ProPlanalto Project
Soils CRSP - Angola Project
SM-CRSP Travel Report - R. Yost, University of Hawaii
Aug. 6 - 17, 2004

Executive Summary

The workshop was a major success, largely due to the efforts of World Vision Staff, with the assistance of other members of the ProPlanalto team (IIA, IDA, FCA, CLUSA, and CDRA). As indicated in this report, approximately 50 technicians attended the workshop and participated in the field trip and field exercise. The third day of the 5 day workshop we journeyed to various regions around Huambo: Caála, Bailundo, M'Bave, and Londiumbali. Some 23 soils were collected and used for soil test kit training. The samples were split and ½ was taken to the University of Hawaii for analysis. The results are given in Appendix III. A preliminary analysis expands on the results from the soil test kit obtained on the spot. The soils are generally low in nutrients, especially nitrogen (N) and phosphorus (P), although there are some notable examples of high P, likely where fertilizers have been added in previous years. Soil potassium (K) is variable, sometimes it was high and sometimes low. For crops such as potato, fertilizers with K will be needed. The variability in sufficiency of P and K indicate a strong need for options in the fertilizer market. The use of solely 12-24-12 as a source of P is highly restrictive and wasteful for those regions where soil is adequate or high. An estimate was made that a savings of nearly $600,000 would occur if a fertilizer such as DAP (diammonium phosphate) were available a Lobito as was delivered to Huambo instead of using 12-24-12. Part of the savings was due to the addition fertilizer that needs to be shipped in order to supply the same amount of P in the more concentrated DAP (18-46-0), rather than 12-24-12. A similar curiosity was mentioned that the market price of low analysis ammonium sulfate (21-0-0),sells for the same price per kg as urea (46-0-0), in spite of containing less than ½ as much actual nutrient nitrogen.

A major limitation to ensuring successful and sustainable maize and potato production was identified when we learned that the soil and plant analysis laboratory at Chiangas station was not functioning, even for the simple analyses of soil pH, P, and nitrate. These simple measurements do not require the sophisticated atomic absorption and should be activated as soon as possible.

Overall we were profoundly impressed with the tremendous food production potential of the Planalto for maize and potato. It truly is a potato heaven if properly managed and if agricultural policies such as credit, appropriate fertilizers, infrastructure such as passable roads and railroads were made available. Lastly, we would like to thank the World Vision and USAID staff for their remarkable support and efficient assistance that made the workshop such a success. Thanks especially to Dr. Chris Asanzi, World Vision, for his assistance and Mr. Ken Lyvers, USAID, for his action in moving all of this forward.

Trip Objectives:

1. Assist in the Workshop on Introduction to Site-specific Nutrient Management and the management of soil fertility.
2. Discuss and suggest options to assist the ProPlanalto project achieve its objectives.
3. Identify opportunities to work with the ProPlanalto project and update the Soils CRSP workplan for 2004-2005.

Activities:

Workshop on Site-Specific Nutrient Management

The workshop was held August 9-13, 2004, on the FAC campus within the IIA compound on the Chiangas Experiment Station, Huambo, Angola. The objectives of the workshop were the following:

- Provide an opportunity for Angolan scientists to present and exchange research concerning food production and specifically maize and potato production in the Planalto provinces, especially those provinces included in the Pro-Planalto project.
- Introduce Site-specific nutrient management (components of Diagnosis, Prediction, Economic Analysis, and Recommendations to the producer) and the preliminary steps of the diagnosis of nutrient status.

A near final copy of the workshop program is given in Appendix I.

The workshop included approximately 52 participants from 5 provinces. A list of the participants is included in Appendix II.

Summary of Institutions, participants, and provinces represented in the Aug. 9-13 workshop.

Institution	No. Participants	Province
ADRA	1	
Africare	1	Bié
CARE	1	Huila
CLUSA	1	Huila
Concern	1	Huambo
FCA Huambo	3	Huambo
IDA Luanda	2	Luanda
IDA Uíge	1	Uíge
IDA Huambo, Bailundo	4	Huambo
IIA Huambo	13	Huambo
IIA Luanda	2	Luanda

INCA	1	
INCER	1	Huambo
Oikos	1	Huambo
WV Luanda	4	Luanda
WV Huambo	8	Huambo

General observations of the Huambo Planalto:

Soils in the Huambo province provided an diverse complex heavily dominated by topographic position. North and East of Huambo a recurring topography was seen, somewhat like that depicted in Figure 1.

The presence of perennial streams indicates that a portion of the land has potential for food production year around. Indeed, numerous plots of potato (*Solanum tuberosum*) were observed in the month of August, which is near the end of the dry season. This suggests an extremely fortuitous resource for ensuring food security year around. Efforts by the ProPlanalto project to use these irrigated lands for seed multiplication were extremely encouraging. As shown in Figure 1, there appeared to be three major soils in the typical landscape to the North and West of Huambo. Probably the most extensive soils were on the planalto top position, often of a light yellowish-brown coloration. Next in extent appeared to be the grayish, loamy soils on the sideslope, sometimes with substantial slope and with a likelihood of severe soil erosion unless properly managed. Soils in the sideslope appeared to be hydromorphic, likely quite wet during the rainy season. Soils of the bottoms of the toposequence, were usually very black with an apparently high percentage of organic matter. These soils were used in the "Nacas" season beginning at the end of the dry season and serve to provide food while crops of the main season are growing. A surprising number of the streams were perennial, which could serve for irrigation during the long dry season.

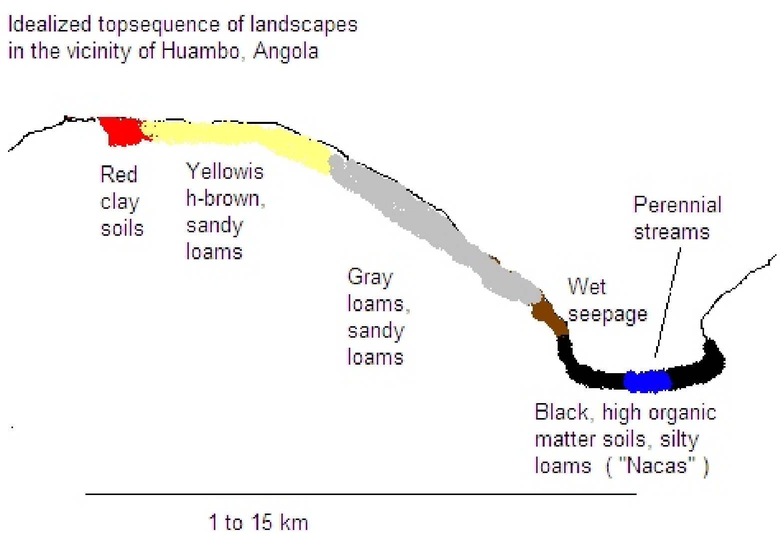


Figure 1. Idealized toposequence observed North and East of Huambo, Huambo Province, Angola.

The third day of the workshop included field visits by each of the four participant groups (Figure 2). Although the intention was to analyze about 4 or 5 samples by each group, the long distance traveled resulted in sufficient time to analyze only two to three samples of each location (Table 1).

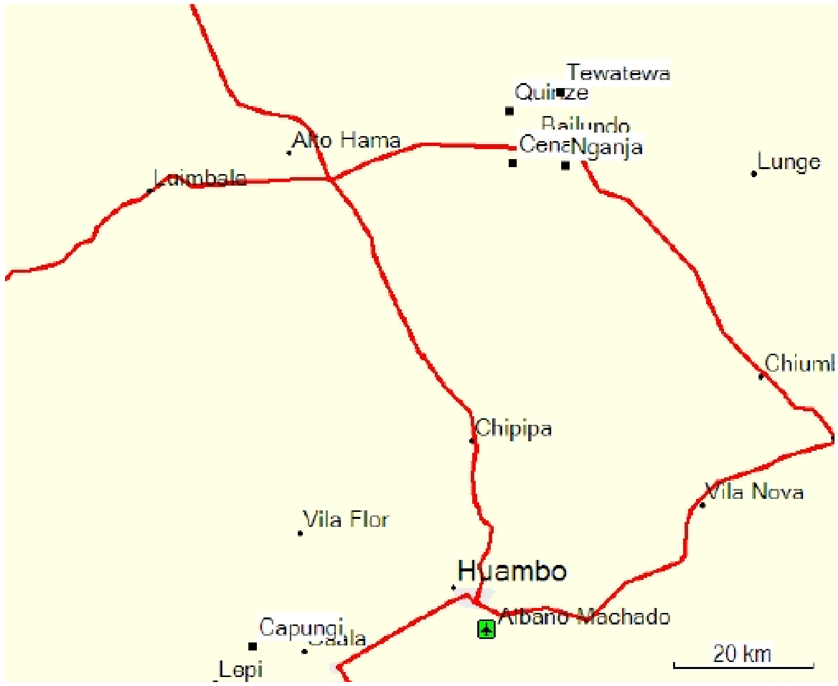


Figure 2. Approximate location of ProPlanalto Experiments visited during the Aug. 9-13, 2004 workshop.

Table 1. Soils collected and analyzed from the vicinity of Caála (Southwest of Huambo city).

	Sample location			
Soil analysis	Cassupé	Cambembwa	Capungi	Dango
pH	6.5	5.5	5.5	6.0
NH_4	Very Low	Very Low	Very Low	Very Low
NO_3	Zero	Very Low	Very Low	Very Low
P	Low	Low	Low	Low
K	High	High	High	High

Table 2. Soils collected and analyzed from the vicinity of Bailundo (Northwest of Huambo city).

	Sample location			
Soil analysis	Cena II	Quinze	Nganga	Tewatewa
pH	6.5		6.0	
NH_4	Very Low		Very Low	
NO_3	Very Low		Very Low	
P	Low		Very Low	
K	Medium		Low	

Table 3. Soils collected and analyzed from the vicinity of Londuimbali (North of Huambo city).

	Sample location		
Soil analysis	Sede	Alto Hama	Plo des
pH	5.5	5.0	5.5
NH_4	Very Low	Low	Low
NO_3	Very Low	Very Low	Very Low
P	Low	Low	Low
K	High	High	High

Table 4. Soils collected and analyzed from the vicinity of Chipipa (North of Huambo city).

	Sample location				
Soil analysis	Palestina	Chissaco	Keve	Calungulungo	Mussele
pH	6.5				
NH_4	Very Low				
NO_3	Low				
P	Low				
K	Low				

Table 5. List of soils taken to the University of Hawaii for analysis of soil nutrient status and selected other properties.

		Soil pH		Soil P		Soil K	
Sample No.	Soil label	Analyzed in Lab 217	Test kit estimates	Lab	Test kit	Lab	Test kit
1	Cena II - Bailundo Amostra 1	5.65	6.5	2.9	L	70	M
2	Cena II - Bailundo Amostra 2	5.06		17		166	
3	Associação 1S - Bailundo Amostra unica	6.02		14		32	
4	Nganga - Bailundo Amostra unica	5.45	6.0	0.7		25	VL
5	Tewa-tewa - Bailundo Amostra unica	5.14		0.4		47	
6	Capunge - Caála	5.50	5.5	22		37	
7	Capunge EXP - Caála	5.00		21		121	
8	Cassupí I - Caála	5.57	6.5	10		33	
9	Gambembwa - Caála	5.40	5.5	36		68	
10	Dango - Caála	5.43	6.0	33		28	
11	Chianga I	5.13		43		53	
12	Chianga II	5.18		31		183	
13	Chianga III	5.67		69		416	
14	Alto Hama (Parte Alta)	5.78	5.0	4.0		47	
15	Londiumbali - Amostra	5.27		12	L	20	H
16	Polo Londiumbali - 1º Amostra	5.91		14	L	40	H
17	Londiumbali - Baixa	5.32		14		165	
18	Londiumbali - Kuqueta	5.60		4.8		83	

19	Amostra I - Palestina - M'Bave	5.62	6.5	11	L	117	L
20	Amostra II - Crissaco - M'Bave	5.57		3.1		113	
21	Amostra III - Keve - M'Bave	5.91		33		141	
22	Amostra IV - Kalungubongo	6.09		4.8		55	
23	Amostra V - Messele	5.61		4.3		61	

Preliminary interpretation of soil analysis Twenty three soil samples were taken to the University of Hawaii for conventional analysis. The partial results are given in Table 5, with the complete results given in Appendix I. The results reinforce the measurements taken by the soil test kit, but also provide some additional detail of considerable importance.

Soil pH Regarding the soil pH, general the soils were not strongly acid. However, given the sandy nature and the relatively low quantities of cations (low ECEC) in Appendix I, suggests that with continued production soil acidity is likely to become important and yield limiting. In addition, given the occasionally marginal levels of Ca and Mg, limestone will eventually be needed to maintain soil conditions for both sustained and improved productivity.

Soil P Soil P is nearly always deficient, but there are some examples of medium to high levels (levels greater than 50 mg P/kg). This reveals that fertilizers have been applied to some of the fields that were sampled. It also points out that soil analysis is going to be very important since there are both very deficient and sufficient levels of nutrient P in the soils. Soil tests will be the only way to detect such variations.

Soil Potassium Soil K is highly variable. The samples that tested medium to high by soil test kit occur irregularly. Some soils have very high levels and others are quite deficient. Of particular concern will be providing nutrients for potato, which has a very high K requirement. Current levels of soil K will not be sufficient for sustained potato production, some measurement and application of K will definitely be required on some soils.

Activities to assist the Pro-Planalto project achieve its objectives

Obviously a lot of thought has already went into the experiments. It might be useful to others looking at the experiments and the data if some of the rationale were spelled out, the hypotheses stated and clarified. For example, what where the reasons for the selection of the specific locations of Caala, Quinze, Nganja, and Tewatewa?

Soil analysis The experimental protocol does not include preliminary nor after harvest soil analyses. These are crucial for extrapolation of the experimental results to other soils, other locations and help in extrapolating to other crops. We recommend a system of a "Diagnosis, Prediction, Economic Analysis, and Recommendation to the farmer" structure for nutrient management for growing maize and other crops. We think that this provides an efficient estimate of fertilizer requirements and minimizes wasteful fertilization and increases the production while reducing fertilizer costs. It is the basis of our "Site specific nutrient management" technology.

To fully utilize the information generated by the experiments, an analysis of the soils from each treatment by a soil laboratory analysis is needed in addition to the soil test kit analysis Very important for the research data. Also there are analyses such as Ca, Mg, ECEC, and Al that the soil test kit does not analyze. We need those analysis to confirm and verify the soil test kit analysis until there is a body of research data from the experimental sites. We should have a reference laboratory to check the soil test kit results from time to time to ensure operator consistency and as new persons take the samples and analyze the soils.

In establishing the nutrient levels, we need to establish response curves to N, P, and K, and possibly limestone at the same time as we test diagnoses and predictions of the NuMaSS nutrient management software. In this way, we achieve two objectives at the same time with one experiment. This means some preliminary soil analysis is needed before establishing the levels of N, P, K, and lime, if needed. The SM-CRSP Project is ready to assist in this task and it is one activity proposed for the February 2005 workshop.

Agricultural lime is available, however it may not be needed for the first year or two. It is likely, however, to be needed subsequently, especially if acid sensitive plants are intended. On the other hand, the soil pH for potato should not be raised too high to ensure disease control. If the soils are of pH 5.0 or less then it is most likely necessary to have a limestone treatment in the experiments for acid sensitive crops. We can see from the soil pH analysis done in Hawaii and which is somewhat similar to that of the soil test kit, that soil acidity doesn't seem to be a major problem at the moment. With coarse textured soils and the consistent addition of N fertilizers, acidity is expected to become a management issue.

Plans are in progress for shifting to hybrid maize as soon as a seed producing network can be established. This shift will require higher fertilizer, especially N rates, as the excellent potential for maize production becomes a reality.

2. A few extra measurements could substantially increase the overall amount of information that could be obtained from the experiments. For example, the experiments will be analyzed with regard to the information needed to give 1) Diagnosis of nutrient deficiencies and requirements, 2) Prediction of the quantities of nutrients required, 3) The economic analysis of the experimental results in order to assess the profitability and to prepare for marketing the product, and 4) How could this information be best communicated to the maize producing farmers and potential growers in not only the province of Huambo but in the other neighboring provinces with maize production potential? This is proposed as an area of focus for the second year of the SM-CRSP project, although which is unfunded at present.

A. The proposed measurements are:

Before planting and fertilization measurement of soil nutrient status:

- Acidity assessment - Measure the soil pH, Ca, Mg, Al (only where soil pH is less than 5.5), and ECEC before the experiments are planted.

- Nutrients: Determine Nitrate, Phosphorus, and Potassium soil levels. Determine the soil test P before the application of fertilizers.

Repeat the Nutrient assessment after the crop has been harvested and the soil tilled (mixed and homogenized). This permits estimating some of the parameters used in decision-aids such as NuMaSS (N, P, and acidity) and the PDSS (P and K).

B. The soil measurements permit testing the applicability and, if applicable, the calibration of the software for the soil tests, maize varieties, available fertilizers, and growing conditions iin the region. We have used such measurements for NuMaSS, PDSS, and locally derived decision-aids from the PDSS concept in both the Philippines and Thailand. We propose including this activity in the February 2005 Analysis Workshop.

Related questions:

- Currently available fertilizers in Huambo are 12-24-12, ammonium sulfate (21% N), and urea (46% N). What is the availability of fertilizers in the provinces of Bié, Huila, Benguela, and Kwanza Sul?

It seems that available fertilizers are the following:

- 12-24-12
- Urea (46-0-0),
- ammonium sulfate (21-0-0)

So, indeed the availability of fertilizers is very restrictive and severely limits farmer options for supplying nutrients for the crops, especially options for supplying P. At the current situation even knowing the N, P, and K requirements may not be sufficient as the required fertilizers required to supply the proper N, P, and K amounts are not available. The major problem is the lack of options to supply P. This problem occurred in Thailand, for example, where we find that the fertilizers available do not match the requirements.

The implications of low-analysis fertilizers is very serious. As shown in Box 1, the estimated difference in costs in purchasing and shipping 12-24-12 from the coast port of Lobito to Huambo totals nearly $600,000 for about 200,000 ha of maize (the approximate amount of seed that is being made by WorldVision's seed multiplication project).

- What is the Ministry level policy with regard to production inputs, including fertilizers and simple pesticides?

Calculation of savings if 18-46-0 were used instead of 12-24-12

Example of 200,000 ha where 50 kg P_2O_5 fertilizer was needed to meet P needs.

For 50 P_2O_5/ha: 208.3333 kg 12-24-12 needed of which 25 kg of K_2O is unneeded

For 200,000 ha 5,000,000 kg of K_2O is automatically added, even if unnecessary, or 5000 tonnes of unnecessary K_2O

Estimating between 150,000 and 225,000 ha of maize could be planted with the 3000 tons of seed maize to be made available by WorldVision in 2004.

Estimating transportation cost savings from Lobito: 300 km, if 18-46 were shipped instead of 12-24-12 to supply P:

For 50 P_2O_5/ha: 108.6957 kgs of 18-46/ha would be needed.

If transportation were $.10 a tonne/km and 300 km from Lobito to Huambo:30 $ tonne for shipping

Shipping costs for 10 ha: 62.4 $ for 12-24-12 32.4 $ for 18-46 for 200,000 ha: 1248000 $ for 12-24-12 648000 $ for 18-46

The savings for the 200,000 ha planted in Huambo by shipping 18-46-0 (Diammonium phosphate - DAP) rather than 12-24-12 is estimated at $600,000.

Box 1. Example calculation of the additional transportation costs associated with the shipment of a fertilizer such as 12-24-12 (N-P_2O_5-K_2O) rather than a high analysis 18-46-0 from Lobito to Huambo, Angola.

Crop management

The maize planting density seems too low for modern hybrids: The density 80 cm x 50 cm in the row is only 25,000 plants / ha, usual density is upwards of 50,000 to 75,000 plants/ha. Probably the best planting density is lower for open pollinated varieties, however.

Some recent data of maximum and minimum temperature data were provided by Dr. Sperling and indicated that the minimum temperatures during the dry season (June and July) were very low indeed. Probably restricting maize production to the warmer months.

Suggested revisions in the maize and potato experiments of the ProPlanalto Project

The initial experiments that have been designed and implemented are an excellent beginning of the ProPlanalto project. Considering the amount of training of new staff in experimental techniques, it is quite remarkable to see the progress that has been made. The project as designed and implemented so far is a superb effort and the SM-CRSP Project is pleased to participate in such an active, forward-looking project. We look forward to assisting and supporting wherever possible. In discussions with World Vision and ProPlanalto staff, some revisions in the experimental design were proposed. Those include the following conclusions from the 2003-2004 experiments:

1. Observation: the crops the 2003-2004 growing season responded to the highest rates of fertilizer application with no clear yield plateau or flat portion of the response curve. Considering that the crop response plateau was not clearly defined (based on rates of 0, 50, 100, and 150 kg N/ha) a higher rate of application is needed. A hypothetical test of N requirements for 8 tonnes/ha yield of maize indicated about 320 kg N/ha according to NuMaSS estimates.

2. Selected experimental plots should be replanted in order to evaluate the residual effects – especially those of fertilizer P applications.

Maize experiment at two or three selected locations

With these suggestions in mind, we propose the following maize experiments. We propose including some higher rates of N that those applied in 2003-2004 in order to explore the potential for maize production and to conclusively develop a response curve to fertilizer N. While the above levels gave yields of 4 to 5 tonnes/ha, it seems that higher yields are certainly possible, perhaps as high as 7 to 8 tonnes/ha, with hybrids and improved nutrient management. Other factors likely to lead to increased yield include higher plant population, i.e. planting at single plants at 25 cm rather than two plants at 50 cm and the eventual use of hybrids. Proposed rates of application that permit definition of the complete response curve were the following:

- Establish a level of about 100 kg P_2O_5/ha where the soil test kit values are Low or Very low and apply 5 to 6 levels of N, beginning at 0, 50, 100, 200, and 400. We would expect that maximum yields occurred at the 200 kg / ha level, however, the yield plateau with otherwise optimal management is needed in order to explore the economic analysis. We suggest using the "dominance analysis" as a way to compare the various combination treatments. Just for the record, we expect that P levels adequate for maize and potato would fall in the High category as tested by the soil test kit.
- The experiment needs to have soil samples collected before the initial fertilization (probably after the first rains, in order to catch the "Birch effect", or the initial flush of N often seen after a long, several month dry season) and after tillage and before the subsequent crop is planted. That is, we recommend replanting the experiment, probably with re-application of the N treatments, but not a re-application of the 100 kg phosphate. A test of the soil P level with the test kit would be recommended and used for guidance for the second crop on the experimental sites.

Potato experiment also at two to three locations

Although rather briefly discussed, a similar design seems prudent to quantify potato fertilizer requirements. In an approach somewhat analogous to that proposed for maize, but reversing the

N and P priorities, we suggest exploring the P requirement initially, and then the N requirement. Here we proposed to apply a non-limiting rate of N for a blanket level for potato. This might be the high level from the 2003-2004 experiments – 300 or 350 kg N/ha. The potato experiment would begin with levels of 0, 50, 100, 200, 400, and 800 kg P_2O_5/ha on the heavier soils and perhaps ½ that on the sandy loam or loam soils (0, 50, 100, 200, and 400 kg P_2O_5/ha).

This experiment should be continued for at least two to three crops, with no additional P added. It might be that a re-application of P would be needed for the second crop, if yields were nearly linear and increasing. Soil analyses need to be carried out after the harvest and tillage from the first crop. We expect that potato will need to have "Very high" levels of soil test kit P. Anything less is likely to respond to fertilizer P, based on our preliminary guesses. The high elevation of the Planalto and the resultant cool temperatures usually increase the amounts of fertilizer P required. In other words, we expect the critical level of P for potato to be higher than in warmer environments. We observed that many of the maize plantings during the August 11 field trip were showing distinct P deficiency symptoms. While visiting the Quintas site we observed a light streaking and shortening of stems typical of Zn deficiency (Fig. 3).

Figure 3. Comparison of young maize plants, Quinze experimental site near Bailundo (ProPlanalto Project). Photo on the left illustrates possible symptoms of Zn deficiency – broad, yellow streaking of newer leaves, short internodes, in comparison with the "normal" plant on the right. Notice the gray loamy soils at this World Vision experimental site.

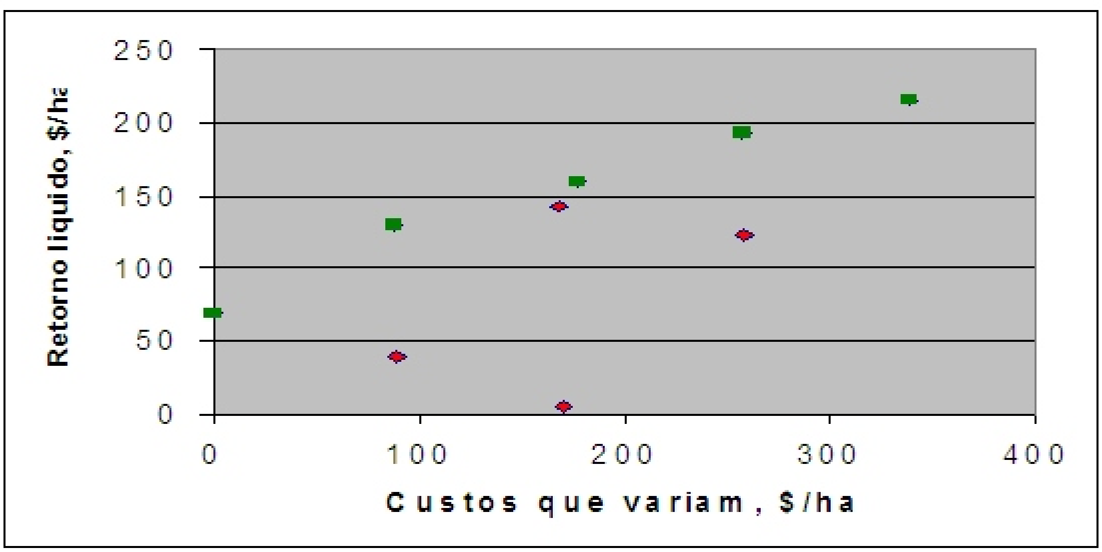
Economic analysis of experimental data In addition to the revision of the rates of nutrient application for the ProPlanalto experiments, we also propose use of the "dominance analysis" methods of CIMMYT (Harrington, 1988). An example of use of the "dominance analysis" is illustrated in Box 2 for some tentative rates of N and P application based on the 2003-2004 experiments.

Appendix I. Program of the workshop

Dominance Analysis of fertilizer response

Milho (2003-2004)	x			x	x			x	x
Tratamento	1	2	3	4	5	6	7	8	9
Nitrogênio, kg N/ha	0	0	0	50	50	50	100	100	100
Fósforo, kg P_2O_5/ha	0	50	100	0	50	100	0	50	100
# applicações	0	1	1	1	2	2	1	2	2
Custo variável	0	89.04	170.2	87.92	177	258.2	168	257	338.2
Rendimento, kg ha^{-1}	457	853	1167	1453	2245	2543	2073	3001	3690
Valor des grãos	68.55	128	175.1	218	336.8	381.5	311	450.2	553.5
Retorno liquido	68.55	38.91	4.81	130	159.8	123.3	143	193.1	215.3
Retorno Dominante	68.55			130	159.8			193.1	215.3

Graphic results:



Box **2**. Example results of a dominance analysis of fertilizer response. Results of a factorial experiment with 9 treatments: 0, 50, and 100 of N/ha and 0, 50, and 100 of P_2O_5/ha. Green columns indicate the "dominant" treatments. As illustrated in the figure, the green squares represent the "dominant" curve and thus the most economical combination of N and P at various levels of input costs ("custos que variam").

Several consultants were contacted for possible work in setting up and initiating laboratory work in the Soil and Plant Analysis laboratory, Chiangas station.
Those persons contacted but currently unavailable were:

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Appendix I. Workshop Program

CRSP/PROPLANALTO

Seminário sobre Maneio e Gestão de Fertilidade de Solo
Huambo, 09 – 13 de Agosto de 2004

Tópicos a serem abordados no curso

- **Conceito de qualidade de solo**
- **Maneio da fertilidade de solos**
- **Diagnóstico, estimação, analíse ecónomica e recomendação de adubação**
- **O papel dos nutrientes no desenvolvvimento e crescimento**

PROGRAMA DE CRSP / PROPLANALTO WORKSHOP

1º Dia – Segunda- feira 9 de Agosto

08:30 .... Registo de participantes
09:30 .... Abertura, pela sua exc. Sr. Vice Governador Dr. Agostinho Jaca
10:00..Apresentação do programa
10:15..Apresentação dos participantes
10:30..Café

1º SESSÃO --------------------------Moderador : Silly Mattews

10:45..A pratica actual de uso de fertilizantes e perspectivas para o futuro (Roque Miguel)
11:15... Zonas Agro-Ecológicas de Angola (Fernando Paulo

Sito)
11:45...Gestão de Fertilidade de Solos ; exemplos de Municípios seleccionados de Huambo (WV/ IDA)
12:25...Discussões
13:00...Almoço

2ª SESSÃO .... Moderador: Sanda Vicente de Paulo

14:00 .... Angola, situação actual e perspectivas Futuras

no maneio da fertilidade de solos (Almeida Felizardo)
14:30.. Resultados de analises de solos e resultados preliminares dos ensaios de milho e batata rena (Almeida Felizardo/Chris Asanzi)
15:15...Discussões
15:35..Café
15:50...Gestão de sistemas Agro-Florestais (IDF)
16:20...Discussões
16:30...Informações e fim de Dia

2º Dia - Terça- Feira 10 de Agosto

3ª ------------------------------------- Moderador: Israel Vongula

08:30 .... O papel de nutrientes no crescimento e desenvolvimento das culturas (Fernando Paulo Sito)
09:00 .... O uso e a importância dos Kits para testes, do solos e Analise económica no uso de fertilizantes (Russell Yost/David Sperling)
10:00 .... Discussões
10:30... Café
10:45 .... Sociologia rural, Extensão agrária e credito no Desenvolvimento da Agricultura (António de Assis)
11:15.. Conceitos basicos sobre maneio da fertilidade de solos e uso de NuMaSS (Smyth)
11:45.. Mapa de Solos Angolanos (Joaquim César)
12:15 .... Discussões
12:45.. Almoço

4 º SESSÃO --------------------------Moderador: José Kambenje

13:45 ....O uso de software (Smyth)
15:15 ....Café
15:30...Exercício sobre o uso de software (Smyth)
16:30 ....Informação sobre a visita ao campo e fim do dia

3º Dia - Quarta – Feira 11 de Agosto

VISITA DE CAMPO

Primeiro Grupo – Partida ás 6 horas / Lugar Bailundo (Chris Asanzi)
Segundo Grupo – Partida ás 7 horas / Lugar M´bave (Gomes Cambuta)
Terceiro Grupo – Partida ás 7 horas / Lugar Caála (Almeida Felizardo)
Quarto Grupo - Partida ás 6 horas / Lugar Londuimbali (Israel Vongula)

4º Dia - Quinta –Feira 12 de Agosto

5ª SESSÃO ---------------------------Moderador: Roque Miguel

08:30 .... Apresentação dos resultados das visitas ao Campo
12:30 .... Almoço

6ª SESSÃO --------------------------Moderadora : Joana Raul

13:30 ....Visita de Laboratorio de Solos e os Ensaios
On-Station (Bartolomeu Pequinino/Israel)

16:30...Fim do dia

19:00...Jantar de Confraternização (no Hotel.Konjevi)

5º Dia Sexta –Feira , 13 de Agosto

09:00 ....Conclusões e recomendações
10:30 ....Entrega de Certificados e Encerramento
11:00...Almoço
12:00...Excursâo a Cidade

Appendix II. List of participants.

Seminário sobre Maneio e Gestão de Fertilidade dos Solos
Huambo de 9 a 13 de Agosto de 2004

Relação Nominal dos Participantes do Seminário

No	Nome	Instituição	Província
1	António Gonçalves	Save the Children USA	Kwanza Sul
2	Arnaldo Tomas Sapalo	Catholic Relief Services (CRS)	Benguela
3	Antonio Domingos Maiato	IDA	Luanda
4	Andre Kapingala	IIA	
5	Augusto Samuel	IDA	Huambo – Bailundo
6	Araujo Pedro da Silva	ADRA	Huambo
7	Branco Vicente	CLUSA	Huila
8	Bartolomeu Pequenino	IIA	Huambo
9	Clementino Ngola	IDA	
10	Christophe Asanzi	World Vision	Luanda
11	Dacia Julieta Vaz Pereira	IIA	Huambo
12	David Kiala	Faculdade de Ciências Agrarias	Huambo
13	Eurico Leongongo	INCER	
14	Eduardo D. Rodrigues	IIA	Huambo
15	Fernando Paulo Sito	IIA	Luanda
16	Francisco Gomes	IIA	Huambo
17	Felizardo de Almeida	IIA	Huambo
18	Henrique Malungo	World Vision	Luanda
19	Helder Chipaco Evambi	IIA	Huambo
20	Idalia Mateus	World Vision	Huambo
21	José Rui Afonso	CARE	Huila

22	Júlio Silva	EDA	Huambo
23	Jacline Kussema	World Vision	Huambo
24	José Kambenje	IDA	Huambo
25	José Pedro João	Faculdade de Ciências Agrarias	
26	Joaquim Pinto Afonso	EDA	Huambo – Caala
27	Joaquim Faustino	IDA	Huambo
28	Luzia Jaoquina Baptista	IIA	Huambo
29	Letra Quarenta	World Vision	Huambo - Londuimbali
30	Lemos Pascoal Ganga	World Vision	Huambo
31	Leonor Lazary	World Vision	Huambo – Caala
32	Luis Kavekolo	Africare	Bié
33	Monica Mbui Martins	IIA	Huambo
34	Moises Soares Cardoso	Faculdade de Ciências Agrarias	Huambo
35	Oscar Morais	IIA	Huambo
36	Pedro Francisco João	World Vision	Huambo – Bailundo
37	Paulo Chipandeca	Oikos	Huambo
38	Roque R. Miguel	IDA	Luanda
39	Rafael dos Anjos Ricardo	INCA	
40	Sandra Domingos J. Afonso	IIA	Huambo
41	Simão Zacarias	IIA	Huambo
42	Sanda Vicente de Paulo	IDA	Huambo
43	Tomas Hungulo	IIA	Huambo
44	Israel Vangula	World Vision	Huambo
45	Rafael Antunes	Concern	Huambo
46	Jose Bonifacio Sucumula	World Vision	Huambo
47	Joaquim Pedro	IDA	Uíge
48	Zeferino Moma	IDA	Uíge
49	Russell Yost	CRSP	Hawaii
50	Ken Lyvers	USAID	Angola
51	Smyth Jot	Universidade, Carolina do Norte	EUA
52	Joaquim Cesar	IIA	Luanda

Appendix III. Recommendation: soil analysis laboratory consultant for the soils laboratory, Chiangas Station and the soils laboratory at IDA Headquarters, Luanda.

Fortunately the IIA (Instituto de Investigações Agronomicas), Chiangas station, Huambo Province, has a new building that is housing various laboratory facilities. Among them is a soil analysis laboratory that includes an entire wing of the main building. Various equipment has been purchased for the laboratory including the following:

- Flame photometer, designed for the determination of K, Na, Li and possibly Ca and Mg.
- Spectrophotometer designed to handle all types of colorimetric analysis, including soil nitrate, phosphate and various others.
- Buck Scientific Atomic absorption spectrophotometer that can determine a wide range of metallic elements such as Ca, Mg, K, Na, Fe, Mn, Zn, Cu among others.
- Precision analytical balance for measuring milligram and sub-milligram quantities for standards and reagents.
- Digestion blocks and tubes for the preparation of plant tissue for element analysis.
- An automatic granulometric analysis instrument for soil particle size estimation

Unfortunately, this laboratory is not current functioning and thus not supporting the diverse experiments being carried out by the ProPlanalto project. There is a strong immediate need for the soils laboratory to begin functioning in order to provide diagnostic support to all the field experiments on maize, potato, bean, and other crops. Without a functioning soil analysis laboratory, experimental results remains local and cannot be generalized, transferred, nor applied to other locations. Soil analysis results are needed before and after the application of fertilizer nutrients to assess the corresponding change in available nutrient levels.

In addition the Soils Laboratory at IDA headquarters in Luanda has a Unicam AA that is not set up and functioning. This is extremely unfortunate, and needs to be addressed by the proposed laboratory consultant.

Proposed terms of reference

1. Assemble and test all the above equipment in the Huambo laboratory and set up and test the AA in Luanda. Probably an initial visit to the Luanda laboratory is needed to identify the materials needed for installation prior to continuing on to Huambo for work on the IIA Soils Laboratory.
2. Provide training for 3 or 4 technicians, including some of the those with previous training experience in Brasil in the analysis of soils, plants, and water.
3. Draft analytical procedure documents, in Portuguese, that implement soil and plant analysis methods that are currently accepted by the soils and agronomy scientific community. Soils CRSP staff can assist in this activity.
4. Identify the institutions and businesses that repair and maintain the instruments and equipment and establish an initial communication with them so that rapid repairs of broken instruments is possible.
5. Develop a list of priority instruments and equipment that will provide the analytical support for the short and medium terms goals of IIA, FAC, and IDA.
6. Suggest a cost structure that returns significant funds to the laboratory for maintenance and upgrading.

Estimating duration: 1 month

Appendix IV. Nutrient analysis of soil samples taken to the University of Hawaii for analysis.

Descrip.	pH	%N	%OC	P	K	Ca	Mg	K	Ca	Mg	cations	Sample description
Angola 1	5.5	0.04	0.68	2.9	70	164	59	0.18	0.82	0.49	1.49	Cena II-Bailundo Amostra 1
Angola 2	5.3	0.25	4.81	17	166	371	83	0.42	1.85	0.69	2.97	Cena II-Bailundo Amostra 2
Angola 3	5.7	0.05	0.82	1.4	32	203	71	0.08	1.01	0.59	1.69	Associacao 1S- Bailundo Amo unica
Angola 4	5.3	0.03	0.60	0.7	25	137	40	0.06	0.69	0.34	1.09	Nganga- Bailundo Amostra u
Angola 5	5.2	0.06	1.02	0.4	47	117	49	0.12	0.59	0.41	1.12	Tewa-tewa- Bailundo Amos unica
Angola 6	5.5	0.19	3.05	22	37	454	87	0.10	2.27	0.73	3.09	Capunge- Caala
Angola 7	5.5	0.09	1.40	21	121	406	84	0.31	2.03	0.70	3.05	Capunge EXP – Caala
Angola 8	5.4	0.06	0.98	10	33	155	38	0.08	0.77	0.31	1.17	Cassupi I – Caala
Angola 9	5.4	0.14	2.29	36	68	460	88	0.18	2.30	0.73	3.21	Gambembwa – Caala
Angola 10	5.2	0.03	0.54	33	28	82	18	0.07	0.41	0.15	0.63	Dango – Caala
Angola 11	5.2	0.13	2.24	43	53	169	56	0.14	0.85	0.47	1.45	Chianga I
Angola 12	5.1	0.13	1.95	31	183	387	59	0.47	1.94	0.49	2.89	Chianga II
Angola 13	5.6	0.19	2.90	69	416	734	135	1.07	3.67	1.12	5.86	Chianga III
Angola 14	5.6	0.03	0.63	4.0	47	147	40	0.12	0.74	0.33	1.19	Alto Hama (Partye Alta)
Angola 15	5.4	0.28	5.20	12	20	46	9.2	0.05	0.23	0.08	0.36	Loudiumbali – Amostra
Angola 16	5.8	0.23	4.09	14	40	489	66	0.10	2.44	0.55	3.10	Polo Loudfiumbali - 1° Amostra
Angola 17	5.4	0.32	4.80	14	165	524	64	0.42	2.62	0.53	3.58	Loudiumbali – Baixa
Angola 18	5.5	0.08	1.24	4.8	83	257	57	0.21	1.28	0.48	1.97	Loudiumbali – Kuqueta
Angola 19	5.5	0.06	1.00	11	117	311	92	0.30	1.55	0.77	2.62	Amostra I – Palestina – M'B
Angola 20	5.4	0.05	0.82	3.1	113	199	80	0.29	0.99	0.66	1.95	Amostra II – Crissaco – M'B
Angola 21	5.7	0.07	1.21	33	141	980	219	0.36	4.90	1.83	7.09	Amostra III – Keve – M'Bave
Angola 22	5.8	0.06	1.12	4.8	55	434	85	0.14	2.17	0.70	3.02	Amostra IV – Kalungubongo
Angola 23	5.4	0.03	0.66	4.3	61	88	44	0.16	0.44	0.36	0.96	Amostra V - Messele

P analysis by modified Truog