Workplans and Budget
Decision Aids for Integrated Soil Nutrient Management
February 2000

PROJECT YEAR 4 - February 11, 2000 to February 10, 2001

Objective 1: Develop an integrated computerized knowledge base for global use in diagnosing and recommending practical solutions to soil acidity and nutrient problems, which considers differences in resource availability and soil, climate, crop and management factors contributing to location-specific acidity and nutrient constraints.

Baseline: Soil nutrient deficiencies rarely occur in isolation and their correction usually requires more than one amendment. The initial version of the Nutrient Management Support System software (NuMaSS 1.0) was released during year 3. NuMaSS works in an integrated, object-oriented programming language to address soil acidity, N and P constraints. The *Diagnosis* module assesses whether nutrient constraints exist or not for a variety of pasture, grain and tuber crops. If a nutrient constraint exists, the *Prediction* module estimates corrective amendments needed for the particular soil conditions and selected crop. The *Guidance* module enables users to compare economic outcomes for different nutrient sources, crops and price scenarios; it also provides advice and cautions on nutrient management practices for the existing soil conditions and selected crop.

NuMaSS was evaluated by national agricultural research and extension service staff from 17 countries in Africa, Asia and Latin America. During year 3 it was also tested in various on-farm trials with collaborators at intensive testing sites in Ultisols at Ilagan, Isabela, Philippines and in Alfisols at Cinzana, Mali. Feedback from these evaluations has provided guidance for further development. Programmatic and technical refinements have been determined and outlined for the next version of NuMaSS. Planned refinements to the next version of NuMaSS also include additions of crop and soil coefficients gathered from literature synthesis and laboratory and field research at core testing sites in Costa Rica, Mali and Philippines. These coefficients are used in both the diagnosis and correction of soil acidity, N and P constraints. A new economics component for the *Guidance* module will improve evaluations of nutrient interactions.

Information from investigations in Costa Rica and Brazil with peach palm for heart-of-palm production, as our test tree crop, have now progressed to the point that it can also be added to NuMaSS. The growth curve for this perennial crop is now sufficiently defined to identify distinct phases of crop growth; allometric equations were developed to predict biomass and nutrient accumulation with crop age. Prediction equations were also developed for nutrient release and recycling of decomposing crop litter.

Laboratory and field investigations continue at the intensive testing sites. On-farm trials in Mali and the Philippines will be expanded to include additional crops. A second year of testing in existing trials enables evaluation of how NuMaSS

recommendations compensate for residual effects of lime and fertilizers applied during year 3. Continuation of the core experiments enable evaluations of residual effects and interactions among lime, N and P for existing and new crop commodities. This information will eventually lead to refinement of coefficients used in NuMaSS. New trials were initiated in Mali to evaluate the dynamics of nutrient contributions in the traditional practice of fertilizing fields with composted mixtures of manures, crop residues and household organic wastes. On-farm trials will be initiated in Costa Rica to test the diagnostic component of the peach palm knowledge base in NuMaSS. Ongoing field trials in Costa Rica to characterize peach palm response to applied N and P, and calibrate diagnostic criteria for these nutrients have completed their first year and need further time to achieve their objectives.

Output 1: Nutrient Management Support System (NuMaSS) software

Description: Acidity, nitrogen and phosphorus single-nutrient modules merged into an improved, fully functional integrated decisions support system software that accounts for interactions between N, P and lime.

Participants and estimated completion dates for suboutputs and activities for NuMaSS software development during project year 4.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1 Intermediate release of NuMaSS, version 2.0	Continue refinements from year 3 based on feedback from users at Philippines workshop: - refine, interface and algorithms - add additional data - release NuMaSS version 2.0 for testing	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	October 2000
2. Environmental concerns	1. Incorporate environmental effects into NuMaSS 2. Write up units on agricultural effects on environment	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2002
3. Integrated economics module	1. Test existing prototype with rice, corn and soybean data from Cerrados of Brazil 2. If needed, modify to obtain desirable performance 3. Test module with data sets from other regions 4. Replace existing economics module in NuMaSS with new integrated module	Osmond (NCSU)	Hoag (CSU) Reid (CU) Smyth (NCSU) Yost (UH)	August 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Predicting residue nutrient value	1. Develop algorithms that account for residue nutrient content and economic value 2. Incorporate algorithms into NuMaSS 3. Validate the algorithms	Reid (CU)	Osmond, Smyth (NCSU); Yost (UH)	February 2002

Budget:

OBJECT	AMOUNT IN US$
Personnel	83,074
Supplies	10,877
Equipment	7,429
Travel	12,318
Domestic	12,318
International	0
Other Direct Costs	84,395
Total	198,093

Equipment:
Computer - $2500 (UH)
TDR moisture meter - $1500 (UH)
Computer - $2750 (Cornell)

International Travel Events:
None; all travel events are domestic for purposes of interaction between individuals involved in NuMaSS programming efforts at Cornell, Hawaii and N.C. State Universities.

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1 Final release of NuMaSS, version 3.0	Continue refinements from year 4 based on feedback from user evaluations of NuMaSS 2.0: - refine algorithms - add additional data - release NuMaSS version 3.0	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2002
2. Environmental concerns	1. Incorporate environmental effects into NuMaSS 2. Write up units on agricultural effects on environment	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2002
3. Predicting residue nutrient value	1. Develop algorithms that account for residue nutrient content and economic value 2. Incorporate algorithms into NuMaSS 3. Validate the algorithms	Reid (CU)	Osmond, Smyth (NCSU); Yost (UH)	February 2002

Output 2: Field evaluation and refinement of NuMaSS software

Description: Testing NuMaSS under multiple environments and agricultural conditions, and refining it to achieve desired performance.

Participants and estimated completion dates for suboutputs and activities for field evaluation and refinement of NuMaSS software in project year 4.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Finalize report on studies on effects of pruned litter from heart-of-palm plantations on soil chemical properties and nutrient availability in Andisols*	Uribe, Alvarado (UCR)	Hue (UH), Smyth (NCSU), Alvarado (UCR)	May 2000
	2. Complete report on greenhouse trial on peach palm root elongation response to lime, Ca and Mg*	Salas, Alvarado (UCR)	Hue (UH), Smyth (NCSU)	June, 2000
	3. Complete field study on nutrient accumulation with time after peach palm establishment*	Molina, Soto (UCR)	Alvarado (UCR), Hue (UH); Smyth, Wagger (NCSU)	June, 2000
	4. Complete report on peach palm residue decomposition/nutrient release*	Soto, Alvarado (UCR)	Wagger, Luna, Smyth (NCSU)	June, 2000
	5. Continue field experiment to characterize peach palm response to P and develop diagnosis methods for mature peach palm plantations	Molina, Alvarado (UCR)	Ares, Yost (UH)	December, 2001

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
	6. Continue on-farm trials to evaluate diagnostic component of NuMaSS software for peach palm plantations.	Alvarado, Soto, Molina (UCR)	Ares, Hue, Yost (UH); Smyth, Osmond(NCSU)	December, 2001
	7. Continue N fertilization field trials on peach palm	Molina, Salas, Soto (UCR)	Ares (UH); Smyth, Wagger, Luna (NCSU); Reid (CU)	December, 2001
2. Mali - millet/cowpea production on acid, sandy Alfisols of the African Sahel	1. Complete core experiment to acquire cowpea and millet yield response and interactions among N, P and lime rates.	Hossner (TAMU)	Juo, Hons (TAMU); Doumbia, Coulibaly, Kouyate, Sidibe (IER); Israel (NCSU)	February 2001
	2. Continue on-farm trials to develop yield and nutrient input-output budgets for millet fields, and evaluate compost efficiency and nutrient composition.	Hossner (TAMU); Doumbia (IER)	Juo, Hons (TAMU); (IER); Osmond (NCSU)	February 2001
	3. Complete mid-term impact assessment survey report*	Smith (NCSU)	Doumbia (IER); Hossner (TAMU)	March 2000
	4. Continue on-farm evaluations of NuMaSS soil nutrient diagnosis and recommendations	Doumbia (IER)	Hossner (TAMU); Reid (CU); Smyth (NCSU); Yost (UH)	September 2001
	5. Continue on-farm and on-station trials on predicting placement and use of organo-mineral fertilizers	Doumbia (IER)	Kablan, Yost (UH); Hossner (TAMU)	September 2001

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Philippines - upland rice, peanut, soybean, corn production on Ultisol/Oxisol associations in an ustic moisture regime	1. Continue core experiment to acquire crop yield response and interactions among N, P and lime rates.	Yost (UH)	Corton (PhilRice); George (IRRI); Hue (UH)	February 2001
	2. Continue on-farm testing of module and integrated module diagnoses and predictions, estimates of nutrient balance	George (IRRI)	Corton (PhilRice)	September 2001

* Completion of task initiated with prior year funding; not included in year 4 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	30,000
Supplies	8,500
Equipment	4,000
Travel	22,000
Domestic	0
International	22,000
Other Direct Costs	97,508
Total	162,008

Equipment:
Computer for PhilRice - $2500 (UH)
Balance for PhilRice - $1500 (UH)

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
N. V. Hue	Philippines, August 2000	2500
R. Kablan	Senegal and Mali, October 2000	4000
T. Corton	Hawaii, January 2001	2500
J. Bajita	Hawaii - Philippines, May-Aug 2000	2500
T. George	Hawaii, January 2001	2500
L. Hossner	Mali, May 2000	4000
F. Hons	Mali, July-Aug 2000	4000

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Complete field experiment to characterize peach palm response to P	Molina, Alvarado (UCR)	Ares, Yost (UH)	December 2001
	2. Complete on-farm trials to evaluate NuMaSS software components for peach palm	Alvarado, Soto, Molina (UCR)	Ares, Hue, Yost (UH); Smyth, Osmond (NCSU)	December 2001
	3. Complete N fertilization field trial on peach palm	Molina, Salas, Soto (UCR)	Ares (UH); Smyth, Wagger, Luna (NCSU); Reid (CU)	December 2001
	4. Final impact survey; progress assessed by comparison with baseline and mid-term surveys	Smith (NCSU); Alvarado (UCR)	Soto, Molina, Uribe, Salas (UCR); Smyth (NCSU)	February 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Mali - millet/cowpea production on acid, sandy Alfisols of the African Sahel	1. Complete on-farm trials to develop yield and nutrient input-output budgets for millet fields, and evaluate compost efficiency and nutrient composition	Hossner (TAMU); Doumbia (IER)	Juo, Hons (TAMU); Osmond (NCSU)	June 2001
	2. Complete on-farm evaluations of NuMaSS soil nutrient diagnosis and recommendations	Doumbia (IER)	Hossner (TAMU); Reid (CU); Smyth (NCSU); Yost (UH)	September 2001
	3. Complete on-farm and on-station trials on predicting placement and use of organo-mineral fertilizers	Doumbia (IER)	Kablan, Yost (UH); Hossner (TAMU)	September 2001
	4. Final impact survey; progress assessed by comparison with baseline and mid-term surveys	Smith (NCSU); Hossner (TAMU); Doumbia (IER)	Coulibaly, Kouyate (IER); Hons (TAMU); Smyth (NCSU)	February 2002
3. Philippines - upland rice, peanut, soybean, corn production on Ultisol/Oxisol associations in an ustic moisture regime	1. Complete core experiment to acquire crop yield response and interactions among N, P and lime rates.	Yost (UH)	Corton (PhilRice); George (IRRI); Hue (UH)	June 2001
	2. Continue on-farm testing of module and integrated module diagnoses and predictions, estimates of nutrient balance	George (IRRI)	Corton (PhilRice)	September 2001
	3. Final impact survey; progress assessed by comparison with baseline and mid-term surveys	Friday (UH); Corton (PhilRice); George (IRRI)	Smith (NCSU); Yost (UH)	February 2002

PROJECT YEAR 4 - February 11, 2000 to February 10, 2001

Objective 2: Improve the diagnosis and recommendations for acidity and nutrient problems by identifying and resolving knowledge gaps through extensive literature reviews and, when necessary, developmental research.

Baseline: Acidity - in collaboration with IITA, Ca and Mg movement was monitored in an experiment in Oxic Paleustalfs following installation of treatments comparing different combinations of N fertilizers (urea and ammonium sulfate) and *Alchornea* prunings. Soil samples were taken from incremental depths to 30 cm to evaluate soil acidification, Ca and Mg movement. Soils will be analyzed at Texas A&M University and combined with field data for a comprehensive report. Soil data sets for the surface layers were also collected and assembled for two former experiments that monitored soil acidity, and Ca and Mg movement over 10- and 14-year cropping periods. One experiment on Kandiudults contained five lime rates with three replications. The other experiment on Kandiustalfs compared three different cropping rotations and residue management for corn. These data will be evaluated for the purpose of predicting long-term residual lime and soil acidification during continuous cropping. Two experiment comparing Ca sources and rates in two soils of the toposequence at Cinzana, Mali were completed after the second millet crop in year 3. Soil and plant tissue samples are currently being analyzed. A final report is expected next year on this experiment. Laboratory and greenhouse work continued at Hawaii and in Costa Rica to investigate diagnosis and recommendations for Ca/Mg deficiencies, Mn toxicity and lime equivalence of organic inputs. Surface applications of lime-compost mixtures promoted Ca movement in soil columns with a Kandiudult when compared to the movement when lime is applied alone; however greater Ca movement was obtained with applications of equivalent amounts of Ca as gypsum. Apparently, the sulfate ion pair in gypsum was more effective than organic anions in sustaining Ca in solution. Movement of lime-derived Ca in a Costa Rican Hapludand was also enhanced when surface applied in combination with peach palm residues. A comparison of 16 organic acids commonly found in plant materials revealed that revealed that those with two OH functional groups in the ortho position were most effective in dissolving Mn from a Wahiawa Oxisol. Additions of fresh cowpea and peach palm residues reduced soybean growth in pots. Soybean growth reduction was attributed to increased Mn dissolution in the Oxisol resulting from chelation by organic substance released by the plant residues. In the core experiment at Ilagan, Philippines applications of green manures without lime also increase Mn solubility in the Ultisols and plant uptake of Mn in crops. Members of the acidity group continue to monitor treatments for lime, Ca and Mg movement, and organic inputs in core experiments at Mali and Philippines. Our continued search for pertinent literature enabled the establishment of critical % Al saturation and yield response curves to liming for 10 corn and 7 soybean cultivars in 15 published field trials on Inceptisols, Oxisols and Ultisols in Africa, Asia and Latin America. Inclusion of these data in NuMaSS will increase user default options among crop cultivars and improve the prediction of conditions where liming would be economically feasible.

Nitrogen - a review of N fertilization trials with corn throughout South America has established default mean values and suggested ranges for various coefficients used in estimating crop N recommendations in NuMaSS. Their addition to the next version of NuMaSS will provide users with suggested values for crop N accumulation, native soil N supply, legume cover crop N supply and fertilizer N efficiency for different crops and regions within South America. Similar data sets are being collected for Africa and Asia for subsequent evaluation and synthesis using the same protocol developed with data in South America. The N team continues to assist in core experiments and on-farm trials at the intensive testing sites. They helped avoid delays in continuation or starting of existing trials by working with collaborators to define fertilizer N recommendations prior to the release of NuMaSS 1.0. Evaluations of biological N_2 fixation for cowpea in Mali indicated that native *Bradyrhizobium* populations were equally effective to the introduction of competitive isolates from Zimbabwe. Soil P availability had a greater impact on the symbiotic system than soil acidity in the Cinzana Alfisols. Native soil N contributions for peanut in Ultisols at Ilagan, Philippines was estimated via a non-nodulating soybean genotype. Field and laboratory work on long-term experiments to evaluate effects of crop residue management, rotations and green manures on soil/plant N dynamics in two soils at Cinzana, Mali was completed this year. A final report will be provided during the coming year.

Phosphorus - successful diagnosis of soil P conditions and, when needed, fertilizer P recommendations depend on good estimates of critical soil P levels for the targeted crops and the soil's P buffer coefficient. The latter is defined as the change in soil available P per unit of applied fertilizer P; the existing data for field based estimates of this variable is very limited throughout the world. On the basis of data that is available an algorithm was developed in NuMaSS to predict soil P buffer coefficients and critical levels when they are not locally available. Based on user feedback and testing in core experiments and on-farm trials, this algorithm was refined during year 3 to eliminate some discontinuous results encountered in predictions for soils within a certain range of clay content. Concurrently the P team has been evaluating short-term laboratory P incubation techniques as alternative approaches to estimating P buffer coefficients in the absence of local field data. Results from laboratory studies on soils from Mali and Niger show good correlations with predicted values from NuMaSS. Similar laboratory studies on soils in Central America suggest that other soil variables may serve as corollary measures in Andisols. Similar evaluations are ongoing in collaboration with IRRI for soils in Asia. The P team continues to assist collaborators with monitoring and adjusting P treatments for the various crops in core experiments at the intensive testing sites in Costa Rica, Mali and Philippines. Collaboration with investigators in the Brazilian Amazon has expanded the peach palm information base to acid, P deficient Oxisols and provided clearer indications of diagnostic criteria to be used in this crop to assess internal status of both P and other nutrients. Studies were initiated during year 3 to assess the potential for supplementing existing organic fertilization practices in the Sahel with commercial P fertilizers. Results for these experiments are forthcoming during the next year.

Output 1: Enhancing the knowledge base for the acidity module of NuMaSS

Description: Collecting, developing and synthesizing soil, plant and management information to improve the diagnosis and recommendations of location-specific problems related to the soil acidity syndrome.

Participants and estimated completion dates for suboutputs and activities acidity in year 4.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Evaluate Ca and Mg movement in acid, sandy Sahelian soils as influenced by source and rate	1. Complete monitoring Ca and Mg movement from applied lime and gypsum over time.*	Hossner (TAMU)	Coulibaly, Doumbia, Sidibe (IER); Juo, Hons (TAMU)	May, 2001
	2. In Mali core experiment, complete monitoring soil pH, soil and plant Ca & Mg concentration with time in treatments with lime rates and with/without fertilizer N and BNF; 2nd year of data.	Juo (TAMU)	Doumbia, Coulibaly, Kouyate, Sidibe (IER); Hossner (TAMU); Smyth (NCSU)	February 2001
	3. Summarize and report data.*	Hossner, Juo (TAMU)	Coulibaly, Doumbia, Sidibe (IER)	August 2000
2. Diagnostic criteria and recommendations for Ca & Mg deficiencies, excess Mn, and lime equivalence of organic inputs	1. Complete review and assembly of knowledge in the literature.*	Juo (TAMU), Hue (UH), Smyth (NCSU)	Bouldin (CU), Juo (TAMU), Coulibaly (IER), Salas (UCR), Corton (PhilRice)	February, 2001
	2. Continue lab, greenhouse & field studies of Al detoxification, lime equivalence, and Mn toxicity of organic inputs - includes monitoring selected treatments of core experiments in Costa Rica and Philippines, and on-farm trials in Mali	Hue (UH); Smyth (NCSU)	Bouldin (CU), Salas, Soto (UCR); Coulibaly, Sidibe (IER); Corton (PhilRice), Smyth (NCSU), Juo (TAMU)	February, 2002

* Completion of task initiated with prior year funding; not included in year 4 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	22,850
Supplies	4,000
Equipment	1,000
Travel	2,500
Domestic	1,000
International	1,500
Other Direct Costs	5,828
Total	36,178

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
L. Hossner	Honduras, Nicaragua, February 2000	1500

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Diagnostic criteria and recommendations for Ca & Mg deficiencies, excess Mn, and lime equivalence of organic inputs	Complete lab, greenhouse & field studies of Al detoxification, lime equivalence, and Mn toxicity of organic inputs - includes monitoring selected treatments of core experiments in Costa Rica and Philippines, and on-farm trials in Mali	Hue (UH); Smyth (NCSU)	Bouldin (CU), Salas, Soto (UCR); Coulibaly, Sidibe (IER); Corton (PhilRice), Smyth (NCSU), Juo (TAMU)	February 2002

Output 2: Enhancing the knowledge base for the nitrogen module in NuMaSS

Description: Collecting, developing and synthesizing soil, plant and management information to improve the diagnosis and recommendations of location-specific N problems.

Participants and estimated completion dates for suboutputs and activities on N in year 4.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Calibrating N coefficients	1. Continue updating coefficients and major crops to be considered by NuMaSS. Evaluate N predictions at various sites	Reid (CU)	Israel, Osmond, Luna (NCSU); Hons (TAMU); George (IRRI); Corton (PhilRice); Soto (UCR); Coulibaly, Doumbia (IER)	February 2002
	2. Update N transfer coefficients and N recommendations for crops to be grown in core experiments and cooperating farms at Mali and Philippines; evaluate N predictions for each site after each harvest	Reid (CU)	Osmond (NCSU), Hons (TAMU), George (IRRI), Corton (PhilRice), Coulibaly, Doumbia (IER)	February 2002
	3. Complete evaluation of N recycling in pruned peach palm litter in heart-of-palm plantations, Costa Rica.*	Wagger (NCSU)	Soto (UCR), Smyth, Luna (NCSU), Hue (UH)	June 2000
	4. Finalize report on yield response of cowpea and millet, N budgets, and compost efficiency in on-farm trials in Mali	Hons, Hossner (TAMU)	Juo, Blanton-Knewtson (TAMU); Coulibaly, Doumbia, Kouyate (IER)	August 2001
	6. Compute N recommendations for the lime, N and P trials in newly established and mature peach palm plantations, Costa Rica	Reid (CU)	Salas, Soto, Molina (UCR); Yost (UH); Wagger, Smyth (NCSU)	February 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. BNF estimates in core experiments at Mali and Philippines	1. Complete and report on field estimation of BNF cowpea (Mali) and soybean/peanut (Philippines) crops across various combinations of lime and fertilizer P 2. Finalize estimate of N carryover from cowpea (Mali) and peanut (Philippines) residues to succeeding non leguminous crops	Israel (NCSU), Juo (TAMU) in Mali; George (IRRI) in Philippines	Coulibaly, Kouyate, Sidibe (IER); Corton (PhilRice), Reid (CU), Wollum (NCSU), Hons (TAMU)	February 2001
	3. Summarize existing literature data on important legumes with respect to acidity, P and Rhizobia constraints	Israel, Luna (NCSU)	Reid (CU); Osmond, Wollum (NCSU); George (IRRI)	February 2002
3. Guidance for legume management	1. Complete assembly of information on legume N contributions to subsequent crops in terms of nutrient needs for legume growth, C constituents, plant age, soil conditions, and timing/method of incorporation 2. Add assembled information to NuMaSS Guidance module	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2002

* Completion of task initiated with prior year funding; not included in year 4 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	97,494
Supplies	2,248
Equipment	1,359
Travel	3,414
Domestic	1,914
International	1,500
Other Direct Costs	12,909
Total	117,424

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Shaw Reid	Costa Rica, May 2000	1500

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Calibrating N coefficients	1. Complete updating coefficients and major crops to be considered by NuMaSS. Evaluate N predictions at various sites	Reid (CU)	Israel, Osmond, Luna (NCSU); Hons (TAMU); George (IRRI); Corton (PhilRice); Soto (UCR); Coulibaly, Doumbia (IER)	February 2002
	2. Summarize and interpret peach palm response to N, compute N budgets in plantations, add information to NuMaSS		Salas, Soto, Molina (UCR); Yost (UH); Wagger, Smyth (NCSU)	
2. Prediction of BNF contributions	1. Summarize existing literature data on important legumes with respect to acidity, P and Rhizobia constraints 2. Incorporate information into NuMaSS	Israel, Luna (NCSU)	Reid (CU); Osmond, Wollum (NCSU); George (IRRI)	February 2002
3. Guidance for legume management	1. Complete assembly of information on legume N contributions to subsequent crops in terms of nutrient needs for legume growth, C constituents, plant age, soil conditions, and timing/method of incorporation 2. Add assembled information to NuMaSS Guidance module	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2002

Output 3: Enhancing the knowledge base for the phosphorus module in NuMaSS

Description: Collecting, developing and synthesizing soil, plant and management information to improve the diagnosis and recommendations of location-specific P problems

Participants and estimated completion dates for suboutputs and activities on P in year 4 of the project.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Rock phosphate	1. Develop a diagnostic protocol to identify soil/crop/climate/economic conditions in which rock phosphate is likely economic	Yost (UH)	Doumbia (IER); Sene (ISRA)	February 2002
	2. Test diagnostic criteria that identify soil/crop/climate/economic conditions in which rock phosphate is economic		Doumbia (IER), Sene (ISRA), George (IRRI), Corton (PhilRice)	February 2002
2. Tree crops	1. Summarize and report on field work on P diagnosis methods for mature peach palm plantations*	Yost, Ares (UH)	Molina (UCR)	December 2000
	2. Continue assistance with P component in on-farm evaluation of NuMaSS software for peach palm plantations.	Yost, Ares (UH)	Molina, Soto, Alvarado(UCR); Smyth (NCSU)	December 2001
	3. Complete greenhouse trial to evaluate P requirements for peach palm at the nursery phase*	Cox (NCSU); Molina, Salas (UCR)	Alvarado (UCR); Yost, Ares (UH)	February 2001
3. Refining coefficients	1. Complete and summarize short-term laboratory and greenhouse tests to improve methods for simulating field estimates of P buffer coefficients*	Cox (NCSU)	Molina, Alvarado (UCR); Yost (NCSU)	February 2001

* Completion of task initiated with prior year funding; not included in year 4 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	22,000
Supplies	8,155
Equipment	0
Travel	11,000
Domestic	2,000
International	9,000
Other Direct Costs	6,029
Total	47,184

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
R. Kablan	Mali & Senegal, April 2000	4500
R. Yost	Mali, Senegal & Togo, October 2000	4500

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Rock phosphate	1. Develop a diagnostic protocol to identify soil/crop/climate/economic conditions in which rock phosphate is likely economic	Yost (UH)	Doumbia (IER; Sene (ISRA)	February 2002
	2. Test diagnostic criteria that identify soil/crop/climate/economic conditions in which rock phosphate is economic		Doumbia (IER); Sene (ISRA); George (IRRI); Corton (PhilRice)	

PROJECT YEAR 4 - February 11, 2000 to February 10, 2001

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.

Baseline: In order to ensure that NuMaSS systems are user-friendly and have high user value, the software must be piloted under a variety of location-specific conditions. Evaluation is occurring via an extensive network of evaluators. This network includes (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 their specific conditions, and (c) established groups who would be interested and benefit from testing our products in their programs.

In addition to the NuMaSS software, complementary auxiliary tools are developed as we perceive their need among users. Examples of these are (a) spreadsheets for selecting among various sources of lime materials, and (b) a field nutrient input-output and balance estimator. We expect to develop other tools as users gain familiarity with NuMaSS and the need is perceived on how to expand its potential uses.

The initial version of the project's decision support software for diagnosing and correcting soil acidity, N and P constraints (NuMaSS version 1.0) was released in August 1999. Release of the software at the project's midterm was specifically intended to elicit user feedback. User evaluation and feedback on NuMaSS 1.0 was the central focus of a project workshop held on September 6-10 at the Philippine Rice Research Institute (PhilRice) in Maligaya. Both PhilRice and IRRI co-sponsored the workshop which was attended by 55 participants, including representatives from national agricultural research and extension services in Africa (Ethiopia, Gambia, Ghana, Mali, Senegal, South Africa, Tanzania and Zambia), Asia (Indonesia, Laos, Philippines and Vietnam) and Latin America (Bolivia, Brazil, Costa Rica, Ecuador and Venezuela). Participants endorsed continued development of NuMaSS and are willing to contribute by providing data and testing software performance within their regions. Since the workshop, U.S. team-members met to review workshop participant feedback and determined programmatic and technical refinements to be implemented in the next version of NuMaSS. The next release will contain significant modifications and a simplified user interface.

During the year several opportunities developed wherein NuMaSS software could be either tested with existing field and lab data sets or implemented into ongoing projects. Through contacts with collaborators at IFDC/CIMMYT and CIAT we learned of extensive data sets on P fertilization at multiple locations in Colombia. Russ Yost traveled to Cali, established protocols to compare NuMaSS predictions for fertilizer P with field data, initiated analyses and tests with the data, and identified further opportunities for collaborative evaluation of field results and testing of NuMaSS performance. Under invitation and sponsorship of an AID-funded project in Bolivia, Jot Smyth and Russ Yost visited the Chapare Region of Bolivia to assess existing soil nutrient management practices used by farmers who are adopting production of banana and peach palm as alternatives to their traditional coca fields.

Collaborators are interested in using NuMaSS to diagnose nutrient problems in farmer's fields and recommend lime and fertilizers. We assisted collaborators in designing field trials and ancillary laboratory analyses to develop region-specific coefficients needed by NuMaSS to provide fertilizer recommendations. Collaborators from Thailand have visited the University of Hawaii and requested our projects participation in refining nutrient management recommendations. Their data base included numerous field trials to validate crop simulation models, but soil nutrient data in these trials is rather limited. Travel to Thailand during the coming year most likely will lead to development of field and laboratory activities for local adaptation and testing of NuMaSS. We expect to continue these activities and pursue similar ones as opportunities evolve during the coming year.

Version 2.0 of NuMaSS is scheduled for release in October 2000. Thereafter we will request network members to evaluate the software and provide feedback to us for refinements of future versions. Having just completed a workshop last year, we believe that it would be more cost- and time-effective to gather feedback on the software via smaller regional group meetings within Africa, Asia and Latin America. Venues for these regional meetings have not yet been defined. Whenever possible they will be associated with U.S. team-member travels to provide technical backstopping of core experiments in Costa Rica, Mali and Philippines.

Output 1: Extensive evaluation network

Description: Evaluation of products and capturing knowledge under a variety of location-specific conditions.

Participants and estimated completion dates for suboutputs and activities for the extensive evaluation network during year 4.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Regional NuMaSS version 2 evaluation	1. Network member organizations identified in Africa, Asia and Latin America 2. Evaluation format developed. 3. NuMaSS evaluated, feedback elicited 4. Feedback analyzed/discussed and strategy for incorporation into NuMaSS is developed	Osmond (NCSU)	Reid (CU); Smith, Smyth (NCSU); Yost (CU); others as needed	February 2001
2. Data collection, planning and NuMaSS testing	1. Meet with collaborators 2. Plans developed 3. Initiate data collection	Yost (UH)	Corton (PhilRice); Kasetsart, Thailand; Rao (CIAT); Osmond, Smyth (NCSU); others as opportunities arise	February 2002

Budget:

OBJECT	AMOUNT IN US$
Personnel	37,406
Supplies	20,115
Equipment	70
Travel	66,868
Domestic	423
International	66,445
Other Direct Costs	153
Total	124,612

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
R. Yost	Philippines, Thailand & Laos, August 2000	3,500
A. Ares	Costa Rica & Brazil	4,000
Multiple, yet to be identified participants from U.S., Africa and L. America	Regional NuMaSS software evaluation meetings in Africa and Latin America, November 2000 - February 2001	58,945

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Final evaluation and release of NuMaSS	1. Evaluation format and meeting(s) venue(s) defined; financial resources available or sponsors identified 2. Network member organizations identified and invited 3. NuMaSS evaluated, feedback elicited 4. Feedback analyzed/discussed and strategy for incorporation into NuMaSS developed 5. Final release of NuMaSS	Osmond (NCSU)	Reid (CU); Smith, Smyth (NCSU); Yost (CU); others as needed	February 2002
2. Data collection, planning and NuMaSS testing	1. Meet with collaborators 2. Plans developed 3. Initiate data collection 4. Test NuMaSS performance with data 5. Summarize and report NuMaSS testing	Yost (UH)	Corton (PhilRice); Kasetsart, Thailand; Rao (CIAT); Osmond, Smyth (NCSU); others as opportunities arise	February 2002

Output 2: Auxiliary tools to complement NuMaSS software

Description: 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 are printed materials, spreadsheets, decision-making structures and map overlays.

Participants and estimated completion dates for suboutputs and activities for development of auxiliary tools for the NuMaSS software in year 4.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Lime Material and Cost Integrator*	1. Elicit feedback from users 2. Revise/modify if necessary 3. Continue disseminating	Yost (UH), Smyth (NCSU)	Smith (NCSU), George (IRRI), Hue (UH), Bouldin (CU), Juo (TAMU)	February 2002
2. Nutrient balance calculator*	1. Field-test calculator. 2. Elicit feedback from users 3. Incorporate feedback and revise if necessary	Osmond (NCSU)	Reid (CU), Smyth (NCSU), Yost (UH), others as needed	February 2002

* To be completed with funds from previous years. Thus, no budget, travel events, or equipment for this output.

Budget:

OBJECT	AMOUNT IN US$
Personnel	2,443
Supplies	46
Equipment	27
Travel	169
Domestic	169
International	0
Other Direct Costs	8,958
Total	11,643

International Travel:
None

PROJECT YEAR 5 - February 11, 2001 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Other tools	1. Identify need 2. Develop paper prototype 3. Review paper prototype 4. Program prototype 5. Evaluate with existing data sets 6. Revise if necessary 7. Field test 8. Elicit feedback from users 9. Revise if necessary 10. Continue disseminating and tracking feedback 11. Repeat sets 9 & 10 if necessary	Team members as needed	Team members as needed	February 2002