receives slightly more rainfall: the Lango system, receives 1000 – 1500mm per annum compared to 850mm – 1500mm for the Teso system.



Average monthly rainfall, Teso & Lango

Wortmann and Eledu, (1999) proposed an Agro-ecological zonation of Uganda. In this zonation five zones are represented in the target Districts for this study (Kumi, Katakwi and Lira) are as follows :

Zone 3. Northern Moist Farmlands
Zone 6. North central farm-bush lands with sandy soil
Zone 7. Northern grass-farm-bush transition
Zone 10. North-eastern short grass plains with clay soils
Zone 11. Usuk sandy farm grasslands

SOIL AND CLIMATE CHARACTERISTICS OF TESO AND LANGO AGRO-ECOLOGICAL ZONES

Zone	Sand %	OC %	pH %	P %	Ca %	Mg %	K %	MAR mm	July r %	Temp ° C
3	58	37	51	40	19	16	24	1261	10.1	24
6	84	51	47	33	39	36	32	1212	11.8	24
7	58	43	50	25	22	33	21	1034	14.3	23
10	20	49	32	17	14	19	10	948	14.0	23
11	85	68	43	76	81	64	70	1082	11.8	24

NOTE : % above refers to the % of soils in that zone with the following critical levels – Critical levels applied to soil properties are >60% sand; < 1.74% OC; < pH 5.5; , < 10 ppm P; <1.75 me Ca / 100g soil; < 0.8 me Mg / 100g soil; , 0.3 me K / 100g soil.

LAND USE CHARACTERISTICS OF TESO AND LANGO AGRO-ECOLOGICAL ZONES

Zone	Area km 2	Grassland %	Farmland %	Wetland %	Woodland %
3	27527	12	71	1	17
6	10791	16	46	1	37
7	7756	30	33	0	36
10	6608	70	10	1	18
11	1403	33	64	0	3

Vegetation in both farming systems is dominated by tall-tree grassland savannah with shrubs and thickets permeated by some woodland. Variations occur in the Teso system in that Katakwi which lies on the northern plateau is characterised with grassland savanna and frequent shrub vegetation. A particularly distinctive vegetation type of the area described as Butyrospermum savanna by Langdale-Brown dominated by *Butyrospermum paradoxum*.

Teso is generally more densely populated than Lango with a population density of 108 persons/km^2 compared to 79 persons/km^2 in the Lango system although Katakwi has the lowest population density of 31 people per square kilometre. Population is predominantly rural with just under 5% living in urban areas[2].

3.3. Economic activities

The two farming systems lie in the poorest regions of the country with 2.7 and 2.1 million poor people representing 66% and 37% of the population in the north and east respectively.

A recent evaluation placed Kumi District second poorest District in the country, Katakwi 10th and Lira 17th, as shown in Figure 2.3 Although the such evaluations are not definitive the general picture of their relative poverty is confirmed.

District resource allocation based on poverty and deprivation[3]

District	Overall deprivation and poverty rank[4] (1 = highest; 38 = lowest)	Per capita resource share (based on adjusted pop. Projection) %	Adjustment factor	Desired resource allocation using deprivation and poverty adjustment index %
Kumi	2	1.7	1.2	2
Katakwi (Soroti)[5]	10	1.2	1.1	1.3
Lira	17	3.0	1.0	3

Agriculture is the main economic activity in this area with a bias on food crops. In the Lango system annual cropping of maize, finger millet, cassava, beans, simsim, pigeon peas, sunflower, and groundnuts predominate, while cow peas are also grown to a small extent. In the Teso system emphasis is on finger millet, groundnuts,

[2] The proportions of the population living in rural areas is over 95% in Kumi, 99% in Pallisa, 85% in Soroti, 98.7% in Apac & 94% in Lira.

[3] Source National Agricultural Advisory Services Programme (NAADS) Master Document of the NADDS Task Force and Joint Donor Group. Ministry of Agriculture Animal Industry and Fisheries, Entebbe, 20th October 2000.

[4] A composite index of available poverty and depravation indicators at the district level. Including : Human Development Index, [longevity, educational attainment and real GDP per capita] 40%; water coverage, 15%; health facilities coverage, 15%; HIV cases, 10%; physical security, 20 %. The weights applied depend upon the reliability of indicators.

[5] District created in 1997. Due to lack of data, given the rank of the former constituency denoted by ( ).

sweet potatoes, cassava, sorghum, cow peas, soya beans, rice, sunflower, banana and maize. Most of these crops are currently produced to meet both the food and cash needs of the households. Fruits and vegetables (tomatoes, cabbages and onions) are gaining importance especially near the urban centres. Cotton is the traditional cash crop in this part of the country.

The majority of Teso and Lango households keep various livestock (cattle, chicken, pigs, goats, sheep and poultry) to supplement income and food obtained from crop production. Over the years there has been a shift in importance of different types of livestock from cattle to smaller units. Civil unrest and rustling have contributed to the decline in cattle numbers, impoverishing the poor through the loss of productive assets with a profound effect on farm draught power. This has been compounded by decline or slow growth in the prices of crops grown in these regions. Government, NGOs and individual farmers have embarked on a restocking programme to try and restore the oxen. These changes have influenced the choice of crops and varieties grown, with many households resorting to the long-term types as coping strategies to combat food insecurity, a phenomenon that has become rampant in the past 15 years. Fishing is one of the major livelihood strategies especially for those communities close to the wetlands, Lakes Kyoga, Bisina and Kwania. Milling of oil and grains coupled with ginning of cotton are the main industrial activities in the area.

The two farming systems have experienced rapid population growth generally attributed to improved availability of health care. Increasing population pressure and its impacts on land availability have culminated in reduced fallow periods., by unreliable weather patterns. The use of external inputs (seed and soil amendments) remains constrained by the affordability and availability of these inputs, which stem from ineffectiveness of the existing extension system and a weak private sector base.

NGOs engaged in agricultural or environmental activities in Teso and Lango

KATAKWI DISTRICT
1. Amuria Youth Development Association (AYODA)
2. Farmers Friends Foundation (U)
3. Katakwi Women Development Organisation *
4. Okutoi Youth Organisation
5. Omega Community Development Association
6. Sustainable Organic Farming and Environment M...*
7. Teso Students Development Association (TESDA) *
APAC DISTRICT
8. Action Aid – Uganda
9. Aduku Olanyotai Aboko Association of the Blind
10. Christian Charity Centre (U) (CCCU)
11. Development Training and Research Centre
12. Power of Jesus around the Church
13. Te Apena Lipa Women's Association *
14. Aloro Voluntary Service
15. Northern Uganda Widow's Support Organisation
SOROTI DISTRICT
16. Akisim Development Association *
17. Amen Women's Development Organisation
18. Amuria Development Association *
19. Camp Swahili Development Association *
20. Faith Action Ltd Uganda
21. Farmers Friends Foundation (U)
22. Iyalakwe Rural Farmers Development Association

23. Jameler Community Based Development Organisation
24. Kalaki Development Trust
25. Kawo Integrated Rural Women Organisation
26. Komolo Development Association
27. Kop Oroma Christian Union
28. Opot Development Association
29. Oxfam *
30. Support Sustainable Development Initiatives
31. Sustainable Organic Farming and Environment *
32. Teso Development Effort
33. Teso Gospel Foundation
34. Teso Students Development Association (TESDA) *
35. The Resurrection Ministry
36. Usuk County Development Association
37. Kalaki Rural Development Association (KARUDA)
38. Soroti Family Helper Project Ltd.
39. Soroti United Comrades Association
40. Udapakol Youth Mixed Farming Progressive Organisation
PALLISA DISTRICT
41. Action Aid – Uganda
42. Bataaka Nkumbi Voluntary Organisation *
43. Chrisco Fellowship of Churches
44. Hyabene-Son Youth Integrated Farming Organisation *
45. Kawo Integrated Rural Women Organisation
46. Odusai Mixed Farmers Association
47. Pallisa Community Development Trust *
48. Pallisa Women and Youth Initiative to Alleviate F *
49. Puti Puti United Producers Association
50. Sustainable Organic Farming and Environment *
51. Projects Rural Development Initiatives
LIRA DISTRICT
52. Abukamola Mixed Farming Organisation
53. Agali Foundation for Development *
54. Angwetagwet Women Association
55. Barr Rural Development Foundation
56. Chrisco Fellowship of Churches
57. Christian Charity Centre (U) (CCCU)
58. Development Training and Research Centre
59. Dokolo Development Association
60. In Touch with Environment and Development Sus...*
61. Otuke Family Helper Pproject Association
62. Power of Jesus around the Church
63. Rao Development Association *
64. Atabu Development Association
65. Kioga Rural Development Network
66. Maganjo Home Management Group Ltd.
67. Northern Uganda Widow's Support Organisation

KUMI DISTRICT
68. Action Aid – Uganda
69. Africa Participatory Development Initiative *
70. Ajeluk Farmers Association
71. Bukedea Amora Ican Association
72. Bukedea Women Struggles Association
73. Christ's Foundation Ministries
74. Desok Women's Group
75. Faith Action Ltd. Uganda
76. Hosanna Development Project
77. Hyabene-Son Youth Integrated Farming Organisation *
78. Kawo Integrated Rural Women Organisation
79. Nyero-Amagoro Rural Development Association
80. Oxfam *
81. Sustainable Organic Farming and Environment M...
82. Teso Development Effort
83. Teso Students Development Association (TESDA)
84. Hosanna Development Project
85. Oya Rural Development Association

Commissioner for Monitoring and Evaluation (Prime Ministers Office 22nd April 2001)

4. Policy Issues and Linkages

The 2025 Vision for Uganda of a "Prosperous People, Harmonious Nation and beautiful people", is part of the implementation of the Poverty Eradication Action Plan (PEAP) and the Plan for the Modernisation of Agriculture (PMA). The PEAP represents Uganda's Comprehensive Development Framework which aims at reducing the proportion of the population living below the poverty line from the level of 35% (2001) to below 10% by the year 2017. The four goals of the PEAP are:

- creating a framework for rapid economic growth and structural transformation;
- ensuring good governance and security;
- directly increasing the ability of the poor to raise incomes; and
- directly increasing the quality of life of the poor.

The PEAP recognises that most poor people in Uganda are self-employed, mainly in agriculture. They need to be enabled to raise their incomes, by increasing their productivity in existing activities, by increasing the price they can get for their output, by entering new productive activities and by entering wage employment. The principal aim of the PMA is to eradicate poverty by improving the natural resource-based livelihoods of the masses of the population in a sustainable manner.[6] Land is a key resource in agricultural transformation, a critical resource for human settlement, a base for other natural resources such as forests and wetlands, physical infrastructure development, tourism, and is often a measure of social standing. Implementation of PMA has commenced and the National Agricultural Advisory Services (NAADS) is one of its core programs. NAADS will facilitate testing/adaptation and demonstration of technologies from research, and will co-ordinate with the NARO Agricultural Research and Development Centres (ARDCs) for purposes of technology dissemination.

4.1. Technology Generation and Development

Under NAADS, it is proposed that using the bottom-up approach. Districts and sub-counties will plan and make advance requisitions for adaptive research trials arising from expressed collective interests of the sub-county Farmer Fora in case of Districts and Groups in case of sub-counties. This provides an opportunity for linkages between COARD project and NAADS. The project could support researchers to undertake these adaptive trials in collaboration with the farmer groups. The priority technology needs of farmers expressed in Farmer Fora plans at District and sub-county levels should provide a check which could guide the ATF committees in assessing whether proposals articulate felt demands for the technologies/ interventions by the target groups. NARO through the ARDC could also seize the opportunity and locate their adaptive trails in areas which have clearly identified need for these technologies.

- The adaptive trials should be designed with a strong bias on farmer-management with researchers providing technical information.
- Emphasis should be placed on participatory evaluation of the technologies to identify those which meet farmer selection criteria.
- Economic superiority of the new technologies should be demonstrated and arrived at together with the farmers.

[6] PEAP, p. 126

- Care should be taken during implementation of these adaptive trials to ensure that the interests of resource poor farmers are addressed. This category of farmers should participate in decisions about variety/technology selection.
- Each of the trial treatment should be subjected to gender analysis to establish the positive and negative implications of the technology to various members of the household/community.

4.2. Technology Promotion

The Plan for Modernisation of Agriculture highlights provision of foundation technologies as an area where public resources will be used to ensure that farmers can improve productivity. To this effect NAADS proposes facilitating establishment of Technology Development Sites (TDS) for testing, demonstrating, evaluation, and multiplication of technologies from research. The TDS will also be focal points for farmer training either through active participation in the demonstrations, farmer fields days, and farmer field schools. The objective here is to increase knowledge about and availability of these technologies. TDS will be supported by NAADS to access from research, technologies which address felt needs of farmers in the communities where they are located. In addition NAADS will encourage the TDS to explore other avenues of accessing funding for their activities on top of what NAADS provides. The COARD project could supplement NAADS efforts by encouraging TDS operators (existing and potential ones) to submit concept notes for consideration by the ATF committees on a competitive basis. This offers an opportunity for NARO to increase its contact with the farmers by undertaking at TDS adaptive trials and demonstrations for many of the technologies which have already been released from research. Collaborative activities between NAADS, NARO in general and the COARD project in particular will further deepen decentralisation of agricultural services through the TDS which will bring research results and information nearer to the farmers where they live. The TDS are ideally set to operate on private basis and the following issues should be put in consideration while assessing TDS proposals:

- Technologies funded under TDS should be responding to farmers' demands
- Not to compete and subsequently contract the emerging private sector, every effort should be made to ensure that only those technologies that are physically unavailable from local sources, are the ones that receive public funding.
- NAADS, COARD project and NARO through the ARDCs should employ targeting techniques and explore avenues through which resource poor farmers can access technologies from TDS. Smart subsidies and voucher schemes target to the vulnerable groups are among the options for consideration.

4.3. Capacity Building

NARO and the CORAD project in particular is committed to building capacity at SAARI as well as for other development partners in the Teso and Lango farming systems to enable them address farmer technology and information needs in more appropriate and satisfactory ways. Likewise, NAADS through its component on Private sector institutional development, is committed to training potential services (NGOs, CBOs, current extension staff and existing private firms) such that they are equipped with capacities and skill sets which enable them to become eligible for award contracts to provide services which meet identified farmers advice and information needs. Hence the COARD project and NAADS share in the desire to build capacity of the stakeholders in the agricultural sector. This offers an opportunity for close collaboration and joint undertaking of the capacity building

events. There is need for dialogue between NAADS Secretariat and CORSU in order to map out strategies for effective linkages and collaboration.

4.4. National Soils Policy

In 1992 a National Soils Policy document[7] was prepared by a team of national and international experts with the stated aim of "enhancing the quality and productivity of Uganda's soils". The policy document emphasises physical soil degradation as a major concern. These include, water and wind erosion but not in Teso and Lango. Soil compaction is cited as serious in those Districts which were overstocked and overgrazed. Kumi, Soroti and Lira Districts apparently had problems of soil compaction until rustling reduced cattle numbers.

Soil fertility decline and crop yield decline was recognised in Bugerere in Mukono Distirct, Tororo, Mabale, Masaka and other banana growing districts of western Uganda. The low use of chemical fertilizers and other agro-chemicals was noted, but "in those areas where they are used to boost soil fertility they are considered to pollute the soils to an undeniable extent". This problem was particularly noticeable in the banana and coffee growing districts of southern and south-western Uganda. Promotion of mineral fertiliser policy not given much attention in the policy. The aim of creating a "National Commission on Land Use" and a National Soils Research Institute has not yet been realised.

4.5. PMA

The PMA highlights the increased use of external inputs including mineral fertilisers as an important element of the plan for modernisation. However, the Government will not be directly involved in fertiliser supply as a commitment to withdrawal from commercial activities that can be carried out by the private sector has been made. Specifically the Government will not "supply or produce planting materials or other agricultural inputs (except for research and demonstration purposes)[8]". Clearly the important role of NARO and NAADS in demonstrating mineral fertiliser use to farmers will need to be linked closely with commercial partners who can supply the products.

Included in the medium-term thrust for public action in the modernisation of agriculture is the development of technologies for soil fertility management, water conservation and environmental protection. This PMA priority is carried through in the NARO strategy[9].

The PMA emphasises research and demonstration of soil and water conservation methods and highlights agro-forestry as a mainstream activity for the agricultural advisory services and agricultural education curricula.

With respect to the wider enabling environment the implementation of the 1998 Land Act will influence soil fertility management through the development of a comprehensive land-use policy to facilitate development of land markets, efficient land use, construction of community valley dams, land management and administration. The implementation of the Land Act aims to provide a conducive policy, institutional, legal and financial framework for land management. Its implementation will lead to improved security of tenure protected by law, especially

[7] FAO, 1992. A Suggested National Soils Policy for Uganda. FAO/UNEP Project FP/6101-88-01. Advisory Services to Syria and Uganda on the Formulation of National Soils Policies.
[8] PMA, 2000, Executive Summary page x.
[9] NARO, 2000, A Strategy for 2000-2010.

for vulnerable groups; a vibrant land market, affordable land services that are responsive to the needs of the people, and land resources being used in a sustainable manner for use by future generations. Management of the land resource is critical to the achievement of the national goal of poverty eradication and improvement of the quality of life of the poor.

Implementation will take place in a decentralised environment where both the public and private sector have critical roles to play. As part of the effort to improve governance and efficiency in service delivery, the Government passed the Local Government Act of 1997, which provides the legal basis for decentralisation and the devolution of functions, powers and services from the centre to local governments. This process began in 1992, and aims to ensure good governance, democratic participation in, and control of, decision making by the people. Through the decentralisation process, political and financial power is being devolved to local governments, enhancing service delivery by bringing services nearer to the people and empowering them in the management of affairs that affect them. Implementation of Land legislation will build upon the decentralisation policy by developing clearly demarcated roles between the centre and local governments, defining financing and reporting procedures and providing mechanisms for conflict resolution.

The adoption of the sector wide approach has the following implications:

- Land policy and Land Use plans form an integral part of the Plan for the Modernisation of Agriculture;
- Funding for District Land Offices and District Planning Offices under the implementation of the Land Act might come from the Local Government resources such as the District Agricultural Extension Co-ordination Grant or the PMA NSCG
- The training and capacity building required for land managers should be built into the Education Sector Strategic Investment Plan

Land information gained through demarcation and certification could improve the delivery and cost effectiveness of a wide range of social and economic services including rural electrification, water supply , provision of health services and help to strengthen the rural tax base.

4.6. The NARO Strategy for 2000-2010

The NARO strategic document "A Strategy for 2000-2010, Facing the Research Challenges for the Modernisation of Agriculture" published in May 2000 makes clear reference to national environmental concerns in its opening Chapter. These include recognition that "soil degradation is a worsening problem" and the "lack of a national land-use policy complicates efforts to address critical soil management problems" (p.4.). "Inappropriate agro-chemical use" is also identified as a cause of environmental concern. (p. 6).

NARO's accomplishments during the 90's include providing farmers with "techniques for improving soil quality" confirmed by a beneficiary assessment survey conducted by FAO in Feb 2000 (p. 10). The strategy recognises the importance of stakeholder involvement but, acknowledges that there is considerable scope for improvement in this area.

Included in the section on Strategic challenges is "Improving environmental management : beyond taking environmental concerns into account in the design of research activities, NARO should contribute to the development and testing of more effective natural resource management methods an expand the ecological knowledge base." (p12) Emphasis is placed on the establishment of a database on physical resources. (p.11).

The strategy emphasises environmental caution, for example, "The main aim of agricultural research and development is to improve production without degrading the natural resource base". Intensive cultivation systems, including the use of chemical fertilisers are not viewed as the only option, emphasis is placed on the management of natural resources for sustaining productivity increases at the system and agro-ecological levels.

Needs assessments will be undertaken to characterise the country's agro-ecological zones and production systems. These are seen as prerequisites for determining location specific needs and sharpening research priorities. (p.22)

Major results expected from research in progress during the coming decade include, "packages on the appropriate use of organic and inorganic fertilisers for restoring and maintaining soil fertility".(p.23).

NARO has developed six performance indicators to evaluate progress during the next 10 years. The second indicator is to complete "up-to-date descriptions of agro-ecological zones and production systems of Uganda". Soil resources and soil fertility management practices will be central to this. In addition comprehensive baseline surveys will be conducted to set benchmarks against which future improvements will be gauged. (p.26)

4.7. The Soil Fertility Initiative (SFI)

According to the Soil Fertility Initiative review soil fertility problems in Uganda have arisen due to the following degradation processes :

1. **Nutrient mining** : Losses that occur under intensive and long-term cropping when both grain and crop residues are removed and the nutrients lost are not replaced. Losses from harvested producs are inevitable. Intense and prolonged cropping combined with losses due to erosion, leaching, volatilization and denitrification intensify the decline.
2. **Water losses by runoff and evaporation**. The loss of rainwater as runoff may often be as, if not more, limiting than the loss of soil nutrients.
3. **Loss of soil cover by "in situ" destruction or removal of crop residues**. Low levels of residue production from horticultural crops or crops with rapidly decomposing residues. Residues may also incorporated by tillage, grazed, removed for use as a fodder, mulch, composting, thatching and fuel or consumed by termites or burned.
4. **Accelerated loss of soil organic matter**. This is attributed to , removal of crop residues for use as a fodder, mulch, composting, thatching and fuel. Accelerated loss of soil OM also occurs by rapid mineralization due to frequent disturbance of the soil by tillage, ridging and weeding operations in intensive and prolonged annual cropping systems. The process is more pronounced in hot humid regions and in sandy soils, resulting in deterioration of soil structural stability causing crusting. Ultimately this process may result in the production of "sterile"

very poorly-productive soils. The process is most evident in the hot and humid "Northern and eastern cereal-cotton-cattle system" including parts of Lira, Soroti and Kumi where the soils are predominantly sandy.

5. **Restricted rooting caused by soil densification.** This may be caused by human-induced compaction or the natural process of hard-setting. Widespread soil compaction problems have been reported in Jinja and Kotido districts (NEMA, 1998) Observations suggest that soil densification may be a more widespread and serious problem than generally believed.

SFI also reports a study of farmer perception on soil fertility as follows :

Farmers opinions on productivity trends of their farms

Productivity Trend	Tropical Forest %	Highlands %	Savannah %	Urban %
Declining	82	74	49	49
Improving	8	20	46	11
No change	8	6	4	33
Don't know	2	0	1	7

SFI Working Paper 1.

The SFI Review identifies low soil organic matter and low biomass production as the principal problem for the Northern and Eastern cereal-cotton-cattle farming systems and suggests the following technical approaches receive further attention as possible solutions to soil fertility problems for annual cropping systems such as Teso and Lango.

1. **Leaving crop residues on the surface**. SFI claim that residues of annual crops are seldom left in the field. The solutions being investigated involve production of alternative fodder for livestock, with the assumption that if these are made available then livestock will not have to utilise crop residues. In Teso many livestock are tethered and we saw no evidence of crop residues being carried to animals.
2. **Conservation tillage** – Currently there is little promotion, research, extension or adoption in Uganda, although work has recently been initiated in Teso.
3. **Mulch** is very rarely applied to annual crops in Uganda. Although recent work studied the nutritional characteristics and use as mulch of the shrubby weeds *: Lantana camara, Tithonia diversifolia, Cassia hirsuta and Aspilia africana.* (Kaizzi, 1996, Briggs and Twomlow, 1998). These shrubs appear to have the potential to accumulate N and P and grow along roadsides and waste areas. Studies in Kenya with applications of 5 t / ha of *Lantana camara, Tithonia diversifolia* have given improved maize and bean yields. (Niang *et. al.* unpublished, ICRAF, 1997).
4. **Accelerated fallows**, with fast growing cover crops such as *Mucuna pruriens*, *Canavalia ensiformis* and *Tephrosia vogelii*.
5. **Tree fallows**, with fast-growing species such as *Calliandra calothyrsus*, *Sesbania sesban* and *Tephrosia vogelii* both for the restoration of soil fertility and the production of timber, poles and firewood.
6. Promotion of **locally-available low cost organic materials**, including swamp grasses, sedges, water hyacinth and shrubby weeds. It has been suggested that hedgerows along field boundaries could be used for this purpose. Other low-cost organic materials that could be investigated include : coffee husks, ash from domestic sources and brick kilns; animal manure and domestic compost.
7. Promotion of **low-level mineral fertiliser** applications to selected crops. The approach suggested by Wortmann (1998) for maize and beans should be

investigated further, particularly for farmers who have received farmer field school training on the principles of soil and nutrient management.

The SFI recommendations are supported by the studies findings. The key issue to re-emphasise being the approach used in working with farmers i.e. participatory, system based and integrated.

5. Institutional Influences on Soil Fertility Management

In analysing the influence of various institutions across districts and farmer categories, the scores assigned in the field were transposed such that 3=high influence and 1=low influence. Scores of each institution for particular farmer category across all districts were summed and then rankings assigned to ranges of scores as follows. Priority rank/high influence (H) assigned to any institution with a total score between 7-9, medium influence (M) assigned to institutions whose sum ranges between 4-6, and Low priority/least influence (L) assigned to institutions with sums between 0-3 (Table 1.1).

Table 1.1 Comparison of institutional influence across farmer categories

Wealth rank	Well off (A)	Middle (B)	Poor (C)
Extension	H	H	H
Parents/family members	M	H	H
Elders	H	H	M
School	M	H	M
NGOs	H	M	M
Local Council 1	M	H	M
Research	M	M	H
Radio	H	M	L
Chiefs/civic leaders	M	M	M
Friends/neighbours	M	M	M
Church	L	L	M
Farmer groups	L	L	M
Health	L	L	M
Forestry	L	L	L
Markets/Traders	L	L	L
Drinking groups/ social gatherings	L	L	L
Cooperative Society	L	L	L
Adult Literacy Campaigns	L	L	L
Clan	L	L	L
District Farm Institutes	L	L	L
Parish Credit Committees	L	L	L
Politicians	L	L	L

Familial, communal and governance institutions (especially village elders, family and front-line extension workers) were of considerable importance to all farmer categories, and tended to reinforce similar management practices (observation of boundaries; time of planting; crop rotations; discouraging burning, etc). Commercial institutions (traders, middlemen, markets) were of low importance for all categories. The study suggests somewhat less importance attached by poorer farmers to radio, schools and NGOs, and greater importance to churches and health clinics in terms of influence. This may have implications for communications strategies for poverty-alleviation focused soil management projects, both in considering ways to disseminate information and who to include in project implementation. In light of the these findings the following points should be considered in the design of interventions :

- Inclusion of village elders in project design, problem and solution analyses, project reviews and dissemination activities; Emphasise and facilitate farmer-farmer dissemination;

- Critical consideration of use of radio for announcing meetings and disseminating agricultural information, to ensure that information is appropriate to, and gets to the intended audience;
- Actively seek novel ways to get information to poorer groups, such as health clinics;
- Carefully consider criteria for inclusion in farmer groups when discussing these with rural communities, to ensure that they do not repeat the mistakes of some NGO-led efforts

Parents and other family members are the key familial institutions while elders are the key communal institution influencing the soil management practices of farmers of all wealth categories in Teso and Lango. Roles of these institutions in addressing soil productivity management were reported as:-

- Show boundaries and do not allow children to plough beyond these boundaries thereby encouraging maintenance of the grass bands, which often form these boundaries. Nevertheless, it was also argued that the old bands may be ploughed so that the fertility that has accumulated there is utilised and they had plans to plant new ones.
- Encourage crop rotation and advise on specific crops suitable to specific pieces of land Head of family decides on crop rotation and discourage removing bands. Family members provide labour for maintenance of bands, making compost manure and spreading it.
- Advise on resting land and applying manure.
- Advise on proper land preparation i.e plough twice with intervals between to allow soil to decompose, and leaving some parts unploughed at the end of a piece of land so as to prevent erosion.
- Advise weeding crops to avoid competition and depleting nutrient and teach children to bury weeds such that they rot under the soil and give manure.
- Discourage cutting trees without planting new ones which would lead to wind blowing away soil.
- Discourage burning but tell people to leave residues to rot and give soil manure. Burning leads to loss of grass cover hence wind erosion and loss of top soil.
- Advise people not to plant to many seed in the field to reduce competition because over plant populated fields lead fast nutrients depletion.
- Advocate for periodic changing location of grazing areas to spread manure. Parents advise people to change the kraal from one place to another on their land in order to spread manure to different places. They also encourage applying manure to the fields rather than just sweeping the poultry waste, goat droppings or residues from local brew (Ajon) just around the compound. However farmers noted that they do not collect the beer residues from local drinking joints because others may laugh at them.

Extension featured as the most influential governance institution across all districts. With the exception of the better off farmers in Katakwi and the least well off farmers in Lira who classified extension in rank two, extension ranked highly across all farmer categories, featuring more prominently in Kumi district, compared to Katakwi and Lira with roles explained as training and advising on :

- Crop rotation, fallow, mulching and preserving grass bands. They encourage crop rotation to check disease build up and enhance soil productivity.
- Advise on proper method of crop production e.g. use of improved varieties, proper spacing (for crops like maize, g/nuts and cassava), early planting and crop protection (information on spraying regimes).

- Proper use of land to prevent soil erosion. They advise on row planting. In case of a field with a slope, put the rows across rather than down wards the slope in order to check water run off.
- Advise on weeding crops for better yields (weeds compete with crops and reduce nutrients if left in the field.
- If you have animals alternate grazing fields with crop fields. Fallow a field then graze on that latter open it for crops and fallow another one. This way manure is spread to many fields.
- Advise on the use of manure. Advise on taking crop residues back to fields such that they can decompose from their and turn into manure. Advocate planting Mucuna which suppresses weeds at the same time improving fertility of the soil. Train farmers in making compost to enhance soil fertility.
- Advise against intercropping crops of same feeding habits. i.e sunflower and maize. Recommend sunflower and beans or sesame and beans.
- Advise people to use chemical fertilise. Only one person acknowledged having once used chemical fertiliser. Price was cited as the limiting factor.
- Advise people to plant trees to get poles and fuel wood as well as manure after the leaves fall off and decompose. Discourage cutting big trees because these act as wind breaks thereby checking wind erosion which would lead to loss of top soil and reduced fertility.

Results show that NGOs and radio were more important to the wealthier group than to the others in influencing their soil management practices. Radio was not cited by the least well off farmers in any of the districts. Influences mentioned include:

- Advise on proper spacing such that the plant can cover the soil and protect it from erosion.
- Encourage the planting of trees, use of improved seed and row planting.
- Encourage mulching to help retain moisture and later turn into manure.

Poorer groups would have less access to radios (and the batteries needed to operate them) than wealthier groups both greatly influenced by the financial resources available to farmer (as also reported in the communications study – A Turrall, personal communication 2001, for instance). Study finding that NGOs (such as AT(U), Vision Terudo, Send A Cow, Red Cross, UNDP, NAWOU) are more influential for the wealthy groups may indicate an unintentional bias by NGOs or the persons that help them establish/implement their programs, or "hi-jacking" of the NGO development efforts by the elite.

Schools and local leaders featured among the institutions cited by all farmer categories across all districts. Overall these institutions were more important to the middle farmers compared to well off and poor categories. Roles of schools were reported as :

- Pupils learn/get information on erosion control such importance of grass bands, cover crops line planting, planting across field which has a slope rather than down the slop to check water run off and stop soil erosion.
- Crop rotation to enhance fertility and reduce disease build up. This information is shared with parents who put it into practice. When the children start farming on their own they also adopt the practices.
- Children learn the need to protect the environment and transfer knowledge on farming to family members. They advise against cutting trees which act as wind breaks and the roots hold soil such that it is not easily washed away.
- Advise against burning grass which can be cut to decompose into manure.

- Teach use of farm yard manure i.e while at school people are taught to scatter crop residues all over the field rather than leaving it heaped in one corner of the field, resting land.

While Local leaders were reported to influence farmer soil productivity management by:

- Advise/enforce leaving grass bands for erosion control along the road and between the fields. Discourage removing grass bands which help reduce erosion caused by running water.
- Enforce by-laws against burning. They advise against burning of bushes which exposes soil to wind erosion in addition to denying it manure from crop residues. Advise against burning of crop residues/grass because this leads to loss of soil cover thereby exposing it to erosion.
- Giving advise on when to start planting; proper land preparation. Encourage people to plough twice and at the right time to get high yields.
- Discourage indiscriminate cutting of trees but advise on selective cutting of trees.
- Advocate for periodic changing the location of grazing areas to spread manure.
- Settle land disputes.
- Advise people to cultivate across the field rather than down the slope as this would accelerate erosion.
- Promote crop rotation and advise farmers to gather crop residues/weeds in small heaps throughout the field (especially sites with infertile soil) then burn, the ash enhances soil fertility.
- Mobilising people for meetings where they are sensitised on production activities including soil management

The governance institutions of research and health workers coupled with the socials institutions of church, and farmer groups were more influential to the poor categories compared to other farmer types. Farmers noted that research influences them through: Creating awareness of agricultural problems e.g soils and recommends possible interventions and try them out for people to see outcome. Furthermore when farmers tour research station they are trained on production technologies, given information on crop rotation, advised to apply manure and resting land to enable it regain fertility. Researchers were noted to discourage cultivation in areas along the swamps but recommend such areas to be used for grazing purposes.

With the exception of research where the upper categories considered it to be of ample influence, the rest of institutions in this set were considered to have little or no influence to the wealthier and middle groups. The explanation for this in case of health may lie in the fact that this category often has enough food at their disposal, are more able to meet household cash obligations, have better houses and sleep in slightly better conditions, hence health problems become less important to them unlike the lower categories which are often exposed to sickness. The poor noted that health is vital since soil management practices are often labour intensive, hence requiring a healthy person to undertake such activities. Role of health workers include:-

- Keeping you healthy for effective work (Giving treatment for people to remain healthy /avoid falling sick which would unable them to carry out farming activities).
- Sensitise people to practice good sanitation to ensure good health and avoid falling sick which would unable them to carry out farming activities.

- Encourage people to ensure good nutrition to enable them have the energy to carry out their activities.
- Advise people not to share houses with animals (chicken) which might bring mites hence sleepless nights and subsequently the person is sleepy during the day and unable to farm properly.

Farmer groups (youth groups, women groups, work groups) generally considered to fall under class two of institutions influencing soil productivity management and this is more applicable to least well off and middle category of farmers while the well off farmers (except in Kumi) do not recognise this among the institutions influencing them.

The study findings on importance of schools, health, farmer groups in influencing various types of farmers' further support the Poverty Eradication Action Plan and PMA which emphasize a holistic approach in trying to improve productivity in poor households. Hence further justification for the investments in education and health as PAF/PMA priority sectors.

The results show that a number of other institutions that were mentioned by only one or two groups, and were ranked as low in the survey – forestry, market/traders, *etc.* There was no discernable difference with wealth ranking in these various institutions.

In summary the same kinds of institutions influence all farmer categories in the study districts. Variations exist mainly in importance attached to particular institutions by various farmer categories but no particular institution is singled out as the most effective to reach out to particular farmer category. The implication for soil management projects is that using a combination of institutions likely to give better results.

The institutions were often reinforcing similar messages and there is generally high farmer awareness of basic land management practices although this does not translate into high level of adoption/application. Some farmers apply the knowledge but majority do not. This seems to suggest that the institutions are providing awareness type of messages, but not sufficient technical information/guidelines to enable execution. The farmers now consider a lot of this information indigenous and they perceive it as serving the interests of the providers not rather than. Soil productivity projects should note that having information *per se* is not necessarily a sufficient condition for adoption/ putting it into practice and dissemination efforts should adequately address farmer's appreciation of the information. It is vital for future emphasis to be placed on understanding why farmers do not practice what they have already been told, and ascertain the blocking factors, then putting in place strategies which empower farmer to appreciate the value of this knowledge by putting it into practice. Priority should be on empowering/mobilising farmers to implement the available soil productivity management practices.

Institution	Rankings by study site and wealth category															
	Okwang Sub-county, Lira district (Lango)			Usuk Sub-county Katakwi District (Teso)			Mukura Sub-county, Kumi District, Teso system									
	Balarege A	Balarege B	Balarege C	Aterai A	Aterai B	Aterai C	Adokar A	Adokar B	Adokar C	a	b	C	H=9-7, M=6-4, L=0-3 a	b	c
Local Council 1	2	3	0	0	3	3	2	3	2	4	9	5	M	H	M
Chiefs/civic leaders	0	0	3	2	3	0	2	3	2	4	6	5	M	M	M
Parents/family members	0	3	3	3	3	3	3	3	3	6	9	9	M	H	H
Elders	2	3	3	3	3	0	3	3	3	8	9	6	H	H	M
Friends/neighbours	3	2	3	2	1	2	1	3	1	6	6	6	M	M	M
School	1	3	3	2	2	0	3	2	3	6	7	6	M	H	M
Extension	3	3	2	2	3	3	3	3	3	8	9	8	H	H	H
Research	1	0	2	1	3	3	3	3	3	5	6	8	M	M	H
Forestry	0	0	1	0	0	1	0	2	1	0	2	3	L	L	L
Church	0	1	1	0	1	3	2	3	2	2	5	6	L	L	M
Farmer groups	0	1	3	0	2	2	2	2	1	2	5	6	L	L	M
Markets/Traders	0	0	1	0	1	1	0	1	1	0	2	3	L	L	L
NGOs	3	2	1	2	2	2	2	1	2	7	5	5	H	M	M
Drinking groups/ social gatherings	0	0	0	0	2	1	1	1	1	1	3	2	L	L	L
Health	0	0	0	0	0	2	0	3	2	0	3	4	L	L	M
Cooperative Society	0	0	0	0	0	0	0	1	2	0	1	2	L	L	L
Radio	3	2	0	1	2	0	3	0	0	7	4	0	H	M	L
Adult Literacy Campaigns	0	0	0	0	0	0	0	2	0	0	2	0	L	L	L
Clan	0	0	0	0	0	2	0	0	0	0	0	2	L	L	L
District Farm Institutes	1	1	0	0	0	0	0	0	0	1	1	0	L	L	L
Parish Credit Committees	0	0	0	0	2	0	0	0	0	0	2	0	L	L	L
Politicians	0	0	0	0	1	0	0	0	0	0	1	0	L	L	L

An expanded discussion of the institutional issues is given in Annex 2

6. Resource Flows

Although the actual resource flow diagrams best illustrate the individual circumstances, the following summary gives the range of circumstances and differing access to resources encountered during the field studies. Attention is drawn to the range of holding sizes as given by the farmers. Although the farm sizes were unverified the information can be used for comparative purposes. Areas ranged from over 20 acres in Baralegi, Group A to less than 2 acres in Adokar Group C. The presence and absence of livestock and the use of fallows are also important differentiating characteristics. Table 1.2 shows the main differences.

Soil fertility management in both Teso and Lango is integrated into general farming practices. It is perhaps an artificial and academic distinction to consider it as a separate activity. For example crop rotations which include legumes can make a significant contribution to soil fertility, but this is not the primary reason legumes are grown. The primary justification is likely to be the production of a crop, but there are other advantages to rotations such as pest and weed control as well as land preparation for a more valuable following crop.

Crop rotation and natural fallows are the main means of fertility management. As can seen from Table 1.2 and from the resource flow diagrams individual farmers studied grew a minimum of five and up to ten crops which are rotated in different plots from season to season. Rice being the exception. Fallowing is generally practiced, apart from Kumi District where individual holdings are too small amongst the poorest group to allow fallowing. Although the concept of rotation and fallowing are well established there is not necessarily strict adherence to a particular sequence for individual plots. “Typical” rotations were cited, but within the general pattern of cereal, legume, root crop there appeared to be individual variation.

Incorporation of crop residues and ploughing in of grass fallows is the main means of active fertility management. Farmers were aware of the theoretical benefits of incorporating organic materials as opposed to burning, but further investigation would be required to establish actual practice. Where farmers have livestock and a source of manure in some cases but not all this was applied to plots. In some cases animals were tethered in fallow plots or encouraged to consume crop residues in harvested fields where their manure was consequently deposited. This practice would appear to be more strongly motivated by the feeding requirements of the animals than soil fertility, although the benefit was generally recognised. In some cases farmers did not apply manure to their fields, where they had a plentiful supply. Reasons for non-application included lack of knowledge and the difficulty of transporting the material. Livestock manure was valued for its contribution to soil fertility, but not sufficiently to justify its application at all costs. Lack of transport was most frequently cited as a reason why manure was not applied to fields. Household waste, chicken and goat manure were generally returned to the plots immediately around the homestead, but not in a systematic manner. Such applications can make a considerable impact on soil fertility and crop productivity locally (the soil fertility analysis from Aterai C is a good example of this). Minimal use of mineral fertilizers occurred in the sample farms, although most farmers had some familiarity with them.

With respect to regional variation, the main differences relate to the crops grown. Groundnut is the main legume in Teso, while pigeon pea is generally absent. Pigeon

pea is important in Lango. Sweet potato is widely grown in Teso, increasingly as a cash crop while it is less frequent in Lango. Cassava was the only crop that was grown on every farm studied. Although the range of crops grown is wide, there is further potential to extend the cultivation of a wider range of crops throughout the region, particularly the legumes. The range of crops grown and the consequent rotation options in general is a positive contribution to the maintenance of soil fertility. The Plan for the Modernisation of Agriculture advocates crop specialisation with an inevitable reduction in rotation options as an important modernisation strategy. The soil fertility maintenance implications of specialisation should be carefully examined to ensure sustainability.

Table 1.2 Selected Characteristics from resource flow diagrams

Sample Farm	Area (farmer est.)	Livestock	Main Crops	Land Fallowed ?	Organic Material Recycled ?	Produce Marketed ?
Adokar A	5 acres	7 cows, 2 pigs, 3 goats	Cowpea, cassava millet, g-nuts sorghum, s-pots, maize, beans banana	yes	Livestock manure	yes
Adokar B	6 acres	2 oxen, 1 pig with 5 piglets, 1 goat, 3 ducks	Cassava, sweet potatoes, groundnuts, cowpeas, bambara nuts, maize, rice	yes	Livestock manure	yes
Adokar C	2 acres	1 chicken	Cassava, g-nuts, s–pots, millet ,cowpeas, green gram	no	No	occasional
Aterai A	14 acres	6 cattle, pigs, goats, chickens	Cassava, g-nuts, maize, sorghum, millet, s- pot, erudurude peas.	yes	Only chicken manure not cattle	yes
Aterai B	15 acres	chicken	Sorghum, millet, g-nut, maize, cassava	yes	Chicken droppings	yes
Aterai C	7 acres	none	Cassava, g-nuts, millet, maize, s-pots, sorghum	yes	Household waste only	no, food deficit most years
Baralegi A	20 acres	2 oxen, 5 goats, 7 chicken	Cassava, maize, g-nut, sorghum, beans, p-pea, simsim, cotton, rice	yes	Livestock manure	yes
Baralegi B	11acres	2 oxen, 8 chicken	Cassava, sunflower, millet, sorghum, simsim, p-pea, cotton	yes	Household waste	yes
Baralegi C	10 acres	2 pigs, 4 chicken	Maize, g-nut, millet, rice, cowpea, cassava, sorghum, simsim, p-pea, cotton	yes	Household waste	yes

7. Soil Characterisations

The following section gives a brief summary of the main characteristics of the soils at each village site.

7.1. Adokar

Site observations indicated reasonably consistent soil characteristics, with the exception of unpredictable depth to a laterite layer or weathering rock. Depths varied from 120cm + to 40cm, but were generally less than 70cm and independent of slope position. Surface textures were generally sands and loamy sands with sandy clay loam at depth. Upper slope positions were well drained with poorly drained conditions in the lower slopes and bottom lands. The profiles were stone free above the laterite.

Soil analysis showed the majority of samples to have a pH at or slightly above the critical limit of 5.2. Organic matter was typically only 25% of the critical level of 3%. Phosphorus was typically 40% of the critical level and calcium 50% of critical levels. Potassium was generally at or slightly above the critical level.

The Adokar soils are the least “fertile” of the three villages in the study, the combination of sandy surface textures, low organic matter and phosphorus being the main limitations. The depth limitation could influence rooting depth and have consequences for moisture availability, but this could not be verified in this study. The low relief reduces the effects of accelerated soil erosion, however any reduction in depth in such shallow profiles is a major threat to productivity. The loss of a significant amount of soil and exposure of the laterite layer although unlikely would result in a complete and irreversible degradation of the soils productivity.

7.2. Aterai

The site observations indicated reasonably consistent soil characteristics. Laterite was encountered occasionally but generally the soils were deeper than 90cm over laterite, with the majority of samples over 120cm+. Surface textures were generally sands with sandy clay loam and sandy clay at depth. Upper slope positions were well drained with poorly drained conditions in the lower slopes and bottom lands. The profiles were stone free above the laterite.

Soil analysis showed the majority of samples to have a pH well above the critical limit of 5.2. Organic matter was typically 50% of the critical level of 3%. Phosphorus, potassium and calcium were typically above the critical levels.

The main soil limitation at Aterai are the sandy surface textures and the organic matter levels. Increasing organic matter in soils with sandy textures is known to be difficult as a higher clay fraction tends to protect the organic fraction.

7.3. Baralegi

Soil depths at Baralegi were similar to Aterai and again occasionally limited by laterite. Crest and upper slope sites can be shallower with one profile having a depth of 38cm. Baralegi had the highest clay content of all the soils sampled, with surface textures consistently sandy clay loam over sandy clay sub-soils. Upper slope

positions were again well drained with poorly drained conditions in the lower slopes and bottom lands. The profiles were stone free above the laterite.

Soil analysis for Baralegi showed surface pH at or slightly above the critical limit of 5.2. Organic matter levels were the higher than Adokar or Aterai mainly at or near the critical limit of 3%. This is probably correlated with the higher clay content of the soils. Phosphorus was 50% below the critical limit in half of the samples. Calcium was well above the critical limit and potassium limiting in a few samples. Apart from phosphorus, the Baralegi soils are probably the most "fertile" of the three villages and consequently the most suited to intensive production.

7.4. Comparison between the mapped soil units and site observations

According to the soils maps both Baralegi and Adokar are located on the "Amuria catena" . Which is described as follows :

Amuria catena soils are developed on ancient lake deposits. Nowhere is the relief large, interfluves are rounded with gently undulating topography. The underlying rock is Basement Complex gneiss or granite which outcrops in occasional bornharts as at Soroti. The soil profile is similar to the Mazimasa catena. Predominantly sandy loams, with clay content increasing with depth, except in the valley bottoms. Brown colours prevail and the soils are generally structure-less and break down easily to single grains. Laterite is almost invariably present and is frequently massive. Soil depths of around 45cm to laterite are frequent, but depths can also reach 120 cm + Organic matter is variable, depending on land use. It is low on the whole, but on land that has not been used for a number of years there is a reasonable accumulation. Soils are invariably acid and base content is low. Phosphate is generally very deficient.

This description is generalised, but broadly consistent with the soils described at Adokar but not Baralegi. To map the two areas as the same unit raises doubts as to the utility of the maps at any other than a very general scale.

The Aterai soils are located on the Usuku Series, this only occurs in Teso in a very flat area dissected by swamp filled valleys. There are a few inselburgs with pediments. Laterite occurs throughout and where it outcrops it gives rise to a shelf feature on valley sides. The parent material sand appears to be an ancient lacustrine sediment over Basement Complex granites and gnesisses which are occasionally exposed. The basic geomorphic history is postulated as follows – laying down of sandy sediments over Basement Complex, with islands formed by protruding inselburgs, slow draining of the lake, eluviation and laterite formation, uplift and dissection of the plateau and deposition of new clay soils in the swamps. The upper part of the profile is nearly homogenous, below this a gradual change to heavier textures and warmer colours. These soils gradually merge into the Amuria series by becoming shallower, redder and heavier in texture. Leaching is excessive and results in a low base content. All the upper sandy layers have no detectable bases except calcium, which is low; available phosphate is deficient throughout the profile. Acidity does not seem great and increases with depth.

This description is too general to meaningfully compare with the Aterai soils characterised in the field study.

8. Farmer perceptions of soil fertility

Findings on farmer perceptions reveal that all farmer categories in both Lango and Teso concur that soil fertility has been on the decline over the past decade or so. Low yields were cited to be the indicator of reduced soil fertility by the farmers in Lango while increased prevalence of *striga* was attributed to declining soil fertility in Teso.

8.1. Perceived causes of fertility decline

Several factors were reported to have contributed to the decline in soil fertility and these include: reduced fallow periods; reduction in number of animals, continuous cultivation of same piece of land; *Karimojong* invasions, prolonged dry spells, increased pest prevalence and increased intensity of burning.

a. Reduced fallow periods. All farmer categories in Lango and Teso noted that the fallow periods have reduced. Differences exist by District and wealth category, with Lira farmers reporting that they can still fallow land for at least 2-3 years while only well off farmers in Katakwi can fallow land, fallowing has almost lost meaning in Kumi where fallow periods range between one season to one year. The implication is that land is no longer rested for long enough for it to regain fertility through natural process.
b. Reduction in the number of animals was cited by both the well off and middle category farmers in Lango and Teso regions but not the least well of farmers. These categories of farmers noted that due to reduced livestock numbers, the amounts of animal manure available have also greatly reduced, they no longer have kraals where they could collect the manure and change locations in order to spread manure on their land. Also reduction in cattle numbers meant loss of oxen which used to incorporate grass and crop residues has stopped and negatively impacted on nutrient recycling.
c. Closely linked to the above to issues is continuous cultivation of the same piece of land which was cited by all farmer categories in Lango and Teso. Farmers note that due to lack of oxen, land opening has become difficult. In addition the land available to these farming households was also reported to have decreased as land is continually sub-divided among the offspring as population grows. Continous cultivation of land has intensified nutrient mining from these fields hence the decline in soil fertility.
d. *Karimonjong* invasions were cited to have compounded the problem of land fertility especially in Katakwi district in a number of ways.

    - The large herds of cattle which break/loosen the top soil,exposing it to soil erosion.
    - The influx of people running away from *Karamonjong* invaded areas increase pressure on land
    - Increased bush burning as farmers destroy the natural pastures on in an effort to discourage *Karimonjong* .

e. Increased pest prevalence and prolonged dry spells were both noted to result wide spread burning as farmers try to eliminate the crop residue in order

to check pests. The outcome is that land is often left bare with no vegetation cover exposing it to wind or water erosion

8.2. Suggested solutions

Farmers cited some interventions which could help check the reduction in soil fertility these include:- crop rotations; fallowing land; applying manure; burring grass/crop residues in the process of ploughing, and changing the direction of ploughing.

All farmer categories in both Lango and Teso acknowledged that crop rotation can be used to help soils regain fertility. Among the possible rotations cited in Lango were pigeon peas / sorghum / groundnuts / pigeon peas / cassava. In Teso groundnuts / millet / sorghum / sweet potatoes /cassava/ fallow. Both rotations include a legumes, with a higher percentage in Lango than Teso.crop It was reported that decisions regarding crop sequencing are made by men.

Applying manure featured most in Teso compared to Lango, with the well-off farmers in Lango noting that the work is difficult and they have no time for it. Least well-off farmers in Lira and all farmer categories in Katakwi reported applying manure especially household waste, goats and poultry waste as an option. The responsibility of moving manure to the fields rests with women and children to a lesser extent.

Farmers in Lira noted that planting trees could help check soil erosion in addition the leaves which fall and decompose to add manure to the soil while Katakwi farmers highlighted burying crop residues or spreading them in small heaps over the field.

9. Understanding concepts of soil fertility and soil productivity

This section has been included in the report because during the course of the consultancy it became clear that understanding of the term soil fertility varied considerably and that some attempt to analyse the concept could be useful.

During the field work training session participants were asked for their understanding of the term soil fertility. Their replies included :

- The ability of a soil to sustain plant growth
- The chemical nutrients in the soil
- The balance of nutrients in soil
- The availability of nutrients in soil
- The structure of the soil
- The ability of a soil to supply plant nutrients in the right proportions, amounts and forms required for adequate growth

These responses are typical and illustrate that although there is a common general understanding of the factors which influence fertility the replies cover a wide range of understanding.

Questions that challenge the use of the word "fertile" include questions such as "Is a soil that contains sufficient nutrients to theoretically support plant growth, but is too dry or too shallow to allow growth still fertile ?" It may be considered that such a soil is fertile but not productive. How should a soil that contains adequate plant nutrients but also contains toxic levels of an element that suppresses growth be considered ? The issue of sustainability is also relevant . Included in the responses was the concept that a fertile soil was one that could sustain plant growth. To some this might mean indefinitely.

We recognised that the terms are used in both the technical and non-technical sense, but in order to have a more informed technical debate more precise terms are desirable.

For example it can be helpful to separate chemical (nutrient) fertility from site fertility (structure, drainage etc) and importantly relate the description of fertility to a specific crop or group of crops.

Various systems of land suitability and land evaluation exist which overcome these difficulties. The main concept to appreciate when using the terms is that they mean different things to different people. This is particularly relevant when referring to results of PRAs. For example "soil fertility in the study area was considered by 61% of farmers interviewed to be high in the past". Further discussion revealed that this was mainly attributed to an increased frequency of drought.

It is also important to appreciate that soil fertility and soil productivity are not necessarily synonymous. Soil fertility as defined by Ingram (1990) is " the capacity of a soil to support plant growth, in which soil chemical, physical and biological properties all contribute to soil fertility". Soil productivity refers to the capacity to produce crops.

The perception of a problem with soil fertility is frequently via a change in productivity in an economically important crop or livestock system, rather than from any direct assessment of the soil itself. Consequently the change in productivity may be due to environmental change or to management change or accumulated effects of both.

It is important to distinguish between a location specific problem which may be soil and geology specific e.g. the low availability of phosphorus on Agro-ecological zone 11.(Usuk sandy farm grasslands). As distinct from those related to an increasing frequency and intensity of cultivation in which more is taken out of the system than is returned.

Studies in eastern and central Uganda have shown negative nutrient balances, mainly due to loss of nutrients in crop harvests and from erosion, plus limited amounts of added nutrients (Wortmann, C.S. and Kaizzi, C.K. 1998).The majority of soils in Uganda are likely to be in nutrient imbalance, particularly given the very low use of mineral fertilisers. The consequences of this imbalance will depend on level of reserves. The recycling nutrients more efficiently together with the increased use of legumes can reduce the rate of decline but cannot replace all nutrients lost.

10. Historical Perceptions of Soil Fertility in Uganda

Jacks (1956) in an address to the British Association for the Advancement of Science made the following statement. "Soil fertility the world over is being exploited mainly for immediate gain and subsistence, and that it is only when there is a shortage of land that fertility is likely to improve. Man will only really start enhancing soil fertility (per se.) when he has the money to do so and that only occurs when most of the population is located in towns and can pay high prices for agricultural produce which will, in turn, pay for the fertilisers and manure". According to Chenery[10] writing in 1960, on this basis Uganda has a very long time to go before any real and lasting improvement to the land can be expected. Chenery also gives a (dated, but informative) review of the status of individual nutrients as follows :

Nitrogen : most soils are rich in nitrate. Total N content varies directly with organic matter content.

Phosphorus : status of Ugandan soils is, on the whole good. P, like total N is closely linked with organic matter, especially for the red soils. The soils of the African Surface are least well supplied with P and deficiency levels are frequently encountered. Deficiency symptoms occur when the Truog figure is below 15 ppm for clays and 10 ppm for sandy soils.

Potassium : Soils of Uganda are adequately supplied with K.

Calcium : Usually in good supply in all soils.

Magnesium Marine deposits are virtually non-existent and Mg rich minerals are not common, consequently soils are naturally rather poor in available Mg. Deficiency syndromes are common in citrus and ornamental trees. Arabica coffee frequently shows well-defined Mg deficiency syndrome consisting of a green herring-bone vein system in a bronze-yellow background. This condition is closely associated with long-established mulching practices, heavy cropping and inherently Mg poor soils. The deficiency is induced by the antagonising effects of excessive supply of available K contained in the mulches which hinder the entry of Mg into the coffee roots (Robinson and Chenery, 1958). Premature leaf fall is probably the most serious effect of Mg deficiency.

Manganese This is universally abundant in Uganda, so much so that often it is present in toxic amounts. Ugandan tea is rich in Mn and correspondingly poor in Fe, possibly responsible for the pale leaf colour.

Sulphur S like Mg is very mobile and most has been leached into swamps. Ugandan top-soils are practically devoid of free sulphate in upland sites and plant growth relies on slow mineralisation of organic S. Old savannah areas are particularly poor in S because of annual grass fires in which S is lost to the atmosphere. Legumes with a high S requirement often fail to grow in these soils. At Kitale economic responses to gypsum were obtained for lucerne and clover. It is believed that the carrying

[10] Chenery E. M. 1960, An Introduction to the Soils of the Uganda Protectorate.

capacity of Trans-Nzoia pastures (eastern and northern Uganda) would be more than doubled by combined applications of S and P.

Zinc Mottled little-leaf syndrome of Z deficiency in citrus often observed.

Boron This trace element is becoming increasingly important as the missing element that will trigger off healthy growth in otherwise worn-out or highly leached soils. Red subsoils are practically devoid of available Bo. Low supplies of topsoil boron have been demonstrated for most of the soils of eastern Uganda and the Lake Victoria littoral. Visible syndromes of vein splitting and suberization have frequently been seen in Eucalyptus plantations in Entebbe and Masaka. Boron deficiency-like symptoms occur sporadically in coffee. The cure for Bo deficiency is to spray with 0.5% borax solution or 10 lb/ acre borax. Dusting seed such as cotton, may eventually be necessary for some areas in Uganda.

Molybdenum : Suspected Mo deficiency has been confirmed in only on instance in a small swamp in Kigezi District.

Cobalt: only identified in one case of deficiency in a pasture in Kigezi.

Copper : Cu. is not deficient in Uganda, but "tonic" effects have been produced with coffee at Kawanda.

In summary from a 1960's perspective soil fertility management was focused on maintaining organic matter status with attention to potential deficiencies in Sulphur, Zinc and Boron.

Chenery's perspective on soil amendments are also informative. According to him very little manure was spread on crops in Uganda because of the prevalent system of night paddocking and kraaling of stock and the disinclination of people to transfer the muck to the fields. The long-term fertility experiments at Serere showed striking benefits from 2.5 tons/ acre which were additive over time. Mills (1960) showed that by manuring the cropping period could safely be extended from 3 years to 4 in a 4 year rotation. Every effort was being made by the Dept of Agriculture to teach cattle owners the value of the droppings of their stock apart from its use as a fuel and mortar.

Between 1940 and 1960 efforts were made to evolve techniques of applying mineral fertilizers to smallholder crops so that better economic returns might be obtained. Economic responses were only obtained for high priced crops such as coffee and perhaps chillies. There is no reliable information on K giving economic responses with any crop.

Later work by Foster (1981) based on 1700 trials throughout Uganda showed that for non-volcanic soils, the availability of Nitrogen, Phosphorus , and base saturation were positively correlated with soil organic matter content. His conclusions supported that of Chenery that for a soil to remain productive it must be managed to ensure that physical properties do not deteriorate and that soil organic matter and nutrients are not lost.

11. Ugandan Soil Survey and Soil Classification

The soil catena concept was developed by Milne (1936) when he was based at Kawanda. He appreciated that the pattern of soil distribution in south Buganda was such that the same soil types occur repeatedly up and down slopes like the links of a chain suspended on posts of equal height. The flat ridge crests of the Buganda Surface corresponded to the posts and slopes and valleys of later erosion cycles to the chain loops. The essential concept of the catena is the repetition of soils in an orderly sequence which may be due to differences in parent material, drainage or both. (NB this is different interpretation from that of a catena developed on a uniform parent material, - which may be the more useful mapping concept).

The idea of a dominant soil type or series was combined with the catena concept because very large mappable areas of Uganda are often the same series. The areas occupied by several members of the same catena are often very small and the catena is virtually two series – the upland and the valley bottom soils. Since the latter are readily delineated from aerial photographs they have usually been separated from the associated upland soils and the mapping units are in fact half catenas. By applying Milne's catena concept and the complete aerial photographic coverage of Uganda was mapped at a scale of 1:250,000. During the course of soil survey operations over 20,000 samples were collected which entailed some 220,000 determinations in the Kawanda laboratories. 138 soil mapping units have been recognised in Uganda, mapped at a scale of 1:250,000 on 17 map sheets. On the basis of the soil maps It is interesting to note that SAARI was located in an unrepresentative soil type.

The Ugandan soil classification system is a geomorphic or geographic system together with the pedogenic system based on the Belgian Congo system. The primary division of soils is based on erosion surfaces. Further sub-divisions based on parent material, including basic and acid rocks; red soils on ancient pre-weathered material; brown soils on old lake deposits and young alluvial and rocky or skeletal soils. In the eastern and western provinces volcanic soils are separated.

The classification and mapping units do not easily translate into the FAO/UNESCO or Soil Taxonomy systems. However they do constitute an information source that should be used to provide additional information and enable results to be extrapolated where possible.

12.Field Methods

Participatory, needs assessments co-ordinated by the Serere Agricultural and Animal Research Institute in the Teso and Lango Farming Systems of Uganda highlighted declining soil fertility as a important concern to farmers (Akwang *et.al*. 1998; Akwang *et.al*. 1999), which echoed similar concerns expressed nationally (Wortman and Kaizzi, 1998). These needs assessments documented three villages where soil fertility concerns were identified by the community. Following consultation with NARO and District Agricultural staff these three villages were selected for detailed field work. The villages were as follows :

Adokar Village	Mukwra Sub-County	Kumi District
Aterai Village	Usuk Sub-County	Katakwi District
Baralegi Village	Okwang Sub-County	Lira District

In each selected village the elected Local Council representatives were asked to classify the residents into three groups according to their perception of relative "wealth". The criteria used in their classification included, area of holding; number of livestock; type of housing etc. This wealth ranking was important to capture within-village differences in access to resources and influences in order to improve targeting of the strategies.
For each group three farming systems based participatory exercises were undertaken, facilitated by a multidisciplinary team, they included :

- Institutional influence mapping, which identified and prioritised institutions influencing natural resource management practices.
- Resource flow diagrams of a representative farm, to record the quantity and quality of resources and flows available.
- Land characterisation, including site and soil characterisation and the collection of samples for analysis.

12.1. Institutional Influence Mapping

Within the context of this study the term "institution" refers to both formal and informal norms, rules, procedures and processes that define the way in which individuals inter-relate and act. As such, institutions do not necessarily have to occur within some structure, or be bounded units with physically defined characteristics in time or space. Bigen (2000) makes reference to five categories of institutions, Familial; Communal; Social; Collective and Policy/ governance institutions.

Familial institutions cover a range of decent or kin-based (clan, lineage tribe) relations and practices. These are the institutions that people draw upon to give meaning and identity to their lives and relationships. While geographic origins may be a part of this identity the institutions are not bound by location.
Communal institutions are grounded on principles of trust and reciprocity that are commonly tied to shared physical or natural resources. Geographic place and location play a role in defining these institutions. *Social institutions* usually embody some principles of trust and reciprocity, but the norms or codes of conduct are derived from a social interest. *Collective institutions* are those in which the relations and practices are defined as contractual. In addition to common property resource

institutions, these include a range of practices and relations concerning various types of production, marketing and distribution activities. *Policy/Governance institutions* consist of constitutional or judicial conditions and stipulations, policies and specific legislation and/or regulations, as well as the norms that guide public action and conduct, including those guiding the programmes of government technical services.
For the purpose of this study it was considered useful to recognise two further types of institutions, namely, *Commercial institutions* consisting of market driven enterprises involving both local entrepreneurs, SME's and large companies operating within liberalised economies and, *Political institutions* such as political parties which are based on the concept of an ideology which may be more or less developed. Approaches to key issues may be expressed in a political manifesto.

These distinctions between institutions provide a framework to aid understanding and analysis but it is recognised that the definitions are not definitive or mutually exclusive.

12.2. METHOD GUIDELINES FOR INSTITUTIONAL INFLUENCE MAPPING

Team composition : Ideally composed of female and male members known and trusted by the target group. Depending on the group type, at least one facilitator and one recorder/observer will be required. Depending on the distribution of groups, it is advisable to include an additional team member who can provide continuity with work in a particular area or target group type. Language skills and familiarity with local issues are essential.

Size of target groups: 10-15 people is the ideal size. This has been found to encourage confidence, debate and avoid exclusion. Larger groups tend to become dominated by a minority; smaller groups can lack confidence. The 10-15 size is easier to facilitate and easier for the recorder/observer to monitor group behaviour and encourage inclusion where necessary.

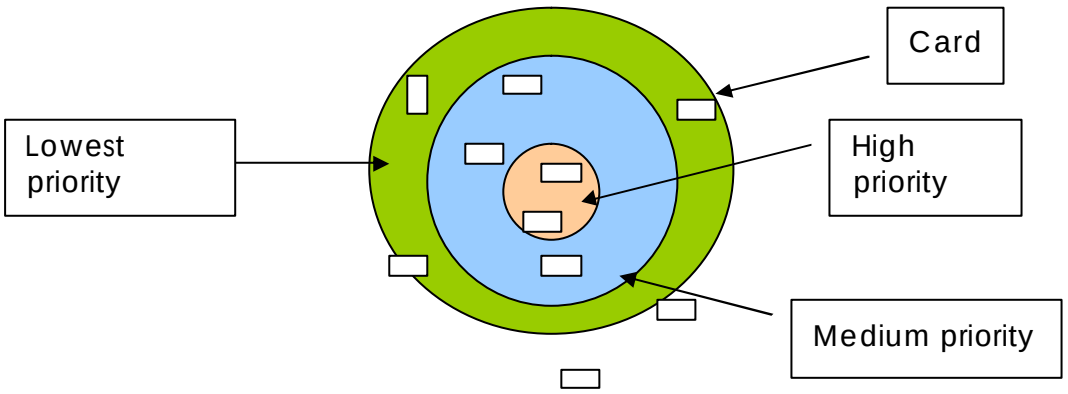
Introductory team meeting/training: At this first meeting discuss and clarify the objectives and options for the methods with the team. Prepare formats, translate key words and concepts as necessary. Prepare reporting materials and assign group roles to individuals. Practice roles in simple role play exercises.

Local staff hold a preliminary meeting: with group representatives. The overall objective should be clearly explained and their co-operation requested. The representatives should be given every opportunity to decline involvement. On the assumption that they wish to proceed, the next step is group selection. Depending on the approach [e.g. in an example from Tanzania, the representatives were asked to select three groups of 10-15 farmers from the 3 wealth categories identified in a previous PRA]. It should be clearly explained that participants would need to attend an introductory meeting and be available for 2-3 hours over the following 3 days. Convenient times for these activities should be discussed.

Introductory meeting for all participants: All the team members are introduced, the objectives should be explained and any questions answered. At this meeting, the schedule for the following 3 days should be arranged and for each group a location/farm should be selected.

Suggested conduct of Individual group meetings

1. The group should be invited to assemble in a circle and the appointed facilitator explains the specific objective. The concept of identifying "influences" [in the widest possible sense] on "soil fertility" and "soil productivity and soil management" should be explained in various ways using a variety of examples. Influence is not the easiest concept to explain and we found that the most useful explanation involved trying to answer the question "what are the kinds of influences on your day to day life ? "
2. When the facilitators were confident that the group understood what is required, the group should be invited to make a **free listing** of all the issues as they occurred to them. These should be recorded on cards, using symbols/words familiar to the group as appropriate, and laid out on the floor in the middle of the circle of participants. [Previous experience has shown a consistent pattern, the first few examples came slowly, until the group developed confidence in the task, when issues were identified more rapidly]. It is important that the facilitators do not judge or comment on the groups' suggestions at his stage or ask any leading questions. The recorder should make duplicate copies of the freely listed issues.
3. After the free listing is complete, the group is invited to consider each card in turn, and ask the question "how important is this land issue in my day to day life? "i.e. they allocate a **priority** to each issue. The group should be asked to place the cards with the greatest priority in the centre of 3 concentric rings which can be drawn on the ground, lowest priority issues should be placed in the outermost ring, and intermediate issues in the middle (see below).The cards should be placed so they are visible to all the group members. The facilitators can withdraw during this process, but should observe if there is any dominance of the decisions from any individuals in the group.



4. After all the cards are allocated their priority, the highest priority cards are considered in turn. The group are asked for specific examples of how a particular land issue influenced their particular circumstances, i.e. they should be asked to **justify** the priority given previously. In a few cases, following discussion some issues may be re-allocated. The individual examples of issues should be recorded as well as any re-allocation of priority.
5. Depending on the number of issues identified, it may be possible solicit examples for each issue. In practice, the priority issues should be concentrated on, plus a few of examples from the lower priorities. From previous experience, the process

from introduction to completion takes 2-2.5 hours, which is about as much concentrated effort as can be expected.

6. Thank the group. The group should be left with a copy of the priority issues and examples if possible.
7. After the first group has carried out the whole process, the team should de-brief and discuss any modifications/improvements to the methodology as might be necessary. For example, it might be appropriate for the team members to exchange roles. Subsequent group work can be facilitated by giving one or two examples of issues identified by the initial group to speed the process or give examples of symbols, etc., but care should be taken not to unduly influence the result.

In summary the method involves three steps:

- Free listing of issues
- Prioritisation of issues
- Justification of issues

The method can produce reasonably robust and replicable results in a format appropriate for analysis of the importance of issues and identification of possible differences between group categories. Another advantage is the possibility of reporting the findings effectively and succinctly, while avoiding some of the limitations of less consistent narrative descriptions. Finally, the method also provides a clear entry point for further joint activities.

12.3. Resource flow mapping

This was carried out according to the procedures described in Defoer and Budelman (2000) on a farm selected as representative by the group. Using a participatory approach the farmer was invited to draw her holding and indicate with quantities where possible the distribution of resources and resource flows. Resource flow maps (RFMs) were initially developed by Lightfoot *et al*[11] (1989) and have been widely used by ICLARM in SE Asia, Malawi and elsewhere to analyse flows of resources in aquacultural and agricultural systems at the farm level.

Resource flow diagrams help to examine the movement of resources around the farm. They are particularly useful for assessing the wider impact of a change to a specific part of the farming system. For example, if a new enterprise is undertaken, what resources will it require and how will this impact on the other enterprises on the farm which compete for those resources? How will the introduction of a new technology affect these resources flows and the rest of the farming system? If flows of resources into and away from the farm are included on the diagram the impact of changes in the external environment can also be assessed. RFMs have also been used to assess the sustainability and performance of farming systems using the indicators of bio-diversity (number of enterprises), input-output balance, efficiency, and recycling (for example number of bio-resource flows)[12].

[11] Lightfoot, C; De Guia, O. Jn.; Aliman, A. ; Ocado, F., 1989. System diagrams to help farmers decide in on-farm research. In Farmer First : Farmer Innovation and Agricultural Research. pp 93-105. (Eds. R. Chambers, A. Pacey and L.A. Thrupp). Intermediate Technology Publications, London.

[12] Lightfoot, C. Dalsgaard, J.P. and Bimbao, M. A. 1993. Farmer Participatory procedures for managing and monitoring sustainable farming systems. Journal of the Asian Farming System Association, 2:1, 66-87.

12.4. METHOD GUIDELINES FOR RESOURCE FLOW MAPPING

1. The members of the team are introduced, the objectives, procedure and expected outputs explained.
2. A suitable place should be selected by the farmer for drawing the map. It is important to ensure that the head of the household and active household members were present. The materials should be explained, A1 size card, coloured pens and symbols. An example map drawn by another farmer in the same village can be shown as a guide.
3. The household head is invited to draw the field boundaries including any fields that were separate from the main homestead. An inventory of the household and animal production systems (food stocks; waste heaps; kind and number of animals) was made and these features should be drawn on the map.
4. All of the present crops were identified and drawn on the map using a standard key.
5. The yield and destination of last years crop produce, livestock products and crop residues should then be estimated and added to the map. The respondents were then asked to identify and illustrate the use of fertiliser materials on different fields and crops giving estimated quantities (all quantities related to the same time-scale i.e. a year) Any other external nutrient inputs and outputs should then identified and included.
6. The completed map can be analysed and discussed by the group, and preliminary possibilities for improving soil fertility management discussed.
7. A copy of the map should be made, and the original retained by the farmer.

12.5. Site and Soil characterisation

Soil profiles were described and sampled from representative catenary sequences and areas with different land use histories to support the resource flow exercise. A GPS receiver was used to plot the location of sample sites and field boundaries within a GIS.

12.6. METHOD GUIDELINES FOR SITE AND SOIL CHARACTERISATION

1. On arrival at the farm a knowledgeable informant should guide the team on a rapid tour of the farm boundaries. Most farms will be located on a predominant slope (however slight) and the overall arrangement of the farm and its position in the landscape can be judged. At each of the corners of the farm the location should be recorded using a GPS receiver.
2. Using the information gained from the tour 3 to 4 positions should be selected to give a representative samples from the top to bottom of the slope.
3. At each of these positions, which may be located in cultivated fields or fallow a soil auger is used to auger to the depth of a limiting horizon. The position chosen to auger should be selected with care to avoid any unrepresentative features such as termite mounds, old hut sites etc.
4. The augered sample should be carefully laid out on a plastic sheet and the following observations recorded : Location; Land Use/Cover; Slope Position; Evidence of Erosion; Surface characteristics and Depth. For each individual soil horizon identified the following should be recorded : Depth range; Munsel soil colour (moist); hand determined texture; drainage status; stone content and any other relevant comment. This information was recorded on a prepared form.

5. After describing each horizon the approximately 0.5 kg of soil should be placed in a sample bag and clearly labelled for subsequent laboratory analysis.
6. At each site in addition to the auger description a "soil fertility assessment" sample can also be taken using the following procedure. Using a spade approximately twenty samples of the top 10-15cm of soil should be taken from randomly selected locations over the sample field or fallow area. These should be mixed well together and a single sub-sample of approximately 0.5 kg selected and labelled for subsequent laboratory analysis.

12.7. Soil Analysis

Soil samples were analysed at Kawanda Agricultural Research Institute laboratories using the following procedures. The soil samples were dried, and later analyzed for texture, total N, available P, exchangeable K+, Ca2+, Na+, organic matter and pH using standard laboratory methods. Texture was determined by the hydrometer method, exchangeable bases and phosphorus were extracted with excess of ammonium lactate solution at pH 3.8 (Foster, 1972) and the exchangeable Ca2+, K+ and Na+ cations determined by a flame emission while Mg2+ was determined by Atomic Absorption Spectrophotometry (AAS). Total nitrogen was determined by the micro-Kjeldahl technique. Organic carbon was determined by Walkley and Black (1934) with chromic acid titration method and the value obtained multiplied by 1.729 to give percentage organic matter. Soil pH was measured in a 1:2.5 soil:water ratio using a pH electrode (Okalebo *et al*., 1993). Effective cation exchange capacity (ECEC) was determined following displacement of Ca2+, Mg2+, K+, Na+ and exchangeable acidity with 1M KCl. These are summed to give ECEC.

13.Fieldwork Results Adokar

Adokar Village	Mukwra Sub-County	Kumi District

13.1. Village Wealth Ranking Criteria

These are shown in the following Table.

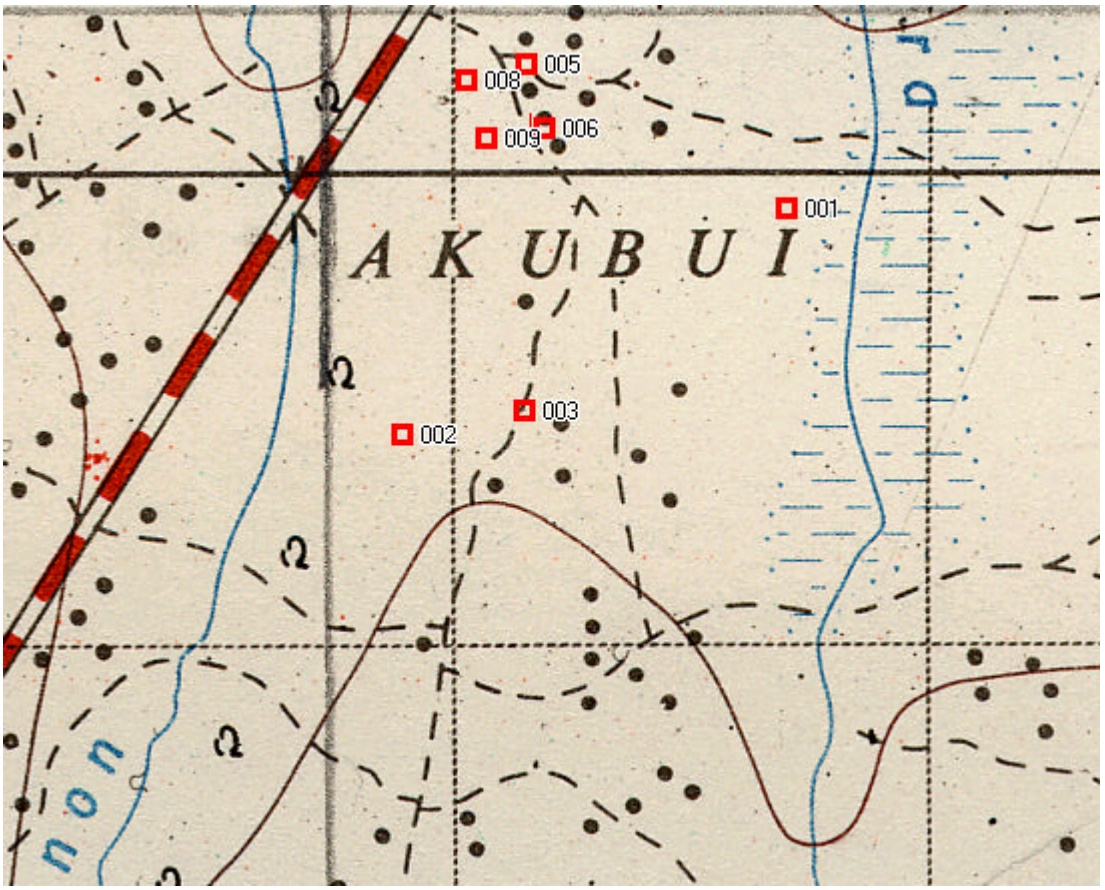
TABLE 3.1 .

Adokar Village : Group Criteria
Total Number of Households = 65
Group A : 44 % of village households • Many cattle • Large area of land • Owns a plough • Owns a bicycle or motorcycle • Iron roofed house • Enough food through-out the year • Have a business or are employed
Group B : 28 % of village households • Two or less cattle • Around 2-5 acres of land • Some have bicycles • A few goats
Group C : 28 % of village households • No cattle or goats • No land or only small garden • Only use hand hoes, no access to ploughs • Many children • Regularly hires out labour

13.2.Location

Adokar Village	Mukwra Sub-County	Kumi District

As shown on the following Map.



PART OF KAPIRI 1:50,000 TOPOGRAPHIC MAP (Series Y732, Sheet 43/4, Edition 1-U.S.D.) SHOWING ADOKAR SAMPLE SITES

POINT 001 ADOKAR GROUP C SAMPLE FARM
POINTS 002-003 ADOKAR ONE SIDE OF GROUP B SAMPLE FARM
(the distance between points is approximately 260m)

POINTS 005,006,008 and 009 ADOKAR CORNERS OF GROUP A SAMPLE FARM
(location co-ordinates are given on site characteristic sheets)

13.3. Institutional Influence Mapping, A

The Group A institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP A Adokar village Kumi District

TABLE 3.2

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Elders	Local leaders (LCs/chiefs)	Drinking groups
Parents	Women /youth Groups	Neighbours/friends/relatives
Radio	Vision Terudo (NGO)	
Research	Church	
Agricultural Extension		
School		

Group consisted of 20 people (11 men and 9 women).

JUSTIFICATIONS OF PRIORITY RANKING

Elders

- Advise on taking manure to fields
- Advise on planting/retaining grass bands which stop water taking the soil
- Discourage cutting trees as this would accelerate erosion
- Show boundaries such that people do not cross them and minimise conflicts

Radio

- Advise against burning indiscriminately
- Pass on information about conservation the environment by not cutting trees which serve as wind breaks
- Give information on source of seed and encourage farmers to use improved seed
- Pass on advice of planting time, encourage early planting and planting in rows. Give information on when the rains are expected.

Extension workers

The agricultural staff were reported to influence farmers through teaching them on the following issues :-

- Crop rotation, fallow, mulching and preserving grass bands
- Proper spacing for crops like maize, g/nuts and cassava, and early planting
- Advise on proper method of crop production e.g. use of improved varieties and crop protection (information on spraying regimes).
- Advise on the use of manure
- Provide seed (soya beans, maize, sunflower and cotton)

Researchers

- Give information on crop rotations
- Source of improved seed (Igola 1 groundnuts, Migyera and SS4 cassava, and Sekedo sorghum.

Parents

- Show boundaries and do not allow children to plough beyond these boundaries
- Advise on specific crops suitable to specific pieces of land and encourage rotation
- Advise on resting land and applying manure

- Advise on proper land preparation i.e plough twice with intervals between to allow organic materials to decompose

School
- Advise not to leave land without cover and to plant with cover crops.
- Advise people to scatter crop residues all the field rather than leaving it heaped in one corner of the field
- Children learn the need to protect the environment and transfer knowledge on farming to family members
- Teach children on nursery management, proper spacing and high yielding varieties

Church
- Advise people to preserve seed for next season's planting
- Teaching people to keep within boundaries when ploughing so as to avoid land disputes
- Advise to keep grass bands to stop water taking soil

Local leaders (LCs/Chiefs)
- Advise leaving grass bands for erosion control along the road and between the fields
- Advise against burning of bushes which exposes soil to wind erosion in addition to denying it manure from crop residues
- Mobilise community to weed the road

Vision Terudo
- Brings improved planting material (Cassava)
- Encourage the planting of trees, use of improved seed and row planting

GROUP A PERCEPTIONS ON SOIL FERTILITY

Fertility was reported to have declined over the past ten years. This is attributed to the high population in the area that has resulted in reduction in land area available to households and of continuous cultivation of fields every season with minimal or no resting/fallow periods. The increased prevalence of *striga* in crop fields is viewed as an indicator of reduced soil fertility.

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP A
- Reinforce and maintain appropriate crop rotations.
- Increase fallow periods where possible. However, this was viewed as difficult because the fallow period has already been reduced from 2-3 years in the 1980s to only one season if any at present.
- Apply manure. Mainly homestead waste, chicken waste and goat droppings. However this option is limited by reduction/loss of animals hence most people do not have kraals to collect the manure.

13.4. Institutional Influence Mapping, B

The Group B institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP B, Adokar village, Kumi District

TABLE 3.3

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Elders	School	Drinking groups
Parents	Youth group	Send A Cow (NGO)
Neighbours/friends/relatives	Adult literacy campaigns	Co-operative society
Research	Forestry	Traders
Agricultural Extension	Women Groups	
Church		
Health		
Local leaders (LCs/chiefs)		

Group consisted of 18 people (10 men and 8 women).

JUSTIFICATIONS OF PRIORITY RANKING

Elders

- Teach youth how to use land
- Knowledge of which kind of crops grow well on a particular piece of land

Neighbours

- Advise against not growing the same crop on the same piece of land (crop rotation)
- Teach soil conservation methods e.g. making ridges and grass bands
- Advise farmers not to go beyond their boundaries when ploughing hence maintaining the bands.

Extension workers

The agricultural staff were reported to influence farmers through teaching them :-

- Proper use of land to prevent soil erosion
- Advise on proper method of crop production e.g. use of improved varieties and crop protection (information on spraying regimes).
- Advise on the use of manure
- Advise against applying fresh ash on the fields

Researchers

- Farmers attended tour of research station and are trained on various topics.
- Source of improved seed (Igola 1 groundnuts, Migyera and SS4 cassava, and Sekedo sorghum).

Parents

- Decide on land allocation for children,
- Allocate specific crops to specific pieces of land
- Advise on proper care of land during ploughing e.g. leaving some parts unploughed at the end of a piece of land so as to prevent erosion.

Health workers

- Keeping you healthy for effective work (giving treatment for people to remain healthy /avoid falling sick which would prevent them from carrying out farming activities).

- Advise on proper sanitation to avoid diseases
- Teach general cleanliness in the fields and homes

Church
- Church leaders teach on proper land use patterns and make useful announcements regarding source of information on agriculture after service.
- Teaching people to keep within boundaries when ploughing so as to avoid land disputes
- Preach against working on Sunday

Local leaders (LCs/Chiefs)
- Advise leaving grass bands for erosion control along the road and between the fields
- Advise against burning of bushes
- Advise on selective cutting of trees

School
- Children learn farming at school. i.e. how to prepare land and plant crops
- Children transfer knowledge on farming to family members
- Teach children on nursery management and timing of different crops
- School children taught to grow cabbage and tomatoes and how to use manure.

Forestry staff
- Teach farmers on important trees in land conservation
- Teach the importance of trees in influencing rainfall patterns
- Encourage the planting of 3 seedlings on cutting one tree

Youth groups
- They search for information from neighbouring areas on proper use of land
- Work together in Aleya groups hence share information
- They have energy to clear forest land/bushy land

Adult Classes
- Teach adult people how to read and write
- Taught soil conservation methods
- Taught preservation of grass strips on garden boundaries for use in thatching houses and erosion control from running water

13.5. Institutional Influence Mapping, C

The Group C institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP C Adokar village Kumi District
TABLE 3.4

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Elders	LCs	Drinking groups
Family members	Church	Forestry
School	Health	Neighbours/friends/relatives
Research	Chiefs	Youth group
Agricultural Extension	Red Cross	
	Co-operative society	

Group consisted of 20 people (11 men and 9 women).

JUSTIFICATIONS OF PRIORITY RANKING

Elders

Elders were reported to always be easily accessible for information and :-

- Advise people to apply manure (take rubbish to the garden not just around the compound).
- Advocate for crop rotation and leaving grass strips/bands to control erosion.

Family Members

- Head of family decides on operations on the farm
- How to make compost manure and spread it
- Provide labour for maintenance of bands

School

- **Learn re**ading and writing
- Learn farming and handwork
- Children transfer knowledge on farming to family members
- School children taught to grow cabbage and tomatoes and how to use manure.

Researchers

- Create awareness of agricultural problems e.g. soils. Recommends possible interventions and tests them for people to see outcome
- Source of improved seed (I gola l groundnuts, Migyera and SS4 cassava, and Sekedo sorghum.

Extension workers

The agricultural staff were reported to influence farmers through teaching them :-

- Crop rotation
- Proper spacing and general agronomy.
- Crop protection and making compost to enhance soil fertility

LCs

LCs were reported to influence through:

- Enforce leaving grass bands for erosion control along the road and between the fields

Church

- Grow crops near the church (demonstration plots) for members to learn from

- Advise on proper farming practices for instance leaving grass bands

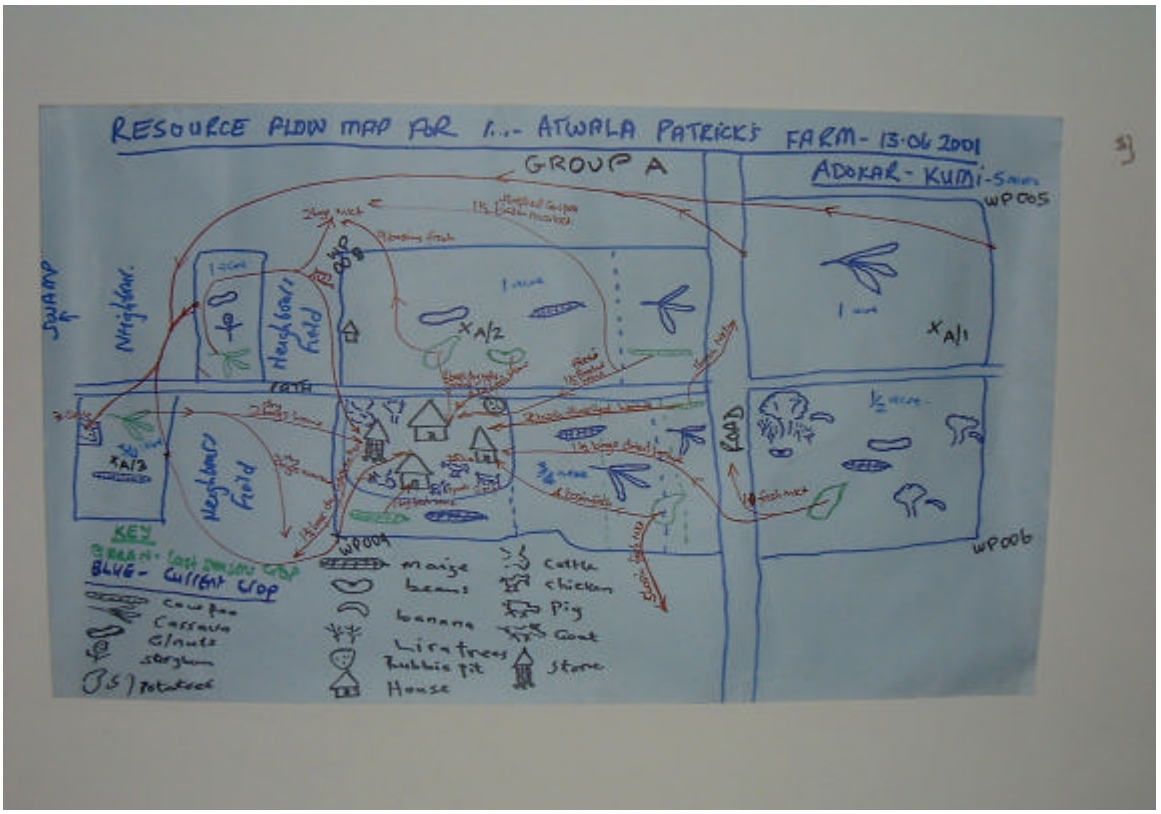
Health workers
- Keeping you healthy for effective work (avoid falling sick which would unable them to carry out farming activities).

Chiefs (Civic leaders)
- Enforce leaving grass bands for erosion control along the road and between the fields
- Enforce by-laws against burning
- Mobilising people for meetings

Red cross
- Provide improved seed e.g sunflower, simsim, cassava and beans
- Provide information on row planting

Co-operative society
- Distribution of cotton seed
- Marketing of cotton
- Used to sell artificial fertiliser in the 1960s and 1970s.

13.6. Resource Flow Diagram Adokar Group A



Resource flow map Adokar, Group A
Name of farmer: Atwala Patrick
Land available: 5 acres (approx)
Educated : senior two, one wife, two children and a mother
Livestock : 7 cows, 2 pigs, 3 goats

Current crops grown: cassava, cowpea, sweet potatoes, maize, groundnuts and beans. Last seasons cropping and yields:- Millet 1st plot – 4 bags total (dried), 2 bags for home consumption and 2 bags sold. 2nd plot – 6 bags – 2 bags for consumption and 4 bags sold. Sweet potatoes: - 9 basins (fresh) to market, and 4 bags (dried) for home use. 2nd plot – 1 ½ bags dried – home use, I bag fresh to market . Beans – 4 kilos (fresh) for home consumption. Cowpea, 1st plot – 3 basins (threshed) – 1 ½ for consumption. 1 ½ was sold (market). 2nd plot — 1 basin sold market, 2 basins consumed. Maize: 1 bag fresh to market.

Manure from rubbish pit applied under banana plants. Grass from bands used for feeding animals. Animals are tethered on fallow land. Before putting up his own kraal, he was collecting animal manure from neighbour's kraal to his fields with aim of improving his soil fertility. Goats and chicken waste is occasionally poured onto fields. He practices crop rotation, typically sweet potatoes, groundnuts, sorghum, and cowpea.

Other management practices include, after sweet potatoes harvest, remaining vines fed to animals and balance left to rot in field. After cassava harvest, stem either planted or left to dry and used as firewood.

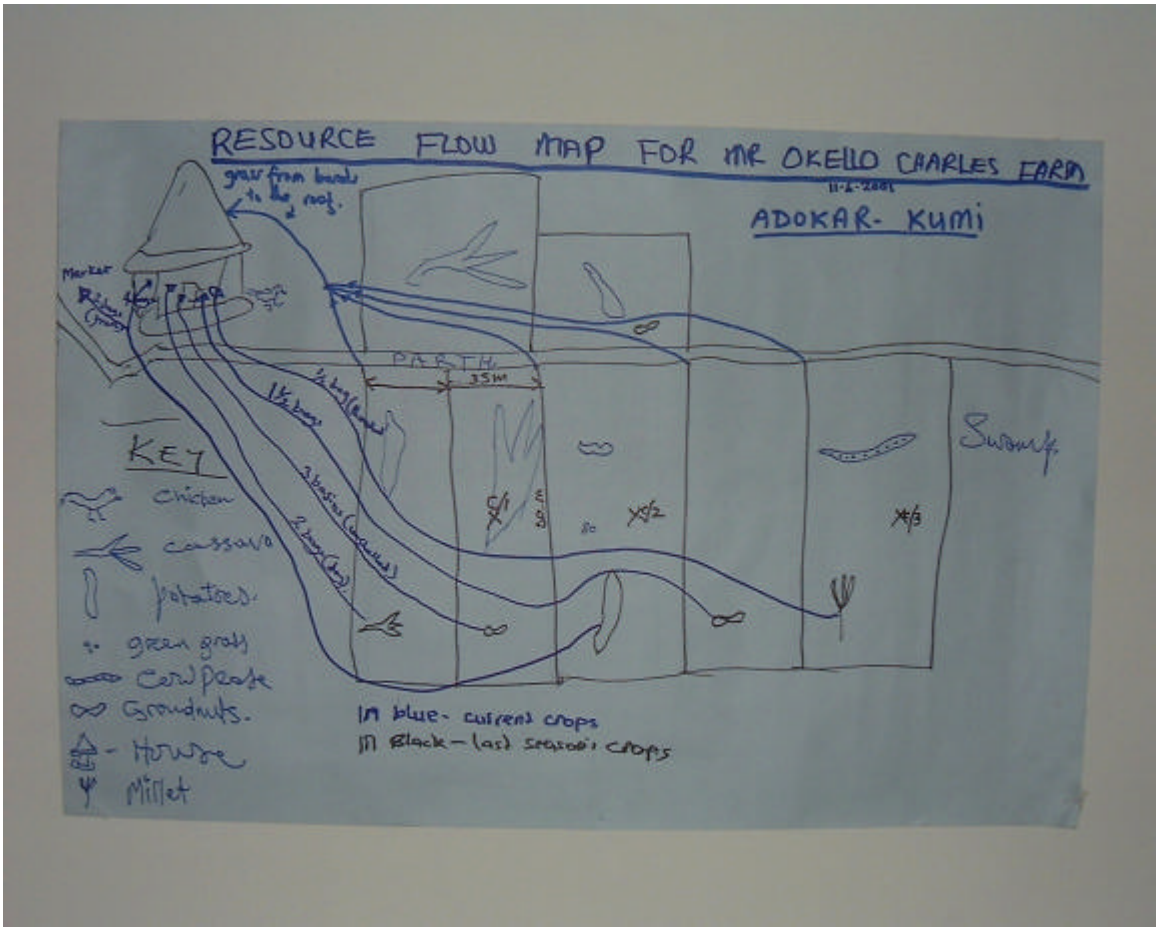
13.7. Resource Flow Diagram Adokar Group B



Resource flow map Adokar, Group B
Name of farmer: Aogon David, slightly educated, primary seven one wife 3 children and a mother.
Land availability: Approximately 6 acres
Livestock : 2 oxen, 3 ducks, 1 pig with five piglets, 1 goat.

Current cropping: Cassava, sweet potatoes, groundnuts, cowpeas, bambara nuts (most of them intercropped).

13.8. Resource Flow Diagram Adokar Group C



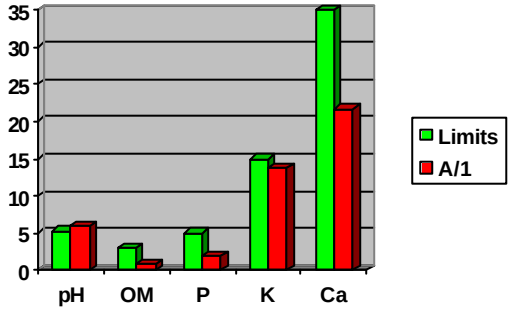
13.9. SOIL FERTILITY ANALYSIS

The following graphs are identified by a group letter and site number which provides a link to the resource flow diagrams and sample site characteristic information. The maximum auger depth, surface and subsurface textural class are also given. The vertical "y" axis shows soil property values. The horizontal "x" axis gives the critical fertility limits (in green) as defined by Kwanda Agricultural Research Institute as follows :

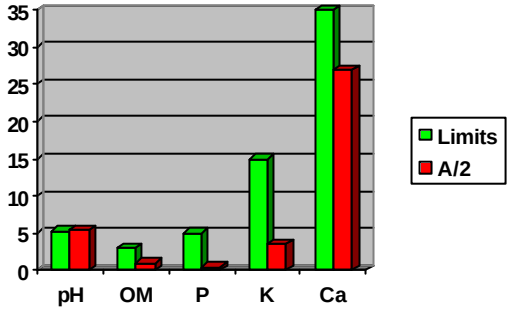
pH	(acidity/alkalinity)	5.2
OM	(organic matter)	3.0 %
K	(potassium)	15.0 mg/100g
Ca	(calcium)	35.0 mg/100g
P	(available phosphorus)	5 ppm

These critical limits are paired with the results of the site sample analysis (in red) to aid comparison.

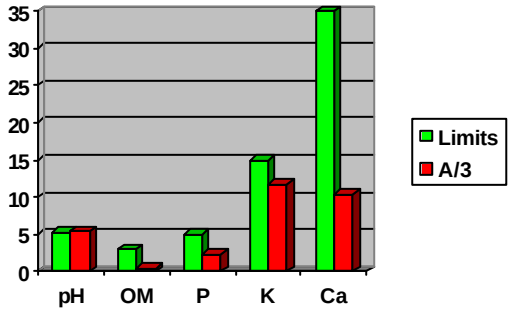
Adokar A/1, **90cm, L Sa/SaC**



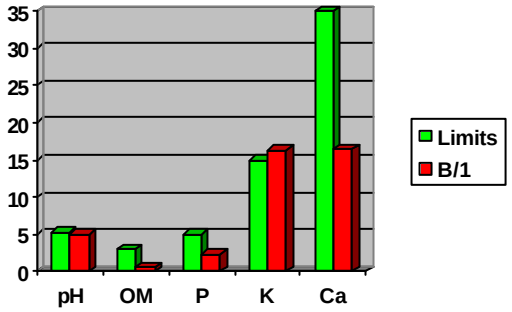
Adokar A/2, **50cm, Sa/LSa**

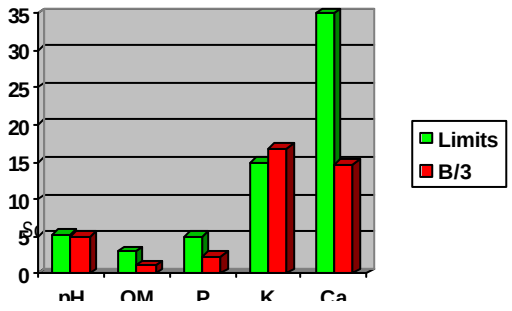


Adokar A/3, 105cm +, Sa/SaCL

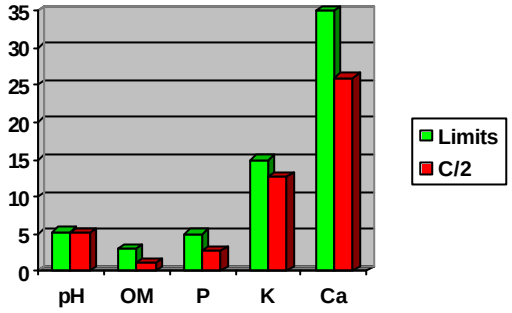


Adokar B/1, 84cm, Sa L/SaC

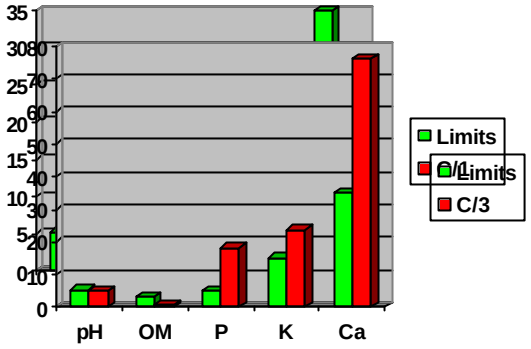




Adokar B/3, 62cm, L Sa/SaCL



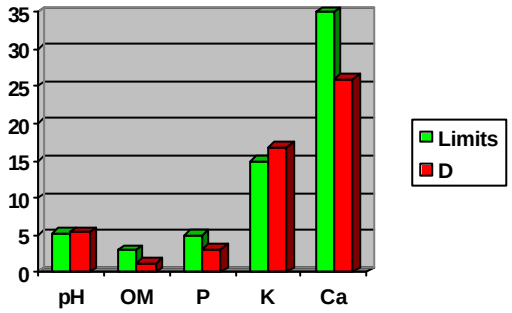
Adokar C/1, 85cm, Sa/SaCL



Adokar C/2, 62cm, LSa/SaCL

Adokar C/3, 94cm, SaL/SaC

Adokar D, 84cm, LSa/SaCL



13.10. Sample Site Characteristics

These are shown in standard format in the following section.

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Group A sample farm	DATE 13/06/01
GPS WAYPOINT No. 005 A/1	Lat 1.5373012, Long 33.8379268 1091m
LAND USE / COVER Cassava, moderate to good vigour Upper sample site Mapped as Mapping Unit 61 Amuria on 1: 250,000 soils map.	
SLOPE POSITION Upper-slope/crest SLOPE 2 %	EROSION Weed cover/ very slight sheet erosion
SURFACE Weeds Composite surface (0-10cm) sample taken from cassava field	DEPTH (max auger) 90cm stopped by laterite

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	A/1/1 Adokar	7.5YR 3/2	m L Sa >Sa L	Slightly restricted drainage	none	
20-60	A/1/2 Adokar	10YR 4/3	m SaC	Restricted	none	
60-90	A/1/3 Adokar	10YR 4/4	m SaC	Restricted	Few weathering stones	lateritic gravels below 90cm

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	5.7	1.3	3.03	26.5	1.39	43.3	79.1	12.3	8.6
20-60	5.5	1	0.76	14.2	3.71	107.5	53.1	38.3	8.6
60-90	6.7	0.9	12.50	14.2	3.01	713.4	63.1	34.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Sample site A/2	DATE 13/06/01
GPS WAYPOINT No. 008 A/2	Lat 1.5369912, Long 33.8367885, 1095m
LAND USE / COVER G-nut and a few inter-cropped sorghum, moderate vigour Upper-mid sample site Mapped as Unit 61 (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Upper mid - slope SLOPE 2 %	EROSION Very slight sheet
SURFACE Some surface wash Composite surface (0-10cm) sample taken (A/2)	DEPTH (max auger) 50 cm stopped by lateritic gravel

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-22	A/2/1 Adokar	10 YR 3/4	m Sa	Well drained	None	
22-50	A/2/2 Adokar	7.5 YR 3/2	m Sa L	Well drained		Lateritic gravel beyond 50cm

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-22	5.2	0.6	1.52	4.1	1.62	18.2	91.1	6.3	2.6
22-50	4.8	1.2	1.14	2.5	2.67	15.6	75.1	20.3	4.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Group A sample farm	DATE 13/06/01
GPS WAYPOINT No. 009 A/3	Lat 1.5358916, Long 33.8371814, 1090m
LAND USE / COVER Poor cowpea Lowest sample site Mapped as Unit 61 (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Lower-slope adjacent to hydromorphic grassland SLOPE 2 %	EROSION Some surface wash
SURFACE Loose separated sand Composite surface (0-10cm) sample taken from field Large macro termite mound adjacent sampled, very hard.	DEPTH (max auger) 105 + cm (no restriction)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-28	A/3/1 Adokar	10YR 4/3	Sa	Very slightly restricted	None	
28-50	A/3/2 Adokar	10YR 5/3	L Sa	Restricted	None	
50-60	A/3/3 Adokar	10YR 5/2	Sa L	Poorly drained	None	
60-105	A/3/4 Adokar	10YR 5/2 + mottles	Sa CL	Very poorly drained		Strongly gleyed and mottled

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-28	5.2	0.3	0.15	6.6	0.93	8.7	95.1	2.3	2.6
28-50	4.8	0.3	1.89	7.1	1.16	13.0	85.1	10.3	4.6
50-60	4.9	0.4	0.08	6.6	1.39	22.5	77.1	20.3	2.6
60-105	5.4	0.5	0.38	14.2	0.70	64.1	61.1	34.3	4.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Group B sample farm	DATE 12/06/01
GPS WAYPOINT No. 002 B/1	Lat 1.5301865, Long 33.8355814, 1096m
LAND USE / COVER Ratooned cassava, moderate to good v igour Lowest sample site 150m downslope of sample B/2 Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map. Owner claims field is more productive than upper slope sites	
SLOPE POSITION Lower slope position 75m from edge of hydomorphic grassland. SLOPE 2 %	EROSION Slight surface wash.
SURFACE Slight separation of coarse fraction Composite surface (0-10cm) sample taken from cassava field	DEPTH (max auger) 84cm + stopped by hard dry compact nature of horizon.

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-18	B/1/1 Adokar	7.5YR 3/2	m SaL	Well drained	none	
18-42	B/1/2 Adokar	10YR 3/4	m SaC	Restricted	none	
42-62	B/1/3 Adokar	10YR 5/4	m SaC	Poorly drained	none	increasingly hard and compact with depth, but dry, horizon that might restrict water and root growth, possibly low infiltration of water
62-84		Common mottles 5YR 4/8		Very poorly drained		

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-18	5.4	1.2	2.27	19.8	0.70	28.6	75.1	18.3	6.6
18-42	5	1.2	0.38	7.1	1.51	31.2	57.1	40.3	2.6
42-62	4.9	0.6	0.38	8.1	1.51	36.4	47.1	50.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Group B/2 sample farm	DATE 12/06/01
GPS WAYPOINT No. 002 B/3	Lat 1.5301865, Long 33.8355814, 1096m
LAND USE / COVER G-nuts Mid - sample site 50m slightly down slope of sample B/3 Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Near crest SLOPE 1 %	EROSION V. slight surface wash.
SURFACE 90% gnut cover No composite surface sample taken	DEPTH (max auger) 40 cm stopped by lateritic gravel

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-22	B/2/1 Adokar	7.5YR 3/2	m LSa	Well drained	none	
22-40	B/2/2 Adokar	7.5YR 3/2	m SaCL	Well drained	none	laterite observed at surface in nearby eroded path, but no evidence of restricted drainage in the profile

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-22	4.8	0.7	1.52	11.7	0.70	10.4	83.1	14.3	2.6
22-40	4.5	1.1	0.38	5.6	1.28	13.0	69.1	28.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Adokar Village, Mukura S-County, Kumi District Group B/3 sample farm	DATE 12/06/01
GPS WAYPOINT No. 003 B/3	Lat 1.5306721, Long 33.8379123, 1088m
LAND USE / COVER G-nuts and green gram intercrop,moderate vigour, aphids on green gram pods. Upper sample site 50m up slope of sample B/2 Mapped as Unit 61 (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Crest SLOPE 1 %	EROSION V. slight surface wash.
SURFACE Slight separation of coarse fraction Composite surface sample taken	DEPTH (max auger) 62 cm stopped by lateritic gravels

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	B/3/1 Adokar	7.5YR 3/2	m L Sa	Well drained	none	
20-60	B/3/2 Adokar	5YR 3/3	m Sa CL	Well drained	none	laterite observed at surface in nearby eroded path, but no evidence of restricted drainage in the profile

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	4.9	0.9	3.79	17.8	0.81	14.7	83.1	14.3	2.6
20-60	5.1	0.6	1.14	7.6	0.93	31.2	69.1	22.3	8.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Mr Charles Okelo's farm Adokar Village, Mukura S-County, Kumi District	DATE 11/06/01
GPS WAYPOINT No. 001 C/1	Lat 1.5345132, Long 33.8429016, 1101m
LAND USE / COVER Cassava, poor growth Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map	
SLOPE POSITION Midslope, upper sample of 3 in slope sequence SLOPE 3 %	EROSION Slight sheet erosion.
SURFACE Some surface accumulation of fine sand.	DEPTH (max auger) 85 cm stopped by weathering rock

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	C/1/1 Adokar	7.5YR 3/2	m LS	Well drained	none	
20-50	C/1/2 Adokar	7.5YR 3/2	m SaL+	Well drained	none	
50-70	C/1/3 Adokar	7.5YR 4/2	m SaCL	Very slightly restricted	none	
70-85		5YR 3/4			start of weathered rock (grus)	Small outcrop of granitic rock near

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	5.1	0.4	1.89	15.3	0.47	20.8	89.1	10.3	0.6
20-50	4.6	1.2	0.38	9.2	1.28	29.5	73.1	24.3	2.6
50-70	4.7	1.1	0.00	7.6	1.05	15.6	71.1	26.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Mr Charles Okelo's farm (Group C) Adokar Village, Mukura S-County, Kumi District	DATE 11/06/01
GPS WAYPOINT No. 001 C/2	Lat 1.5345132, Long 33.8429016, 1101m
LAND USE / COVER Groundnut, medium vigour Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map	
SLOPE POSITION Lower- Midslope 40 m downslope of C/2 SLOPE 3 %	EROSION Slight sheet erosion on areas exposed between plants
SURFACE Some surface accumulation of fine sand between plants	DEPTH (max auger) 62 cm stopped by weathering rock

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-10	C/2/1 Adokar	10YR 3/2	m L Sa	Well drained	none	
10-36	C/2/2 Adokar	10YR 3/2	m Sa CL	Well drained	none	
36-57	C/2/3 Adokar	10YR 4/2	m SaCL	Very slightly restricted	none	
57-62		5YR 3/2			start of weathered rock (grus)	Small outcrop of granitic rock near

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-10	5.3	1.1	1.52	11.2	0.24	26.0	87.1	10.3	2.6
10-36	4.9	1.3	0.38	8.6	0.70	37.3	75.1	22.3	2.6
36-57	4.8	1.5	0.38	6.6	0.58	22.5	65.1	32.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Mr Charles Okelo's farm Adokar Village, Mukura S-County, Kumi District	DATE 11/06/01
GPS WAYPOINT No. 001 C/3	Lat 1.5345132, Long 33.8429016, 1101m
LAND USE / COVER Recently ploughed (ox hire for U.Sd. 10,000) with the intention to plant cowpeas Lowest sample site 60m downslope of sample C/2 Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map	
SLOPE POSITION Edge of hydomorphic grassland, lower slope. Cultivation further into area risks loss of crops in heavy rain. SLOPE 2 %	EROSION Recently cultivated
SURFACE Ploughed surface, dark coloured compared to upper fields.	DEPTH (max auger) 94 cm stopped by weathering rock

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-15	C/3/1 Adokar	10YR 2/1	Sa CL	Well drained	none	
15-50	C/3/2 Adokar	10YR 2/1	Sa CL	Very slightly restricted	none	
50-80	C/3/3 Adokar	10YR 3/1	Sa C	Restricted	none	
80-94		Common mottles		Restricted	start of weathered rock (grus)	Small outcrop of granitic rock near

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-15	5.3	3.7	29.55	38.2	0.81	96.2	61.1	22.3	16.6
15-50	5.4	3.2	13.26	25.9	1.51	90.2	53.1	32.3	14.6
50-80	5.7	1.5	5.68	24.4	4.05	78.0	53.1	36.3	10.6

SAMPLE SITE CHARACTERISTICS						
LOCATION Adokar Village, Mukura S-County, Kumi District LC1 Chairpersons farm sample D			DATE 13/06/01			
GPS WAYPOINT No. 010 D			Lat 1.5152256, Long 33.8357330, 1120m			
LAND USE / COVER Intercropping, finger millet, pearl millet and maize, moderate vigour Upper-mid sample site Mapped as Unit 61(Amuria catena) on 1: 250,000 soils map.						
SLOPE POSITION Upper-slope/ broad crest SLOPE 2 %			EROSION Very slight sheet			
SURFACE Irregular surface from land preparation Composite surface (0-10cm) sample taken			DEPTH (max auger) 84cm stopped by lateritic gravel			
HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-28	D/1	7.5 YR 3/2	L Sa	Well drained		
28-56	D/2	5 YR 3/4	Sa C	Well drained		
56-78	D/3	5 YR 4/6	Sa C	Well drained		Lateritic gravels beyond 78 cm

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-28	4.6	1.1	1.52	14.8	0.58	17.3	83.1	12.3	4.6
28-56	4.6	1.3	1.14	10.7	0.58	20.8	61.1	32.3	6.6
56-78	4.8	1	1.52	8.1	0.93	18.2	61.1	38.3	0.6

14. Fieldwork Results Aterai

Aterai Village	Usuk Sub-County	Katakwi District

14.1. Village Wealth Ranking Criteria

These are shown in the following Table.

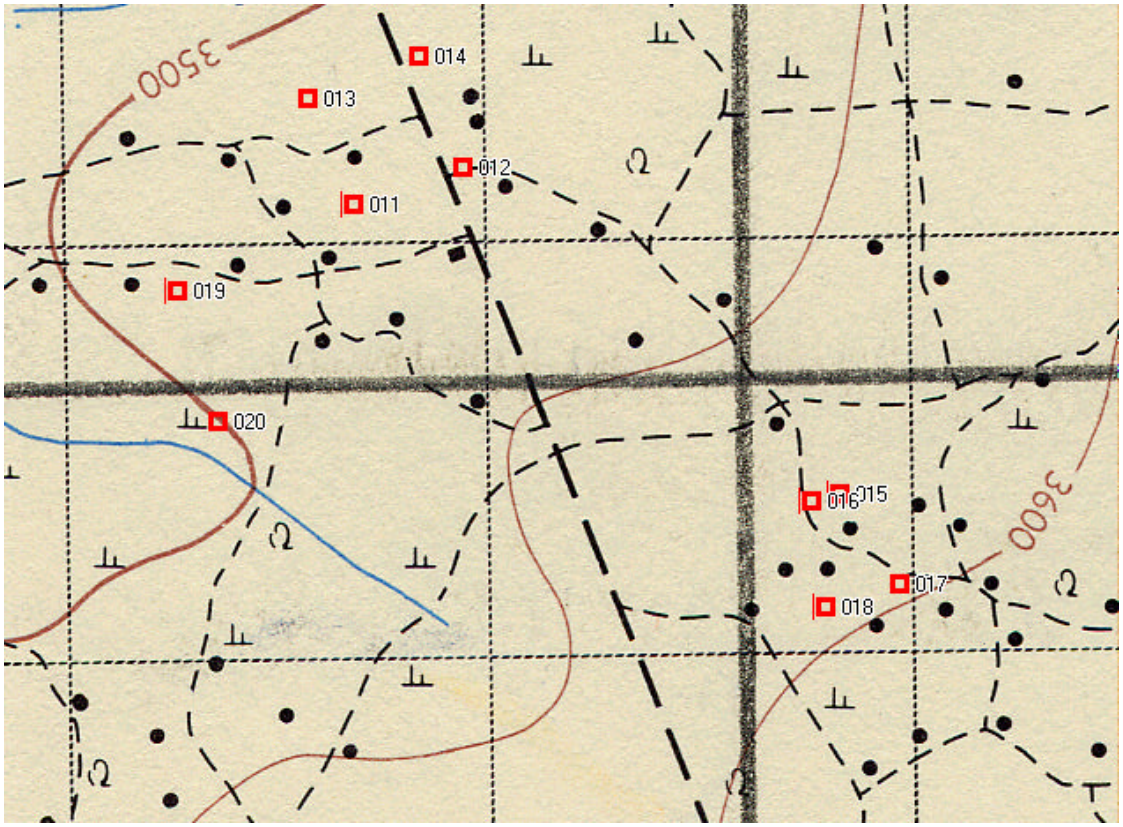
TABLE 4.1

Aterai Village : Group Criteria
Total Number of Households = 60
Group A : 23 % of village households • Five or more cattle • Ten or more acres of land • Owns a plough • Owns a bicycle • Four or more grass thatched houses • Enough food through-out the year • Some off-farm employment
Group B : 33 % of village households • Two or less cattle • Around six acres of land • Some have bicycles • About two good houses and a kitchen • Frequently not enough food throughout the year • Occasionally hires out own labour
Group C : 44 % of village households • No cattle • Less than two acres of land • Only use hand hoes, no access to ploughs • One house • Frequently hires out labour

14.2. Location

Aterai Village	Usuk Sub-County	Katakwi District

As shown on the following Map.



PART OF ACHWA 1:50,000 TOPOGRAPHIC MAP(Series Y732, Sheet 34/4, Edition 1-D.O.S.) SHOWING ATERAI SAMPLE SITES

POINTS 019-020 ATERAI ONE SIDE OF GROUP A SAMPLE FARM
(the distance between points is approximately 340m)
POINTS 011-014 ATERAI CORNERS OF GROUP B SAMPLE FARM
POINTS 015-017 ATERAI CORNERS OF GROUP C SAMPLE FARM
(location co-ordinates are given on site characteristic sheets)

14.3. Institutional Influence Mapping, A

The Group A institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP A Aterai village Katakwi District

TABLE 4.2

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Elders	Neighbours	Radio
Parents	Research	
Family members	NAWOU	
	Chiefs	
	Schools	
	Agriculture Extension	

Group consisted of 10 people (6 men and 4 women).

JUSTIFICATIONS OF PRIORITY RANKING

Family Members
- Advise on land preparation. After land clearing, put in small heap then burn the grass.
- Children advised not to put a cereal in a field with history of *striga* but to plant groundnuts.

Parents
- Advised on changing direction of ploughing after some years to stop development of gullies or slope to check water run off.
- Advice to apply manure from kraal to exhausted fields. Men do not take manure to fields they are decision makers and the responsibility of spreading manure (cattle manure, chicken or goat droppings) rests on women and to some extent children.
- Advice to plant some grasses in places where water passes so that the grass can stop water taking soil in effect checking soil erosion.
- Advise them to rest land for at least 3 years. Then follow rotation. Groundnuts, millet, sorghum, sweet potatoes and cassava then fallow again. Currently fallow period is between 1-3 years. In the 1980s when land was plenty fallow would be up to five years and these areas were used for grazing.
- Elders
- Advise on the right time to plant
- Advise on use of manure. Would advise to place kraals on land perceived to be exhausted/poor of that the manure would help regain fertility.
- Advise on crop rotation
- Advise to plant grass, which is latter, ploughed down to add manure

Schools
- Pupils learn about crop rotation and pass on the message (Esirito)
- Demonstrations on row cropping, planting time, which are done at school children pass on the information to parents.
- Learn to use residues from Ajon (Adakai) as manure it is the responsibility of women and children to take these to fields

- Children taught advantage of planting trees, i.e. leaves from trees decompose to give manure, and trees stop wind erosion. Rainwater washes the manure to fields

Agricultural extension
- Advise farmers to practice crop rotation; resting land (fallow)
- Advise on use of manure (cattle manure, goat dropping, home waste)
- Advise of planting legume trees to use in regaining soil productivity
- Advise on which crops to plant in particular areas, if land is near a swamp with a lot of water advised to plant rice.

NAWOU
- Advise to take manure to fields rather than just dropping it near the compound
- Supply women with improved seed (free to women in groups)
- Teaches them health care so that they do not fall sick
- Encourages them to grow various vegetables to improve their nutrition so that they get energy to enable them carry out the farming activities effectively.

Chiefs
- Advise to leave grass bands in the field so that water does run through the fields and take soil. This is not observed in most cases, reasons cited include decreasing land, hence any piece is used, and over grown bands are sources of rats.
- Advise against indiscriminate burning so that wind does blow the soil when no cover is left.
- Used to encourage group work and alternative allocation of fields to crops and livestock to enhance fertility

Relatives/friends
- Advise on manure application, crop rotation, planting times learn which crops can help bring nutrients deep in the soil back to the top i.e. sweet potatoes in process of heaping.

GROUP A PERCEPTIONS ON SOIL FERTILITY

Group reported declining trends in soil fertility, attributed to the following causes. Loss/removal of animals to secure places has led to non-availability of manure unlike in the past when they would apply manure or change location of kraals within ones land. Continuous cultivation of land due to increasing population (migrants and many children). Prolonged dry spells encourage widespread burning leading/accelerating wind erosion. Also, because of little rain the heat in the soil is high and believed to contribute to reduction in fertility of soils. Believe that certain pests produce harmful waste, which lead to reduction in soil fertility

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP A
- Crop rotation is the preferred strategy.
- Fallow land for at least 3 years
- Application of manure (8 out of 13 people reported applying manure)
- The crop residues are either left to decompose on the surface or ploughed under the soil, or gathered in small heaps in the field and burnt at the time of planting.

14.4. Institutional Influence Mapping, B

The Group B institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP B Aterai village Katakwi District

TABLE 4.3

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Elders	Radio	Neighbours
Parents	Schools	Market
Family members	NAWOU (NGO)	Church
Extension	Parish credit committee	Politicians
Chiefs	World Learning (NGO)	
LCs	Youth groups	
Research (SAARI)	Social gatherings	
	Agriculture Extension	

Group consisted of 10 people (6 men and 4 women).

JUSTIFICATIONS OF PRIORITY RANKING

Elders

- The elders advise and encourage applic ation of animal manure in crop fields. (goat droppings, chicken waste and cow dung).
- Advise farmers to gather weeds after weeding. The weeds are put in small heaps scattered all around the field and then burnt. The ash acts as manure to the soil.
- Advise on land preparation. The encourage people to plough twice with the first ploughing giving the soil time to cool, disintegrate. Then the second ploughing helps to kill emerging weeds and spread/turn around the soil in the garden.

LCs

- Tell farmers to leave grass bands between fields and roads as well as from one field to another. The grass band is to check water run off there by minimising soil erosion.
- LCs advise people to cultivate a cross the field instead of down the slope which would accelerate water run off hence eroding topsoil.
- Give advise on which crops to plant in particular fields/seasons for better yields to be realised. This way LCs encourage crop rotation.

Parents

- Show their children boundaries of their land and advise against removing the bands which form boundaries
- Tell the children not to plough/cultivate down the slope but across the field in order to check water run off which would take soil.
- Advise on fallowing to enable land regain fertility
- Encourage crop rotation; e.g. sorghum, cassava, groundnuts, sweet potatoes, maize, fallow

- Advice on which fields are suitable for particular crops e.g. maize to be grown on land which formally housed a kraal.

Extension workers
- Give advice on row cropping, pest control and preserving seed for next seasons planting.
- Encourage production of crops, which can give some manure back to the soil. For example cotton shades its leaves, which rot in the field, and subsequent crops like millet would perform well in such fields.

Research/SAARI/IGOLA
- Advice to farmers on how to use land in a better way. For instance they advised farmers on which grasses/cover crops to leave in the field e.g. *Panicum maximum* which would improve fertility when ploughed under the soil.

Chiefs
- Advise against indiscriminate burning, which would leave, soils with not cover and increase chances of the soil being taken by wind or water.
- Discourage cutting big trees, which act as windbreaks. They encourage people to plant more trees in when they cut one.
- Tell farmers to leave grass bands, cultivate across fields and practice crop rotation.

Family members
- Children encourage their parents to open land early. Often parents wait to get oxen for opening land but children encourage them to at least open a small portion using the land hoe and plant something early.
- Advise to cultivate across the field

Schools
- Children learn and pass on information to their parents regarding application of manure, burying weeds under the soil and soil erosion control measures (grass bands, wind breaks and ploughing across fields) The children latter adopt these practices on their own farms.

Parish Credit Committee (PCCs)
- The PCCs were set up under Katakwi District Development Programme (KDDP). The PCCs advise people on how to access credit and utilise it for agriculture production. PCCs avail improved planting materials. Encourages farmers to form groups through which they are advised on production (agronomic activities and seed multiplication).

Radio

- Farmers reported getting information from the radio advising against burning in order to stop destroying vegetation cover which leaves soils bear and exposed to wind erosion consequently loss of top soil with its nutrients.
- From radio farmers also get to know of planting times and rainfall pattern expected in the season

Drinking joints/social gatherings

- Discussions on agricultural activities during these gatherings trigger action from those who have not undertaken a particular activity. For instance when one narrates how he ploughed early or use manure and the crops have already germinated and doing well, the others realise what they have not done properly and try it on their own gardens.

GROUP B PERCEPTIONS ON SOIL FERTILITY

Fertility was reported to have declined over the last 10 years. This has resulted from reduced length of fallow period from 5 years in the past to 1 year at present. Reduced livestock population led to reduction in amounts of animal manure available to farmers. Farmers used to graze animals on the fallow lands and this would hasten the process of regaining fertility as animals leave excreta on the land. All this has greatly reduced or disappeared. Land is becoming scarce as the population in the area increases. Several people who run away from areas adjacent to Karamoja have migrated to these villages hence intensity of land use have gone up. Increased occurrence of *striga* in fields is attributed to low/declining soil fertility.

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP B

Change direction of ploughing in the field to close gullies formed following ploughing in one direction. This is done to check soil erosion, which takes topsoil and nutrients out of the field. Using cassava or sweet potatoes as fallow crops
Using grass bands to check water run off. Dig trenches to divert running water from entering the field. Apply animal manure especially goat droppings, as reported by 3 out of the 9 participants. Bury the grass under soil after land clearing, so that it gives manure to the soil.

14.5. Institutional Influence Mapping, C

The Group C institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP C Aterai village Katakwi District

TABLE 4.4

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
LCs	Clan	Drinking groups
Parents	Health	Forestry
Church	Youth group	Market
Research	Friends/relatives	
Agricultural Extension	NAWOU	

Group consisted of 15 people (10 men and 5 women).

JUSTIFICATIONS OF PRIORITY RANKING

LCs

- Giving advise on when to start planting; proper land preparation. Encourage people to plough twice and at the right time to get high yields
- Mobilise people to form work groups especially at times of peak labour demand.
- Discourage removing grass bands which help reduce erosion caused by running water
- Advise people to cultivate across the field rather than down the slope as this would accelerate erosion.
- Promote crop rotation and advise farmers to gather crop residues/weeds in small heaps throughout the field (especially sites with infertile soil) then burn, the ash enhances soil fertility.

Parents

- Teaching their children how to weed and telling them to bury the weeds under the soil such that they can rot.
- Advise on not crossing boundaries that way bands at the boundaries are not removed. However most of the fields lacked grass bands and the group claimed that the bands were not very useful in that location because it is not a passage for water and they have maintained ploughing across the field which checks water run off. It was also argued that the old bands were ploughed so that the fertility that had accumulated there is utilised and they had plans to plant new ones.
- Parents advise people to change the kraal from one place to another on their land in order to spread manure to different places. They also encourage applying manure to the fieldsrather than just sweeping the poultry waste, goat droppings or residues from local brew (Ajon) just around the compound. The group noted that they do not collect the beer residues from local drinking joints because others may laugh at them.
- Parents advise on which crops are suitable for particular fields and encourage crop rotation (millet followed by groundnuts followed by sweet potatoes then fallow).

Extension workers

- Bring improved seed and advise on disease and pest control, row planting (maize, groundnuts and cassava), and preserving seed for next season.
- Advise people to plant trees to get poles and fuel wood as well as manure after the leaves fall off and decompose. Discourage cutting big trees because these act as wind breaks thereby checking wind erosion, which would lead to loss of top soil and reduced fertility.
- Encourage crop rotation to check disease build up and enhance soil productivity.

Church

- Encourage people to plant early to enable a good harvest part of which is taken to church for blessing. The following year harvests will be better.

Researchers

- Advise people to apply manure. The group reported hearing this on the radio.
- Advise farmers to fallow land to enable it regain fertility.
- Discourage cultivation in areas along the swamps but recommend such areas to be used for grazing purposes.

Health workers

- Sensitise people to practice good sanitation to ensure good health and avoid falling sick which would unable them to carry out farming activities.
- Encourage people to ensure good nutrition to enable them have the energy to carry out their activities.
- Advise people not to share houses with animals (chicken) which might bring mites hence sleepless nights and subsequently the person is sleepy during the day and unable to farm properly.

Elders

- Advise people to apply manure, leave land to fallow for sometime rather than cultivating it over and over again. They advise those with small pieces of land to go to their relatives and hire land. The elders broker this process and ensure that the relative accepts to lend out his land.

Relatives and friends

- Advise on application of manure (crop residues/home waste, and local beer residues)

GROUP C PERCEPTION ON SOIL FERTILITY

Fertility has declined in the last ten years.

- This is due to prolonged dry spells lead to reduced vegetation cover thereby exposing the soil which is blown away by wind during the dry period or taken by rain water at the on set of heavy rains.
- Increase in prevalence of pests Due to increased pests people burn the crop residues in the field thereby leaving the soil exposed and so loose the nutrients in the residues.
- Karamojong invasions. They come with a lot of animals which trample on the soil and break the top soil thereby making it easily blown up by winds. The invasions also

lead to increased intensity of burning by both the local population and the immigrants. The local population tries to destroy the pasture on their land in an effort to stop the nomads using it for grazing while the nomads were reported to love burning.

- Continuous cultivation of some pieces of land. Due to lack of oxen to open new land, farmers reported that they have resorted to using the less bushy fields which can easily be opened by the hand hoe.

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP C

Crop rotations and fallow. The fallow period has reduced from 4-5 years in the 1980s to 1-2 years currently depending on amount of land one owns.Apply manure. Mainly homestead waste, chicken waste, goat droppings. Amounts have decreased due to reduction in number of livestock. Dig pit latrines when it is full cover it with soil then dig another one and latter utilise the manure from the first. Late in the second season plough down a field, bury grass under the soil to let it rot and give the soil some manure. Ash from the kitchen is poured around the homestead. If one has planted yams, then one keeps pouring the ash in that field.

Responsibility for taking manure to the fields rests with women while men take decisions on crop rotation and maintaining or removing grass bands.

14.6. Resource Flow Diagram Aterai Group A



Aterai, Katakwi resource flow mapping Group A

Name: Imalingat Jane

Age: 39 years

Village: Aterai, Koritok

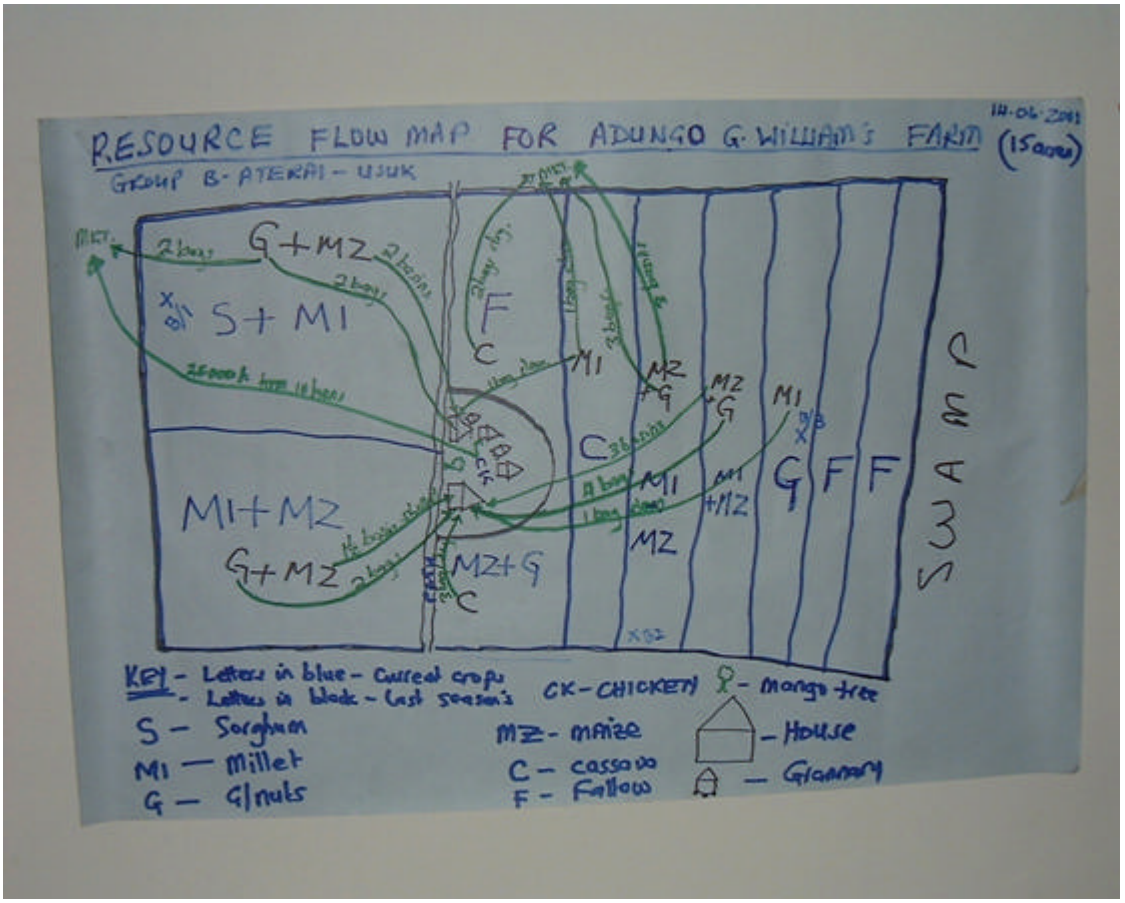
Household members: Total of 10, Including,5 children (heirs) caretaker with his wife and 2 children plus 1 cattle boy.

Acreage: 14 acres

She crops a few gardens and leaves the rest of the land under fallow because of lack of oxen for ploughing, also some gardens are considered infertile with water logging in lower fields. She has been cultivating the land since 1981.The upper side of the homestead has fertile and productive soils compared to the lower side. She has lived on the land for one year, at first she stayed on it but later shifted to the neighbourhood but still cultivated the land. She has noticed no change in productivity of the soils on the upper side of the homestead since 1981. Apart from the addition of chicken and goats droppings no other attempt to improve soil fertility. Fallow land is typically left under

fallow for 1-2 years, then ploughed and planted to cassava, millet, groundnuts, local peas (erudurude) then sorghum.

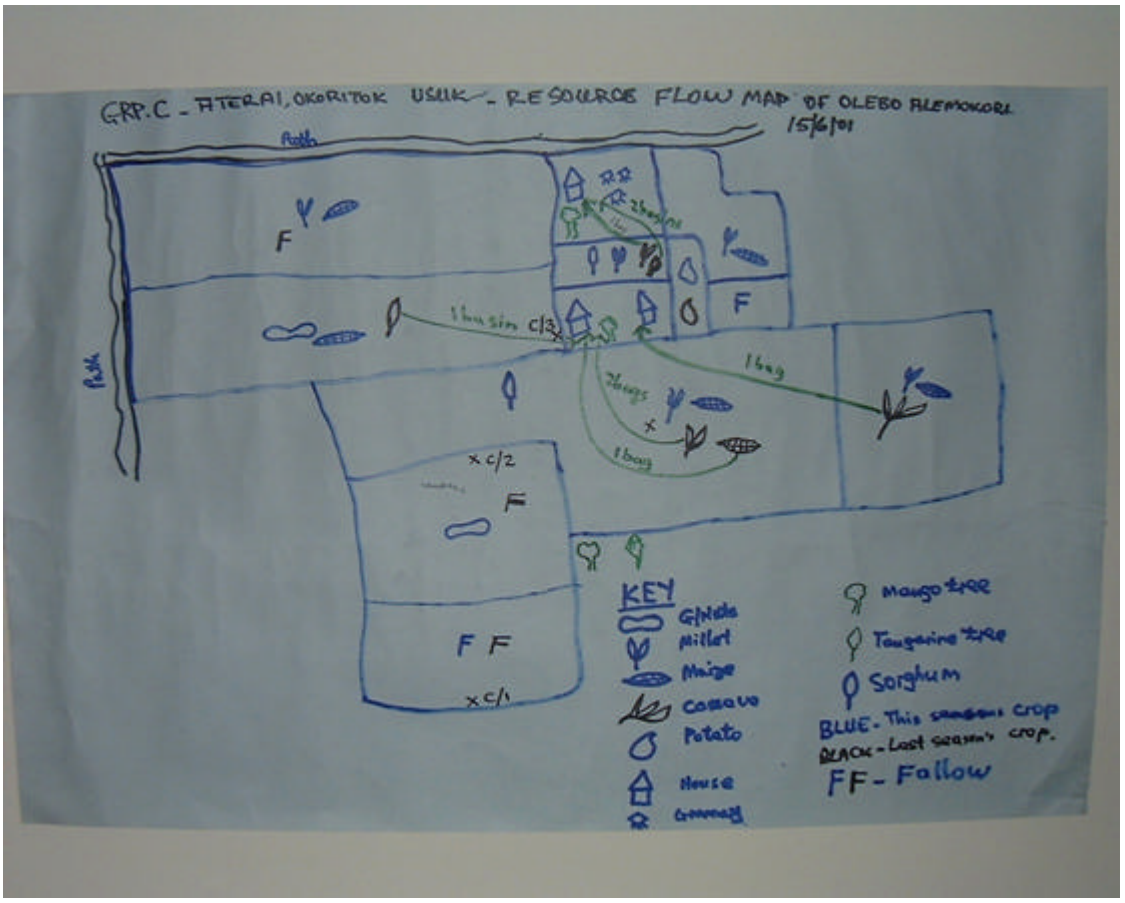
14.7.Resource Flow Diagram Aterai Group B



Aterai, resource flow mapping Group B
Name: Adungo G W, 32 years of age.
Acreage 15 acres
Household of 4, wife and 2 children, farming for 22 years. Educated up to S2 after the murder of parent (father).

Organic material management : chicken sleep on a tree or under the granary the droppings are thrown around the homestead. Groundnut stems ploughed under for fertility enhancement learned from school. Fallow only takes place if has succeeded in cropping the 2 strips near the swamp. Cassava stems burnt in field during dry season, farmer believes the ash enhances soil fertility. Aware of fertilisers but unable to afford and so uses crop rotation as the main method of soil fertility management.

14.8. Resource Flow Diagram Aterai Group C



Aterai, resource flow mapping Group C
Name: Odebo Alemukori
Age: 30 years
Acreage: 7 acres
He has been farming for 3 years, 4 family member in household.

Typical rotation: groundnuts, millet, sorghum, groundnuts, millet, sorghum, potatoes. Some areas are less fertile than others, as indicated by low yields of millet last year. The soils around the compound are more fertile than others, because sometimes they collect rubbish and spread it around the compound. Not possible to transfer rubbish to far/distribute to all gardens because it's tiresome/labour intensive.

The food produced is for home consumption with little for sale. Not enough food crops are harvested to sustain the family throughout the year. The farmer left some of the land under fallow because of lack of labour/oxen for opening it. Cassava stems after harvesting are planted, those which remain are left to dry and used for firewood. Maize stems ploughed down to add manure to the soil. Groundnuts add more manure to the soil because it sheds leaves and shells decompose to add manure. Ploughs down the vegetation to add manure to soil, but still the fertility of the soils is declining.

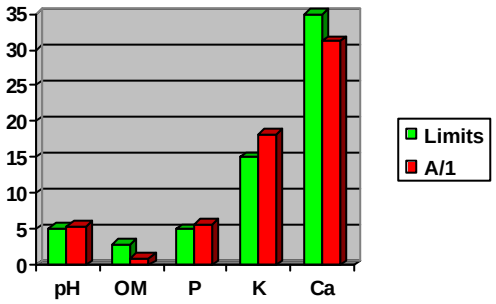
14.9. SOIL FERTILITY ANALYSIS

The following graphs are identified by a group letter and site number which provides a link to the resource flow diagrams and sample site characteristic information. The maximum auger depth, surface and subsurface textural class are also given. The vertical "y" axis shows soil property values. The horizontal "x" axis gives the critical fertility limits (in green) as defined by Kwanda Agricultural Research Institute as follows :

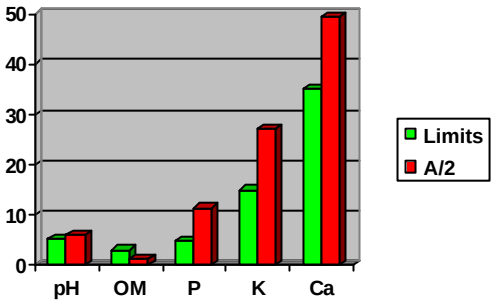
pH	(acidity/alkalinity)	5.2
OM	(organic matter)	3.0 %
K	(potassium)	15.0 mg/100g
Ca	(calcium)	35.0 mg/100g
P	(available phosphorus	5 ppm

These critical limits are paired with the results of the site sample analysis (in red) to aid comparison.

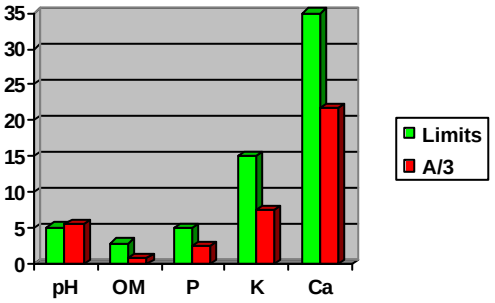
Aterai A/1, 120cm+, Sa/SaC



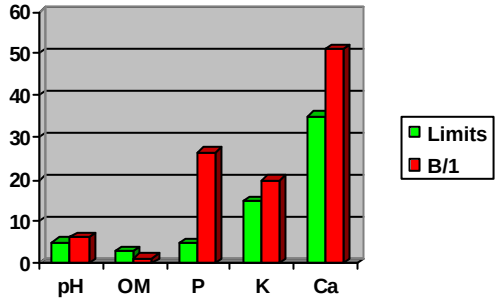
Aterai A/2, 87cm, LSa/SaCL



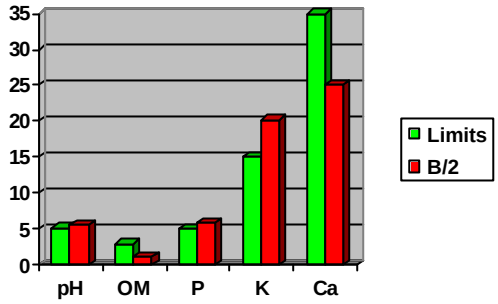
Aterai A/3, 70cm+, SaCL/SaC



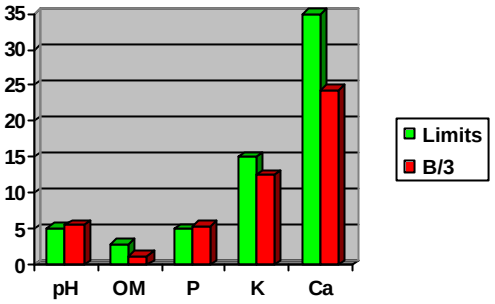
Aterai B/1, 90cm, LSa/SaC



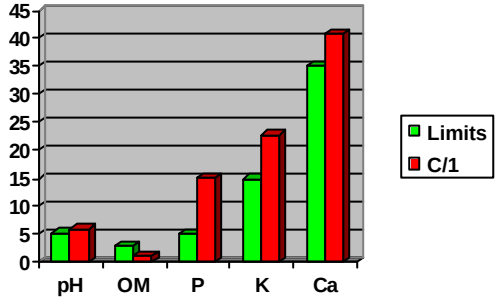
Aterai B/2, 120cm+, Sa/SaC



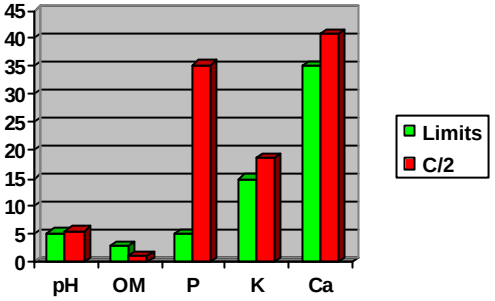
Aterai B/3, 90cm, Sa/SaCL



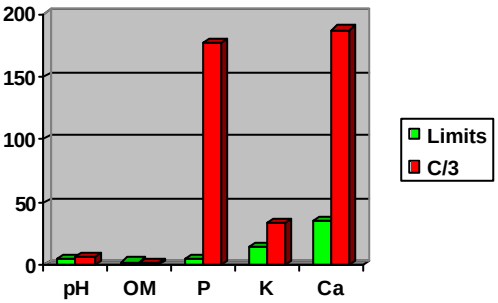
Aterai C/1, 76cm, Sa/SaC



Aterai C/2, 120cm+, Sa/SaC



Aterai C/3, 92cm+, Sa/SaCL



14.10. Sample Site Characteristics

These are shown in standard format in the following section.

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group A sample farm	DATE 16/06/01
GPS WAYPOINT No. 019 A/1	Long 2.0408004, Lat 33.9468006, 1072m.
LAND USE / COVER Gnuts- moderate vigour. Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Upper-mid slope. Upper sample in 3 auger catena SLOPE 1 –2 %	EROSION Very slight surface wash.
SURFACE Soft, sealed crust. Composite surface (0-10cm) sample taken from field (Aterai A/1)	DEPTH (max auger) 120 +

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-28	A/1/1 Aterai	10YR 3/2	Sa	Well drained	None	.
28-54	A/1/2 Aterai	10YR 3/3	Sa L	Very Slightly Restricted Drainage	None	
54-80	A/1/3 Aterai	10YR 4/3	Sa C L	Slightly restricted drainage	None	
80-120	A/1/4 Aterai	10YR 4/4 with 2.5YR 4/6 mottle	Sa C	Restricted drainage> Poorly drained	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-28	5.3	0.6	1.52	11.7	1.05	17.3	91.1	8.3	0.6
28-54	4.6	1.2	1.14	9.2	0.47	21.7	80.6	16.2	3.28
54-80	4.8	0.8	0.00	6.1	1.05	43.3	67.1	28.3	4.56
80-120	5	0.8	0.38	5.6	1.74	44.2	59.1	38.3	2.56

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group A sample farm	DATE 16/06/01
GPS WAYPOINT No. 019 A/2	Lat 2.0408004, Long 33.9468006, 1072m
LAND USE / COVER Maize and Gnuts intercropped - moderate vigour. Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Mid-slope position, mid sample in 3 auger catena SLOPE 1 %	EROSION Very slight surface wash.
SURFACE Dark colour soil surface over extensive area not related to slope, apparently not related to previous homestead or kraal site. Possibly site of large tree ? Tamarind seem to have this pattern. Noted in other areas of farm and village. Composite surface (0-10cm) sample taken from field (Aterai A/2)	DEPTH (max auger) 87cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-36	A/2/1 Aterai	10YR 2/1	L Sa	Well drained	None	No compelling reason from the pedological properties why this should be dark. Check for O.C. status.
36-64	A/2/2 Aterai	10YR 3/3	Sa L	Restricted Drainage,few stains	None	
64-80	A/2/3 Aterai	10YR 4/2	Sa L	Poorly drained, strongly mottled	None	
80-87	A/2/4 Aterai	5 YR 4/8		Restricted drainage> Poorly drained	Laterite gravel	Dry at base, restricted water movement ?

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-36	6.5	1.3	70.96	16.3	0.93	68.5	84.6	12.2	3.28
36-64	6	0.6	5.30	7.6	0.70	36.4	NES	NES	NES
64-80	5.4	0.6	1.14	12.7	1.86	45.1	NES	NES	NES

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group A sample farm	DATE 16/06/01
GPS WAYPOINT No. 019 A/3	Lat 2.0408004, Long 33.9468006, 1072m
LAND USE / COVER Grass and woody re-growth fallow, previously cultivated in 1999 Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Lower-slope position, mid sample in 3 auger catena SLOPE 1 %	EROSION Very slight surface wash.
SURFACE Macro-termite mound, upslope. Grass and shrub re-growth Composite surface (0-10cm) sample taken from field (Aterai A/3)	DEPTH (max auger) 70 cm (stopped by hardness, dryness and compaction of clay horizon) This sample, lowest in all catenas, shows higher clay content from the surface, clay transported from up-slope likely source. Question of why the soils with this ammount of rainfall are like they are compared to high rainfall areas to south ? is the current climate recent ?

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	A/3/1 Aterai	10YR 3/2	Sa CL	Slightly restricted drainage	None	
20-42	A/3/2 Aterai	10YR 4/3	Sa C	Restricted Drainage, with mottles	None	
42-70	A/3/3 Aterai	10YR 5/2 (grey)	Sa C	Poorly drained, uniform grey	None	dry, appears to restrict downward water movement

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	5.8	2.2	2.65	11.2	3.24	82.4	62.6	34.2	3.28
20-42	5.7	1.5	1.14	8.6	8.68	103.2	53.1	40.3	6.6
42-70	6.1	1.1	0.38	15.8	14.24	144.8	53.1	46.3	0.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group B sample farm	DATE 14/06/01
GPS WAYPOINT No. 011 B/1	Lat 2.0426347, Long 33.9506386, 1089m
LAND USE / COVER Sorghum, millet and maize inter-crop, moderate vigour Upper sample site Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Upper-slope SLOPE 1 %	EROSION Some surface wash
SURFACE Irregular cultivated surface Composite surface (0-10cm) sample taken from field (Aterai B/1)	DEPTH (max auger) 90 cm (stopped by lateritic gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-18	B/1/1 Aterai	10YR 3/2	L Sa	V Slightly Restricted	None	
18-38	B/1/2 Aterai	10YR 3/3	Sa CL	Slightly Restricted	None	
38-53	B/1/3 Aterai	10YR 4/4	Sa C	Slightly Restricted	None	
53-90	B/1/4 Aterai	10YR 5/6	Sa C	Restricted (no mottles)	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-18	6.2	1.2	28.79	18.3	0.12	47.7	83.1	12.3	4.6
18-38	6	1.2	7.95	14.8	0.81	64.1	65.1	32.3	2.6
38-53	5.9	1.2	0.76	15.3	0.58	71.1	53.1	44.3	2.6
53-90	6	1	0.38	14.2	0.58	55.5	61.1	38.3	0.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group B sample farm	DATE 14/06/01
GPS WAYPOINT No. 011 B/2	Lat 2.0426347, Long 33.9506386, 1089m
LAND USE / COVER Gnut, moderate vigour, inter-cropped with poor maize (N deficient ?) Mid sample site Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Upper-mid slope SLOPE 1 %	EROSION Some surface wash
SURFACE Irregular cultivated surface, some washed sand Composite surface (0-10cm) sample taken from field (Aterai B/2)	DEPTH (max auger) 120 cm +

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-15	B/2/1 Aterai	10YR 3/3	Sa	Well drained	None	
15-34	B/2/2 Aterai	10YR 3/2	Sa CL	V. Slightly Restricted	None	
34-53	B/2/3 Aterai	10YR 4/4	Sa C	Slightly Restricted	None	
53-120	B/2/4 Aterai	10YR 5/4	Sa C	Slightly Restricted (no mottles)	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-15	5.9	1	0.76	10.7	1.05	22.5	91.1	8.3	0.6
15-34	5.1	1.4	0.38	15.3	0.70	26.0	69.1	26.3	4.6
34-53	4.6	1.3	0.00	11.7	1.05	29.5	63.1	36.3	0.6
53-120	4.6	1.2	0.76	7.6	1.05	27.7	56.6	38.2	5.28

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group B sample farm	DATE 14/06/01
GPS WAYPOINT No. 013 B/3	Lat 2.0449572, Long 33.9496593, 1079m
LAND USE / COVER Gnut, moderate vigour, inter-cropped with poor maize (N deficient ?) Lower sample site Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Lower slope SLOPE 2-3 %	EROSION Some surface wash
SURFACE Soft surface sealed crust Composite surface (0-10cm) sample taken from field (Aterai B/3)	DEPTH (max auger) 90 cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-30	B/3/1 Aterai	10YR 4/2	Sa	Slightly restricted	None	Grey, partially bleached sand, clay fraction leached out.
30-50	B/3/2 Aterai	10YR 4/2	L Sa	Restricted slight mottles	None	
50-90	B/3/3 Aterai	10YR 5/3	Sa CL	Poorly drained common, clear mottles	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-30	5.4	1	2.10	10.6	0.23	14.7	91.1	4.3	4.6
30-50	5	0.7	0.84	7.6	1.37	12.1	89.1	10.3	0.6
50-90	5.4	0.7	0.42	10.6	3.31	26.9	75.1	22.3	2.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group C sample farm	DATE 15/06/01
GPS WAYPOINT No. 015 C/1	Lat 2.0361811, Long 33.9610676, 1093m
LAND USE / COVER Recently cultivated field, ploughed and weeded to remove Cynodon grass, prior to sowing gnuts. Lower sample site, but only very gentle slope, Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Lower slope, almost level SLOPE 0-1 %	EROSION Not evident
SURFACE Recently cultivated Composite surface (0-10cm) sample taken from field (Aterai C/1)	DEPTH (max auger) 76 cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-22	C/1/1 Aterai	10YR 3/2	Sa	Well drained	None	.
22-48	C/1/2 Aterai	10YR 3/2	Sa CL	Slightly restricted drainage	None	
48-76	C/1/3 Aterai	10YR 4/4	Sa CL	Restricted drainage but no clear mottles	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-22	5.5	1	8.39	13.1	0.34	29.5	91.1	4.3	4.6
22-48	5.4	1.2	5.03	17.2	0.34	43.3	75.1	22.3	2.6
48-76	5.1	1.1	2.10	17.2	2.85	82.4	63.1	36.3	0.6

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group C sample farm	DATE 15/06/01
GPS WAYPOINT No. 016 C/2	Lat 2.0360274, Long 33.9604797, 1093m
LAND USE / COVER Gnut, cowpea, some maize intercrop, moderate vigour Mid-slope sample site, but only very gentle slope, Mapped as Unit Us (Usuku) on 1: 250,000 soils map. Very similar to C/1 apart from depth.	
SLOPE POSITION Mid-slope, almost level SLOPE 0-1 %	EROSION Very slight surface wash.
SURFACE Slight surface sorting of coarse fraction Composite surface (0-10cm) sample taken from field (Aterai C/2)	DEPTH (max auger) 120 cm +

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-24	C/2/1 Aterai	10YR 3/3	Sa	Well drained	None	.
24-50	C/2/2 Aterai	10YR 3/3	L Sa	Slightly restricted drainage	None	
50-86	C/2/3 Aterai	10YR 4/3	Sa CL	Restricted drainage	None	
86-120	C/2/4 Aterai	10YR 5/6	Sa C	Restricted drainage with few clear mottles	None	Dry below 90 cm

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-24	5.5	0.6	13.84	11.6	0.11	22.5	93.1	6.3	0.6
24-50	5.5	0.7	2.94	17.7	0.68	27.7	83.8	14.9	1.3
50-86	4.9	0.9	0.84	19.7	1.14	30.3	67.8	30.9	1.3
86-120	4.5	0.9	0.84	15.2	1.03	20.8	61.8	36.9	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Aterai Village, Usuk S-County, Katakwi District Group C sample farm	DATE 15/06/01
GPS WAYPOINT No. 016 C/3	Lat 2.0360274, Long 33.9604797, 1093m
LAND USE / COVER Maize and sorghum, very good vigour, site immediately around the homestead. Domestic waste scattered around homestead. Mid-slope sample site, within 100m of C/2 Mapped as Unit Us (Usuku) on 1: 250,000 soils map.	
SLOPE POSITION Mid-slope, almost level SLOPE 0-1 %	EROSION Very slight surface wash.
SURFACE Cultivated, some weed growth Composite surface (0-10cm) sample taken from area of good crop growth (Aterai C/3)	DEPTH (max auger) 92cm (stopped by compaction/dryness)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-32	C/3/1 Aterai	10YR 3/2	Sa	Well drained	None	Charcoal fragments and ash visible. .
32-59	C/3/2 Aterai	10YR 3/4	Sa L	Slightly restricted drainage	None	
59-92	C/3/3 Aterai	10YR 4/4	Sa CL	Slightly restricted drainage	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-32	5.4	1.3	41.95	21.2	0.57	43.3	91.8	6.9	1.3
32-59	6.7	0.8	7.13	32.8	0.68	34.7	79.8	18.9	1.3
59-92	4.6	0.9	2.10	30.3	1.14	23.4	69.8	28.9	1.3

15. Fieldwork Results Baralegi

Baralegi Village	Okwang Sub-County	Lira District

15.1. Village Wealth Ranking Criteria

These are shown in the following Table.

TABLE 5.1

Baralegi Village, Lira District: Group Criteria
Total Number of Households = 102
Group A : 4 % of village households • Two or more cattle • Ten or more acres of land • Owns a plough and oxen • Owns a bicycle • Permanent house • Enough food through-out the year • Off farm employment
Group B : 18 % of village households • Around 5-10 acres of land • Own a bicycle • Semi-permanent house • Food does not always last the whole year • Own a plough and oxen
Group C : 78 % of village households • No cattle or goats • Own a few chicken • Less than 5 acres of land • Many children • One or two houses • Frequently short of food

15.2. Location

Baralegi Village	Okwang Sub-County	Lira District

Unfortunately a map was not available for this study area.

15.3. Institutional Influence Mapping, A

The Group A institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP A Baralegi village, Lira District

TABLE 5.2

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
NGOs	Local leaders Cs/chiefs)	Schools
Radio		
Friends/neighbours		
Agricultural Extension		

Group consisted of 5 men.

JUSTIFICATIONS OF PRIORITY RANKING

NGOs

- Lira Cotton Development Organisation (LCDO) gives them advice against burning fallow land, which leaves the land bare and exposed to erosion by both wind and water. This NGO advised them that fire kills the predators, which reduce the pest damage on their crops. Also organic matter, which would have decomposed into the soil if in co-operated into the soil, is lost.
- Co-operative Office for Voluntary Organisation (COVOL) gives them advice on the usefulness of shea nut trees in providing vegetative cover which provide litter and decompose therefore increasing soil fertility as well as reducing wind erosion on their land/soil.
- Poverty Alleviation Programme (PAP) which provides them with advice on crop rotation, issue short-term loans for purchase of oxen for land preparation as well as purchases of improved seeds.

Friends/Neighbours

- The farmers said these people give advice on the best crop rotation to be followed, tell them the uses of grass bands in checking soil erosion. They also give advice on appropriate stocking rate to avoid overgrazing, crop rotation to avoid depletion of the same field and to reduce the weed population. In addition these group of people advice them to cultivate across the slope/contour ploughing to reduce soil erosion and provide improved seeds.

Radio

- Provides them with information concerning crop rotation, fallowing/crop rotation, restricted burning of fallow land, planting trees to provide vegetative cover to their sol to reduce soil erosion and increase fertility. Radios provide them with additional information on improved seeds to raise the farmer's production, the importance of spraying their crops to reduce pest attack on their crops. They, also receive information on mulching to retain moisture in the soil and application of organic manure. Mass media also provide them with information on leaving crop residues in the field to add fertility, use of fertilisers to increase farmers yields. Contour ploughing and the appropriate stocking rate to avoid over grazing the available vegetation cover.

Extension

- Extension services give them information on crop rotation, provide improved seeds, stocking rate, planting trees, agronomic practices such as proper land preparation e.g. virgin land for cotton be ploughed twice before planting. Pest control weeding and thinning and row planting, which simplifies weeding and reduces over crowding of plants optimum plants population.

Elders/local leaders

- The farmers said elders teach them proper land preparation, the usefulness of early planting in escaping pest damage. They gave an example of millet, which is normally sown during the period such that when it rains it will germinate better than these sown when soil is wet. Elder's advice them on crop ration, proper weed control, restricted bush burning citing that it is only allowed in the production of sim sim where the soil has to be demarcated before burning and ploughing is done later. These peoples advice then on seed preservation/storage- selection of good healthy cobs of maize which is hanged in the kitchen for next cropping season, cowpea seeds are mixed with ash and kept for next season.
- Local councils restrict bush burning and cutting down of trees for charcoal. They also advise on tree planting and crop rotation.

Schools

- Demonstration plots on how to manage soil fertility.

GROUP A PERCEPTIONS ON SOIL FERTILITY

The farmers generally agreed that the fertility status has declined due to the following causes: -

- Lack of ox cultivation due to cattle raids. In the past ox ploughs were used to cut sub soil and bury the trash, which rot to provide manure to the soil.
- Increased population – due to limited land availability, the used fallow period of 5-10 years has been reduced to 2-3 years.
- Little crop rotation is being practised – here the farmers gave an example of opening land for rice, as being a difficult job/activity, so once opened it has to be cultivated year after year.
- Bush burning which is common compared to the past due to lack of cattle to check the vegetation growth.

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP A

- The farmers agreed to practice crop rotation
- Follow increased fallow period of 3-5 years
- Sensitise the community against bush burning
- To plant more trees to reduce erosion
- To adopt row planting which makes mulching easier.

The farmers agreed that they know the value of taking animal manure and crop residues back to the fields but said they have no time and this work is too difficult for them. They said that the animal manure is left where the animals sleep and rubbish from the homestead, crop residues scattered around the homestead by women and children while the majority burn it. The farmers said that burning of crop residues in the morning to warm themselves during cold days especially January is a common practice while residues of soya bean, beans, cowpea, pigeon pea the ash is used as a local salt for cooking vegetables like spinach/eboo.

They explained that decision making is done by the man/father because he is the overall owner of the land and his decisions are trusted by the family members, he is

the one to decide which field to be cultivated, which crop to be planted, who to cultivate and when to cultivate.

15.4. Institutional Influence Mapping, B

The Group B institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP B, Baralegi village, Lira District
TABLE 5.3

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
LCs	COVOL (shea-nut project)	Red Cross
Parents	Friend/relatives	District Farm Institute
Elders	Radio	Farmer groups
School/teachers		Church
Extension		Lira District Dev. Program
AT(U)		

Information gathered from a group of 13 people (4 women and 9 men)

JUSTIFICATIONS OF PRIORITY RANKING

Elders

- Crop rotation. Encourage people to alternate deep feeding crops with shallow feeding crops in a field.
- Advise against ploughing too deep to reach red soil which is not fertile but plough within the top soil which is productive
- Resting land/ fallow (2-3 years) to allow land to regain fertility.
- Advise on early opening of land and bury the grass to let it rot under soil because this is away of adding manure to soil.
- Plough across the fields rather than down the slope to avoid soil being washed away by running water.

Agricultural extension

- Advise on row planting. In case of a field with a slope, put the rows across rather than down wards such that the slope to check water run off.
- Advise on weeding crops for better yields (weeds compete with crops and reduce nutrients if left in the field).
- If you have animals alternate grazing fields with crop fields. Fallow a field then graze on that latter open it for crops and fallow another one. This way manure is spread to many fields.
- Advise on taking crop residues back to fields such that they can decompose from and turn into manure.
- Advise against intercropping crops of same feeding habits. i.e sunflower and maize. Recommend sunflower and beans or sesame and beans.
- Advise people to use chemical fertilisers. Only one person acknowledged having once used chemical fertiliser. Price was cited as the limiting factor.
- Advise to plant *Mucuna* which suppresses weeds at the same time improving fertility of the soil

AT (U)

- Supply improved seed e.g. Longe 1.
- Advise on proper spacing such that the plant can cover the soil and protect it from erosion
- Encourages mulching to help retain moisture and later turn into manure.

School
- Pupils learn/get information on line planting, planting across field which has a slope rather than down the slope in order to check water run-off.
- Advise on grass bands to check water run-off and stop soil erosion.
- Crop rotation to enhance fertility and reduce disease build up. This information is shared with parents who put it into practice. When the children start farming on their own the also adopt the practices.
- Advise against cutting trees which act as wind breaks and the roots hold soil such that it is not easily washed away.
- Advise against burning grass which can be cut to decompose into manure
- Teach use of farm yard manure
- Teach people to fallow land
- Advise people not to take hot ash to fields

LCs
- Advise against burning of crop residues/grass because this leads to loss of soil cover thereby exposing it to erosion.
- Discourage cutting trees
    - Mobilise people
    - Advocate for periodic changing location of grazing areas to spread manure

Parents
- Advise weeding crops to avoid competition and depleting nutrient and teach children to bury weeds such that they rot in soil and give manure
- Encourage crop rotation
- Advise people to apply manure
- Discourage cutting trees
- Advocate for periodic changing location of grazing areas to spread manure
- Advise people to rest land/fallow

GROUP B PERCEPTIONS ON SOIL FERTILITY

Fertility perceived as declining in the last ten years. Farmers noted that this is reflected by the low yields. The causes were cited as :

- Reduced length of fallow periods due to increasing population in the area. Fallow periods have reduced from 10 years in the 1980s to 2-3 years at present.
- Reduction in number of animals led to loss of oxen which used to bury crop residues in process of opening land
- Continuous use of the land due to high population

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP B
- Crop rotation. Pigeon peas- sorghum- g/nuts- pigeon pea- cassava
- Fallow
- Planting trees which check soil erosion but also improves on rainfall.

15.5. Institutional Influence Mapping, C

The Group C institutional influence priorities are shown in the following Table.

INSTITUTIONAL INFLUENCE MAPPING: GROUP C Baralegi village , Lira District

TABLE 5.4

PRIORITY RANK		
FIRST	**SECOND**	**THIRD**
Chief	Research	Red Cross
Parents	Extension	Forestry
Elders		Market
Friend/relatives		Church
School		UNDP
Work groups		

Information gathered from a group of 8 people (2 women and 6 men)

Chiefs

- Helps in settling land disputes and directs/discourage removing grass bands which act as boundaries
- Advise against burning of crop residues/grass

Parents

- Teach children to bury weeds such that they rot in soil and give manure
- Advise on planting time to get yields
- Discourage burning but tell people to leave residues to rot and give soil manure. Burning leads to loss of grass cover hence wind erosion and loss of top soil.
- Advise people not to plant too many seeds in the field to reduce competition because over plant populated fields are depleted of nutrients fast

School

- Pupils learn/get information on line planting, planting across field which has a slope rather than down the slop in order to check water run off.
- Crop rotation to enhance fertility and reduce disease build up. This information is shared with parents who put it into practice. When the children start farming on their own the also adopt the practices.

Elders

- Manure application
- Resting land/ fallow

Relatives and friends

- Advise on early planting for one to get good yields.
- Encourage practising crop rotation and resting land (fallow) to allow land regain its fertility
- Work (Alea) groups
- Supply labour and helps carrying out activities in a short time
- Encourages and trains members to weed properly by burying weeds such that they rot under ground.

GROUP C PERCEPTION ON SOIL FERTILITY

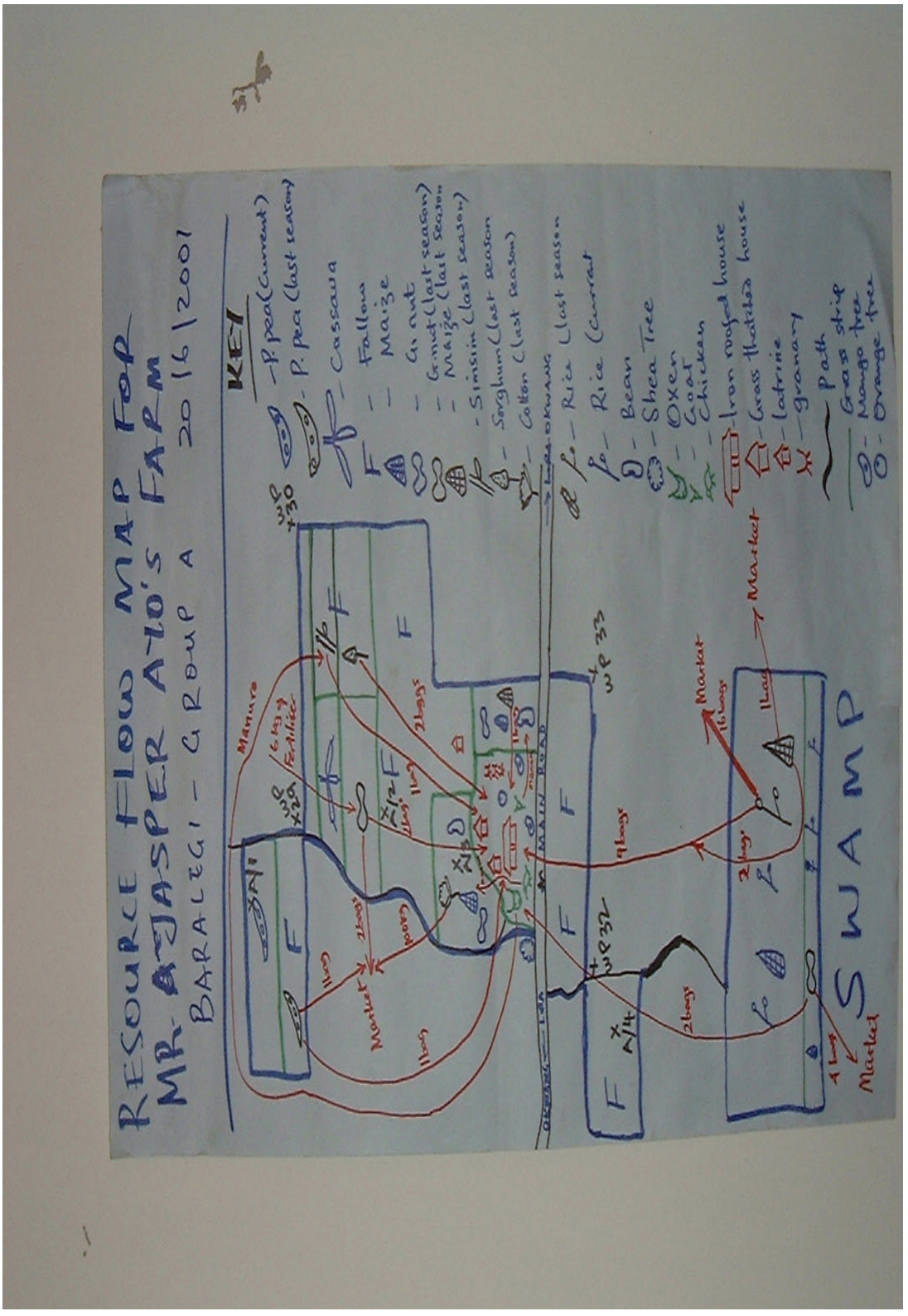
Fertility declining in the last ten years as reflected by the low yields. This is perceived as being caused by :

- Reduced length of fallow periods due to increasing population in the area. Fallow periods have reduced from 5-7 years ten years ago to 2-3 years at present.
- *Karmajong* invasions. Large herds over graze the land and loosen top soil leaving it with no cover. The loose soil is easily blown by wind or taken away by rain water
- Increased intensity of burning. Hunters set bush fires in an effort to trap the animals, these fires spread to other areas and leave the soil bear which accelerates erosion.
- Charcoal burners reducing tree cover from which leaves would fall and rot to give manure.
- Heavy rains in a short period of time wash away soil

SOIL MANGEMENT OPTIONS PROPOSED BY GROUP C

- Crop rotations
- Fallow. Reduced from 5-7 years in the 1980s to 2-3 years currently
- Apply manure. Especially chicken/goat droppings are taken to the field instead of just pouring it around the compound. Women responsibility for taking manure to the fields
- Plough across fields

15.6.Resource Flow Diagram Baralegi Group A

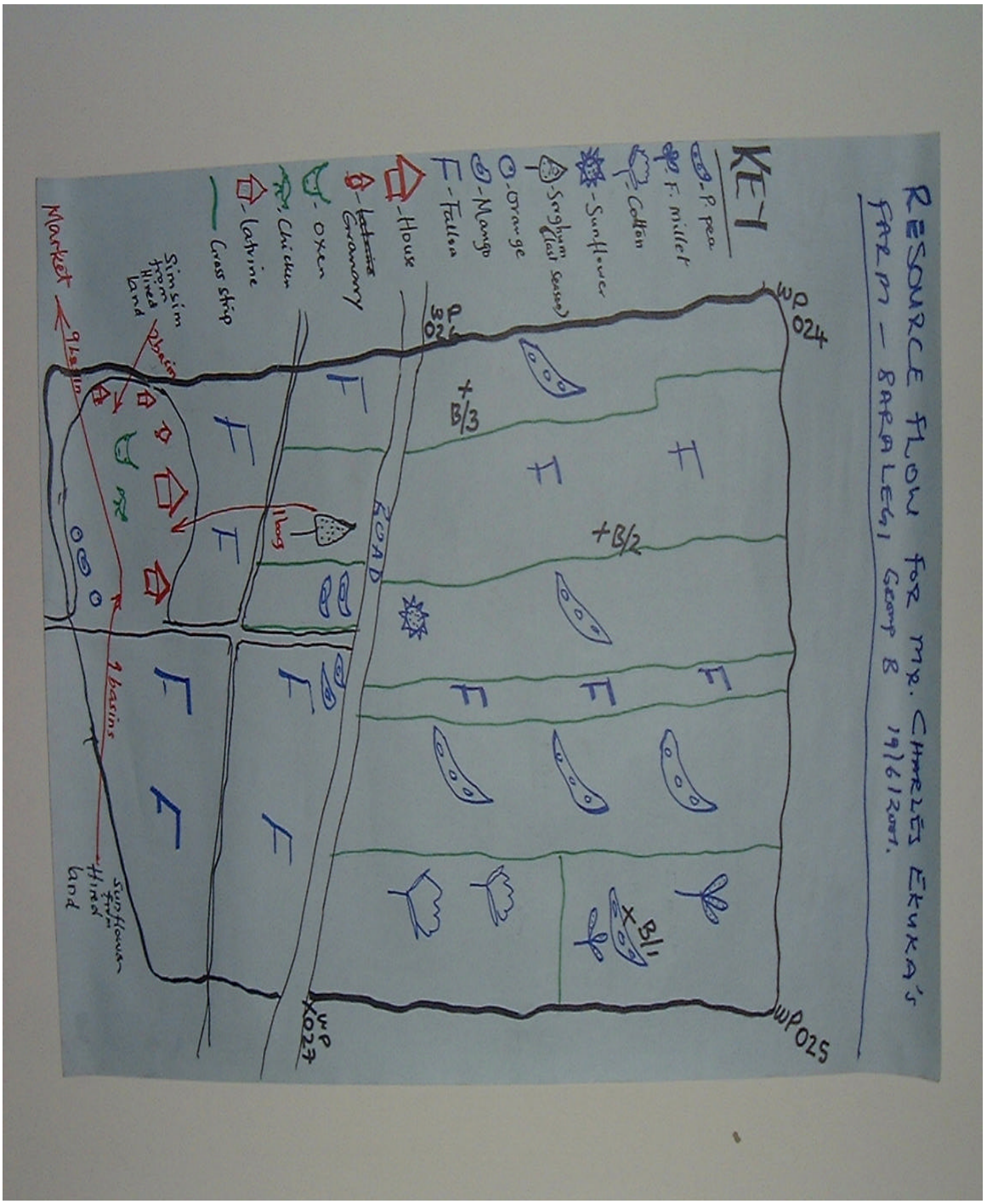


Resource Flow mapping for Group A, Baralegi
Name: Jasper Ayo
Age: 30 years
Married: 1 wife, 2 children
Total Area 20 acres

Area cropped per year– 9 acres
Livestock; 2 oxen2 - ties them around homestead; 5 goats, ties them on verandah; 7chicken, sleep in a tree

Lived on land for 9 years, resting period 4 years, cropping period 4 years. Opening crop – p. peas – cassava – sorghum-simsim – millet – rest. Rice field – 5 acres cropped continuosly for 8 years yields decreasing. Suspected reasons, increasing number of pests; erosion of the soil towards the swamp. Uses the manure on crops near the homestead. Cattle manure is tranported to fallow land which has just been ploughed. Uses a wheel barrow for transporting the cow manure. Fertiliser use, last year 2000, a friend offered him 6 kg at shs.3000/- which he put on groundnut plot. Signs of soil fertility decline – appearance of striga weed in sorghum fields.

15.7. Resource Flow Diagram Baralegi Group B



Resource flow for Group B, Baralegi

Name of the farmer:	Charles Ekuka
Age:	41 years
Married with:	5 children [one wife]
Education:	Primary Seven
Duration of farming:	Has farmed the land since 1979
Livestock	2 oxen, 8 chickens.

Land use: For the last three years (1998-2000) has been renting three gardens at 3,000/- each, while his own land was resting (fallow).

Crops cultivated last season/year

Crops	Total Yield	Amount consumed at home	Amount sold
Sorghum	1 bag	1 bag	
simsim	2 basins	2 basins	
Cassava	Destroyed by draught		
Sunflower	9 basins	-	9 basins

Use of crop residues

Simsim: Burnt and the ash used as soda ash for cooking. Sunflower: Heads cut off brought home, beaten and threshed. The residues poured/scattered around the homestead. Stems left in the field rot and ploughed down. Pigeon pea: The residue burnt at home and the ash used as soda ash for cooking.

Sorghum: Head harvested, threshed and burnt. While the stems are left to dry in the field and then ploughed down to add manure to the soil. Cotton: The stems cut, put in small heaps all over the field and burnt. The farmer believes that the ash from cotton adds manure to the soil. Chicken droppings swept and poured around the home. Rubbish from the house and the compound is thrown the homestead. NB: It is the responsibility of children and the wife to clean the house and compound. Cow dung: Left where the animals (oxen) are tethered. There is nothing added or taken back to the fields.

Soil/land management

Fallow: Fallow period is normally three years. At times hires/rents fields from other people while his land is fallowing

Reasons for fallow.

-To allow the land to regain fertility

-The fallow period has remained the same

-Makes land preparation easy since the ground becomes soft and there are few weeds.

Typical Rotation : Pigeon pea – sorghum – cassava-pigeon pea-fallow

Cotton-finger millet and pigeon pea-sorghum-cassava

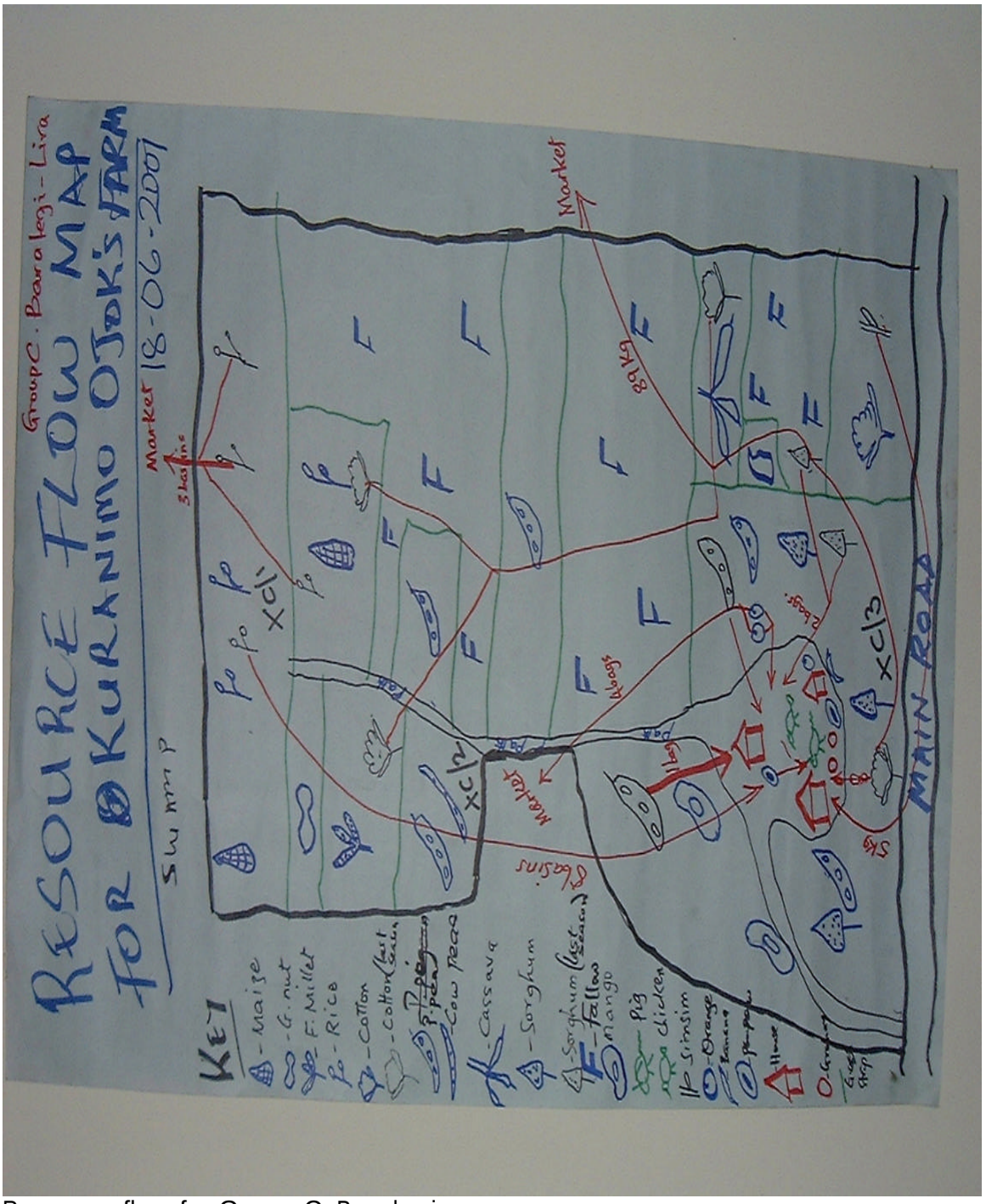
Pigeon pea-sorghum-cassava and fallow

Application of manure: Not done at all. Reason: Did not know that it is beneficial.

Use of inorganic fertilisers: Not used

Perception of trends in soil fertility over 20 years. It is declining due to over use.

15.8. Resource Flow Diagram Baralegi Group C



Resource flow for Group C, Baralegi

Name of farmer:	Kuranimo Ojok
Age:	52 years
Education:	Nil
Marital Status:	Married to one wife with 4 daughters
Duration of farming:	He has farmed the land for over 25 years
Animal/Livestock kept:	2 pigs, 4 chickens.

Crops cultivated last season/year

Crop/Animal	Total Yield	Amount consumed at home	Amount sold
Pigeon peas	1 bag	1 bag	
Sorghum	2 bags	2 bags	
Cotton	89 kg	-	89 kg
Rice	1 ½ bags	-	-
	11 basins	8 basins	3 basins
Simsim	5 kg	5kg	-
Oranges	More than 4 bags	Not known	4 bags
Pigs	4	-	4

Management of residues. Chicken droppings and waste matter swept from houses and compound (wife's duty). Cotton - cut, collected into small heaps all over the field and burnt ash left in the field. simsim -cut, then after threshing, the residues burnt near or in the field. Pigeon pea stems/branches broken off, brought home, threshed and burnt and the ash utilised as soda ash for cooking. Sorghum burnt or left to rot in the field. After threshing heads are burnt or poured around the home. Women are responsible on the above activities (i.e. collecting the residues and burning).

Land/soil management
Fallowing : Fields are cropped for 3 years then left to fallow for 3 years. However, land around the homestead is cropped year after year. It's done to reduce weed population. Typical rotations :. pigeon pea – cassava – sorghum – fallow or simsim. Cotton – finger millet – cowpea and fallow. Cotton – finger millet – cassava – fallow.

Application of manure it not practised. Aware of mineral fertilisers, but not used because they are not available. Soil fertility status/trend. Over the last 10 years the soil fertility has declined. The reasons being, Loss of cattle resulting in poor land preparation. Preparation of land using ox-plough used to bring up the fertile soil from below to the surface and also bury grass/vegetation and crop residues.

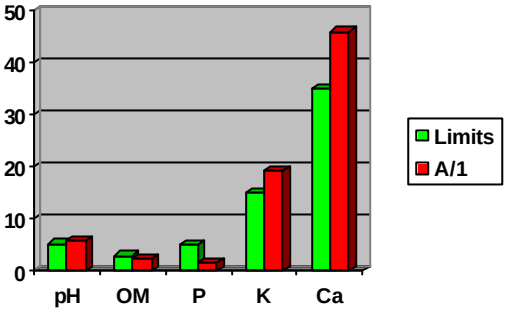
15.9. SOIL FERTILITY ANALYSIS

The following graphs are identified by a group letter and site number which provides a link to the resource flow diagrams and sample site characteristic information. The maximum auger depth, surface and subsurface textural class are also given. The vertical "y" axis shows soil property values. The horizontal "x" axis gives the critical fertility limits (in green) as defined by Kwanda Agricultural Research Institute as follows :

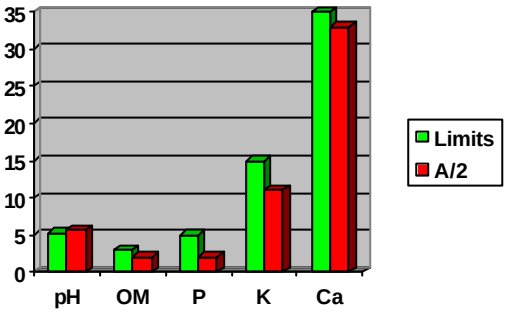
pH	(acidity/alkalinity)	5.2
OM	(organic matter)	3.0 %
K	(potassium)	15.0 mg/100g
Ca	(calcium)	35.0 mg/100g
P	(available phosphorus)	5 ppm

These critical limits are paired with the results of the site sample analysis (in red) to aid comparison.

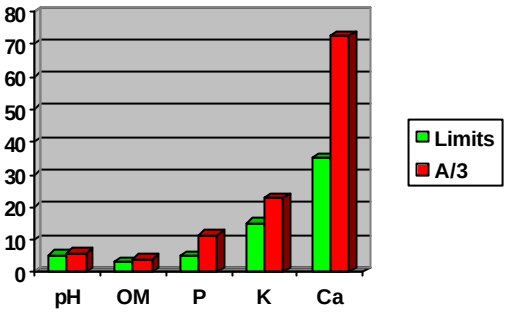
Baralegi A/1, 38cm, SaCL/SaC



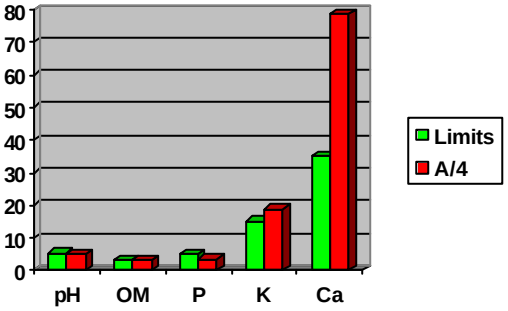
Baralegi A/2, 110cm+, SaCL/SaC



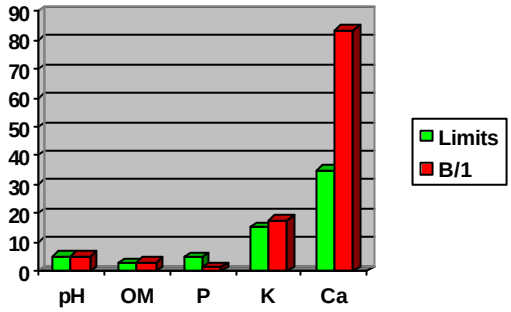
Baralegi A/3, 71cm, SaCL/SaC



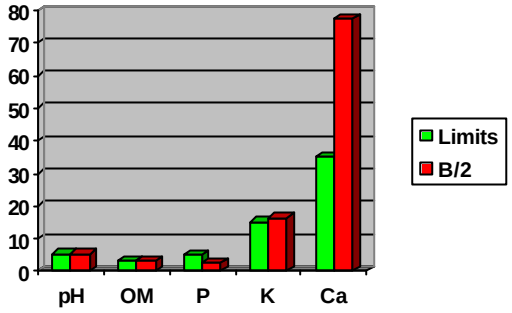
Baralegi A/4, 110cm+, SaCL/SaC



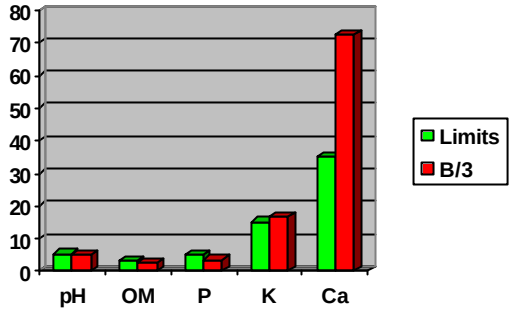
Baralegi B/1, 50cm, SaCL/SaC



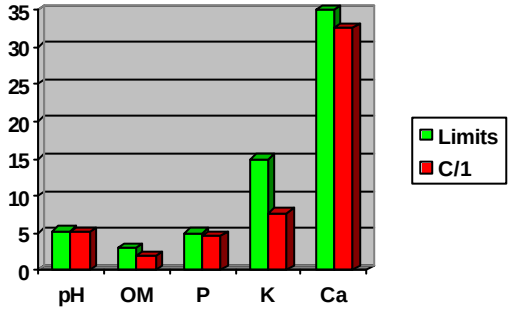
Baralegi B/2, 110cm+, SaCL/SaC



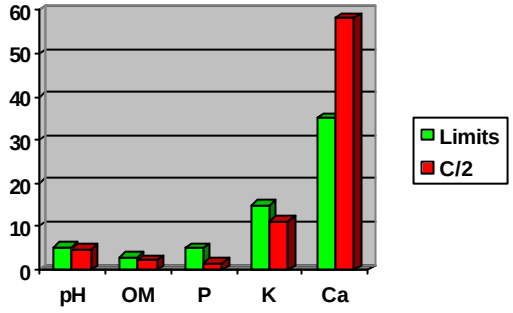
Baralegi B/3, 76cm, SaCL/SaC



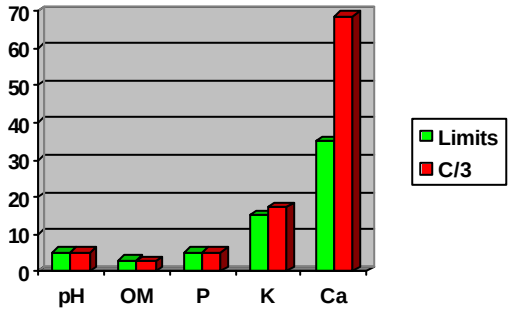
Baralegi C/1, 107cm+, LSa/SaCL



Baralegi C/2, 94cm, SaCL/SaC



Baralegi C/3, 76cm, SaCL/SaC



15.10. Sample Site Characteristics

These are shown in standard format in the following section.

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group A sample farm	DATE 20/06/01
GPS WAYPOINT No. 029 A/1	Lat 2.5759631, Long 33.1785050, 1042
LAND USE / COVER Pigeon-pea, inter-cropped with tapra beans (short-duration, white and sweet) and malakwan, moderate vigour. Shea butter trees left in field to give "Butter Parkland" effect. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Upper slope / crest site. Upper site 4 auger catena, parallel to the main road. SLOPE 1 %	EROSION Some v. slight sheet erosion
SURFACE Cultivated, Composite surface (0-10cm) sample taken from field (Baralegi A/1)	DEPTH (max auger) 38 cm (stopped by laterite gravel) locally areas of lateritic rock on the surface

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	A/1/1 Baralegi	10YR 3/2	Sa C L	Well drained	None	
20-38	A/1/2 Baralegi	10YR 3/4	Sa C	Slightly restricted drainage	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	4.6	2.7	0.84	22.7	0.91	52.0	63.8	28.9	7.3
20-38	6	1.9	0.42	12.6	1.60	37.3	59.8	38.9	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group A sample farm	DATE 20/06/01
GPS WAYPOINT No. 029 A/2	Lat 2.5759631, Long 33.1785050, 1042m
LAND USE / COVER Fallow : *Hyperenia rufa* and "Ugandan rubber plant". Atypical site, neat base of degraded termite mound and old homestead (Charles) Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Upper slope. 2nd upper site in 4 auger catena, parallel to the main road. SLOPE 1 %	EROSION None observed
SURFACE Fallow, some bare patches and evidence of burning Composite surface (0-10cm) sample taken from field (Baralegi A/2)	DEPTH (max auger) 110 + cm

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-18	A/2/1 Baralegi	10YR 3/2	Sa CL	Well drained	None	
18-54	A/2/2 Baralegi	10YR 4/4	Sa C	Well drained		
54-110+	A/2/3 Baralegi	10YR 4/6	Sa C	Well drained	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-18	6.2	3.6	5.87	31.8	0.68	66.8	71.8	24.9	3.3
18-54	5.4	2.2	0.42	15.2	0.91	17.3	55.8	42.9	1.3
54-110	5	1.8	0.42	9.1	0.57	9.5	55.8	42.9	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group A sample farm	DATE 20/06/01
GPS WAYPOINT No. 029 A/3	Lat 2.5759631, Long 33.1785050, 1042m
LAND USE / COVER Groundnut and beans. Shea butter trees left in field to give "Butter Parkland" effect. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Mid-slope. Mid site 4 auger catena, parallel to the main road. SLOPE 1 %	EROSION Some v. slight sheet erosion
SURFACE Cultivated, soft. Composite surface (0-10cm) sample taken from field (Baralegi A/3)	DEPTH (max auger) 71 cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-22	A/3/1 Baralegi	10YR 3/2	Sa C L	Well drained	None	
22-47	A/3/2 Baralegi	10YR 3/3	Sa C L	Well drained	None	
47-71	A/3/3 Baralegi	10YR 5/4	Sa C	Slightly restricted drainage	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-22	5.8	2.9	1.68	15.7	0.80	51.1	71.8	26.9	1.3
22-47	5.4	2.1	8.39	6.6	0.68	20.8	65.8	32.9	1.3
47-71	5.2	1.9	0.42	6.1	1.14	8.7	61.8	36.9	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group A sample farm	DATE 20/06/01
GPS WAYPOINT No. 030 A/4	Lat 2.5756088, Long 33.1766491, 1045m
LAND USE / COVER Recently ploughed from grass fallow prior to planting sim-sim . Shea butter trees left in field to give "Butter Parkland" effect. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Lower mid-slope. Lowest site 4 auger catena, parallel to the main road. SLOPE 2%	EROSION Grass ploughed in not burnt.
SURFACE Cultivated, soft. Composite surface (0-10cm) sample taken from field (Baralegi A/4)	DEPTH (max auger) 110+ cm

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	A/4/1 Baralegi	10YR 2/1	Sa C L	Well drained	None	Darker surface colour, these lower areas apparently waterlog in Oct.
20-52	A/4/2 Baralegi	10YR 3/3	Sa C L	Slightly restricted drainage	None	
52-110	A/4/3 Baralegi	10YR 5/4	Sa C L	Restricted drainage >	Lat gravel at base of horizon	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	6.3	2.7	1.26	12.6	1.03	62.4	73.8	24.9	1.3
20-52	5.9	2.2	0.84	7.1	0.80	37.3	63.8	34.9	1.3
52-110	5.5	1.7	0.84	6.1	0.68	23.4	57.8	40.9	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group B sample farm	DATE 19/06/01
GPS W AYPOINT No. 024 B/1	Lat 2.5754270, Long 33.1868245, 1044m
LAND USE / COVER Pigeon-pea, inter-cropped with finger millet, (and malakwan) moderate vigour. Shea butter trees left in field to give "Butter Parkland" effect. Apparently before this cultivation in fallow since 1998. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Lower-mid slope position, Lower auger in 3 auger catena, slope not very distinct SLOPE 1 %	EROSION Some slight sheet erosion
SURFACE Cultivated, Composite surface (0-10cm) sample taken from field (Baralegi B/3)	DEPTH (max auger) 50 cm (stopped by laterite gravel) some areas of lateritic rock on the surface

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-24	B/1/1 Baralegi	10YR 3/2	Sa C L	Well drained	None	
24-50	B/1/2 Baralegi	10YR 3/4	Sa C	Well drained	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-24	5.5	3.5	2.10	19.2	0.68	54.6	62.6	32.2	5.3
24-50	5	2.9	0.42	13.6	2.34	37.4	54.6	44.2	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group B sample farm Photo	DATE 19/06/01
GPS WAYPOINT No. 024 B/2	Lat 2.5754270, Long 33.1868245, 1044m
LAND USE / COVER Grass fallow since 1998- Possibly *Hyperenia rufa* ? Apparently grass will be burnt before ploughing Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Mid slope position, mid auger in 3 auger catena SLOPE 2 %	EROSION None apparent
SURFACE Clumps of grass with some bare, compacted patches Composite surface (0-10cm) sample taken from field (Baralegi B/2)	DEPTH (max auger) 110 cm +

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	B/2/1 Baralegi	10YR 3/2	Sa C L	Well drained	None	
20-50	B/2/2 Baralegi	10YR 3/4	Sa C	Well drained	None	
50-110	B/2/3 Baralegi	7.5 YR 4/4 > 5YR 4/8	C	Slightly Restricted	None	dry at depth

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	5.4	3.8	0.84	14.5	1.75	90.6	60.6	34.2	5.3
20-50	4.4	3.5	0.42	4.1	1.17	35.0	44.6	52.2	3.3
50-110	4.4	1.9	2.52	3.6	0.58	26.6	30.6	68.2	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group B sample farm	DATE 19/06/01
GPS WAYPOINT No. 024 B/3	Lat 2.5754270, Long 33.1868245, 1044m
LAND USE / COVER P-pea, some sorghum, cowpea, green gram, with malakwan Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Upper - slope position, upper auger in 3 auger catena SLOPE 2 %	EROSION Slight – surface wash, grass strips left between plots

SURFACE	DEPTH (max auger)
Cultivated, weeded. Composite surface (0-10cm) sample taken from field (Baralegi B/3)	76 cm (stopped by laterite gravels)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	B/3/1 Baralegi	10YR 3/2	Sa C L	Well drained	None	
20-43	B/3/2 Baralegi	10YR 4/4	Sa C	Well drained	None	
43-76	B/3/3 Baralegi	7.5 YR 4/4	Sa C	Slightly Restricted	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	5.8	3	0.84	10.9	0.58	39.9	62.6	34.2	3.3
20-43	4.2	2.6	2.52	5.4	1.75	14.5	54.6	42.2	3.3
43-76	4	2	0.42	3.2	0.58	6.0	50.6	44.2	5.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group C sample farm	DATE 18/06/01
GPS WAYPOINT No. 021 C/1	Lat 2.5812096, Long 33.1728306, 1021m
LAND USE / COVER Paddy rice, moderate. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Lower-slope position, 50m from steam . Lowest auger in 3 auger catena SLOPE 2 %	EROSION Surface wash, and slight incipient gully
SURFACE Cultivated Composite surface (0-10cm) sample taken from field (Baralegi C/1)	DEPTH (max auger) 107 cm (stopped by water)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-20	C/1/1 Baralegi	10YR 3/2	L Sa	Restricted drainage	None	
20-43	C/1/2 Baralegi	10YR 4/2	L Sa	Poorly drained, stained	None	
43-87	C/1/3 Baralegi	10YR 5/2	Sa CL	Poorly drained - mottles	None	
87-107	C/1/4 Baralegi	10YR 5/2 (matrix) 5YR 4/8 (mottle)	Sa CL	Very poorly drained, strong mottles	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-20	4.4	1.8	0.42	6.8	0.58	33.8	88.6	10.2	1.3
20-43	4.3	1.5	7.13	1.8	8.76	18.1	84.6	14.2	1.3
43-87	4.3	1.3	1.68	3.2	10.51	32.6	74.6	24.2	1.3
87-107	4.5	0.8	0.84	3.2	9.35	37.4	68.6	30.2	1.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group C sample farm	DATE 18/06/01
GPS WAYPOINT No. 022 C/2	Lat 2.5784491, Long 33.1734229, 998m
LAND USE / COVER Pigeon-pea, inter-cropped with moderate-good vigour, plus "malakwan" vegetable, used as a IPM decoy crop, heavily attacked by leaf eaters, but P-pea unaffected. Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Lower-mid slope position, middle auger in 3 auger catena SLOPE 2 –3 %	EROSION Some surface wash
SURFACE Cultivated, some sand accumulation Composite surface (0-10cm) sample taken from field (Baralegi C/2)	DEPTH (max auger) 94cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-24	C/2/1 Baralegi	10YR 3/1	Sa C L	Well drained	None	
24-44	C/2/2 Baralegi	10YR 3/3	Sa C L	Slightly restricted	None	
44-94	C/2/3 Baralegi	10YR 5/4	Sa C	Restricted	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-24	4	2.2	0.42	3.6	0.00	22.9	66.6	32.2	1.3
24-44	4.2	2.7	0.42	5.9	2.34	38.6	66.6	28.2	5.3
44-94	4.2	2.2	0.42	2.7	0.00	16.9	58.6	36.2	5.3

SAMPLE SITE CHARACTERISTICS	
LOCATION Baralegi Village, Okwang S-County, Lira District Group C sample farm	DATE 18/06/01
GPS WAYPOINT No. 022 C/3	Lat 2.5784491, Long 33.1734229, 998m.
LAND USE / COVER Pigeon-pea, intercropped with sorghum cowpea and beans, moderate vigour Mapped as Unit Am (Amuria catena) on 1: 250,000 soils map.	
SLOPE POSITION Upper-mid slope position, Upper auger in 3 auger catena SLOPE 2 %	EROSION Some slight sheet erosion
SURFACE Cultivated, some sand accumulation Composite surface (0-10cm) sample taken from field (Baralegi C/3) Sample taken from large macro termite mound "termite C/3"	DEPTH (max auger) 76 cm (stopped by laterite gravel)

HORIZON (cm)	SAMPLE No.	COLOUR (moist)	TEXTURE	DRAINAGE	STONES	COMMENT
0-19	C/3/1 Baralegi	10YR 3/2	Sa CL	Well drained	None	
19-52	C/3/2 Baralegi	10YR 3/3	Sa C	Well drained	None	
52-76	C/3/3 Baralegi	10YR 4/4	Sa C	Slightly Restricted	None	

Analysis

HORIZON cm	pH	% OM	P	K	Na	Ca	% SAND	% CLAY	% SILT
0-19	5	2.7	1.68	13.1	0.00	56.8	58.6	32.2	9.3
19-52	4.9	2.3	1.68	2.3	2.34	21.7	44.6	48.2	7.3
52-76	4.2	2.3	0.42	4.1	0.00	18.1	48.6	46.2	5.3

Annex 1 Stakeholder Views of Soil Fertility and Soil Management in Teso and Lango.

This section of the report contains the views and perspectives of a number of stakeholders consulted during the first phase of the study. The specific nature of the questions asked during stakeholder interviews varied according to the individual but in general they included queries on sources of information on soils and soil management and current soil fertility management activities in the area.

Dr. Ssali, Head of Soils, KARI
KARI is the NARO Institute with primary soil productivity responsibility. Currently there are six soil scientists in post, and consequently human resources are stretched. SAARI had one soil scientist in post until earlier this year, when sadly Nelson Olani died.

There has been limited activity in the area due to civil disturbance combined with the limited human resources. The prospects of transferring an existing member of KARI soil science staff to SAARI or recruiting new staff are remote. Detailed recent knowledge of the soils and soil management issues within NARO is limited. Dr Ssali welcomed the NARO/DFID proposal to look at soils issues in Teso and Lango in more detail. He cautioned that the SFI should be viewed as a first attempt in developing regional programmes which will hopefully be refined as further information comes available.

He suggested the main reference sources on the soils of Uganda were the national soil maps (17 sheets at 1:250,000 scale) prepared during the 1950s' and the accompanying reports. These documents have not been re-printed and are difficult to access. KARI has a complete set of maps and reports. SAARI has the Teso and Lango maps but not the reports.

Recent and current activities in the Teso and Lango area include :

- Database compilation and analysis of the long-term fertility experiment at SAARI funded by Rockafeller completed in Dec 2000.
- The IFPRI project on land management policy, which collected data in Soroti District.
- Water harvesting and soil conservation work by Dr Moses Tenywa in Katakwi District.
- Makerere M.Sc. students working on soil fertility management in Kumi District.

Dr. Ssali is closely involved with the Ugandan Soil Fertility Initiative (SFI) process. Despite a promising start and preparation of the SFI Concept Paper for Uganda, problems with obtaining approval from the Ministry of Finance have limited further progress to secure funds for the initial projects proposed in the SFI.

Dr Jacob Aniku, Associate Professor, – Makerere University Dept of Soil Science
According to Dr. Aniku until approximately 2 years ago politicians frequently proclaimed Uganda's soils to be "fertile", consequently it was difficult for the research community to challenge this and obtain funding. In 1992 NAROs' priorities for agricultural research did not include concerns about soil fertility. In the early 90s he also perceived a bias against the use of mineral fertilisers, apparently from the highest level of Government. This historical perspective clearly contrasts with current

concerns and commenced when in a 1998 watershed speech the Vice-President endorsed the use of mineral fertilisers.

Dr Akimu was also aware of negative publicity about "damage to the soil" resulting from the use of mineral fertilisers. This impression is apparently being promoted by environmentally biased NGOs. During subsequent field work we were conscious of very limited experience of mineral fertilisers. We did not encounter scepticism but no outright hostility to their use.

With respect to specific work in Teso and Lango : Two Masters students are currently carrying out soil fertility work in Kumi District, on-farm trials with sorgum as a test crop looking at manure and mineral fertilizer interactions, also sweet potato and green manure, with funding from the Rockefeller Foundation.

District Agricultural Officer Katakwi.
The DAO explained the District had very variable soils, but these are mostly productive. The very sandy soils are becoming a problem particularly when they are over-utilised . *Karamajong* raids limit access to some of the more productive soils on the boarders of the District. The clustering of people at centres because of security concerns has resulted in more intensive use of sandy soils and declining yields. Katakwi and Usuk had a particular problem with this.

In a overview of the main crops in the District the following were cited : millet; sorghum; cassava; maize; sweet potato; green gram; groundnuts and beans with rice in the wetlands. Of these crops maize is probably increasing in area fastest. Groundnut is the main cash crop, with very little interest in cotton.

The DAO listed the following NGOs involved in agriculture –

Self Help Development International : main focus food security seed multiplication for groundnut and cassava.
Action Aid : have six staff, main agricultural activity being multiplication of cassava.
SOCADIDO : Cassava multiplication, with less emphasis on groundnuts

We were informed that the District Environment Dept. have had an active campaign against the use of mineral fertilisers for the last 2 years, unfortunately we were unable to confirm this directly but if confirmed the contradictory messages being promoted at District level require reconciling.

Joanne Bosworth : DFID Land Policy Advisor
Uganda passed a new Land Act in July 1998. This provided a framework for private land ownership, the establishment of institutions and procedures for paper documentation together with local level decision making processes. Despite creating the cheaper land "certificate" instead of the full title implementation has been slow because of cost. Certificates have been issued for approximately 15% of land mainly in Central Uganda on "Mylo land" . There is an increased emphasis on legitimising existing land tenure procedures, which differ from area to area rather than producing a unified system. The main current thrust of the Land Act is conflict resolution rather than issuing title. She was not aware of any on-going work looking at how Land Act implementation is influencing land management practices.

Miss Betty Opeche, AT (Uganda) Soroti Office
Sells small quantities of mineral fertiliser mainly DAP, SSP and Urea (U Sd. 800/kg) from the office. Currently out of stock. Not much demand for mineral fertiliser, seeds are more in demand. Fertiliser can be supplied to order.

Independent agro-chemical supplier, Soroti
Main demand for pesticides, some for herbicides. Little demand for mineral fertiliser, he estimates selling 5 bags of urea per year. This is sold by the kg (U. Sd.800). Some SSP is sold at the same price.

Michael Okoy, SOCADIDO (Soroti Catholic Diocese Integrated Development)
SOCADIDO has been involved in agriculture since 1990, with a total of 100 staff, 26 directly involved with agriculture. SOCADIDO have a demonstration farm near Soroti and manage 15 tree nurseries mainly in Kumi, Katakwi and Soroti District. With this level of resources and infrastructure are a major developmental/agricultural player in the region. There main activities include seed multiplication; cassava multiplication and resistant varieties, particular emphasis on working with women's groups. They are also involved in other exchange/ return schemes for seed especially for groundnuts. SOCADIDO work directly with SAARI on rosette resistant varieties of groundnuts (Serenut I and II Project).

Soil management/improvement initiatives mainly involve agro-forestry. The agroforestry programme was initiated in 1995, due to concerns about reduced yields attributed to declining fertility. Sesbania sesban has been demonstrated / promoted as an improved fallow, but interest and adoption rates by farmers has been low. During field work we visited several SOCADIDO tree nurseries where this limited demand for tree seedlings was confirmed. In addition they have a small programme on organic banana and pineapple and production of liquid organic fertiliser.

Samuel Peter Ejoku, SODIFA (Co-ordinator Soroti District Farmers Association)
SODIFA employs 8 staff (4 field staff, 2 extension staff, 2 tutors) and has 4,800 paid up members. SODIFA is independent, but affiliated to the Uganda National Farmers Union (UNFU) formed in 1997. Objectives – to unite farmers; provide training; information dissemination including magazines and radio (currently Voice of Teso charges prohibit this); marketing and encouragement of bulking of produce, as well as supporting quality control. SODIFA members are mainly drawn from the resource-rich farmers of the District.

Soil management is viewed as a priority issue, emphasised that if soils are not managed properly then production will inevitably decline. Soil management is included amongst the training packages requested by farmers. In April 2001 they held a course on soil management for 30 farmers with UNFA resource person. The emphasis was given to rotations, manure use and mineral fertiliser. DANIDA provide some support for soil fertility management training. Mr Ejoku was aware of the negative publicity surrounding the use of mineral fertiliser, but he was not aware of any organisation actively discouraging its use.

Valdo Odeke, (District Agricultural Officer, Kumi)
Considered the main problem with soils in Kumi is their sandy textures. In his view there has been a rapid decline in fertility because of the loss of draught power and

consequently the frequency of cultivation of the same area has been increased. With the recent increase in the number of cattle the situation is now beginning to improve. Locally where there is a high population density the soils are over-used causing a significant decline in yield.

Soil management activities in the District include some agroforestry work involving varoius tree and crop intercropping and improvement in manure management and use (unfortunately he was not able to provide further details of location etc.)

Agriculture staff from Kumi have attended training courses in organic farming at Masaka, particularly in compost making. Other main activity in the District is the Makerere University students work on green manure and manure / fertilizer interactions (see next section).

Mr John Robert Okwalinga, Kanyumu sub-county, Aguket-Olele [1 deg 21 min 47.7 sec N; 33 deg 57 min 1.67 sec E, 1132 m) (farmer hosting Makerere University manure/ fertiliser interaction site). Main crops grown on 12 acres : sorghum, cowpea, maize, cassava, millet, sweet potato, groundnuts, sunflower, cotton and wetland rice. Cultivated this area for 7 years and generally pleased with productivity and has not noticed any yield trends over this period, positive or negative. He hosts the demonstration / trial but appeared not to be that well informed about the details. Test crop, sorghum, 2 replicates 4 treatments : control; cattle manure; mineral fertiliser (CAN and SSP); mineral fertiliser and cattle manure.

Mr Guido Okwir, co-ordinator Lira Organic Farming Promotion and board member of the National Organic Association (NOAMU) established this year.
Lira Organic Farming Promotion was established in 1994 with support from SIDA, has grown initially from 200 members to 12,000 currently. Main concern is the production of organic cotton, plus sesame for specialised markets (last year 1,100 bales of cotton and 144 tons of sesame). One major buyer in the Netherlands. Tried organic chilli pepper, had difficulties in establishing a reliable market. High cost of international organic certification and additional ginning costs have caused difficulties for cotton.

Initial training in organic techniques was provided Kulika Trust in Masaka. The use of neem tree extract to control cotton pests has been shown to be effective. There has also been some collaborative research with SAARI entomologists on the use of black ants in biological control. Despite a positive start to organic cotton production and the ability to pay farmers a premium, there have been administrative difficulties. The main current concern is the difficulty of finding a market for the 100 + cotton bales currently held in the Lira store. European partners are apparently looking for additional markets, but it appears that the organic cotton market is currently over supplied.

Mr Fredrick Doi and Mr Geoffrey Opori-Okello (OUSPA, Uganda Oil Seed Producers and Processors Association, Lira.
Since 1995 involved in promotion and development of the oil seed industry. USAID has provided support since 1997 but this ends in Sept 2001. Sunflower and soya main crops, with more emphasis on sunflower. Operate an outreach service in 12 districts, with on-farm trials for new varieties including Nam I and II soya. They also identify, train and support “seed outgrowers” who are individuals with 15 acres available in

isolated areas to avoid cross contamination. Typical yields of sunflower 1000-1200 kg/ha; soya 1000-1600 kg/ha.

Soya is of particular interest because of its nitrogen fixing ability, cash and food crop potential, it is also tolerant of low soil fertility conditions and can be usefully used as a component of a soil management approach.

Initially there was limited interest in soya, but this has increased with buyers coming from Kenya to buy the soya whole. Apparently there is limited processing of soya locally because there is limited demand for the soya cake.

Concerning other soil issues. OUSPA encourages farmers to leave sunflower residues in the field, not to burn or remove. Apparently farmers believe that a crop of sunflowers improves the soil, particularly the sap from cut stems. The following rotation is encouraged : Cereal >legume> sunflower> cassava > 1-2 years fallow > cereal.

With respect to the use of mineral fertilizers, trials have been carried out in Apac, but there was little response. Animal manure use is also encouraged. Soya Innoculant treatments have been tested but with little success.

Mr G W Ebulu, Zonal Programme Officer, AT (Uganda) Lira Office.
Asked for his general view on the use and supply of mineral fertilisers. He claimed that fertilisers are generally viewed positively and by the use of demonstrations interest and demand have increased. Some farmers view fertilisers with suspicion, but this is not a widespread view. He claimed it was difficult to obtain DAP, but supplies of SSP and urea are adequate. Within Teso and Lango, Katakwi farmers are most aware of mineral fertilisers. Considers mineral fertilisers most likely to be cost effective on maize.

Annual sales of DAP 1445 kg, SSP 300 kg. (DAP 800 Sd / kg, urea. ssp 650 sd./kg) Currently difficult to obtain DAP. The majority of fertilizer sales are to order and mainly to NGOs and schools. Apart from AT (Uganda) the supply of fertilizer in Lira likely to be very limited.

Mr Jacob Oweta (District Production Co-ordinator, Lira), **Mr Clement Ojele**, (Crops specialist) Lira.
Claimed that soil fertility decline was a genuine concern in Lira District. The Lira agricultural office had at one time investigated the possibility of undertaking a District wide fertility survey with Kawanda ARI, to compare with 1950's records, but the cost was too high so this was abandoned. West and south Lira have good soils, there are poorer soils to the east and north. They confirmed that Baralegi village identified in the needs assessment was a typical example of the poorer soil types.

The DPC was aware of the Sustainable Farming Project in the lake shore area that ended in 2000, support from the Netherlands. The DPC was not aware of any other soil management project / initiative active in the District. There is a SG2000 co-ordinator in the Lira office but unfortunately he was not available, apparently only involved in limited activities.

Mrs Phoebe Angol, farmer, Aeronyero village, Anywali Parish, Apti, sub-county. Received training under the "Sustainable farming" project.
Owns approximately 12 acres of which 4 are currently cultivated, the remainder in long term (10 year +) fallow. Land spread in 3 locations, around the homestead, and two other sites. Main crops, cassava, maize, beans, millet, sesame and some cotton. Farmed in this area for last 20 years, she has noticed trends in that period e.g. simsim used to give 4 bags/acre, but now only 1.5 bags. But she said this is complicated by drought, when rain fall is good, soil fertility is not a major problem.

Her soil fertility management methods include burying grass and crop residues, she no longer burns, she has smaller better managed plots and collects and uses animal manure – (goats and chickens) from which she notices a benefit. Also makes "plant tea" from the leaves of *Tithonia sp.* but has problems in obtaining a suitable container. Plant tea particularly good for tomatoes and cabbages. She was aware and had tried to make compost with the "3 hole" system but she has now abandoned this because it represented too great a labour demand.

Annex 2 Analysis of Institutional Influence Mapping

A summary of the results of the Institutional Influence Mapping is presented in Section 1. This Appendix contains the full analysis.

Institution	Rankings by study site and wealth category								
	Okwang Sub-county, Lira district			Usuk Sub-county Katakwi District (Teso)			Mukura Sub-county, Kumi District, Teso system		
	BalaregeA	BalaregeB	Balarege C	Aterai A	Aterai B	Aterai C	Adokar A	Adokar B	Adokar C
Local Council 1	2	1	-	-	1	1	2	1	2
Chiefs/civic leaders	-	-	1	2	1	-	2	1	2
Parents/family	-	1	1	1	1	1	1	1	1
Elders	2	1	1	1	1	-	1	1	1
Friends/neighbours	1	2	1	2	3	2	3	1	3
School	3	1	1	2	2	-	1	2	1
Extension	1	1	2	2	1	1	1	1	1
Research	3	-	2	3	1	1	1	1	1
Forestry	-	-	3	-	-	3	-	2	3
Church	-	3	3	-	3	1	2	1	2
Farmer groups	-	3	1	-	2	2	2	2	3
Markets/Traders	-	-	3	-	3	3	-	3	3
NGOs	1	2	3	2	2	2	2	3	2
Drinking groups/ social gatherings	-	-	-	-	2	3	3	3	3
Health	-	-	-	-	-	2	-	1	2
Cooperative Society	-	-	-	-	-	-	-	3	2
Radio	1	2	-	3	2	-	1	-	-
Adult Literacy Campaigns	-	-	-	-	-	-	-	2	-
Clan	-	-	-	-	-	2	-	-	-
District Farm Institutes	3	3	-	-	-	-	-	-	-
Parish Credit Committees	-	-	-	-	2	-	-	-	-
Politicians	-	-	-	-	3	-	-	-	-

Familial Institutions

Study findings reveal that across all study sites and all farmer categories, Familial institutions are the most important type of institution influencing the way farmers manage their soils. Parents and other family members were given priority rank number one.

Parents: These were reported to be instrumental in the way farmers address soil productivity management because they:-

- Show boundaries and do not allow children to plough beyond these boundaries thereby encouraging maintenance of the grass bands which often form these boundaries. Nevertheless, it was also argued that the old bands may be ploughed so that the fertility that has accumulated there is utilised and they had plans to plant new ones.
- Encourage crop rotation and advise on specific crops suitable to specific pieces of land
- Advise on resting land and applying manure
- Advise on proper land preparation i.e plough twice with intervals between to allow soil to decompose, and leaving some parts unploughed at the end of a piece of land so as to prevent erosion
    - Advise weeding crops to avoid competition and depleting nutrient and teach children to bury weeds such that they rot under the soil and give manure
    - Discourage cutting trees without planting new ones which would lead to wind blowing away soil
    - Discourage burning but tell people to leave residues to rot and give soil manure. Burning leads to loss of grass cover hence wind erosion and loss of top soil.
    - Advise people not to plant to many seed in the field to reduce competition because over plant populated fields lead fast nutrients depletion
    - Advocate for periodic changing location of grazing areas to spread manure. Parents advise people to change the kraal from one place to another on their land in order to spread manure to different places. They also encourage applying manure to the fields rather than just sweeping the poultry waste, goat droppings or residues from local brew (Ajon) just around the compound. However farmers noted that they do not collect the beer residues from local drinking joints because others may laugh at them.

Family members

- Make compost manure and spreading it
- Provide labour for maintenance of bands
- Head of family decides on crop rotation and discourage removing bands

COMMUNAL INSTITUTIONS

Among the communal institutions, elders featured prominently in all districts and wealth categories while clan was only cited by least well off category in Aterai village, Katakwi. Elders were reported to greatly influence the way farmers manage their soils, receiving priority rank one across all wealth categories in the Teso faming system (Kumi and Katakwi districts), as well as middle and least well off farmers in Lango Sub-farming system (Lira district). Only the well-off farmers in Lira prioritised elders among the second most important institutions influencing soil productivity

management. Elders were noted to influence soil productivity management through the following ways:

- Advise leave land to fallow for sometime to allow it regain fertility rather than cultivating it over and over again. They advise those with small pieces of land to go to their relatives and borrow/hire land. The elders broker this process and ensure that the relative accepts to lend out his land and the one who has borrowed will return the land into the hands of the rightful owner.
- Advise people to apply manure to fields
- Advise on planting/retaining grass bands which stop water taking the soil
- Discourage cutting trees as this would accelerate erosion
- Show boundaries such that people do not cross them and minimise conflicts
- Crop rotation. Encourage people to alternate deep feeder crops with shallow feeder crops in a field using their knowledge of which kind of crops grow well on a given piece of land.

- Advise against ploughing too deep to reach red soil which is not fertile but plough within the top soil which is productive
- Advise early opening of land and burry the grass to let it rot under soil because this is away of adding manure to soil.
- Tell people to plough across the fields rather than down the slope to avoid soil being washed away by running water.

GOVERNANCE INSTITUTIONS

Governance type of institutions were next to familial and communal institutions in influencing soil management practices and they featured prominently in all districts. These included local leaders (agricultural extension, LCs and chiefs, research, schools, health workers and forestry). The importance of these institutions varied across regions and wealth categories.

Extension workers: With the exception of the better off farmers in Katakwi and the least well off farmers in Lira who assigned priority rank two to extension workers, all the categories in Kumi, well off and middle categories in Lira as well as the middle and least well of in Katakwi, acknowledged that extension workers are among the most important institutions influencing how they manage their soils. This was more pronounced in Kumi district, compared to Katakwi and Lira.

The agricultural staff were reported to influence farmers through teaching them on:-

- Crop rotation, fallow, mulching and preserving grass bands. They encourage crop rotation to check disease build up and enhance soil productivity.
- Proper spacing for crops like maize, g/nuts and cassava, and early planting
- Advise on proper method of crop production e.g. use of improved varieties and crop protection (information on spraying regimes).
- Advise on the use of manure
- Proper use of land to prevent soil erosion. They advise on row planting. In case of a field with a slope, put the rows across rather than down wards the slope in order to check water run off.
- Advise on weeding crops for better yields (weeds compete with crops and reduce nutrients if left in the field.
- If you have animals alternate grazing fields with crop fields. Fallow a field then graze on that latter open it for crops and fallow another one. This way manure is spread to many fields.
- Advise on taking crop residues back to fields such that they can decompose from their and turn into manure.

- Advise against intercropping crops of same feeding habits. i.e sunflower and maize. Recommend sunflower and beans or sesame and beans.
- Advise people to use chemical fertilise. Only one person acknowledged having once used chemical fertiliser. Price was cited as the limiting factor.
- Advise to plant Mucuna which suppresses weeds at the same time improving fertility of the soil
- Advise people to plant trees to get poles and fuel wood as well as manure after the leaves fall off and decompose. Discourage cutting big trees because these act as wind breaks thereby checking wind erosion which would lead to loss of top soil and reduced fertility.
- Train farmers in making compost to enhance soil fertility

Local leaders (LCs/Chiefs): These were reported to be very important in Katakwi where the average priority rank assigned was one. LCs/chiefs were also important in Lira especially for middle and least well off category of farmers. In Kumi district only middle category assigned priority rank one to local leaders while better off and least well off felt that these are in the second tier of institutions influencing the way they manage their soils. Overall local leaders were more influential to the middle category, followed by least well off and less influential to the better off farmers. Local leaders were reported to influence farmer soil productivity management by:

- Advise/enforce leaving grass bands for erosion control along the road and between the fields. Discourage removing grass bands which help reduce erosion caused by running water
- Enforce by-laws against burning. They advise against burning of bushes which exposes soil to wind erosion in addition to denying it manure from crop residues. Advise against burning of crop residues/grass because this leads to loss of soil cover thereby exposing it to erosion.
- Giving advise on when to start planting; proper land preparation. Encourage people to plough twice and at the right time to get high yields
- Discourage indiscriminate cutting of trees but advise on selective cutting of trees
    - Advocate for periodic changing location of grazing areas to spread manure
- Settle land disputes
- Advise people to cultivate across the field rather than down the slope as this would accelerate erosion.
- Promote crop rotation and advise farmers to gather crop residues/weeds in small heaps throughout the field (especially sites with infertile soil) then burn, the ash enhances soil fertility.
- Mobilising people for meetings where they are sensitised on production activities including soil management

Researchers: This was cited to be most influential by all farmer types in Kumi as well the middle and least well off categories in Katakwi. Research was less important in Lira where the well off category assigned rank three while the middle category did not even acknowledge that they are influenced by research. Likewise the well off category in Katakwi felt that the influence from research was negligible. Overall research was more influential to the middle farmers, followed by least well off and less influential to the well off farmers. Farmers noted that research influences them through:

- Creating awareness of agricultural problems e.g soils and recommends possible interventions and try them out for people to see outcome

- Farmers tour research station and are trained on production technologies
- Give information on crop rotation
- Advise people to apply manure. The group reported hearing this on the radio.
- Advise farmers to fallow land to enable it regain fertility.
- Discourage cultivation in areas along the swamps but recommend such areas to be used for grazing purposes.

Health workers

Health was only cited in the Teso region and not in Lango. The least well off categories in both Katakwi and Kumi acknowledged that health is in the second tier of institutions which affect how they farm while the middle category in Kumi noted that it is among the most important institutions. It worthy noting that health did not feature among the institutions cited by well off farmers across all districts. The explanation for this may lie in the fact that this category often has enough food at their disposal, are more able to meet household cash obligations, have better houses and sleep in slightly better conditions, hence health problems become less important to them unlike the lower categories which are often exposed to sickness. The farmers argued that because soil management practices are often labour intensive, it requires a healthy person to undertake these activities.

- Keeping you healthy for effective work (Giving treatment for people to remain healthy /avoid falling sick which would unable them to carry out farming activities).
- Sensitise people to practice good sanitation to ensure good health and avoid falling sick which would unable them to carry out farming activities.
- Encourage people to ensure good nutrition to enable them have the energy to carry out their activities.
- Advise people not to share houses with animals (chicken) which might bring mites hence sleepless nights and subsequently the person is sleepy during the day and unable to farm **properly.**

School

Schools featured among the institutions cited by farmers in all districts except for the least well off category in Katakwi. Overall schools were more important to the least well off category where the average rank is one and the importance became less as the wealth status progressed to well off. Farmers noted that schools feature among the institutions influencing their soil productivity management practices because of the following reasons:

- Pupils learn/get information on line planting, planting across field which has a slope rather than down the slop in order to check water run off.
- Advise on grass bands and not to live land bear with out cover crops to check water run off and stop soil erosion.
- Crop rotation to enhance fertility and reduce disease build up. This information is shared with parents who put it into practice. When the children start farming on their own they also adopt the practices.
- Children learn the need to protect the environment and transfer knowledge on farming to family members. They advise against cutting trees which act as wind breaks and the roots hold soil such that it is not easily washed away.
- Advise against burning grass which can be cut to decompose into manure

- Teach use of farm yard manure i.e while at school people are taught to scatter crop residues all over the field rather than leaving it heaped in one corner of the field, resting land,

Study findings on importance of various types of governance institutions further support the Poverty Eradication Action Plan and PMA w hich emphasize a holistic approach in trying to improve productivity in poor households. Hence further justification for the investments in education and health as PAF/PMA priority sectors.

SOCIAL INSTITUTIONS

The social institutions which were cited by farmers in the various categories included friends and neighbours, church, and drinking joints/groups. Although importance varied across region and wealth category, friends and neighbours as well as the church were cited in both Teso and Lango while the drinking groups featured only in Teso where they still considered to be of low importance by all farmer categories.

Relatives/friends/neighbours

Relatives/friends/neighbours were mainly categorised as priority two in influencing the way people manage their soils in the Teso farming system while they were viewed to be more important in Lango farming system (Lira) where the average priority rank was closer to one. This type of institution was reported to have more influence on the middle category of farmers while the better off and least better off farmers viewed it as following in priority two at most. Relatives/friends/neighbours influence soil productivity management through:

- Encouraging others to practice crop rotation and resting land (fallow) to allow land regain its fertility. They advise on not growing the same crop on the same piece of land (crop rotation)
- Advise on application of manure (crop residues/home waste, and local beer residues
- Teach on soil conservation methods e.g making ridges and grass bands. Advise farmers not to go beyond their boundaries when ploughing hence maintaining the bands.

Church

In terms of influencing farmers soil productivity management, the church was more important in Kumi district, somehow important in Katatwi and of little importance in Lira district. The church was considered to fall under class two of institutions by the well off and least well off farmers in Kumi while the latter category in Katakwi felt it falls in class one. Farmers noted that church leaders teach on proper land use patterns and make useful announcements regarding source of information on agriculture after service.

- Advise people to preserve seed for next season's planting
- Teaching people to keep within boundaries when ploughing so as to avoid land disputes
- Advise to keep grass bands to stop water taking soil
- Grow crops near the church (demonstration plots) for members to learn from

COLLECTIVE INSTITUIONS

Those categorised as collective institutions in this study include :-NGOs (such as vision Terudo, AT(U), Vision Terudo, Send A Cow, Red Cross, UNDP, NAWOU), radio, and farmer groups. Collective institutions were generally less important in influencing farmer soil productivity management. Nevertheless the importance varied across farmer categories. NGOs were cited by all farmer categories in all the three districts. These tended to be more important to well off farmers compared to the middle and least well off categories.

- Encourage the planting of trees, use of improved seed and row planting
- Advise on proper spacing such that the plant can cover the soil and protect it from erosion
- Encourages mulching to help retain moisture and later turn into manure.

Farmer groups (youth groups, women groups, work groups) generally considered to fall under class two of institutions influencing soil productivity management and this is more applicable to least well off and middle category of farmers while the well off farmers (except in Kumi) do not recognise this among the institutions influencing them.

Radio featured among the institutions influencing well off farmers in all the districts as well as middle farmers in Lira and Katakwi while it was never cited by the least well off farmers in any of the districts. The explanation seems to lie in the ability to own the radio or to put in batteries which are both influence by the financial resources available to farmers.

Farmer perception of soil fertility

Farmer perceptions on trends in soil fertility, causes and available/possible options/interventions are summarised in table xx below. Findings reveal that all farmer categories in both Lango and Teso concur that soil fertility has been on the decline over the past decade or so. Low yields were cited to be the indicator of reduced soil fertility by the farmers in Lango while increased prevalence of striga was attributed to declining soil fertility in Teso.

Perceived causes of fertility decline

Several factors were reported to have contributed to the decline in soil fertility and these include: reduced fallow periods, reduction in number of animals, continuous cultivation of same piece of land, Karimojong invasions, prolonged dry spells, increased pest prevalence and increased intensity of burning.

f. Reduced fallow periods. All farmer categories in Lango and Teso noted that the fallow periods have reduced. Differences exist by district and wealth category, with Lira farmers reporting that they can still fallow land for at least 2-3 years while only well off farmers in Katakwi can go up to those years and land fallowing has almost lost meaning in Kumi where fallow periods range between one season to one year. The implication is that land is no longer rested for long enough for it to regain fertility through natural process.

g. Reduction in number of animals. Reduction in number of animals was cited by both the well off and middle category farmers in Lango and Teso regions but not the least well of farmers. These categories of farmers noted that due to reduced livestock numbers, the amounts of animal manure available have also greatly reduced, they no longer have kraals where they could collect the manure and change locations in order to spread manure on their land. In addition reduction in cattle numbers meant loss of oxen which used to burry grass and crop residues under the soil, since this stopped and negatively impacted on nutrient recycling.

h. Closely linked to the above to issues is continuous cultivation of the same piece of land which was cited by all farmer categories in Lango and Teso. Farmers note that due to lack of oxen, land opening became difficult and this forces them to cultivate the garden used recently where the bush is still small. In addition the land available to these farming households was also reported to have decreased as land is continually sub-divided among the offspring as population and sons turn into men. None stop cultivation of land has intensified nutrient mining from these fields hence the decline in soil fertility.

i. Karimonjong invasions were cited to have compounded the problem of land fertility especially in Katakwi district in a number of ways.

- The large herds of cattle which they come with break/loosen the top soil thereby exposing it to soil erosion.
- The influx of people running away from Karamonjong invaded areas increase pressure on land where they migrate
- Lead to increased bush burning as farmers are trying to destroy the natural pastures on their land in an effort to discourage Karimonjong to graze on that land

j. Increased pest prevalence and prolonged dry spells were both noted to result into wide spread burning as farmers try to eliminate the crop residue in order to check pest build up. The outcome is that land is often left bare with no vegetation cover thereby exposing it to wind or water erosion

Possible options

Farmer cited some interventions at their disposal which could help check the reduction in soil fertility and these include:- crop rotations, fallowing land, applying manure, burring grass/crop residues after in the process of ploughing, and changing the direction of ploughing.

All farmer categories in both Lango and Teso acknowledged that crop rotation can be used to help soils regain fertility. Among the possible rotations cited were: Pigeon peas followed with sorghum, then groundnuts followed with pigeon peas then cassava in Lira and groundnuts followed by millet and sorghum, sweet potatoes/cassava then fallow in Teso. Either rotations includes a legume crop but the Lira case may give better returns since the legume take longer in the field compared to groundnuts or cow peas in case of Teso. It was reported that decisions regarding crop sequencing are the domain of men.

Applying manure featured most in Teso compared to Lango with the well off farmers in Lango noting that the work is difficult and they have no time for it. Least well off farmers in Lira and all farmer categories in Katakwi reported applying manure especially household waste, goats and poultry waste as an option. The responsibility of moving manure to the fields rests with women and children to a small extent.

Farmers in Lira noted that planting trees could help check soil erosion in addition the leaves which fall off and decompose to add manure to the soil while Katakwi farmers highlighted burying crop residues or spreading them in small heaps all over the field.

Variable	Perception By Farmer Category by Study Site						
	Balarege A	Balarege B	Balarege C	Aterai A	Aterai B	Aterai C	Adokar A
Status of soil fertility in the last 10 years	Declining	Declining	Declining	Declining	Declining	Declining	Declining
Indicator of decline	Low yields	Low yields	Low yields	-	Prevalence of Striga	-	Prevalence of Striga
Perceived Causes							
Reduced Fallow periods	From 5-10 years to 2 –3 years	From 5-10 years to 2 –3 years	From 5 - 7 years to 2 –3 years	From 5 years to 1 –3 years	From 5 years to 1 year	From 4-5 years to 1 –2 years	From 2-3 years to one season
Reduction in number of animals	Loss of Oxen which used to burry grass after ploughing	Loss of Oxen which used to burry grass after ploughing	-	Animals are kept in secure areas hence reduced/no manure	Reduced amounts of manure available to farmers	-	No kraals to get manure as in the past
Continuous cultivation	Same piece is used due to difficulty in land openning	Population increase hence less fallows	-	Population increase due to immigrants increase pressure on land hence less fallows	Population increase	Due to lack of oxen land opening is a problem	Due to high population land holding has reduced
Karimojong invasions	-	-	Come with large herds which break top soil and expose it to erosion	-	Influx of people increase pressure, and people burn the grass from their fields	Come with large herds which break top soil and expose it to erosion	-
Prolonged dry spells	-	-	-	Encourage wide spread burning	-	With reduced vegetation cover, wind blows away to soil	-
Increased intensity of burning	Exposes soil to erosion	-	Hunters and charcoal burners destroy soil cover	-	-	-	-

Variable	Perception By Farmer Category by Study Site						
	Balarege A	Balarege B	Balarege C	Aterai A	Aterai B	Aterai C	Adokar A
Increased pest prevalance	-	-	-	Encourages burning crop residues	-	Encourages burning crop residues to reduce disease /pest build up	-
Possible Options/interventions							
Rotation	✔ ✔	pp-sg-gn-pp-fallow	✔ ✔	Gn-mi-sg-sp/cs-fallow	Sg-cs-gn-sp-mz-fallow	✔ ✔	✔ ✔
Fallow	3-5 years	2-3 years	2-3 years	At most 3 years	1 year using cassava or s/potato	1-2 years	One season
Apply manure	Labour intensive & time consuming	-	Especially poultry and goat waste	Crop residues, poultry & goat waste	Crop residues, poultry & goat waste	Household waste, poultry & goat waste	✔ ✔
Plant trees	✔ ✔	✔ ✔	-	-	-	-	-
Burry crop residues after ploughing	-	-	-	✔ ✔	✔ ✔	✔ ✔	
Change direction of ploughing	-	-	✔ ✔	-	✔ ✔	-	-

Key

PP= Pegion peas **Mi= Millet**
Gn=Ground nuts **Sp= Sweet potato**
Sg= sorghum Cs= Cassava

Farmer prioritisation of Influencing Institutions

Institution	Average Rankings by study site and wealth category						
	District				Farmer category		
	Lira	Katakwi	Kumi	Overall Rank	Better off (A)	Middle (B)	Least well off
Local Council 1	1.50	1.00	1.67	1.42	1.67	1.00	1.50
Chiefs/civic leaders	1.00	1.50	1.67	1.50	2.00	1.00	1.50
Parents/family members	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Elders	1.33	1.00	1.00	1.13	1.33	1.00	1.00
Friends/neighbours	1.33	2.33	2.33	2.00	2.00	1.33	2.00
School	1.67	2.00	1.33	1.63	2.00	1.67	1.00
Extension	1.33	1.33	1.00	1.22	1.33	1.00	1.33
Research	2.50	1.67	1.00	1.63	2.33	1.00	1.00
Forestry	3.00	3.00	2.50	2.75	-	2.00	3.00
Church	3.00	2.00	1.67	2.14	2.00	2.33	2.00
Farmer groups	2.00	2.00	2.33	2.14	2.00	2.33	2.00
Markets/Traders	3.00	3.00	3.00	3.00	3.00	3.00	3.00
NGOs	2.00	2.00	2.33	2.11	1.67	2.33	2.33
Drinking groups/ social gatherings	-	2.50	3.00	2.80	3.00	2.50	3.00
Health	-	2.00	1.50	1.67	-	1.00	2.00
Cooperative Society	-	-	2.50	2.50	-	3.0	2.00
Radio	1.50	2.50	1.00	1.80	1.67	1.50	-
District Farm Institutes	3.00	-	-	3.00	3.00	3.00	-

Annex 3 Linkages to other Initiatives

During the course of the consultancy two workshops were held of direct relevance, namely the :

- IFPRI co-ordinated "Policies for Improved Land Management in Uganda" Workshop 25th and 27th June 2001
- Rockefeller Foundation Uganda Consultative Meeting on Integrated Nutrient Management, 10th – 12th October 2001.

IFPRI co-ordinated "Policies for Improved Land Management in Uganda" Workshop 25th and 27th June 2001

The timing of this workshop was fortunate as it provided an opportunity to examine many of the issues raised during the consultancy in a national context with a range of key stakeholders.

The workshop was organised by the International Food Policy Research Institute (IFPRI, Makerere University Faculty of Agriculture, NARO, Agricultural Policy Secretariat and the Centre for Development Research University of Bonn.

The workshop had the following objectives :

1. To familiarise policy makers and other stakeholders in Uganda with the objectives and activities of the project.
2. To review the preliminary findings of the research so far, and obtain feedback from stakeholders on these findings.
3. To consider key policy issues affecting the prospects for improved land management in Uganda.

The workshop was well attended by over 40 participants, including two SAARI staff. Presentations were made under the following themes :

- Characterisation of Land Management Problems in Uganda
- Development of Input Markets
- Development Pathways and Land Management
- Assessing Impacts of Land Management Practices

Socio-economic and land management survey data collection has been the major effort to date, with the majority of analysis still awaited. The available survey data for Teso and Lango has been obtained from IFPRI and made available at SAARI. This data should be valuable in the design and implementation of future programmes. Full sets of workshop presentations have also been deposited at SAARI.

Rockefeller Foundation Uganda Consultative Meeting on Integrated Nutrient Management, October 10th – 12th.

Over the last decade the Rockefeller Foundation has supported both research and dissemination work in the area of integrated nutrient management across a range of stakeholders within the country. Yet widespread impact at the farm level remains limited. This workshop was convened to facilitate the soils research and development community in Uganda and the Foundation to define a vision for future strategies and work in the area of integrated nutrient management.

The overall aim of the meeting was to assess progress and challenges of INM in Uganda and suggest a way forward. More specifically to :

1. Assess the general approach of INM research, application and downstream interface with farming communities in Uganda.
2. Identify results/ outputs and early elements of impact.
3. Put forward concrete recommendations for INM innovative research, downstream dissemination and the stakeholders to be involved in INM.
4. Generate a set of recommendations for RF's role to support INM initiatives over the coming 5-10 years.

The meeting was attended by over 40 participants, mainly from Uganda and was organised under the following headings :

- Understanding of soil and nutrient management in Uganda.
- review of existing INM research, its effectiveness and its outcome.
- Dissemination approaches methods and community based learning.
- Capacity needs in both research and dissemination.
- Future niche/role of the Foundation.

Despite a packed agenda the meeting provided a very useful opportunity to meet key players in the soils field and review developments. Copies of papers presented at the meeting as will be deposited at SAARI. These include reviews of soils research undertaken by NARO and by Makerere University (during the last 15 years).

It is particularly notable that the majority of soils work Nationally has been concentrated in Kabale, Mukono and Tororo Districts. Lango and Teso were notable for their absence. The historical reasons for this, due to historical disturbance are clear. However, perhaps because of work commenced in other areas during this period there is a natural tendency to continue. A conscious effort to develop work in new areas will need to be made. Despite the high quality of most of the presentations made at the meeting, the most innovative work consistently involved a range of partners and frequently included an international centre.

Particularly interesting and innovative work was presented by :

- Caroline Nankinga (KARI/IITA) on Adaptive Research in the Banana Research Programme.
- David Siriri (AFRENA/ICRAF) on Agroforestry in Kabale District.
- Pascal Sanginga, (CIAT) on Participatory land management work in Kabale District.

Particularly relevant work included :

Makerere University Soil Science Dept. (M. Bekunda)

District	Topic	Main finding
Kumi	Estimated macronutrient balance sheets	negative balance
Lira	Biological nitrogen fixation inoculation studies	153% yield response
Katakwi	Indigenous vs. scientific basis of soil mapping	Mapping units based on indigenous knowledge correspond with those based on scientific data only for wetland soils.
Katakwi	Contour ridging, sorghum, cowpea	Contour ridges did not sig. increase crop yields over 3 years
Kumi	Mineral fertilizer and organic inputs integration in maize, sorghum and sweet potato.	Studies recently commenced.

Soils and Soil Fertility Management Programme, NARO KARI (H. Ssali)

District	Topic
	Effect of plant residues and other organic manure on the maintenance and improvement of soil fertility.
	On-farm evaluation of the potential for improved utilisation of locally available materials in soil management.
	Study of potential of utilising cassia and lantana as organic amendments.
	Effect of combining low quality organic materials with inorganic fertilizer.
	Improving integrated nutrient management strategies in small scale farms
	Development and verification of farmer orientated decision guides to soil fertility management.
Pallisa	Enhancing smallholder farm productivity through integrated soil fertility management.
	Increasing cereal yields through efficient use of fertilizer /organic resources.
Katakwi	A study of indigenous knowledge of soil and water management in Katakwi District.
	Strategies, cost and benefit of soil fertility replenishment in soils with different productivity potential to assist develop appropriate strategies for land use management.

Key meeting issues

- Human resource capacity concerns for INM / agricultural staff, issues of status, image, career prospects, low University enrolment, freeze of NARO recruitment.

- The need for a new breed of "agricultural development worker" who combines the research and extension in a participatory, problem orientated, farmer specific approach to work on issues at community level.
- The need to emphasise the poverty focus of interventions.
- The implications and opportunities offered by NAADS.
- Scaling-up, decentralisation and appropriate entry points.
- Exchange networking of best practice.

Future direction of RF

The Uganda meeting was one of four in the target countries (Kenya, Uganda, Malawi, and Zimbabwe) programme as part of a larger review exercise.

For Uganda the RF wishes to identify interventions over the next 10-15 years (with an annual budget of US $1million) that will create an impact on :

- Creating linkages across stakeholder/partnerships and multi-stakeholder learning.
- Scaling-up successful research and dissemination strategies.
- Strengthening institutional capacity of various stakeholders.

The meeting was asked to identify various components of the interventions and priorities for funding. As yet these are provisional, but they are likely to include :

- Continuing support to capacity development in the short to medium term, because of the severe shortage of Ugandans trained in the subject area.
- An increased emphasis on strategies for resource-poor farmers.

- Development of a INM "Tool Box" of participatory social and bio-physical characterisation tools; soil management options practical dissemination approaches for each AEZ, working in close collaboration with the ARDC network. The term "tool box" was used to emphasise the practical impact the approaches require. Further development of new tools is anticipated in a subsequent phase.

Annex 4 Itinerary

ITINERARY / CONTACT LIST 1st VISIT

	Date First Seen	Name / Organisation	Contact Details	Comments
		PB Travel UK – Entebbe		
1.	23/4	Dr. Joseph Oryokot Director SAARI, Serere	Tel. 045 61192 Fax. 045 61444	Initial briefing meeting
2.	23/4	Nathan Nangoti, NARO/DFID Project, Seeds/Soils, SAARI, Serere	Tel. 045 61192 Fax. 045 61444	Join team for 2nd week
3.	23/4	Nelson Olani, Soils, SARRI, Serere	Tel. 045 61192 Fax. 045 61444	Join team for 1st week
4.	23/4	Godfrey K ayobyo, Socio-Economic Consultant, Kampala	Mob. 077 459952	Part of team for duration
5.	23/4	Chris Kyerere, Director Impact Associates, Kampala	Mob. 077 722054 Tel. 041 231583	Agrisystems Ugandan partner, logistic support
6.	23/4	Dr. Isaac Minde Coordinator ECAPAPA	Tel. 41 321780 Fax. 41 321777 ecapapa@imul.com	Overview of seed regulatory harmonisation
7.	23/4	Dr Otim Nape Dep. Director General (Outreach) NARO Secretariat Entebee	Mob. 077 502907 Tel. 41 320178 / 320264 Onape@infocom.co.ug	Strong support for consultancy, encouraged wide scope
8.	24/4	Dr. Henry Ssali Head of Soil Science KARI, Kawanda Agricultural Research Inst.		SFI Uganda Co-ordinator Chair, Documents
9.	24/4	Dr. Ann Stroud African Highlands Initiative Coordinator, Kawanda Agricultural Research Inst.	Tel. 041 566722 Fax. 041 567635	DFID funded research, Land management policy
10.	24/4	Dr. Pascal Sanginga, Research Fellow, CIAT, African Highlands Initiative, c/o Kawanda Agricultural Research Inst.	Mob. 077 789604	Working on land management policy, Kabale
11.	24/4	Dr Roger Kirkby, CIAT	[KL has details in UK]	
12.	24/4	Dr Soniia David, Research Fellow, CIAT	[KL has details in UK]	Out of office when we visited
13.	24/4	Dr Flavia Kabere, Senior research Officer / Seed Technologist, Post Harvest Programme, NARO-Kawanda	Mob. 077 454313 Tel. 41 567708 /507 /649 karihave@starcom.co.ug	Rockefeller-funded study in Lira (Omarare & Bata).
14.	24/4	Emmanuel Gareeba-Gaso Project Director, Uganda Seed Project, Kawanda	Mob. 077 594066 seeds@infocom.co.ug	USP is in process of privatisation and will be moving out of Kawanda
15.	24/4	Joseph Bazaale National Seed Certification Service, Kawanda	077 505405 077 405561	Very helpful
16.	24/4	Emmanuel Mubangizi Farm Inputs Care Centre (FICA) Ltd.	Mob. 077 454288 fica.project@mail.com Plot 167, Bombo Rd	Private seed company, began operating 2000. Sister

				company = Afro Kai
17.	24/4	Fred Muhhuku Low Value Crop Specialist, agribusiness Development Centre, IDEA Project	Mob. 077 432677 Tel. 41 255482 /83 /68 Plot 18 Prince Charles Drive, Kololo adc@starcom.co.ug	Out of office when we visited
18.	24/4	J. Nuwamanya Commissioner for Coordination and Monitoring Office of the Prime Minister, Kampala	Mob. 077605014 Tel. 348854	Colleague from Zimbabwe Provided (draft) list of NGOs involved in Agric And Environment
	24/4	J. Richard Opjt Land Act Implementation Unit Ministry of Water, Lands and Environment, Kampala	Mob. 077 412702 Tel. 041 320304 /343138 campus@imul.com	Provided Info. on current status of Land Act
19.	24/4	Dr. Joanne Bosworth Social Development Consultant Land Act Implementation Unit Ministry of Water, Lands and Environment, Kampala	Mob. 077 446557 Tel. 041 343138	DFID supported position
20.	25/4	Dr. Ephraim Nkonya Project Leader, Policies for Improved Land Management in Uganda, Kampala	Mob. 077 451672 Tel. 041 234613 3rd Floor, Colline House, Kampala e.nkonya@cgiar.org	IFPRI Project, invite to Dissemination Workshop June 25-26, Kampala
21.	25/4	Crammer Kaizizi, Ph.D. student looking at nutrient balance and green manure.	Mob. 077 518875	Trials in Soroti District Not seen contact details only.
22.	25/4	Dr. Dick Sserunkuuma Dept. of Agricultural Economics Makerere University, Kampala	Mob. 077 504454 Tel. 041 530505	Responsible for MU Component of Policies for Improved Land Management in Uganda
23.	25/4	Dr. Moses Tenywa Head Soil Science Dept, Makerere University, Kampala	Mob. 071 808374 Tel. 041 540707	Not seen contact details only. Has report on soils in Katakwi
24.	25/4	Dr. Jacob Aniku, Associate Prof. Soil Science Dept. Makerere University, Kampala	Mob. 071 803080 Tel. 041 541047	Contact details for Teso soil research
25.	25/4	Joseph Eateng, Lupert Lupe, M.Sc. Makerere students	Via Mob. 071 803080 Tel. 041 541047	Supervised by Prof. Aniku, working on soil fertility in Kumi District
26.	25/4	Mathew Kasule, NARO Business Consultant, NARO Sec. Entebee	Mob. 077 484652	Identifying profitable activities for new NARO Business Company
27.	25/4	Dr. Okorio Programme Leader FORI (Forestry Research Institute/ICRAF), Nr. Mukono	Mob. 077 410125	Not seen contact details only
28.	25/4	Josephine Okot, General Manager, Harvest Farm Seeds Ltd	Mob. 077 467365	Very helpful
29.	25/4	National Biomass Study, Forestry Department. Kampala Ministry of Water, Lands and Environment	Tel. 041 251779 Nbsfd@imul.com Nakawa Forest Station,	Paper and Digital Maps

			31 Spring Rd	
	26/4	Travel – Kampala to Soroti		
30.	27/4	Hillary Edep, Sec. Production, Katakwi District	Tel. 045 73026	Political position, provided background in absence of DAO
31.	27/4	Margaret Aamyu, Fisheries Officer, Katakwi District	Via Tel. 045 73026	Provided background
32.	27/4	Silver Ongom, District Agricultural Officer, Katakwi	Via Tel. 045 73026	Not seen contact details only
33.	27/4	Godfrey Sanyu, Accountant Action Aid Katakwi	Tel. 045 73009	Provided some background
34.	27/4	Michael Olupot, Agriculturalist, Action Aid, Katakwi	Tel. 045 73009	Not seen contact details only
35.	28/4	Miss Betty Opeche, AT (Uganda), Soroti		Explained AT's activites
36.	30/4	Michael Okoy, Agriculturalist, Soroti Catholic Diocese Integrated Development Organisation (SOCADIDO), Soroti	Tel. 045 61505 Fax. 045 61400	SOCADIDO's Agricultural Activites
37.	30/4	Peter Samuel Ejoku, Co-ordinator, Soroti District Farmers Association (SODIFA), Soroti	Mob. 077 623454 Tel. 045 61558	SODIFA's activities, and Publications
38.	30/4	Charles Aben, Production Coordinator & District Agricultural Officer, Soroti	Mob. 077 489060 Tel. 045 61707	Soroti District overview
39.	30/4	Valdo Odeke, District Agricultural Officer, Kumi	Mob. 077 463936	Kumi District overview and priorities
40.	30/4	Ms. Betty Adong, Monitoring and Evaluation, Kumi District	Via Mob. 077 463936	Helped with field visit
41.	30/4	John Robert Okwalinga, Fertility trials farmer, Aguket , Kanyumu ? Kumi District	Via DAO, Kumi	Interviewed re. Makerere trials see 18. above
	1/5/01	Travel from Soroti to Lira		
42.	1/5/01	Guido Okwir, Co-ordinator, Lira Organic Farming Promotion	PO Box 59, Lira Tel. 0973 20179 Mob. 077 622069 Lofp@africaonline.co.ug	Member of National Organic Growers Committee.
43.	2/5/01	Fredrick Doi, UOSPA Officer Apac District	C/o Uganda Oil Seed Producers and Processors Association, (UOSPA) Box 383, Lira Tel. 20517	Shares Lira office
44.	2/5/01	Geoffrey Opori-Okellow, UOSPA Extension Supervisor, Apac District	C/o Uganda Oil Seed Producers and Processors Association, (UOSPA) Box 383, Lira Tel. 20517	Shares Lira office
45.	2/5/01	Joseph Okellowange Zonal Prog. Officer, Apac, Masindi, AT (Uganda)	PO Box 455, Lira. Tel. 077 587519	Shares Lira AT office
46.	2/5/01	George William Ebulu Zonal Prog. Officer, Soroti, Katakwi, AT (Uganda)	Plot 1Serere Rd Soroti Mob 077 520144 Tel. 045 61558	Resp. for Soroti, Katakwi & Kaberamaido
47.	2/5/01	Jacob Oweta, District Production	Tel. 0473-20010 (DAO)	Some intro. But

		Co-ordinator, Lira District	Mob. 077 625833	wanted prior notice.
48.	2/5/01	Clement Ojele, District Agricultural Officer (Crops), Lira District	Tel. 0473-20010 (DAO)	Info. on good/poor soils for Lira
49.	2/5/01	Dr. Ebong, District Veterinary Officer, Lira District	Tel. 0473-20010 (DAO)	Our guide on field visit
50.	2/5/01	Ms. Grace Opudo, Dairy Farmer, Lira peri-urban		Benefited from loan of dairy cattle, successful but v. limited scheme
51.	2/5/01	Patrick Ekwong, Passion Fruit Farmer, Okii, Nr. Lira		Also animal husbandry officer, not representative
52.	2/5/01	George Ebong AT (Uganda) Distributor, Lira	PO Box 455, Lira. Tel. 077 587519 c/o Zonal Officer	Provided sales data
53.	3/5/01	Ms. Kezia Oteng (Assistant DAO, Retired) Former Project Manager Sustainable Agriculture Project, Kioga County, Lira.	C/o Tel. 0473-20010 (DAO)	Our guide for field visit to Kioga
54.	3/5/01	Ms. Phoebe Angol, farmer, Aeronyero village, Anywali Parish, Apti sub-county		Female headed household, resource poor
55.	3/5/01	Nelson Owira, farmer, Abalodyang village, Apit sub-county		Male headed household, Some cash cropping
56.	3/5/01	Peter ?? Extension Agent	Aceng Rweny, Aputi sub-county, Kioga	assisted in farmer discussions
57.	4/5/01	Debreifing / Planning SAARI		
	5/5/01	Travel Soroti to Entebbe		
	6/5/01	PB travel Entebbe-UK		

ITINERARY 2nd VISIT

Date	*Name / Organisation*
3/6	PB Travel UK – Entebbe
4/6	Survey and Mapping Dept. Entebbe Impact, Kampala Travel to Soroti
5/6	SAARI, Planning meeting, Director briefing
6/6	SAARI Training preparation
7/6	SAARI Team Training
8/6	SAARI Team Training
9/6	Fieldwork preparation
10/6	
11/6	Fieldwork – Kumi District
12/6	Fieldwork – Kumi District
13/6	Fieldwork – Kumi District
14/6	Fieldwork – Katakwi District
15/6	Fieldwork – Katakwi District
16/6	Fieldwork – Katakwi District
17/6	Travel to Lira District
18/6 19/6	Fieldwork – Lira District Fieldwork – Lira District

20/6	Fieldwork – Lira District
21/6	Travel from Lira to Soroti and prep. for seminar.
22/6	Prepare and present seminar on activities and preliminary results at SAARI
23/6	Consolidate data and prepare soil samples
24/6 25/6	Travel Soroti to Kampala Kampala. Attend workshop on Policies for Improved Land Management in Uganda.
26/6	Kampala, (public holiday) prepare abstract and report preparation
27/6	Attend workshop on Policies for Improved Land Management in Uganda Meet Dr. Moses Tenywa Head Soil Science Dept, Makerere University, Kampala KARI, soil samples
28/6	DFID Travel Entebbe -UK

ITINERARY 3rd VISIT

Date	Location(s)	Activity
25/9/01	Rwanda > Entebbe >Kampala	Travel
26/9	Kampala >KARI> Soroti	KARI soil results > travel
27/9	Soroti >SAARI>Soroti	Orientation briefing, set-up
28/9 29/9	Soroti >SAARI>Soroti Soroti	Guidelines GIS / GPS Training Prep
30/9	Soroti	Sunday
1/10	Soroti >SAARI>Soroti	GIS / GPS Training Prep
2/10	Soroti >SAARI>Soroti	GIS / GPS Training Workshop
3/10	Soroti >SAARI>Soroti	GIS / GPS Training Workshop
4/10	Soroti >SAARI>Soroti	Stakeholder analysis, Guidelines
5/10	Soroti >SAARI>Soroti	Soil Workshop Prep, Report
6/10	Soroti	Soil analysis, Report
7/10	Kampala	Sunday (Travel to Kampala)
8/10	Kampala	Cross-cutting issues
9/10	Entebbe	Report, Rockerfeller W-shop
10/10	Entebbe	Rockerfeller W -shop
11/10	Entebbe	Rockerfeller W -shop
12/10	Entebbe	Rockerfeller W -shop
13/10	Entebbe	Rockerfeller W -shop, Report
14/10	Soroti	Sunday (Travel to Soroti)
15/10	Soroti >SAARI>Soroti	Compile Working Draft Report
16/10	Soroti >SAARI>Soroti	Prep Soils W -shop
17/10	Soroti >SAARI>Soroti	Soils W -shop
18/10	Soroti >Entebbe> UK	Debrief > travel

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