

**Objective 3** Develop auxiliary tools to the integrated knowledge base to enable local agriculturalists to diagnose and solve soil acidity and nutrient problems that predominate within the social, economic and agronomic characteristics of their regional domains

*Output 1* Extensive evaluation network - evaluation of products and capturing knowledge under a variety of location-specific conditions

Within this group we envisage a) individuals with knowledge that should be incorporated into products. b) individuals with field and laboratory data sets that could be used to evaluate products for location-specific conditions, and c) established networks who would be interested and benefit from using our products in their programs. Milestones in activities related to this task are project meetings held in years 1, 2, 4 and 5. Participants would be asked to consider relevance of planned tools to their local needs and suggest potential modifications or additions. In later years we would focus on obtaining feedback on evaluations of NuMaSS and auxiliary tools when applied to their local conditions.

#### Lead Investigators and Contributors

Deanna Osmond provides overall coordination to activities related to the network, but all U.S. project team members participate as they travel overseas and interact with network members. Collaborators from the following institutions (countries/regions) have agreed to participate in the network, contribute their nutrient management knowledge base and evaluate the decision support software prototypes and auxiliary tools under their location specific conditions:

IBSRAM Steepland Network (Asia)

IRRI Rice Consortium (Asia)

CIMMYT Regional Maize Program (Central America)

Potash&Phosphate Institute Andean Program (Central-Latin America)

IBTA (Bolivia)

ICRAF (Peru)

INIAP (Ecuador)

EMBRAPA (Brazil)

University of Viçosa (Brazil)

SRI (Ghana)

ISRA (Senegal)

Cedara Agric. Res. Station (S. Africa)

Some of these and many others attended the workshop held in Philippines and are active in the network.

#### Progress

##### 1. *Visits to Network Member Sites*

Through travel opportunities during the year, several members of the NuMaSS team have made worldwide contacts. Those listed below generated significant interest and mutual benefit to the program.

##### Brazil -

*a. Field experiments with peach palm in Brazil -* (Adrian Ares with local collaboration by Charles Clement, Newton Falcão and Kukio Yuyama at the Amazon National Research Institute(INPA) in Manaus, and Manoel Cravo and Jefferson Macêdo at EMBRAPA,

Manaus) as part of the effort to determine growth response, foliar and soil critical levels of peach palm to P additions, three field experiments on peach palm carried out by INPA researchers were visited and sampled during March 1999. One experiment was located at Rieda farm about 8 km from Manaus on BR-174, and two experiments were located at the Yuricam Farm, Rio Preto da Eva, on AM-10, about 100 km from Manaus. The experiment at Rieda farm was started on March 1996 with the objective of determining the optimal levels of N, P and K and the effect of liming, animal manure and micronutrients on peach palm for heart-of-palm production. Twenty treatments were set up in a replicated experiment on a “terra firme” (upland) Oxisol. The “terra firme” area is of Tertiary age and, therefore, older than the “várzea” or flood plains of Quaternary age. The “terra firme” soils known as “latossolo amarelo” in Brazil are common under peach palm and have high clay and moderate organic C contents. Ranges in fertilizer rates were between 0 and 180 kg ha<sup>-1</sup> for urea, 0 and 90 kg ha<sup>-1</sup> for TSP and 0 and 240 kg ha<sup>-1</sup> for KCl. Peach palm responded to P additions six months after fertilization based on increased plant stem diameter and plant height (data not shown). At age 3 years of the experiment, we sampled soil at 0-5 cm and 5-20 cm and the third and sixth leaf of peach palm plants.

The other two experiments at Yuricam Farm were also on an Oxisol. Experiment I was set up in 1996 to study the effect of NPK levels, spacing and trunk numbers on heart-of-palm production. The experiment is a 3 x 5 factorial with three plant spacings (1x1, 1x2 and 1.5x2 m) and 5 different NPK levels. Ranges in fertilizer rates were between 0 and 225 kg ha<sup>-1</sup> for N, 5.5 and 39.3 kg ha<sup>-1</sup> for P and 74.7 and 224.1 kg ha<sup>-1</sup> for K. A randomized complete block design with three reps was followed. We sampled the plots with plants at the 2 m by 1 m spacing within two blocks out of three. Results at six months after fertilization have indicated a response to P additions for the 2 x 2.5 m spacing treatment. Also, recent measurements showed that P additions (39.3 vs 10.9 kg ha<sup>-1</sup>) increased the number of harvested stems which, in turn, positively correlated to stem diameter, plant height and number of stems. Experiment II within Yuricam Farm was set up in 1996 to determine the effect of increasing levels of NPK on peach palm fruit production. There are 10 treatments with P amounts ranging from 0 to 59 kg ha<sup>-1</sup> and K<sub>2</sub>O doses varying between 0 and 224 kg ha<sup>-1</sup>. The experiment followed a completely randomized design with three replications. At 26 months after planting, stem diameter and height for peach palm plants under all fertilization treatments were higher than those for the control but there were no differences among the treatments with nutrient additions.

Soil and foliar sampling for experiments I and II at Yuricam farm was performed as at Rieda farm. In experiment II, an older leaf (determined as the total number of leaves divided by two) has been sampled recently and foliar nutrient data from this tissue will be compared to those from the 3<sup>rd</sup> and 6<sup>th</sup> leaves.

Peach palm tissues of different age and soil P values obtained by different methods (e.g. modified Olsen, Mehlich I and III) and for different depths are being compared to select the best method of P diagnosis. Mehlich I is the standard extraction method used for soil P at INPA laboratory and a calibration phase was necessary to carry out the modified Olsen and Mehlich III methods. An analysis on soil and tissue sensitivity to P additions and yield response for the experiments in both Costa Rica and Brazil will be run as follows:

Fertilization Level	Yield Response	Deficiency Symptoms	Response Obtained by P Levels			
			3 <sup>rd</sup> Leaf	6 <sup>th</sup> Leaf	Soil 0-5 cm	Soil 5-20 cm
Control						
Level X	yes/no	yes/no	yes/no	yes/no	yes/no	yes/no
Level 2X	yes/no	yes/no	yes/no	yes/no	yes/no	yes/no
etc.	yes/no	yes/no	yes/no	yes/no	yes/no	yes/no

*b. Diagnostic criteria for P deficiency in peach palm* - ( Adrian Ares in collaboration with Charles Clement, Newton Falcão and Kukio Yuyama at the Amazon National Research Institute(INPA) in Manaus, Brazil) a conceptual analysis of diagnostic methods for plant nutrient status and their use in decision support systems was presented to the workshop on NuMaSS held at PhilRice in the Phillipines. The framework for discussing the characteristics of sound diagnostic methods followed the criteria developed by Meynard in France for N deficiency diagnostics (Meynard et al., 1996).

Peach palm stands in the Amazon region provide better opportunities to detect P deficiencies than most stands in Costa Rica. Photographs of whole plants and plant organs were taken in representative plots of every treatment of INPA experiments. Plant and organ characteristics are being examined in relation to growth responses and P deficiencies. Exercises with independent observers are being conducted to obtain unbiased estimates of P deficiency symptoms. Plant species that can be indicators of P deficiency were recorded in the field and their characteristics and relationships to site conditions were discussed with collaborators both in Brazil and Costa Rica.

Also, symptoms of nutrient deficiency in peach palm were recorded in greenhouse experiments carried out by INPA collaborators. In these studies, symptoms of deficiency were studied by using the ‘missing element’ method (all macro and micronutrients are applied at one time except one). As in previous research, there were no clear symptoms of P deficiency in peach palm seedlings. Some of the observed symptoms for other nutrients were:

- a) *N deficiency* - reduced growth and development, and generalized chlorosis,
- b) *K deficiency* - chlorosis and subsequent necrosis of the tips of old leaves,
- c) *Mn deficiency* - interveinal chlorosis in leaves,
- d) *Ca deficiency* - dark green-colored leaves, and
- e) *S deficiency* - chlorosis of young leaves.

Results so far indicate that whole-plant characteristics may be more useful than tissue features to characterize P deficiencies in peach palm. Number of shoots per plant, for instance, may indicate nutrient deficiencies in early (before harvest) stages of peach palm development. In mature plantations, number of shoots may also indicate level of management.

*c. Visits to EMBRAPA-CPAC and Federal Univ. Viçosa* - Jot Smyth had the opportunity to visit both of these institutions. Both have strong interests in decision support systems and data bases with information needed to fill knowledge gaps in NuMaSS. A seminar on the project’s 5-year workplan and the NuMaSS software was presented at each location. A

pre-release version of NuMaSS 1.0 was also demonstrated to interested parties. The Cerrado Research Center (CPAC) is interested in collaborating with NuMaSS development. They are particularly interested in helping ensure that the final version is translated into Portuguese. CPAC would also like project assistance in coding the ruleset for diagnosis and recommendations for soil acidity based on the method which they use in the Cerrados - % base saturation of cation exchange capacity measured at pH 7. Two of their staff, Drs. Leo Miranda and Claudio Sanzonowicz, were designated as CPAC contacts for project-related matters. A major constraint to timely collection of unpublished data for use in NuMaSS is funds to support clerical staff to transfer and organize printed data on electronic files. A visit to the U.S. AID representative in Brasilia for assistance in this matter produced no encouraging results.

Faculty in the Soil Science Department at the Federal University of Viçosa (UFV) have 5-6 graduate students who are compiling published data in Brazil on soil nutrient diagnosis and fertilizer recommendations as their thesis topics. They have agreed to provide us with copies of the compile information. UFV also is interested in approaches used in NuMaSS used to diagnose soil acidity and N problems and recommend lime and fertilizer applications. UFV provides technical assistance in eucalyptus production and management to cellulose companies throughout Brazil. Their extensive database on soil nutrient management and production of eucalyptus offers an excellent opportunity to test, refine and expand NuMaSS functionality with tree crop commodities once it is fully developed for palmito.

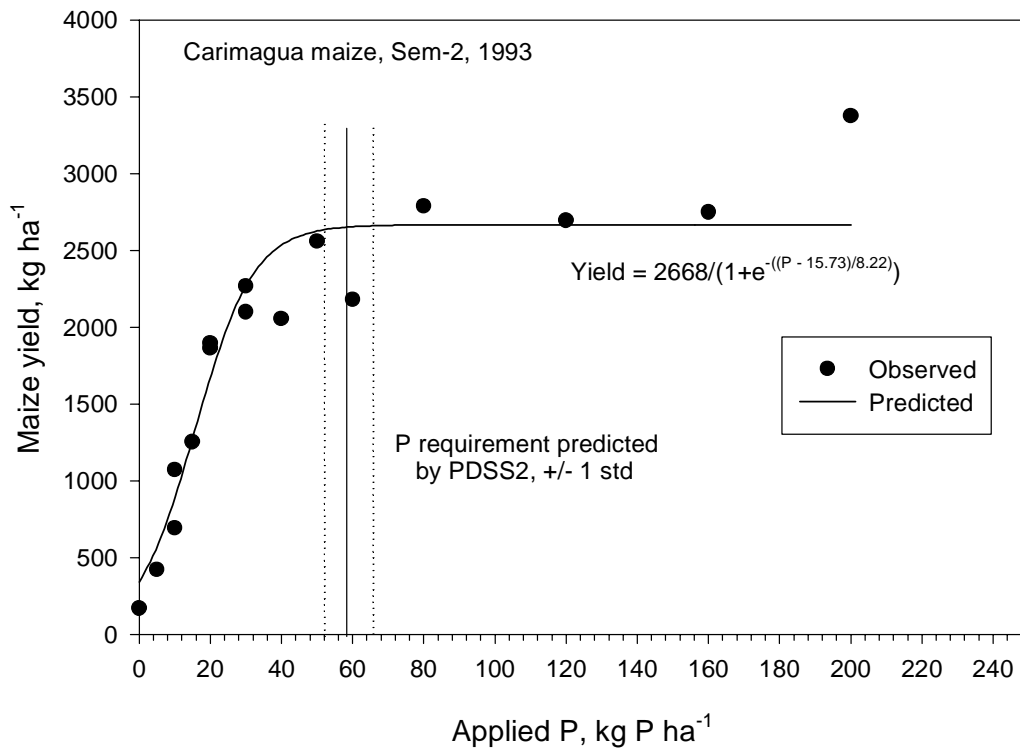
Kwazulu-Natal, South Africa - the approaches used to diagnose soil nutrient constraints and recommend lime and fertilizers by Cedara Agric. Dev. Institute at Pietermaritzburg has many common features with those used in NuMaSS. Liming is based on exchangeable Al, N is based on crop accumulation for a targeted yield, and P is based on P buffer coefficients and clay content. The Cedara Institute staff, with Mr. Alan Manson as the designated contact, is interested in evaluating NuMaSS and comparing its diagnosis and recommendations with those they have developed via numerous field trials on Alfisols, Oxisols and Ultisols.

Guatemala - Jot Smyth attended by invitation the annual meetings of the Central American Crop and Animal Improvement Program (PCCMCA) and presented a paper on the fundamental rulesets used in NuMaSS to diagnose constraints and recommend corrective nutrient management strategies. This meeting provided opportunities to establish and renew contacts scientists from CIAT, Mexico and Panama who are interested in collaborating in NuMaSS development and evaluation.

CIAT, Colombia - (Russell Yost in collaboration with D.K. Friesen, IFDC/CIMMYT formerly IFDC/CIAT, and Mariela Rivera and I.M. Rao, CIAT, Colombia) during recent travels in Latin America, Russell Yost visited CIAT and developed protocols to perform a comparison of decision-aid predictions of fertilizer requirement (level 0 comparisons) with field-determined P fertilizer requirements. Subsequently coefficients used in PDSS2 and the P module of NuMaSS will be compared to predict P fertilizer requirement (level 1 comparisons and testing).

*a. Carimagua maize* - a series of experiments have been carried out at the CIAT, Colombia site in Eastern Colombia. The purpose of the experiments was to determine the nutrient P requirements and residual value of P applications for several annual crops including maize,

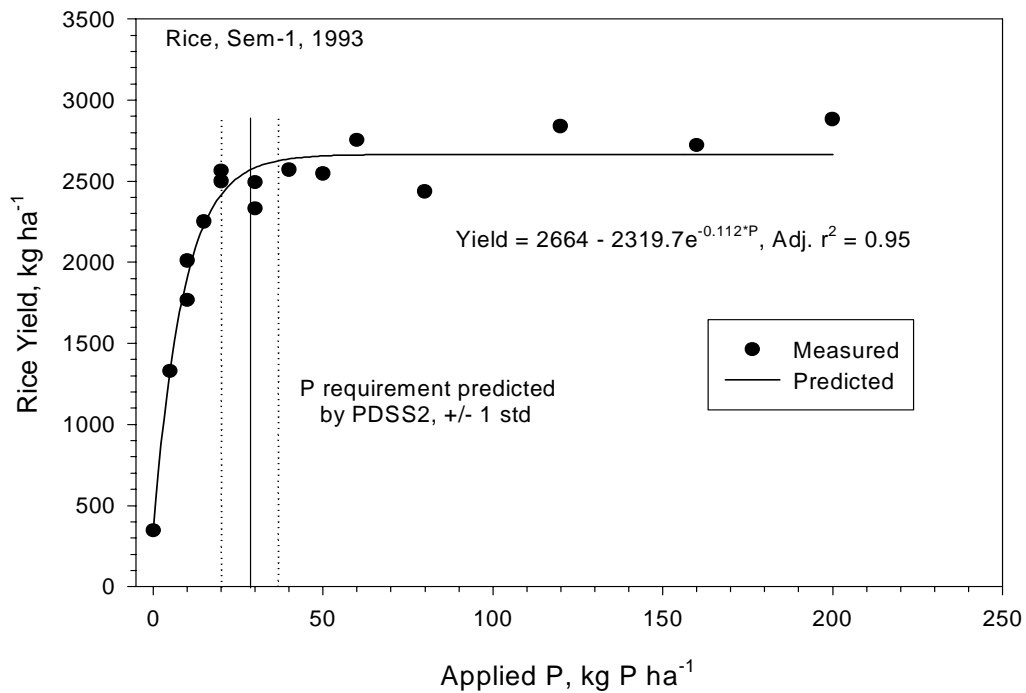
cowpea, and upland rice grown in cereal-legume rotations. Two of the experimental sites and three crops were selected to test the predictions of the PDSS2 and the P module of NuMaSS with estimates of P requirements from the response curve experiments conducted in the field. As indicated in Figure 38, the PDSS2 prediction of P requirement for maize on this soil was slightly more than that estimated from the field-experiment, although the differences were not great. The experimental response curve is also shown in the figure and indicates a relation between the prediction and the field estimates. The predictions from PDSS2 are based on coefficients developed largely from experiments from the Brazilian Cerrado and from North Carolina (Cox, 1994).



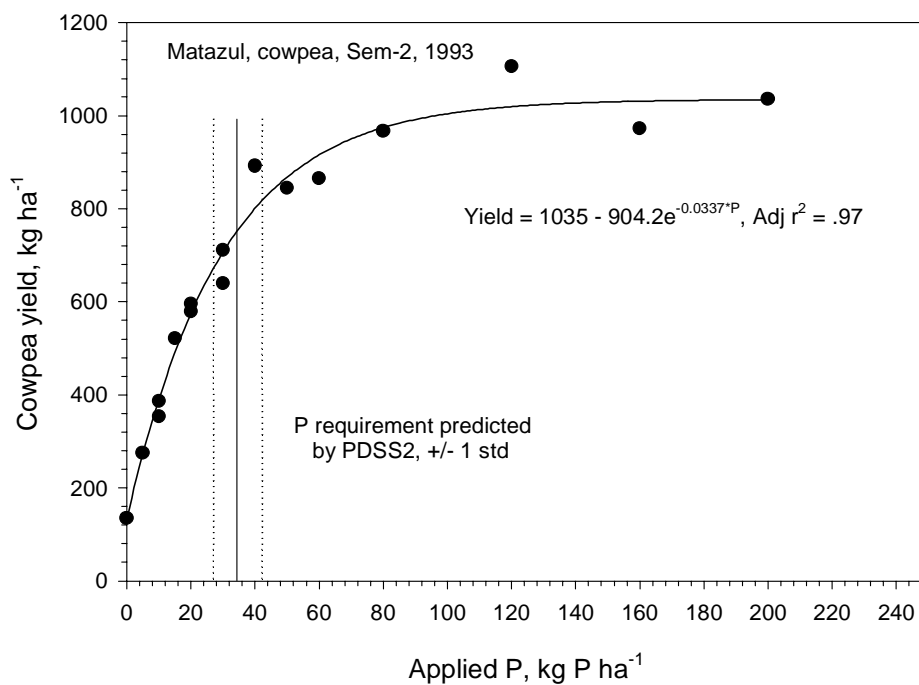
**Figure 38.** Comparison of P requirement estimated from PDSS2 with experimentally determined P response curve. Carimagua maize, initial crop, Sem-2, 1993. Data from D. Friesen et al. 1994. The prediction based on initial 0.5M NaHCO<sub>3</sub> P of 5.2, critical level for maize of 15, and 42 % clay.

*b. Matazul initial upland rice, cowpea and second upland rice crop.* - a comparison was also made between the field estimates of P requirement for the initial crop of upland rice, second crop cowpea and second crop upland rice at Matazul and the PDSS2 predictions (Figs. 39, 40 and 41). As in the case of Carimagua, this site is also located in the Eastern Llanos of Colombia. The results were somewhat different than those of the Carimagua site. The PDSS2 prediction for the first crop of rice (93) was very close to the amount of P that would be recommended from the response curve in order to give 80 - 90% relative yield. The PDSS2 prediction for the second crop of rice tended to be somewhat less than that suggested from the response curve (Figs. 40 and 41). The under-prediction in the case of the cowpea and the second crop upland rice may be related to the fact that the P was applied either entirely to the previous year's crop (residual value treatments) or in equal annual applications to each rice crop. The P requirement for cowpea may also have been underestimated because this crop grew on residual P applied to the preceding rice crop, that is, no fresh P was applied to cowpea in any of the treatments. Critical levels for the cowpea were derived from experiments in which the 0.5M NaHCO<sub>3</sub> had been modified with the addition of EDTA in order to measure micronutrients. The critical levels and buffer coefficients for the modified Olsen may also have affected the cowpea underprediction. Nonetheless, we conclude that the PDSS2-based estimates of P requirement were sufficiently close to be useful in estimating P requirements for these crops in soils of this type.

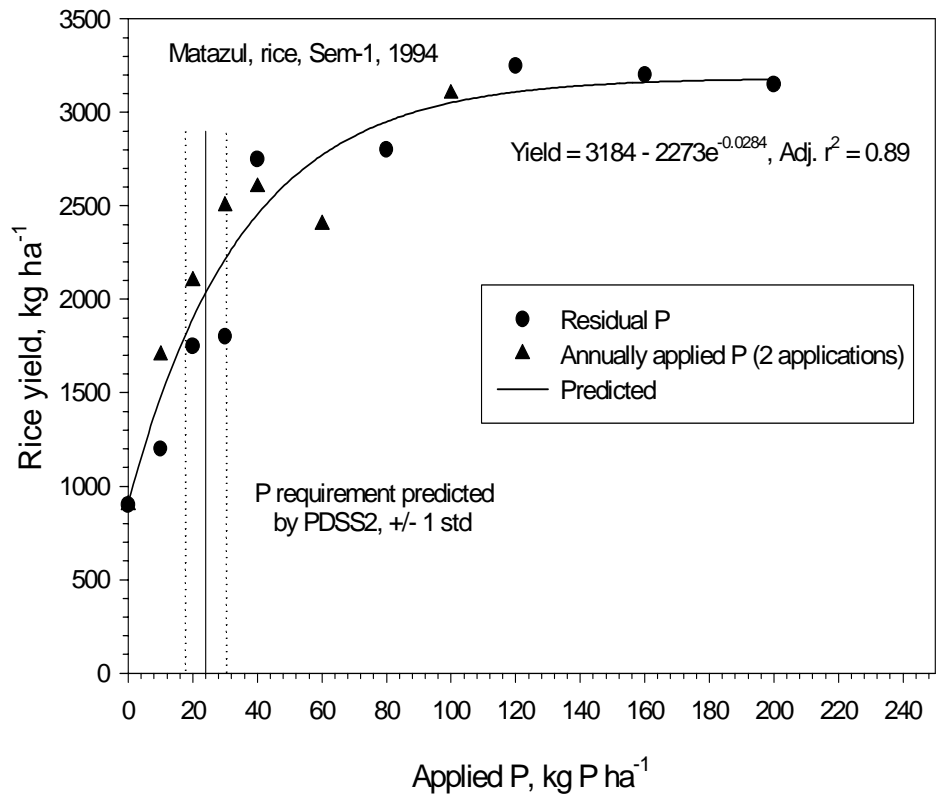
Further studies are underway to compare field estimates of the remaining coefficients used in PDSS2 predictions: P critical levels for Bray P2 for maize, cowpea, and upland rice, P buffer coefficients for Bray P2 and 0.5M NaHCO<sub>3</sub>, coefficients for the slow reaction of fertilizer P with the soils at Carimagua and Matazul, and coefficients for the desorption of extractable P. Bolivia (collaborators are Larry Szott at DAI/NCSU, Armando Ferrufino at PRAEDAC/IBTA, Walter Gomez at IBTA and Angel Salazar at FAO) North Carolina St. Univ. and Development Alternatives Inc. (DAI) are partners in the Counter Narcotics Consolidation of Alternative Development Efforts (CONCADE) project funded by AID-Bolivia and targeting the Chapare region of that country. At CONCADE's invitation and sponsorship, Russ Yost and Jot Smyth traveled to Bolivia to assess existing practices in soil nutrient management and recommend actions favoring farmer adoption of alternative cropping systems to coca production. Banana and peach palm for 'palmito' are the two most promising crop alternatives. Production systems for both crops target the export market in the Southern Cone region of South America. Collaborators are interested in using NuMaSS to assist farmers in diagnosing nutrient problems and recommending lime and fertilizers. Based on previous work conducted in this region by the SM-CRSP, we identified K as a major nutrient constraint in addition to those currently addressed by NuMaSS. Based on the existing soil and crop performance data, compiled by Armando Ferrufino, we assisted collaborators in designing field trials and ancillary laboratory analyses that would enable development of region-specific coefficients needed to provide fertilizer recommendations in NuMaSS. This activity illustrates how AID Mission-sponsored projects can benefit from collaboration with SM-CRSP projects.



**Figure 39.** Comparison of P requirement predicted by PDSS2 with the experimentally determined response curve. Matazul rice, initial crop, Sem.1, 1993. Data from D. Friesen et al., IFDC/CIAT.



**Figure 40.** Comparison of P requirement estimated by PDSS2 with the experimentally determined P response curve. Matazul cowpea, Second semester, data from Friesen et al., 1994.



**Figure 41.** Response of upland rice to residual P and annually applied treble superphosphate at the Matazul farm, data from D. Friesen, J.I. Sanz, and Mariela Rivera, CIAT, Colombia.

2. *NuMaSS Evaluation Workshop* (Deanna Osmond and Teodula Corton coordinated the workshop) - selected participants from Africa, Asia, and Latin America were invited to participate in a nutrient management workshop in the Philippines during September of 1999. The Philippine Rice Research Institute (PhilRice) and the International Rice Research Institute co-sponsored the workshop, which was held at PhilRice's headquarters. There were

26 Asian participants, 22 from the Philippines and 4 from either Laos, Viet Nam or Indonesia. The ten Africans came from Senegal, Mali, Ethiopia, South Africa, Zambia, and Tanzania. There were seven Central and South Americans representing Brazil, Equador, Bolivia, Venezuela, and Costa Rica. In addition, a researcher from PPI-Singapore was in attendance as were two representatives of the SM-CRSP External Evaluation Panel (EEP) and USAID's Project Officer for the CRSP. Participants, their country and work affiliation are listed in Table 50.

Objectives of the workshop were to threefold:

1. Compare among countries and regions decision making processes which are used to diagnose soil nutrient problems, recommend solutions, and assess their economic feasibility;
2. Evaluate the current prototype of the integrated decision support system (NuMaSS) software and identify future developments needed to improve its performance and usability; and
3. Work with interested parties in providing pertinent data and/or designing and planning experimentations in support of NuMaSS refinement to suit regional needs.

There were three expected outcomes of the workshop:

4. Present country- and region-specific decision-making processes for diagnosis of soil nutrient problems and fertility recommendations;
5. Evaluation of the IntDSS software prototype; and
6. Design of experiment for IntDSS refinement to suit regional needs.

The agenda of the workshop, designed to meet the workshop objectives, is attached as an Appendix.

In order to meet the first objective of the workshop, participants were asked to bring papers describing nutrient management in their countries. To standardize this reporting effort, a suggested format for the paper was sent to the participants. We received reports from the majority of the participants. These reports have been edited into a proceedings that is currently being printed by PhilRice and IRRI. Participants presented and summarize their information on nutrient management by climatic regime (humid, wet/dry, and semi-arid). During the second day of the workshop, presentations on IntDSS (NuMaSS) were made. Participants were divided based on the climatic region that they work in. The software was then used and tested by the participants. Recommendations were subsequently reported in a plenary session.

At a group meeting, held by the EEP, all workshop participants endorsed the continued development of the NuMaSS software. All believed that NuMaSS provides an important tool that can be regionalized by participants for their own countries. The participants are anxious to contribute to the development of NuMaSS by providing regional data and testing the performance of the software. They also view the project as providing a forum that allows them to interact closely with an international group of soil scientist and agronomist.

The workshop concluded with a field trip to Ilagan in Isabela Province, where on-farm trials conducted by the SM-CRSP project, in collaboration with PhilRice, IRRI and local agencies of the Department of Agriculture, demonstrated approaches that could be used to field test and adapt NuMaSS to regional conditions within a given country. Results from the on-farm

Table 50. List of workshop participants and their institutional affiliations.

<b>NAME</b>	<b>INSTITUTION</b>	<b>COUNTRY</b>
Dr. Agusli Taher	Sukarami Assessment Institute for Agricultural Technology	Indonesia
Mr. Boun-Ome Soulideth	Soil Survey and Land Classification Center	Laos
Mr. Soulasith Maniphone	Luang Prabang Rainfed Upland Research Program	Laos
Mr. Pham Tien Dung	Hanoi Agricultural University	Vietnam
Ato Solomon Abebe	Bureau of Agriculture	Ethiopia
Ato Kindu Mekonnen	Sirinka Research Center	Ethiopia
Ato Yihenew G. Selassie	Adet Research Center	Ethiopia
Dr. Mohamed Kebbeh	WARDA-Sahel	Gambia
Dr. Charles Yamoah	Council for Scientific and Industrial Research	Ghana
Dr. Mamadou Doumbia	Institut d'Economie Rurale	Mali
Dr. Aminata Badiane	Institut Senegalese de Recherche Agricole	Senegal
Mr. Alan Manson	KwaZulu-Natal Department of Agriculture	South Africa
Dr. Gerald Kimbi	Sokoine University of Agriculture	Tanzania
Dr. Vernon Chinene	University of Zambia	Zambia
Dr. Manoel S. Cravo	EMBRAPA-CPAA Manaus	Brazil
Dr. Leo Nobre de Miranda	EMBRAPA-CPAC Brasilia	Brazil
Dr. Roberto F. Novais	Universidade Federal de Vicosa	Brazil
Dr. Alfredo Alvarado	Universidad de Costa Rica	Costa Rica
Ing. Francisco Mite	INIAP	Ecuador
Dr. Armando Ferruffino	IBTA-Chapare	Bolivia
Ms. Yamily Zavala	FONAIAP	Venezuela
Dr. Jot Smyth	North Carolina State University	USA
Dr. Deanna Osmond	North Carolina State University	USA
Dr. Russell Yost	University of Hawaii	USA
Dr. Shaw Reid	Cornell University	USA
Dr. Anthony S. Juo	Texas A & M University	USA
Dr. Eric Craswell	IBSRAM	Thailand

<b>NAME</b>	<b>INSTITUTION</b>	<b>COUNTRY</b>
Dr. Amit Roy	IFDC	USA
Dr. Charles Sloger	USAID/Washington	USA
Dr. Ernst Mutert	Potash & Phosphate Institute	Singapore
Dr. Eduardo Paningbatan	UPLB	Philippines
Ms. Jovelyn Du-Quiton	UPLB	Philippines
Dr. Perfecto P. Evangelista	BSWM	Philippines
Dr. Rogelio N. Concepcion	BSWM	Philippines
Mr. Jonathan T. Quiton	IRRI	Philippines
Dr. Thomas George	IRRI	Philippines
Dr. Mark Bell	IRRI	Philippines
Dr. V. Manoharan	IRRI	Philippines
Engr. Andrew Valdeavilla	PCARRD	Philippines
Mr. Danilo Tumamao	DA-CVIARC	Philippines
Mr. Quirin Asuncion	DA-CVIARC	Philippines
Mr. Warlito Cayaba	LGU-DA Ilagan	Philippines
Mr. Bonifacio Macarubbo	LGU-DA Ilagan	Philippines
Dr. Arturo Gomez	SEARCA	Philippines
Dr. Santiago R. Obien	PhilRice	Philippines
Dr. Frisco Malabanan	PhilRice	Philippines
Ms. Karen Barroga	PhilRice	Philippines
Engr. Leo Javier	PhilRice	Philippines
Mr. Paterno Rebueta	PhilRice	Philippines
Dr. Teodula Corton	PhilRice	Philippines
Dr. Sergio Francisco	PhilRice	Philippines
Dr. Genaro O. San Valentin	PhilRice	Philippines
Dr. Cesar P. Mamaril	PhilRice	Philippines
Mr. Josue Descalsota	PhilRice	Philippines

trials are expected to have a major impact on upland agriculture in the Philippines. PhilRice is currently considering potential options to extend the results to other upland regions within the country.

A two-page synthesis of the workshop was developed for USAID distribution.

#### Additional Funding and Support

- PCCMCA Meeting, travel for Jot Smyth to Guatemala - \$980
- CIAT, travel for Russell Yost to Colombia - \$800
- CONCADE/Bolivia, travel for Jot Smyth and Russel Yost to Bolivia - \$5,800
- IRRI, in kind contributions to workshop for airport reception desk, transportation, and publication of workshop proceedings
- PhilRice, in kind contributions for state-of-the-art meeting facilities, lodging and support staff, transportation, publication of workshop proceedings, and in-country logistics throughout the workshop.
- Institutions employing workshop participant provided one full week of their time to the workshop

#### Travel and Meetings Attended

- Travel by Jot Smyth to Brazil, South Africa and Philippines
- Travel by Jot Smyth to Guatemala for PCCMCA meeting
- Travel by Juo, Osmond, Reid, Smyth, Yost, Zavala (from US) and numerous foreign participants to the workshop at PhilRice
- Travel to Bolivia by Smyth and Yost
- Travel by Russell Yost to CIAT, Colombia

#### Relevant Publications, Reports and Presentations at Meetings

Ares, A. 1999. "Decision support systems for integrated nutrient management in agroecosystems." Seminar at Instituto Nacional de Pesquisas da Amazônia, March 16 1999, Manaus, Brazil.

Ares, A. 1999. "Nutrient diagnosis and fertilization responses in perennial tree crops for the humid tropics: the case of peach palm (*Bactris gasipaes*) in Costa Rica, Brazil and Hawaii." Seminar at the University of Hawaii, May 12, Honolulu.

Ares, A. 1999. Report on trip to Brazil and Costa Rica. Decision Aids for Integrated Soil Nutrients Project. 10p.  
([http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip\\_Reports/Adrian\\_Brazil\\_CRica\\_99Rept.pdf](http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip_Reports/Adrian_Brazil_CRica_99Rept.pdf))

Deenik J, Ares A. and Yost RS. 1999. Fertilization responses and nutrient diagnostic methods for peach palm (*Bactris gasipaes*). *Nutrient Cycling in Agroecosystems* 55 (4): 1-13.

George, T. et al. 1999. SM-CRSP Project Decision Aids for Integrated Nutrient Management: Mid-Term Evaluation. Paper presented at the Decision Aids Workshop, 6-11 September, PhilRice, Philippines.

George *et al.* 1999. SM-CRSP Project Decision Aids for Integrated Nutrient Management: On-Farm Testing. Paper presented at the Decision Aids Workshop, 6-11 September, PhilRice, Philippines.

Osmond, D.L. 1999. Presentation of an overview of IntDSS at the Philippines workshop, Sept. 1999, PhilRice, Maligaya, Philippines.

- Osmond, D.L., T. Corton, T.J. Smyth W.S. Reid, and R.S. Yost . 2000. Proceedings from a Workshop on Decision Processes for Determining Diagnostic and Predictive Criteria for Soil Nutrient Management. September 6-10, 1999. PhilRice Maligaya, Muñoz, Nueva Ecija, Philippines. (near completion).
- Reid, W.S. Presentation of NDSS as part of NuMaSS at the Philippines workshop, Sept. 1999, PhilRice, Maligaya, Philippines.
- Smyth, T.J. 1999. Decision support systems for integrated soil nutrient management. Plenary Session presentation at PCCMCA Annual Meetings, April 14, Guatemala, Guatemala.
- Smyth, T.J. 1999. Presentation of ADSS as part of NuMaSS at the Philippines workshop, Sept. 1999, PhilRice, Maligaya, Philippines.
- Smyth, T.J. 1999. Report on trip to Guatemala, Honduras and Costa Rica. Decision Aids for Integrated Soil Nutrients Project. 16p.  
([http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip\\_Reports/Smyth\\_CAmerica\\_0499Rept.pdf](http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip_Reports/Smyth_CAmerica_0499Rept.pdf))
- Smyth, T.J. 1999. Decision aids for integrated soil nutrient management: 5-year workplans and software development. Seminar to Soil Science Dept., Federal Univ. Viçosa, Viçosa, Brazil. March 10, 1999.
- Smyth, T.J. 1999. Decision aids for integrated soil nutrient management: 5-year workplans and software development. Seminar to EMBRAPA-CPAC staff, Brasilia, Brazil. March 18, 1999.
- Smyth, T.J. 1999. Decision aids for integrated soil nutrient management: 5-year workplans and software development. Seminar to Cedara Agric. Dev. Inst. staff, Pietermaritzburg, South Africa. March 23, 1999.
- Smyth, T.J. 1999. Report on travel to Brazil, South Africa and Philippines. Decision Aids for Integrated Soil Nutrients Project. 16p.  
([http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip\\_Reports/Smyth0399\\_World\\_Rept.pdf](http://intdss.soil.ncsu.edu/sm-crsp/Download/Trip_Reports/Smyth0399_World_Rept.pdf))
- Smyth, T.J. and D.L. Osmond. 1999. Synthesis of the Workshop on Decision Processes for Determining Diagnostic and Predictive Criteria for Soil Nutrient Management. September 6-10, 1999. PhilRice Maligaya, Muñoz, Nueva Ecija, Philippines. 2p.
- Yost, R.S. and X. Wang. 1999. Presentation of the P module of NuMaSS at the Philippines workshop, Sept. 1999, PhilRice, Maligaya, Philippines.
- Yost R, Ares A., Bajita J and Wang, X. 1999. Diagnosing nutrient deficiencies. Proceedings Workshop on Integrated Nutrient Management, The Philippines.

Appendix - Workshop Program

**Decision Processes for Determining Diagnostic and Predictive Criteria  
for Soil Nutrient Management**

September 6-10, 1999

PhilRice, Maligaya, Muñoz, Nueva Ecija, Philippines

Sunday, Sept. 5	Participant arrival in Manila; check-in at hotel	
Monday, Sept. 6		
0600	Leave hotel for PhilRice (Maligaya)	
1000	Check-in at PhilRice dormitory	C. Tibayan
1030	Coffee break	
1045	Registration (PhilRice Lobby)	E. Javier
1130	Briefing on PhilRice Story and R&D Programs	J. Villanueva
1200	Lunch at PhilRice cafeteria	
1300	Tour of PhilRice laboratories and field experiments	S. Obien
1500	Coffee break	
1530	Opening ceremonies	R. Beronio
	Invocation "Great is Thy Faithfulness"	PhilRice Coral
	National Anthem	PhilRice Coral
	Welcome Remarks	S. Obien
	Opening Remarks	J. Smyth
	Participant Introduction	R. Yost
	Introduction of Keynote Speaker	S. Obien
	Keynote Address	E. Ponce
	Discussion of Workshop Objectives, Mechanics and Expected Output	D. Osmond
	Viewing of posters and exhibits (PhilRice Lobby)	J. de Dios/J. Quilang
1800	Dinner at PhilRice cafeteria	
1930	Social/Cocktails (Social Hall)	H. Orge/L. Abaoag
Tuesday, Sept. 7		
0700	Breakfast	
0800	Group discussion on nutrient management decisions - presentation of participant reports	

	Wet/dry	J. Smyth
	Semiarid	S. Reid
	Humid	R. Yost
0930	Coffee Break	
1000	Continuation of group discussions	
1200	Lunch Break	
1330	Continuation of group discussions	
1500	Coffee Break	
1530	Plenary Report of Group Discussions	
1730	Wraep-up	
1800	Dinner	
1900	Core experiment at Ilagan Intensive Testing Site	T. Corton
2015	On-farm field trials in San Antonio	T. George
Wednesday, Sept. 8		
0700	Breakfast	
0800	Discussions on DSS	
	IntDSS	D. Osmond
	ADSS	J. Smyth
	NDSS	S. Reid
	PDDSS	R. Yost
1000	Coffee Break	
1030	Group Discussion (focus on individual DSS, what works/does not, future modifications needed)	
1200	Lunch Break	
1300	Continuation of group discussions	
1500	Coffee Break	
1530	Continuation of group discussions	
1800	Dinner	
1930	Plenary report on group discussions	
Thursday, Sept. 9		

0700	Breakfast	
0800	Group discussion on IntDSS (future modifications and direction)	D. Osmond
0900	Lessons learned at IRRI in building DSS	M. Bell
0930	Coffee Break	
1000	Probabilities in DSS (presentation followed by participants filling out survey worksheets)	R. Yost
1200	Lunch Break	
1330	Ilagan Mid-term Socio-economic Survey	R. Yost/T. George
1400	Information on visit to Ilagan, Isabela	D. Tumamao
1430	Departure for Ilagan, Isabela (packed snack)	
2000	Dinner (Lutong Bahay at Ilagan)	
2100	Check-in at hotel in Ilagan	
Friday, Sept. 10		
0600	Breakfast at hotels	
0700	Departure for field visit to core experiment	
0900	Visit of on-farm experiment	
1100	Visit of corn and upland rice techno-demo farms	
1200	Lunch, Wrap up, and Closing Ceremonies	

*Output 2* Auxiliary tools to complement NuMaSS software - products that facilitate use of the NuMaSS knowledge base where computers are not readily accessible or interest is in a summary of predictions and nutrient management guidance for prevailing cropping systems, cultivars, lime and fertilizer materials, and soils within a given region.

Examples of such tools are printed materials, spreadsheets, decision-making structures and map overlays. Such tools will be developed as we perceive their need among users. Two current tools under development are (a) the lime material and cost integrator and (b) a nutrient balance calculator.

Yost and colleagues developed a spreadsheet for selection of liming materials. The spreadsheet optimizes selection from locally-available liming materials and determines their correct proportional mixture while considering a variety of constraints such as quantity, cost, quality and distance of transport. We are currently translating the spreadsheet to Spanish, Portuguese and French before testing under a variety of global conditions.

The idea for a nutrient budget estimator came about during travel to select intensive testing areas. This tool should allow users to determine inputs, outputs and balance of major nutrients. By providing a nutrient budget farmers or planners can appreciate what their management practices are doing: depleting soils or particular nutrients, adding excess nutrients, or maintaining a balanced profile. A paper prototype has been developed to function at different scales: field, farm or farms.

Progress:

1. *Selection of Liming Material Spreadsheet* - collaborators have been identified, but we have not yet completed translation. Nevertheless, the spreadsheet and journal publication continues to be distributed upon request.
2. *Nutrient Budget Estimator* - programming of this tool was delayed until release of NuMaSS version 2.0. Much of the data needed for this tool will come from data collected and assembled for NuMaSS.

External Funding and Support

None

Travel and Meetings Attended

None

Relevant Publications, Reports and Presentations at Meetings

None