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REPORT ON SOIL SAMPLING AND ANALYSIS FOR IMVEPI REFUGEE CAMP

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REPORT ON SOIL SAMPLING AND ANALYSIS FOR IMVEPI REFUGEE CAMP

1. Introduction

Some of the refugees from neighbouring Sudan have for many years now been settled at Imvepi refugee camp and other areas. The overall management of these settlements are headquartered at Rhino camp 70 km east of Abi ARDC.

On arrival the refugees are allocated 0.2 hectares of land per head for farming so that they can produce some of the food by themselves and hence reduce over dependence on management for food items. The Camp is funded by the United Nations High Commission for Refugees (UNHCR) through the German Development Service (ded).

The management of Rhino Camp/ded called on Scientists from Abi ARDC to carry out soil sampling and analysis for Imvepi refugee settlement with the objective of obtaining a better understanding of the current soil fertility status. The information obtained would in turn be useful in improving on the soil management practices by the refugees so that they could enhance crop yields and be able to improve on their socio-economic well being.

Consequently a team of Researchers was sent from Abi to Imvepi to carry out blocking and soil sampling. The soils samples were then dried at Abi ARDC and taken to Makerere University for routine analysis.

The results of the laboratory analysis form the main focus of this report. Some recommendations regarding better management of Imvepi soils have also been made based on the results of this study. The report further highlights the secondary information that was collected from farmers and synthesized using a simplified check list.

The team is grateful to the Management of both Imvepi and Rhino Camp settlements for their cooperation and funding this work. Specifically we are grateful to both Mr. Adolf Gerstl and Mr. Joel Okwir. The team worked closely with Mr. Tomijo an Agricultural Officer based at Imvepi settlement during the blocking and sampling phases. Our thanks go to him. The team is further grateful to the staff of Makerere University soils laboratory for carrying out the routine analysis of the soil samples.

2. Methodology

2.1 Blocking

Blocking was done in order to give each settlement unit chance for being sampled. Additionally blocking tremendously increased chances of obtaining soil samples that were representative of the area and therefore increase on precision. A control soil sample was also collected for each block/point. A control sample was one collected from the block/point in nearby virgin soils. Table 1 shows the blocks that were used for sampling.

Table 1: Soil Sampling Blocks at Imvepi Settlement

Block	**No. of soil samples including controls**
Point J	18
Point C	6
Point G	3
Point H	6
Point D	9
Point A	9
Point B	9
Point E	12
Point I	15
Point F	15

2.2 Soil Sampling

Soil sampling was done using the soil auger. Five points were augured (four corners of the farm and centre) at 3 levels (0-15, 15-30 and 30-45 cm depth). The soils were then thoroughly mixed in plastic basins and using the quartering method representative samples were obtain from 34 locations at 3 levels making a total of 102 soil samples. These samples were then dried at room temperature for three (3) weeks. Thereafter they were taken to Makerere University for routine analysis. Table 2 shows the farms and sites that were sampled. The farms were sampled after it was ascertained that they more or less represented the farming circumstances of their parent blocks.

Table 2: Representative Farms/Sites that were Sampled

Block	Name of farm/site	No. of samples including controls
Point J	Demonstration site (DS)	6
	Alex Akilewo (AA)	6
	Jane Modo (JM)	6
Point C	Wani (Wani)	3
Point G	Mary Konga (MK)	3
Point H	Yasimin Peter (YP)	6
Point D	Edina Aya (EA)	6
	Ester Modo (EM)	3
Point A	Duku James (DJ)	6
Point B	Gboya Kemisa (GK)	3
	Monica Dudu (MD)	3
	Rajab Simon John (RS)	3
	Chaplain John (CJ)	3
	Amule Alex (AA)	3
Point I	Bullen Laddu (BL)	6
	Kwaje Jacob (KJ)	6
	Original (O)	3
Point F	Turupaina Kiden (TK)	6
	Omal John (OJ)	3
	Brown Kennedy (BK)	6

2.3 Laboratory Analysis

In the laboratory the soils were crashed and passed through a 2 mm sieve. The soils was then analysed according to available Phosphorous (P) procedures as outlined by Okalebo *et al.* (1993). Exchangeable Potassium (K), Magnesium (Mg), Calcium (Ca) and Sodium (Na) were determined according to procedures again as outlined by Okalebo *et al.* (1993). And total Nitrogen (N) was determined by the micro Kjeldahl method.

2.4 Secondary Information

Farmers whose farms were sampled were also engaged in a conversation with the guide of a simplified checklist. This provided secondary information about soil fertility in the block. It also solicited farmers' views regarding soil management in the block. A sample of the checklist is attached at the end of this progress report (Appendix 1).

3. Results and Discussions

3.1 Laboratory Analysis

3.1.1 Soil Organic Matter (SOM)

Most of the sampling sites tested low in soil organic matter (SOM). The critical value for SOM in Uganda soils is 4%. However, most samples that were analysed were below this value with the exception of Point I (BL and Control) as indicated in Table 3. Low SOM content especially in the furrow slice (0-15 cm) can seriously affect crop production given that SOM is the seat for most plant nutrients in Tropical soils (Russel, 1978), Nyle, 1990). Low levels of SOM could be attributed to high temperatures that cause rapid decomposition of dead plant materials in virgin soils. Continuous cultivation of this land can also lead to rapid decomposition of dead plant materials.

It was not very clear as to why at some points SOM content was higher at 15-30cm than at 0-15cm. However, it is possible that dead plant roots at depth can increase the level of SOM in the lower horizons especially when land is newly opened for cultivation. The deep roots decompose much slower at depth than towards the surface and this may result in SOM being higher at depth than in the furrow slice.

Table 3: Organic Matter Content at Different Locations

Location	N Level %			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	1.48	1.06	1.70	Low
Point I KJ	5.67	4.56	3.92	Average
Point I control	7.31	5.83	4.42	Okay
Point H control	3.39	1.67	1.38	Low
Point C Wani	2.54	3.07	2.01	Low
Point C control	1.11	1.28	1.48	Low
Point J JM	3.60	2.54	1.96	Low
Point J	1.91	3.07	2.12	Low
Point J control	1.11	1.28	1.48	Low
Point J DC control	2.76	2.44	1.91	Low

Point D EM	1.70	0.64	1.27	Low
Point D control	1.17	1.91	0.42	Low
Point EO SA	2.23	1.17	1.27	Low
Point E CJ	1.59	1.27	0.85	Low
Point EO control	2.76	1.38	2.01	Low
Point G MK	2.23	2.86	1.91	Low
Point G MK control	1.11	1.28	1.48	Low
Point B GK	2.86	3.92	2.54	Low
Point F OJ	3.6	2.44	1.48	Low
Point F control	2.86	3.07	2.12	Low
Point E AA	3.60	4.03	2.86	Low
Point D EA	1.38	1.48	1.17	Low
Point A RS	4.42	4.03	3.92	Average
Point I BL	7.78	6.25	5.51	Okay
Point I control	8.80	6.89	4.98	Okay
Point B RS	2.33	1.80	2.22	Low
Point B MD	2.65	2.44	2.65	Low
Point B control	1.11	1.28	1.48	Low
Point F TK	2.22	1.06	1.91	Low
Point F BK	3.60	3.29	2.22	Low
Point A DJ	4.03	3.07	2.23	Low
Point A control	4.56	2.97	2.44	Low
Point H YP	2.01	2.65	1.06	Low
Point J AA	2.23	1.91	1.59	Low

Critical value = 4%

3.1.2 Total Nitrogen

By relative number of atoms, Nitrogen is probably the most required plant nutrient (Frank, 1965). The analysis, however, revealed that this macronutrient was low at all the settlement points with the exception of Point I (BL and Control) which had average levels (Table 4). Low levels of total N could have a result of the low SOM content.

Table 4: Total Nitrogen at Different Locations

Location	N %			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	0.13	0.11	0.12	Low
Point I KJ	0.23	0.16	0.10	Low
Point I control	0.30	0.20	0.10	Low
Point H control	0.23	0.12	0.10	Low
Point C Wani	0.17	0.10	0.10	Low
Point C control	0.13	0.10	0.05	Low
Point J JM	0.15	0.12	0.10	Low

Point J	0.20	0.20	0.12	Low
Point J control	0.13	0.10	0.05	Low
Point J DC control	0.20	0.20	0.10	Low
Point D EM	0.13	0.05	0.10	Low
Point D control	0.10	0.09	0.05	Low
Point EO SA	0.20	0.11	0.10	Low
Point E CJ	0.21	0.10	0.05	Low
Point EO control	0.20	0.15	0.12	Low
Point G MK	0.23	0.15	0.10	Low
Point G MK control	0.13	0.10	0.05	Low
Point B GK	0.17	0.10	0.10	Low
Point F OJ	0.13	0.10	0.10	Low
Point F control	0.17	0.10	0.12	Low
Point E AA	0.20	0.20	0.10	Low
Point D EA	0.20	0.10	0.11	Low
Point A RS	0.27	0.12	0.12	Low
Point I BL	0.30	0.20	0.20	Average
Point I control	0.37	0.25	0.20	Average
Point B RS	0.10	0.09	0.10	Low
Point B MD	0.23	0.11	0.10	Low
Point B control	0.13	0.10	0.05	Low
Point F TK	0.10	0.11	0.05	Low
Point F BK	0.17	0.16	0.18	Low
Point A DJ	0.27	0.18	0.10	Low
Point A control	0.13	0.13	0.10	Low
Point H YP	0.10	0.10	0.10	Low
Point J AA	0.13	0.10	0.05	Low

Critical value = 0.2%

3.1.3 Phosphorus

Phosphorus is one of the macronutrients that are required in large amounts like Nitrogen and Potassium (Johnson, 1987, Mbalule, 1996). The critical value for P in Uganda soils is 15 parts per million (ppm). The analysis, however, revealed that most sampling sites tested low in P (<15ppm) as indicated in Table 4. Exceptions to this overall trend were found at Point I (KJ, Control and BL), which had high levels of P. Average levels of P were also found at Point E original (control). Low soil phosphorus is probably due to the inherently poor soils right from the parent material.

Table 4: Phosphorus Levels at Different Sites

Location	**Available P ppm**			**Remarks**
	0-15cm	**15-30cm**	**30-45cm**	
Point I Original	11.28	8.06	3.33	Low
Point I KJ	32.03	25.12	13.05	High
Point I control	32.92	18.51	15.08	High

Point H control	2.39	2.03	1.25	Low
Point C Wani	15.44	6.19	3.80	Low
Point C control	2.08	1.82	1.52	Low
Point J JM	5.98	2.60	1.61	Low
Point J	2.96	4.16	1.30	Low
Point J control	2.08	1.82	1.51	Low
Point J DC control	2.08	1.81	1.51	Low
Point D EM	6.14	4.68	4.00	Low
Point D control	9.83	4.37	2.86	Low
Point EO SA	18.67	9.46	4.37	Average
Point E CJ	4.68	2.70	2.08	Low
Point EO control	22.36	14.66	11.54	Average
Point G MK	14.61	9.98	4.78	Low
Point G control	2.08	1.82	1.51	Low
Point B GK	12.12	7.23	3.69	Low
Point F OJ	14.51	4.84	2.39	Low
Point F control	20.64	6.86	3.34	Average
Point E AA	28.44	17.26	15.03	Average
Point D EA	9.26	4.58	3.17	Low
Point A RS	18.88	18.15	6.29	Average
Point I BL	41.69	27.35	12.21	High
Point I control	25.74	33.70	23.61	High
Point B RS	15.55	7.90	3.90	Low
Point B MD	8.63	4.99	2.08	Low
Point B control	2.08	1.82	1.51	Low
Point F TK	15.34	4.84	3.80	Low
Point F BK	39.88	30.58	20.23	High
Point A DJ	12.58	7.38	3.21	Low
Point A control	2.08	1.80	1.50	Low
Point H YP	3.48	1.66	1.72	Low
Point J AA	2.24	1.46	1.46	Low

Critical value = 15ppm

3.1.4 Potassium

Potassium is usually associated to Nitrogen and Phosphorus (conjugate nutrients) and are all required in large amounts (Johnson, 1987). The critical value for K in Uganda soils is 0.4 Mill equivalents (Me)/100g soil. The analysis of soil samples at Imvepi revealed that some sites had low, others average and high levels of this important plant nutrient as indicated in Table 5. Overall, Potassium did not seem to be a limiting factor to agricultural production at Imvepi refugee camp unlike Nitrogen and Phosphorus.

Table 5: Potassium Levels at Imvepi Sites

Location	Exchangeable K Me/100g soil			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	0.41	0.26	0.15	Average in 0-15cm
Point I KJ	1.43	1.02	0.87	High
Point I control	1.63	1.68	1.58	High
Point H control	0.51	0.31	0.51	Average
Point C Wani	0.77	0.51	0.51	Average
Point C control	0.26	0.20	0.26	Low
Point J JM	0.92	0.56	0.46	Average
Point J DS	0.97	0.61	0.46	Average
Point J control	0.26	0.20	0.26	Low
Point J DC control	2.65	1.92	1.46	High
Point D EM	0.31	0.26	0.15	Low
Point D control	0.31	0.36	0.15	Low
Point EO SA	0.61	0.56	0.46	Low
Point E CJ	0.41	0.20	0.26	Low
Point EO control	0.82	0.26	0.51	Average
Point G MK	0.82	0.46	0.46	Average
Point G MK control	0.26	0.20	0.26	Low
Point B GK	0.87	0.97	0.61	Average
Point F OJ	0.87	0.61	0.72	Average
Point F control	0.97	0.92	0.61	Average
Point E AA	1.02	0.77	0.71	High
Point E control	0.26	0.20	0.26	Low
Point A RS	0.77	0.36	0.56	Average
Point I BL	2.09	1.63	1.33	High
Point I control	2.40	1.33	0.87	High
Point B RS	0.72	0.61	0.71	Average
Point B MD	8.63	4.99	2.08	High
Point B control	0.26	0.20	0.26	Low
Point F TK	0.82	0.61	0.51	Average
Point F BK	1.12	1.02	0.87	High
Point A DJ	1.43	1.12	0.92	High
Point A control	3.48	3.12	2.18	High
Point H YP	0.41	0.36	0.36	Low
Point J AA	0.36	0.31	0.51	Low

Critical value = 0.4Me/100g soil

3.1.5 Magnesium

Soils of Imvepi refugee camp did not seem to have limitations of Magnesium. Mg is one of the most important cations in plant nutritional requirements. The critical value for Mg in Uganda soils is 0.78 Me/100g soil. Most soil samples collected at the different locations tested high in Mg (>0.78 Me/100g soil) as shown in Table 6.

Table 6: Magnesium Levels at Imvepi Refugee Camp

Location	Exchangeable Mg Me/100g soil			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	3.61	1.21	1.06	High
Point I KJ	2.16	1.96	1.96	High
Point I control	2.18	1.96	1.20	High
Point H control	1.20	0.98	1.26	Average
Point C Wani	1.09	2.30	2.30	High
Point C control	2.11	2.18	2.16	High
Point J JM	3.21	2.20	1.98	High
Point J DS	2.11	1.92	1.23	High
Point J control	2.11	2.18	1.26	High
Point J DC control	3.16	2.19	2.16	High
Point D EM	1.06	0.96	0.88	Average
Point D control	3.80	2.60	1.20	High
Point EO SA	4.11	3.06	2.12	High
Point E CJ	3.00	2.11	0.98	High
Point EO control	0.68	2.16	1.88	Low in 0-15cm
Point G MK	2.06	1.11	0.96	Average
Point G MK control	2.11	2.18	2.16	High
Point B GK	2.61	1.96	1.08	High
Point F OJ	3.10	2.16	2.16	High
Point F control	3.01	1.61	1.06	High
Point E AA	2.16	2.11	1.06	High
Point D EA	1.12	1.06	0.90	Average
Point A RS	1.21	0.98	1.10	Average
Point I BL	2.18	2.01	1.96	High
Point I control	3.16	3.06	2.31	High
Point B RS	2.36	2.11	1.06	High
Point B MD	2.16	1.20	1.10	High
Point F TK	3.18	2.16	1.21	High
Point F BK	2.11	1.16	1.06	High
Point A DJ	3.20	2.16	2.06	High
Point A control	2.11	1.06	1.19	High
Point H YP	3.18	2.20	1.81	High
Point J AA	2.11	2.16	4.11	High

Critical value = 0.78Me/100g soil

3.1.6 Calcium

Calcium plays a very important role in controlling soil reaction (acidity). All sites at Imvepi refugee camp tested high in Calcium, which partly explained the favourable pH, found again in all these areas. The critical value for Calcium in Uganda soils is 2.0 Me/100g soil. Table 7 shows the analytical results for soil Calcium at Imvepi refugee camp.

Table 7: Calcium Levels at Imvepi Refugee Camp

Location	Exchangeable Ca Me/100g soil			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	8.2	6.2	4.1	High
Point I KJ	8.8	9.2	6.6	High
Point I control	10.2	8.8	5.5	High
Point H control	4.8	5.6	5.8	High
Point C Wani	5.9	6.0	7.2	High
Point C control	6.8	7.2	6.0	High
Point J JM	8.2	6.6	5.8	High
Point J	5.3	5.2	4.1	High
Point J control	6.8	7.2	6.0	High
Point J DC control	8.2	7.1	6.0	High
Point D EM	5.8	4.6	5.2	High
Point D control	7.1	6.6	5.2	High
Point EO SA	8.8	7.5	6.2	High
Point E CJ	6.0	5.8	5.0	High
Point EO control	6.5	6.2	6.1	High
Point G MK	6.0	5.2	4.1	High
Point G MK control	6.9	7.0	6.7	High
Point B GK	5.1	4.2	4.6	High
Point F OJ	6.6	5.8	8.8	High
Point F control	6.1	4.9	4.0	High
Point E AA	7.1	5.2	5.0	High
Point E control	6.8	7.3	6.6	High
Point D EA	4.8	4.6	4.0	High
Point A RS	5.2	4.8	5.2	High
Point I BL	8.1	7.2	5.1	High
Point I control	8.6	6.7	6.4	High
Point B RS	5.2	4.6	4.0	High
Point B MD	6.8	6.6	6.0	High
Point B control	6.8	7.2	6.0	High
Point F TK	7.6	6.2	5.1	High
Point F BK	6.2	5.3	5.4	High
Point A DJ	8.8	7.6	7.6	High
Point A control	5.8	5.6	5.0	High
Point H YP	8.1	6.1	6.6	High
Point J AA	4.3	5.1	10.1	High

3.1.7 Sodium

Sodium plays a critical in controlling the hydraulic conductivity/permeability of soil to water (Hinrich *et al*, 1985). Too much Sodium in the soil would reduce the permeability of soil to water resulting into reduced water movement in the soil. This would cause poor aeration and hence poor crop performance. It would also lead to swelling of clay particles, which would further aggravate water movement in the soil. For good crop performance in Uganda, Sodium levels should be < 1.0 Me 100g soil. Soils at Imvepi refugee camp did not seem to have the problem of too much sodium. All soil samples from the settlement tested below 1.0 Me/100g soil. Table 8.

Table 8: Sodium Levels at Imvepi Settlement Camp

Location	Exchangeable Na Me/100g soil			Remarks
	0-15cm	15-30cm	30-45cm	
Point I Original	0.04	0.03	0.02	Okay
Point I KJ	0.15	0.12	0.10	Okay
Point I control	0.18	0.17	0.17	Okay
Point H control	0.05	0.03	0.05	Okay
Point C Wani	0.08	0.06	0.05	Okay
Point C control	0.03	0.03	0.03	Okay
Point J JM	0.10	0.05	0.05	Okay
Point J	0.10	0.06	0.05	Okay
Point J control	0.03	0.03	0.03	Okay
Point J DC control	0.11	0.07	0.04	Okay
Point D EM	0.03	0.03	0.02	Okay
Point D control	0.03	0.04	0.02	Okay
Point EO SA	0.07	0.05	0.04	Okay
Point E CJ	0.04	0.03	0.03	Okay
Point EO control	0.09	0.03	0.05	Okay
Point G MK	0.09	0.04	0.05	Okay
Point G MK control	0.03	0.03	0.03	Okay
Point B GK	0.10	0.11	0.06	Okay
Point F OJ	0.09	0.06	0.06	Okay
Point F control	0.11	0.10	0.06	Okay
Point E AA	0.10	0.08	0.08	Okay
Point E control	0.03	0.03	0.02	Okay
Point D EA	0.03	0.02	0.03	Okay
Point A RS	0.08	0.03	0.06	Okay
Point I BL	0.23	0.18	0.16	Okay
Point I control	0.26	0.17	0.10	Okay
Point B RS	0.07	0.06	0.07	Okay
Point B MD	0.13	0.12	0.10	Okay
Point B control	0.03	0.03	0.03	Okay

Point F TK	0.08	0.06	0.06	Okay
Point F BK	0.12	0.10	0.10	Okay
Point A DJ	0.14	0.13	0.10	Okay
Point A control	0.11	0.12	0.08	Okay
Point H YP	0.04	0.03	0.03	Okay
Point J AA	0.03	0.03	0.05	Okay

Critical value < 1.0 Me /100g soil

3.1.8 Soil pH

Soil pH was okay in all the site of Imvepi refugee camp. The critical level for Uganda soils is pH 5.5. Below this value some important plant nutrients are rendered unavailable such as the main cations. Low pH will also reduce the cation exchange capacity (CEC) of the soil and microbial activity slows down. Soils with low pH will also tend to accumulate heavy metals which are toxic to plants and more to that the soil will be high in the 1:1 clays (Roy *et al*, 1983). The analysis, however, revealed that soils of the refugee camp may not have these problems since their pH levels were above 5.5 as indicated in Table 9.

Table 9: Soil Acidity Levels at Imvepi Refugee Camp

Location	Soil pH			Remarks
	0-15cm	15-30cm	30-45cm	Okay
Point I Original	6.4	6.4	5.7	Okay
Point I KJ	6.8	6.7	6.5	Okay
Point I control	6.87	6.7	6.2	Okay
Point H	7.1	6.6	6.4	Okay
Point H control	6.8	6.3	6.4	Okay
Point C Wani	6.5	6.5	6.3	Okay
Point C control	6.9	6.1	5.9	Okay
Point J JM	6.9	6.5	6.6	Okay
Point J	6.9	6.1	6.0	Okay
Point J control	6.9	6.1	5.9	Okay
Point J DC control	7.1	6.6	6.2	Okay
Point D EM	6.9	6.6	6.6	Okay
Point D control	6.9	6.3	5.4	Okay
Point EO SA	7.2	7.1	6.6	Okay
Point E CJ	6.8	6.4	5.8	Okay
Point EO control	6.7	6.2	6.5	Okay
Point G MK	6.6	6.7	6.7	Okay
Point G MK control	6.9	6.1	5.9	Okay
Point B GK	6.2	6.2	6.3	Okay
Point F OJ	6.8	6.3	6.2	Okay
Point F control	6.7	6.8	6.1	Okay
Point E AA	7.1	6.7	6.7	Okay

Point E control	6.8	6.2	6.0	Okay
Point D EA	6.7	6.6	5.7	Okay
Point A RS	6.6	6.3	6.3	Okay
Point I BL	6.7	6.4	6.3	Okay
Point I control	6.9	6.7	6.5	Okay
Point B RS	6.6	6.5	6.3	Okay
Point B MD	7.1	7.2	6.7	Okay
Point B control	6.8	6.6	5.9	Okay
Point F TK	6.6	6.3	5.9	Okay
Point F BK	6.9	6.4	6.1	Okay
Point A DJ	7.2	7.3	7.5	Okay
Point A control	6.9	6.7	7.0	Okay
Point H YP	6.7	6.4	6.4	Okay
Point J AA	6.9	6.5	6.5	Okay

3.1.10 Soil Texture

Textural analysis of the soils at Imvepi revealed that most of these soils had relatively high sand content (> 60%) with the exception of Point I. Table 10. Hence most soils were classified as sandy soils. Sandy soils have low water holding capacity, poor nutrient retention ability all of which partly explained the low crop yields experienced by the refugee farmers in most locations.

Table 10: Soil Texture for Soils at Imvepi Refugee Camp

Location	**% Particle Content**								
	0-15cm			**15-30cm**			**30-45cm**		
	Sand	**Clay**	**Silt**	**Sand**	**Clay**	**Silt**	**Sand**	**Clay**	**Silt**
Point I Original	80	10	10	60	20	20	59	29	12
Point I KJ	69	22	9	71	19	10	70	15	15
Point I control	36	28	36	32	48	20	30	58	12
Point H control	72	14	14	69	21	10	66	24	10
Point C Wani	62	22	16	60	28	12	66	24	10
Point C control	69	14	17	68	19	13	74	18	8
Point J JM	69	11	20	66	20	14	64	28	8
Point J	71	12	17	60	26	14	54	38	8
Point J control	69	14	17	68	19	13	74	18	8
Point J DC control	61	29	10	62	28	10	56	32	12
Point D EM	86	8	6	76	8	16	74	10	16
Point D control	80	8	12	79	9	13	80	10	10
Point EO SA	74	12	14	76	10	14	76	14	10
Point E CJ	80	10	10	71	11	18	72	10	18
Point EO control	66	11	23	69	13	18	70	18	12
Point G MK	65	21	14	69	20	11	72	18	10

Point G MK contr.	69	14	17	68	20	11	72	18	10
Point B GK	70	12	18	46	32	22	50	31	19
Point F OJ	68	18	14	62	24	14	62	24	14
Point F control	65	20	15	66	24	10	64	26	10
Point E AA	56	24	20	58	20	12	60	21	19
Point E control	69	14	17	68	19	13	74	18	8
Point D EA	74	12	14	86	8	6	80	8	12
Point A RS	60	22	18	50	24	26	44	26	30
Point I BL	40	29	31	36	40	24	32	44	24
Point I control	36	38	26	34	32	34	34	44	22
Point B RS	69	11	20	70	20	10	66	30	4
Point B MD	70	16	14	66	18	16	72	14	14
Point B control	69	14	17	68	19	13	74	18	8
Point F TK	66	14	20	70	20	10	62	28	10
Point F BK	64	16	20	56	24	20	56	28	14
Point A DJ	60	12	28	70	24	6	66	24	10
Point A control	76	10	24	56	28	16	56	28	16
Point H YP	72	14	14	72	18	10	66	24	10
Point J AA	70	19	11	74	24	2	72	22	6

3.2 Secondary Information

Conversations were held with 23 farmers with the guide of a checklist shown in Appendix 1. The total population of the refugee camp was estimated at 2000 refugees per camp and there were 10 camps making an approximate figure of 200,000. Of the 23 farmers 91% of them cultivated only 0.2 – 0.4 hectares of land and only 9% cultivated more than this.

The study further revealed that very few farmers fallowed land pieces more than 0.4 hectares indicating that in most cases there was continuous cultivation year in and year out. This practice, also common in most other parts of Uganda, believed to be the main cause of declining soil fertility and hence reduced productivity. And reduced productivity has been closely linked to both poverty and food insecurity in most developing countries.

As mentioned earlier, on arrival in the camp refugees are allocated 0.2 hectares of land per person. However, over time some refugees made their own efforts to acquire more pieces of land either from other refugees or other means. Farmers who owned up to 1 hectare of land were 65%, 1 –2 hectares (13%), 2 –4 hectares (9%) and >4 hectares (13%).

The study showed that 87% of the farmers started off with virgin land and only 13% got pieces of land that had been cultivated before.

On farmer's perception of the current soil fertility, it was found that 83% of the farmers though that their soil fertility was still high. Seventeen percent (17%) thought

the fertility status of their farms medium/average and none said the fertility of their land was low.

Only 14% felt the soil fertility and other management practices needed to be improved upon. Those who had no idea at all about soil fertility management were 39%, while another 3% gave no response to the question. Some of the suggested soil improvement practices by the farmers included the following:

Construction of bunds (22%)
Contour cultivation (9%)
Crop rotation (18%)
Application of composts (4%)
Dig drainage channels (13%)
Improve on rainfall pattern (4%)
Apply soil and water conservation measures (30%)

4. Conclusions and Recommendations

4.1 Macronutrients

The major plant nutrients (N, P and K) are generally low in soils at Imvepi refugee camp. This coupled with long and severe draught periods has tended to limit the Agricultural productivity in the refugee camp. Soils are inherently low in fertility. Technically the use of inorganic fertilizers to enhance production would be the most appropriate remedy for these soils. However, given the socio-economic status of the refugees it is doubtful if they can invest in buying expensive inorganic fertilizers to boost agricultural production.

Nonetheless, there exists other less expensive soil fertility improving technologies such as Agroforesty, composting, use of animal wastes/manures. It is recommended that the camp management could explore some of these possibilities with the view of building farmers' capacity to apply these technologies.

4.2 Soil Organic Matter (SOM)

Most soils were low in SOM. The contribution of SOM in modifying the adverse effects of the high sand content was being missed out. It is recommended that farmers be encouraged to apply crop residues to the fields to raise the level of SOM. Use of appropriate Agroforestry technologies to replenish SOM is also advisable.

4.3 Major Cations

No major worry exists at the moment in as far as major cations are concerned in the soil of Imvepi refugee camp.

4.4 Soil Texture

These soils are also mostly sandy with low water holding capacity. Unfortunately soil texture is difficult if not impossible to change. However, the adverse effects of unfavourable soil texture can be modified by use appropriate Agroforestry technologies. It is recommended that ded camp management in conjunction with Abi ARDC could work together to look into some of these possibilities.

4.5 Advise on Crops

In light of the soil analytical results and the secondary information that was collected and synthesized, it is generally recommended that hardy crops would be most suited for Imvepi ecological setting. By hardy crops we refer to crops that are not heavy feeders and can resist draught as well as diseases and pests. Such crops include sorghum, cassava, maize and sweet potatoes as sources of carbohydrates. Even on these crops, it is further recommended that quick maturing varieties should be emphasized given the unpredictable rainfall pattern in the area. Early planting should be particularly emphasized in the case of maize to take advantage of the Nitrogen flash at the onset of rains. Legume crops are usually heavy feeders; nonetheless groundnuts could be tried at some Points like Point I, which are still fertile.

4.6 Other Issues

Refugees in most cases have small land holdings with little on no of-farm income generating activities. They, therefore, need to be assisted materially or otherwise to adopt soil fertility improving technologies.

Construction of water harvesting structures, digging drainage channels and construction of bunds may be necessary in some of the camps to prevent destruction of crops during periods of heavy rainfall.

In some situations farmers expressed the desire to be relocated to more fertile sites if they were available. Or they could be allocated more land to allow room for crop rotation and/or use of improved fallows. The ded management could explore some of these possibilities.

There is need to sensitise the refugees on the fact that their soil fertility was not so good and that they could realise even higher crop yields by adopting improved technologies

Abi ARDC lends itself to work together with ded management to avail some of these technologies and build farmers' capacity to use improved technologies.

Appendix 1: Check List for Collecting Secondary Information from Farmers

National Agricultural Research Organisation (NARO)

Abi Agricultural Research and Development Centre (ARDC)

Checklist for Imvepi Soil Management Information

Farmer's name: ………………………………………………………….
County: ………………………………………………………………….
Sub-county: …………………………………………………………..
Parish: ………………………………………………………………...
Village: ………………………………………………………………

Land under cultivation ……………………………………………….. acres
Land under fallow: …………………………………………………. acres
Total land owned: …………………………………………………. Acres

History of the land: ………………………………………………………
……………………………………………………………………………
……………………………………………………………………………..
……………………………………………………………………………….

Farmer's judgement of current soil fertility status: ………………………….
……………………………………………………………………………...
……………………………………………………………………………...
……………………………………………………………………………...

Farmer's feelings about improving the soil fertility status and other management practices: ………………………………………………………………………
…………………………………………………………………………………
…………………………………………………………………………………
…………………………………………………………………………………
…………………………………………………………………………………

For how long does the farmer intend to continues cultivating this land:
…………………………………………………………………………………
……………………………………………………………………….. Years

Any other comments: (from the farmer) ………………………………………
………………………………………………………………………………….
…………………………………………………………………………………
(From the researcher): ……………………………………………………….
…………………………………………………………………………………
………………………………………………………………………………….

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