Workplans and Budget
Decision Aids for Integrated Soil Nutrient Management
March, 1998

PROJECT YEAR 2 - February 11, 1998 to February 10, 1999

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: Nutrient deficiencies rarely exist in isolation. Generally, nutrient deficient soils need amendments of more than one nutrient. In addition, fertilizer recommendations are based on a balanced soil nutrient plan. Currently, three individual decision support systems (DSS) exist for individual nutrient recommendations: one for nitrogen, one for phosphorus, and one for lime. Sound fertilizer recommendations, at a minimum, should include recommendations for nitrogen, lime, and phosphorus. To that end, the three individual decision support systems are being combined into an integrated nutrient management decision support system. The interface for this system has been designed and coded. The data table structure for the system has been determined. In addition the data tables for collecting information have also been determined and are currently under review.

Field testing and initial evaluation and refinement of the integrated DSS will be performed at locations representative of three agroecological zones selected during travels in year 1: a peach palm production area in the humid tropics of Costa Rica predominated by Andisols; a cowpea-millet production area of in semi-arid region of Mali predominated by acid, sandy Alfisols; and an upland rice production area in the wet-dry region of Philippines with Oxisols and Ultisols. These three intensive testing areas provide real life situations where all developmental research by the multi-disciplinary team of U.S. scientists will be conducted jointly with overseas collaborators. Field activities on baseline surveys of social and economic conditions, infrastructure, soil resources and nutrient management constraints were completed for the Costa Rica and Mali sites, and are nearing completion for the Philippine sites. During a 3-day workshop, overseas collaborators and U.S. scientists refined the project's 5-year plan to fit the particular nutrient problems of these sites. Field trials to acquire much needed nutrient interaction data between N, P and lime were designed for Mali and Philippine sites, based on workshop outcomes and in consultation with overseas collaborators. Trials for N, P and lime interactions will be delayed until next year at the Costa Rica site, allowing completion of investigations to collect information on peach palm nutrient accumulation at different stages of maturity, as well as soil acidity and P coefficients needed for diagnosis and prediction of lime and P requirements in these acid Andisols.

Output 1: Integrated Decision Support System (IntDSS) software

Description: Acidity (ADSS), nitrogen (NDSS) and phosphorus (PDSS) single-nutrient decision support system prototypes merged into an improved, fully functional integrated DSS that accounts for interactions between N, P and lime.

Participants and estimated completion dates for suboutputs and activities for IntDSS software development during project year 2.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Functioning prototype of the single-nutrient pathways in the IntDSS	1. Finish reprogramming ADSS* 2. Finish reprogramming PDSS* 3. Finish reprogramming NDSS* 4. Incorporate PDSS and NDSS into the IntDSS shell*	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	April 1998 June 1998 August 1998 October 1998

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Data bases constructed with some collected information.	1. Reformat existing data tables for new programming environment. 2. Input collected information. 3. Continue incorporating agronomic and soils data for all crops based on input from Objective 2. 4. Continue incorporating country-available data from collaborators and cooperators. 5. Reformat latest U.S. soil taxonomy information for incorporation into the data tables. 6. Develop code that translates older versions of U.S. soil taxonomy into the latest U.S. soil taxonomy. 7. Collect georeferenced information when available and incorporate into data tables. 8. Collect and incorporate pictures of plant nutrient deficiency symptoms.	Osmond (NCSU)	Entire team	February 1999

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Initial prototype of Nutrient Management Guidance module	1. Research of optimization routines to be used in the integration. 2. Selection of optimization routines used in the integration. 3. Program optimization tools within the nutrient management guidance. 4. Begin testing outputs from the optimization routines against available data.	Osmond (NCSU)	Yost (UH) Reid (CU) Smyth (NCSU)	February 1999
4. Intermediate release of the initial prototype of the Integrated Nutrient Management Decision Support System	1. Combine the diagnostic, prediction and nutrient management guidance modules. 2. Release initial prototype of IntDSS. 3. Provide users manual. 4. Produce CDS. 5. Begin IntDSS evaluation with extensive evaluation network (*see Objective 3, output 1*).	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 1999

* Completion of task initiated in Year 1; not included in Year 2 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	71,361
Supplies	429
Equipment	500
Travel	4,340
Domestic	4,340
International	0
Other Direct Costs	30,111
Total	106,741

International Travel Events:

None; all travel events are domestic for purposes of interaction between individuals involved in IntDSS programming efforts at Cornell, Hawaii and N.C. State universities.

Equipment:

Batteries for laptop computer; commercial software

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1 Intermediate release of IntDSS	Continue activities from year 2: - refine algorithms - add additional data	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2000
2. Environmental concerns	1. Gather data on N and P effects on the environment 2. Write up units on agricultural effects on environmental	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2000

PROJECT YEARS 4 and 5 - February 11, 2000 to February 10, 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Final Release	Continue activities from year 3: - refine algorithms - add additional data	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2002
2. Environmental Concerns	1. Incorporate environmental affects into IntDSS 2. Write up units on agricultural affects on environment	Osmond (NCSU)	Reid (CU) Smyth (NCSU) Yost (UH)	February 2002
3. Predicting residual nutrient value	1. Develop algorithms that account for residual nutrient content accounting for economic value. 2. Incorporate algorithms into IntDSS. 3. Validate the algorithms.	Reid (CU)	Osmond, Smyth (NCSU); Yost (UH)	February 2002

Output 2: Field evaluation and refinement of IntDSS software

Description: Testing IntDSS 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 IntDSS software.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Completion of data interpretation and baseline survey report.*	Smith (NCSU)	Alvarado (UCR)	April 1998
	2. Determination of aboveground biomass, nutrient accumulation, and recycling in heart-of-palm plantations at nursery, 0.5, 1, 2, 3 and 4 and 10 years after establishment.	Molina (UCR)	Hue (UH); Smyth, Wagger (NCSU)	December 1998
	3. Greenhouse assessment of H and Al rhizotoxicity, and Ca/Mg requirements for peach palm root growth in Ultisols and Andisols.	Salas (UCR)	Hue (UH), Smyth (NCSU)	January 1999
	4. Field trial on effect of pruned litter from heart-of-palm plantations on soil chemical properties and nutrient availability in Andisols.	Soto (UCR)	Hue (UH), Wagger (NCSU)	December 2001

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Mali - millet/cowpea production on acid, sandy Alfisols of the African Sahel	1. Completion of data interpretation and baseline survey report.*	Smith (NCSU)	Coulibaly, Doumbia (IER); Hons, Hossner (TAMU);	May 1998
	2. Initiate core experiment to acquire cowpea and millet yield response and interactions among N, P and lime rates.	Hons (TAMU)	Juo, Hossner, Blanton-Knewtson (TAMU); Doumbia, Coulibaly, Kouyate (IER); Israel (NCSU)	February 2001
	3. Initiate on-farm trials to develop yield and nutrient input-output budgets for millet fields, and evaluate compost efficiency and nutrient composition.	Hossner (TAMU)	Juo, Hons (TAMU); Doumbia (IER); Osmond (NCSU)	February 2001
3. Philippines - upland rice, peanut, soybean, corn production on Ultisol/Oxisol associations in an ustic moisture regime	1. Completion of baseline survey, data interpretation and survey report.*	Yost (UH)	Corton (PhilRice); George (IRRI)	February 2001
	2. Initiate core experiment to test individual module predictions of nutrient requirements and to develop supporting data to estimate interactions among N, P and lime rates.	Corton (PhilRice)	George (IRRI)	
	3. Initiate on-farm experiments to test diagnostic predictions and to compare decision-aid predictions of nutrient requirements.	George (IRRI)	Corton (PhilRice)	

* Completion of task initiated in Year 1; not included in Year 2 funding request.

Budget:

OBJECT	AMOUNT IN US$
Personnel	57,098
Supplies	9,536
Equipment	9,740
Travel	8,439
Domestic	4,689
International	3,750
Other Direct Costs	115,801
Total	200,614

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Yost (UH)	Mali	3750

(*all other travel in support of this output comes from individual activities at intensive testing sites as described under objective 2*)

Equipment:
Costa Rica - Pentium desktop computer, digital camera, field scales - 50 kg capacity, force-air drying oven.

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Continue studies on effects of pruned litter from heart-of-palm plantations on soil chemical properties and nutrient availability in Andisols.	Soto (UCR)	Hue (UH), Wagger (NCSU)	December 2001
	2. Mid-term impact assessment survey of intensive testing site; progress assessed by comparison with baseline survey.	Smith (NCSU)	Alvarado (UCR)	February, 2000
	3. Initiate lime, N and P trials in newly established and mature peach palm plantations.	Alvarado (UCR)	Salas, Soto, Molina (UCR); Hue, Yost (UH); Wagger, 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. Continue core experiment to acquire cowpea and millet yield response and interactions among N, P and lime rates.	Hons (TAMU)	Juo, Hossner, Blanton-Knewtson (TAMU); Doumbia, Coulibaly, Kouyate (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)	Juo, Hons (TAMU); Doumbia (IER); Osmond (NCSU)	February 2001
	3. Mid-term impact assessment survey of intensive testing site; progress assessed by comparison with baseline survey.	Smith (NCSU)	Coulibaly, Doumbia (IER); Hons, Hossner (TAMU);	February 2000
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)	February 2001
	2. Continue on-farm testing of module and integrated module diagnoses and predictions, estimates of nutrient balance	George (IRRI)	Corton (PhilRice)	
	3. Mid-term impact assessment survey of intensive testing site; progress assessed by comparison with baseline survey.			

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Complete studies on effects of pruned litter from heart-of-palm plantations on soil chemical properties and nutrient availability in Andisols.	Soto (UCR)	Hue (UH), Wagger (NCSU)	December 2001
	2. Continue lime, N and P trials in newly established and mature peach palm plantations.	Alvarado (UCR)	Salas, Soto, Molina (UCR); Hue, Yost (UH); Wagger, Smyth (NCSU),	February, 2002
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.	Hons (TAMU)	Juo, Hossner, Blanton-Knewtson (TAMU); Doumbia, Coulibaly, Kouyate (IER); Israel (NCSU)	February 2001
	2. Complete on-farm trials to develop yield and nutrient input-output budgets for millet fields, and evaluate compost efficiency and nutrient composition.	Hossner (TAMU)	Juo, Hons (TAMU); Doumbia (IER); Osmond (NCSU)	February 2000

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. Complete core experiment to acquire crop yield response and interactions among N, P and lime rates.	Yost (UH)	Corton (PhilRice); George (IRRI)	February 2001
	2. Complete on-farm trials to test diagnosis and predictive capability of individual modules and the integrated system	George (IRRI)	Corton (PhilRice)	February 2001

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 lime, N and P trials in newly established and mature peach palm plantations.	Alvarado (UCR)	Salas, Soto, Molina (UCR); Hue, Yost (UH); Wagger, Smyth (NCSU)	February 2002
	2. Final impact assessment survey of intensive testing site; progress assessed by comparison with baseline and mid-term survey.	Smith (NCSU)	Alvarado (UCR)	February 2002
2. Mali - millet/cowpea production on acid, sandy Alfisols of the African Sahel	1. Final impact assessment survey of intensive testing site; progress assessed by comparison with baseline and mid-term survey.	Smith (NCSU)	Coulibaly, Doumbia (IER); Hons, Hossner (TAMU);	February 2002
3. Philippines - upland rice, peanut, soybean, corn production on Ultisol/Oxisol associations in an ustic moisture regime	1. Final impact assessment survey of intensive testing site; progress assessed by comparison with baseline and mid-term survey.	Yost (UH)	Corton (PhilRice), George (IRRI)	February 2002

PROJECT YEAR 2 - February 11, 1998 to February 10, 1999

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 - two activities began in year 1 to improve the diagnosis and recommendations related to Ca and Mg movement into acid subsoils. One activity focuses on development of relations between exchangeable cations and soil solution cation composition from existing data sets for soils in the tropics. A second activity focused on modifications of protocol and installation of field lysimeters to an ongoing field trial in Cinzana, Mali to begin assembling data sets on Ca and Mg movement in an acid Alfisols. There are no such data sets available in soils of the African Sahel. Both of these activities are scheduled for completion during the coming year. New activities, spanning years 2 and 3, will be initiated to improve diagnostic criteria and management recommendations for Ca and Mg deficiencies, excess Mn, and lime equivalence of organic inputs. Team-members working on acidity will also participate in the monitoring and interpretation of lime treatments in field trials at the intensive testing sites (see Output 2 of Objective 1).

Nitrogen - Diagnosis and recommendations for N are based on N content of the above ground dry matter produced for the targeted crop yield. Fertilizer N requirements are based on the differences between total above ground N needs and the N supplied by the soil, manures and atmosphere. Unlike acidity and P, there is no single measure of soil N that allows an evaluation of N source efficiencies and mineralization transfer coefficients among soils and climates. Coefficients must be derived for a variety of soil, crop and climate conditions using existing information whenever possible. Given the size of this task, acquisition and refinement of coefficients will be an ongoing process throughout the entire project. Transfer coefficients for biologically fixed N need to be characterized in terms of a variety of factors: legume source and its nutrient requirements, innoculant availability, C constituents, plant age, soil conditions, and timing and method of incorporation. Nitrogen losses usually reduce plant N supplied from mineralization of organic sources. Most of the variability in NDSS predictions of crop N needs is associated with N losses. Nitrogen losses need to be either incorporated into the transfer coefficients or predicted separately. Literature reviews have been started to determine N transfer coefficients on several of the grain crops grown in the intensive testing areas. There is no fertilization data on heart-of-palm in the conventional literature. Considerable literature is available on flooded rice, but less on upland rice. Few of the data sets for millet have all the information necessary for a complete computation of N coefficients. These preliminary searches provide a starting point and adjusts expectations for the continued search of data sets that will permit computation of the various N coefficients. It also strengthens the need for searches of ‘grey’ literature through personal contacts with overseas collaborators.

Investigations will begin this year to compute N losses from data available in the literature and from core experiments at the intensive testing sites. This entails determining how to apply N loss information across climates and soils without requiring excessive user inputs. Team-members working on N will also participate in monitoring and evaluating results from selected treatments in core experiments at Costa Rica, Mali and Philippines (see Output 2 of Objective 1).

Phosphorus - Peach palm has been selected as an example of a tree crop of the Neotropics that has been developed into a viable, thriving commercial industry in humid tropic conditions. This is, we believe, an example that might be emulated by an extremely large number of perennial species in the future utilization of soils and environments that cannot be economically optimized for annual food crop production in the Tropics. A great deal of work has been completed so far and there are experiments in place for the last 20 years that provide a powerful information base for this work. The diagnosis and recommendation of nutrient deficiencies and excesses in this system suffer from the constraints of diagnosis and recommendation concepts and methods that have been used in annual crops, i.e. the critical level, soil based nutrient assessment, and soil reactivity model as described in PDSS, 1992. While this approach appears to be useful for detecting and resolving nutrient deficiencies and excesses during the juvenile phase, it does not do so during the mature phase. Reasons for this failure appear to be linked with the differing pools of nutrient that are required to supply the growth requirements of new tissue – in mature plants sometimes the majority of the nutrient required for new growth is recycled rather than being re-absorbed as in the case with annual crops.

Estimates of precision with which diagnoses and predictions of nutrient phosphorus requirement indicate disappointingly low precision. Sources of that variation appear to be in both the buffer coefficient and in the critical level as estimated from field studies. Recent work has suggested that additional characterization of soil properties holds promise to improve the precision with which P buffer coefficients are estimated, but there are few if any field verifications of this increased precision. In addition, there have been relatively few attempts to predict variation in field-based estimates of crop critical levels, in fact, there are relatively few studies that quantify variation in field-based critical levels (Cox, 1995).

The estimation of nutrient P requirements also suffers from imprecision when data are not available to predict coefficients necessary to estimate P requirement. In such cases, a method of rapidly estimating P buffer coefficients is needed to estimate nutrient P requirements.

Rock phosphate is being mentioned and described as one of the factors that will replenish the fertility of Africa, yet there have been numerous studies indicating that it is not economically competitive with soluble P materials. The literature on this subject needs to be synthesized into a diagnostic tool that will indicate the

soil/crop/climate combinations under which the application of rock phosphate will likely be economically competitive with soluble materials.

Output 1: Enhancing the knowledge base for the acidity decision support system

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 for ADSS development in year 2.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Developing prediction parameters for Ca & Mg movement into acid subsoils	Acquisition of more data sets from literature and collaborators; analysis, calculation and interpretation of data sets via a matrix of soil properties, rainfall, and nutrient inputs/outputs.	Bouldin (CU)	Hue (UH), Juo (TAMU), Smyth (NCSU), R. Salas (UCR)	February 1999
2. Evaluate Ca and Mg movement in acid, sandy Sahelian soils as influenced by source and rate	In Mali core experiment, monitor soil pH, soil and plant Ca & Mg concentration with time in treatments with lime rates and with/without fertilizer N and BNF.	Juo (TAMU)	Doumbia, Coulibaly, Kouyate, Sidibe (IER); Hossner (TAMU); Smyth (NCSU)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Diagnostic criteria and recommendations for Ca & Mg deficiencies, excess Mn, and lime equivalence of organic inputs	1. Review and assembly of knowledge in the literature and unpublished information through personal contacts.	Hue (UH), Smyth (NCSU)	Bouldin (CU), Juo (TAMU), Coulibaly (IER), Salas (UCR), Corton (PhilRice)	February, 2001
	2. Initiate lab, greenhouse & field studies on 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), Juo (TAMU)	February, 2002
	3. Estimates of tree growth and acid soil conditions suitable for leguminous tree establishment in humid & dry forest regions of Costa Rica	Juo (TAMU)	Gonzalez (OTS), Hossner, Wesch (TAMU)	April 1999

Budget:

OBJECT	AMOUNT IN US$
Personnel	84,114
Supplies	11,444
Equipment	2,926
Travel	21,147
Domestic	4,412
International	16,735
Other Direct Costs	6,686
Total	126,317

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Hue (UH)	Costa Rica	2,700
Smyth (NCSU)	Costa Rica	2,300
Hue (UH)	Philippines	3,800
Smyth (NCSU)	South Africa/Australia	4,500
Smyth (NCSU)	Brazil/Bolivia	3000

Equipment:

Desktop computer

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Evaluate Ca and Mg movement in acid, sandy Sahelian soils as influenced by source and rate	1. Monitor 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, monitor 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 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

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Evaluate Ca and Mg movement in acid, sandy Sahelian soils as influenced by source and rate	1. Final year of data on Ca and Mg movement from applied lime and gypsum collected and summarized.	Hossner (TAMU)	Coulibaly, Doumbia, Sidibe (IER); Juo, Hons (TAMU)	May, 2001
2. Diagnostic criteria and recommendations for Ca & Mg deficiencies, excess Mn and lime equivalence of organic inputs	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)	May, 2002

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	1. 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 decision support system

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 for NDSS development in year 2.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Calibrating N coefficients	1. Continue reviewing literature for data sets to compute N transfer coefficients especially for grain crops	Reid (CU)	Israel, Osmond, Wagger, Wollum (NCSU); Hons (TAMU)	February 2000
	2. Review literature for data sets to compute the N coefficients for contributions of leguminous crops in rotations prior to non leguminous crops as influence by P and lime	Israel (NCSU)	Osmond, Wagger, Wollum (NCSU); Hons (TAMU), Reid (CU)	February 2000
	3. Compute N transfer coefficients and N recommendations for crops to be grown in core experiments at Mali and Philippines	Reid (CU)	Hons (TAMU), George (IRRI), Corton (PhilRice), Coulibaly, Doumbia (IER), Osmond (NCSU)	Before planting season
	4. Design protocol and begin evaluation of N recycling in pruned peach palm litter in heart-of-palm plantations, Costa Rica	Wagger (NCSU)	Soto (UCR), Smyth (NCSU), Hue (UH)	December 2001
	5. Monitor yield response of cowpea and millet, compute N budgets, compute compost efficiency in on-farm trials in Mali	Hons, Hossner (TAMU)	Juo, Blanton-Knewtson (TAMU); Coulibaly, Doumbia, Kouyate (IER)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Predicting N losses	1. Evaluate data sets from literature, testing site experiments and cooperating farms to compute N loss information and the conditions for considering such a loss in NDSS	Reid (CU)	Osmond, Wagger, Wollum (NCSU); Hons (TAMU),	February 2000
	2. Compare literature estimates of N loss with estimates from field sites of legume/rice cropping systems in southeast Asia and Philippines	George (IRRI)	Wollum (NCSU), Reid (CU)	February 2000
	3. Initiate review of literature, especially grey, for information on N losses and relate to environmental conditions causing losses	Israel (NCSU)	Osmond, Smyth, Wagger, Wollum (NCSU), Reid (CU)	February 2000
	4. Add improved N loss prediction to NDSS and test using literature and field data, especially data from testing sites	Reid (CU)	Israel, Osmond, Smyth, Wagger, Wollum (NCSU), Hons (TAMU), George (IRRI)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. BNF estimates in core experiments at Mali and Philippines	1. Develop standardized protocol for field estimation of BNF to be used with cowpea, peanut and soybean	Reid (CU)	George (IRRI), Israel, Wollum (NCSU); Hons (TAMU)	Before planting season
	2. Perform field estimation of BNF on cowpea (Mali) and peanut (Philippines) across various combinations of lime and fertilizer P	Israel (NCSU), Juo (TAMU) in Mali; George (IRRI) in Philippines	Coulibaly, Kouyate, Sidibe (IER); Corton (PhilRice), Reid (CU), Wollum (NCSU), Hons (TAMU)	February 2001

Budget:

OBJECT	AMOUNT IN US$
Personnel	75,079
Supplies	1,936
Equipment	3,368
Travel	8,216
Domestic	3,216
International	5,000
Other Direct Costs	1,525
Total	90,124

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Israel (NCSU)	Mali	3,000
Wagger (NCSU)	Costa Rica	2,000

Equipment:
Desktop computer - $3,368

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Calibrating N coefficients	1. Continue reviewing literature for data sets to computer N transfer coefficients, especially for grain crops	Reid (CU)	Israel, Osmond, Wagger, Wollum (NCSU)	February 2000
	2. Continue reviewing literature for data sets to compute the N coefficients for contributions of leguminous crops in rotations prior to non leguminous crops as influence by P and lime	Israel (NCSU)	Osmond, Wagger, Wollum (NCSU); Reid (CU), George (IRRI)	February 2000
	3. Update N transfer coefficients and N recommendations for crops to be grown in core experiments and cooperating farms at Mali and Philippines; evaluate NDSS predictions for each site after each harvest	Reid (CU)	Osmond (NCSU), Hons (TAMU), George (IRRI), Corton (PhilRice), Coulibaly, Doumbia (IER)	February 2002
	4. Continue evaluation of N recycling in pruned peach palm litter in heart-of-palm plantations, Costa Rica	Wagger (NCSU)	Soto (UCR), Smyth (NCSU), Hue (UH)	December 2001
	5. Monitor yield response of cowpea and millet, compute N budgets, compute compost efficiency in on-farm trials in Mali	Hons, Hossner (TAMU)	Juo, Blanton-Knewtson (TAMU); Coulibaly, Doumbia, Kouyate (IER)	February 2000
	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. Predicting N losses	1. Complete evaluation of data sets from literature, testing site experiments and cooperating farms to compute N loss information and the conditions for considering such a loss in NDSS	Reid (CU)	Osmond, Wagger, Wollum (NCSU); Hons (TAMU)	February 2000
	2. Complete comparisons of literature estimates of N loss with estimates from field sites of legume/rice cropping systems in southeast Asia and Philippines	George (IRRI)	Wollum (NCSU), Reid (CU)	February 2000
	3. Complete literature review, especially grey, for information on N losses and relate to environmental conditions causing losses	Israel (NCSU)	Osmond, Smyth, Wagger, Wollum (NCSU), Reid (CU)	February 2000
	4. Add improved N loss prediction to NDSS; test using accumulated literature and field data, especially data from core experiments at test sites	Reid (CU)	Israel, Osmond, Smyth, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. BNF estimates in core experiments at Mali and Philippines	1. Perform field estimation of BNF on year 2 cowpea (Mali) and soybean (Philippines) crops across various combinations of lime and fertilizer P 2. Estimate N carryover from cowpea (Mali) and peanut (Philippines) residues in year 1 crops to succeeding non leguminous crops in year 2	Israel (NCSU), Juo (TAMU) in Mali; George (IRRI) in Philippines	Coulibaly, Kouyate, Sidibe (IER); Corton (PhilRice), Reid (CU), Wollum (NCSU), Hons (TAMU)	February 2001
4. Guidance for legume management	1. Begin assembling 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	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2002

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Calibrating N coefficients	1. Continue updating coefficients and major crops to be considered by IntDSS. Evaluate NDSS predictions of N needs at various sites	Reid (CU)	Osmond (NCSU), Hons (TAMU), George (IRRI), Corton (PhilRice), Salas, Alvarado (UCR); Coulibaly, Doumbia (IER)	February 2002
	2. Complete evaluation of N recycling in pruned peach palm litter in heart-of-palm plantations, Costa Rica; summarize/interpret; add to NDSS	Wagger (NCSU)	Soto (UCR), Smyth (NCSU), Hue (UH)	December 2001
	3. Monitor yield response of peach palm to N and compute N budgets in newly established and mature plantations - Costa Rica	Reid (CU)	Salas, Soto, Molina (UCR); Hue, Yost (UH); Wagger, Smyth (NCSU)	December 2002
2. 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 IntDSS Guidance module	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Predicting BNF contributions	1. Summarize existing literature data on important legumes with respect to acidity, P and Rhizobia constraints 2. Complete interpretation of Mali and Philippines data on BNF and legume N carry over to succeeding non legume crops under variable P and lime	Reid (CU)	Israel, Osmond, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI), Corton (PhilRice), Doumbia (IER)	February 2002

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Calibrating N coefficients	1. Complete updating coefficients and major crops to be considered by IntDSS. Evaluate NDSS predictions of N needs at various sites	Reid (CU)	Osmond (NCSU), Hons (TAMU), George (IRRI), Corton (PhilRice), Salas, Alvarado (UCR); Coulibaly, Doumbia (IER)	February 2002
	2. Summarize and interpret yield response of peach palm to N and compute N budgets in newly established and mature plantations - Costa Rica; add information to NDSS	Reid (CU)	Salas, Soto, Molina (UCR); Hue, Yost (UH); Wagger, Smyth (NCSU)	February 2002
2. Guidance for legume management	Evaluate NDSS legume management guidance at intensive testing sites and among other collaborators; adjust if necessary.	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI), Corton (PhilRice), Soto (UCR), Doumbia, Kouyate (IER)	February 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Predicting BNF contributions	1. Add prediction algorithms to NDSS 2. Evaluate predictions at intensive testing sites and among other collaborators; adjust if necessary.	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI),Corton (PhilRice), Soto (UCR), Doumbia, Kouyate (IER)	February 2002

Output 3: Enhancing the knowledge base for the phosphorus decision support system
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 for PDSS development in year 2 of the project.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Tree crops	1. Improve or develop plant and soil diagnostic criteria for deficient and excessive nutrient levels in perennial crops and associated soils from field trials, literature and collaborators experience	Yost (UH)	Alvarado, Salas (UCR), Fownes (UH)	February 2000
	2. Conduct field studies on the response of peach palm to P additions on selected soils and stages of maturity			February 2000
	3. Collect diagnostic data at the Philippines and Mali sites based on published criteria in soils and plants		Doumbia (IER), Corton (PhilRice), George (IRRI)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Refining coefficients	1. Test and revise estimates of critical soil P levels for selected crops in order to predict nutrient P sufficiency and soil nutrient P requirements necessary for maximum crop yield from literature and field studies	Yost (UH)	George (IRRI), Cox (NCSU), Hossner (TAMU), Doumbia (IER), Corton (PhilRice)	February 2000
	2. Test and improve estimates of P buffer coefficients from field trials, literature and collaborators		Cox (NCSU), Hossner (TAMU), Alvarado, Salas (UCR), Doumbia (IER), Corton (PhilRice), George (IRRI)	February 2000
	3. Test and improve a short-term, laboratory method of simulating field-estimates of P buffer coefficients	Cox (NCSU)	Doumbia (IER), Corton (PhilRice), George (IRRI), Salas, Alvarado (UCR)	February 2000
	4. Test and improve diagnostic methods of detecting phosphorus deficiency and excess through use of on-farm experiments. Test and improve predictions of nutrient P requirement using on-farm experiments	Hossner (TAMU)	Doumbia (IER), George (IRRI), Salas (UCR)	February 2000

Budget:

OBJECT	AMOUNT IN US$
Personnel	59,788
Supplies	4,399
Equipment	5,569
Travel	20,912
Domestic	4,412
International	16,500
Other Direct Costs	8,196
Total	98,854

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Fownes (UH)	Costa Rica	2,000
Cox (NCSU)	Philippines	3,800
Cox (NCSU)	Costa Rica	2,700
Yost (UH)	Philippines	3,000

Equipment:
Computer projector

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Tree crops	1. Test and revise diagnostic criteria for deficient and excessive nutrient P levels in perennial crops from field trials and collaborator's experience	Yost (UH)	Alvarado, Salas (UCR), Fownes (UH)	February 2000
	2. Conclude and synthesize diagnostic and predictive data from field studies on the response of peach palm to P additions on selected soils and stages of maturity			February 2000
	3. Test diagnostic criteria for tree crop establishment at the Philippines and Mali sites		Doumbia (IER), Corton (PhilRice), George (IRRI)	February 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
2. Refining coefficients	1. Test and revise estimates of critical soil P levels for selected crops in order to predict nutrient P sufficiency and soil nutrient P requirements necessary for maximum crop yield from literature and field studies.	Yost (UH)	George (IRRI), Cox (NCSU), Hossner (TAMU), Doumbia (IER), Corton (PhilRice)	February 2000
	2. Test and improve estimates of P buffer coefficients from field trials, literature and collaborators.		Cox (NCSU), Hossner (TAMU), Alvarado, Salas (UCR), Doumbia (IER), Corton (PhilRice), George (IRRI)	
	3. Test and improve a short-term, laboratory method of simulating field-estimates of P buffer coefficients	Cox (NCSU)	Doumbia (IER), Corton (PhilRice), George (IRRI), Salas, Alvarado (UCR)	February 2000
	4. Test and improve diagnostic methods of detecting phosphorus deficiency and excess through use of on-farm experiments. Test and improve predictions of nutrient P requirement using on-farm experiments	Hossner (TAMU)	Doumbia (IER), George (IRRI), Salas (UCR)	February 2000
3. Predicting placement	Develop and test an algorithm to estimate P uptake from localized placement of P	Yost (UH)	George (IRRI), Corton (PhilRice), Doumbia (IER)	February 2000

PROJECT YEAR 4 and 5 - February 11, 2000 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)	February 2002

PROJECT YEAR 2 - February 11, 1998 to February 10, 1999

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 these IntDSS systems are user-friendly and have user-value, the integrated system must be piloted under a variety of location-specific conditions. We intend to do this via an extensive network of evaluators. Within this network are 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 networks who would be interested and benefit from testing our products in their programs.

In addition to the IntDSS software, complementary auxiliary tools will be developed as we perceive their need among users. Yost and colleagues developed a spreadsheet for selection of liming materials. The spreadsheet optimizes selection from locally-available lime materials and determines their correct proportional mixture while considering a variety of constraints such as quantity, cost, quality and distance of transport. It has been field tested in Indonesia, but needs translation to Spanish, Portuguese and French before testing under a broader variety of 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 of the nutrient balance tool has been developed to function at different scales: field, farm or farms. The prototype is currently under review.

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 2.

ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Evaluation groups identified: a. East/West Group InterCRSP Africa Groups b. IRRI Uplands Consortium c. CIMMYT C. Amer./Caribbean Regional Agronomy trials d. IBSRAM – SE Asia Acid Soils Network e. PhilRice Annual Conference f. Intensive testing site colleagues g. Others 2. Meeting times determined for each of the evaluation groups. 3. Individuals selected from each identified group to participate in the evaluation 4. Evaluations held. 5. Existing data solicited for incorporation into the system. 6. Feedback elicited, documented and incorporated into the system.	Osmond (NCSU)	George (IRRI) Reid (CU), Pratt, Smith, Smyth (NCSU); Yost (CU)	February 1999

Budget:

OBJECT	AMOUNT IN US$
Personnel	13,262
Supplies	66
Equipment	0
Travel	32,795
Domestic	183
International	32,612
Other Direct Costs	156
Total	46,279

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Osmond	Senegal and Kenya	6,470
Pratt	Kenya and Thailand	6,470
Reid	Venezuela and Thailand	6,470
Smyth	Guatemala and Mozambique	6,470
Smith	Cambodia and Venezuela	6,470

Equipment:

None requested

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

None scheduled

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

ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Workshop groups identified. 2. Site location selected. 3. Individuals selected from groups to participate in the evaluation. 4. Workshop held. 5. IntDSS evaluated. 6. Feedback incorporated into IntDSS	Osmond (NCSU)	George (IRRI) Reid (CU), Pratt, Smith, Smyth (NCSU); Yost (CU)	February 2001

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS RESPONSIBLE	INVESTIGATORS CONTRIBUTORS	ESTIMATED COMPLETION
1. Final IntDSS evaluation and release	1. Workshop site determined. 2. Workshop arrangements made. 3. IntDSS evaluated. 4. Feedback incorporated and IntDSS finalized 5. Final version of IntDSS released	Osmond (NCSU)	George (IRRI) Reid (CU), Pratt, Smith, Smyth (NCSU); Yost (CU); others as needed	February 2002

PROJECT YEAR 2 - February 11, 1998 to February 10, 1999

Output 2: Auxiliary tools to complement IntDSS software

Description: Products that facilitate use of the IntDSS 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 IntDSS software.

		INVESTIGATORS		ESTIMATED
SUBOUTPUT	**ACTIVITIES**	**RESPONSIBLE**	**CONTRIBUTORS**	**COMPLETION**
1. Lime Material and Cost Integrator.	1. Develop instruction sheet for a pre-existing lime calculator spreadsheet 2. Translate spreadsheet and instructions into Portuguese, Spanish and French 3. Disseminate the spreadsheet.	Yost (UH), Smyth (NCSU)	Smith (NCSU), George (IRRI), Hue (UH), Bouldin (CU), Juo (TAMU)	February 1999
2. Nutrient balance calculator	1. Finalize paper prototype of Nutrient Balance Calculator. 2. Program Nutrient Balance Calculator 3. Begin evaluation of Nutrient Balance Calculator with existing data sets.	Osmond (NCSU)	Reid (CU), Smyth (NCSU), Yost (UH), others as needed	February 1999

Budget:

OBJECT	AMOUNT IN US$
Personnel	3,404
Supplies	1,113
Equipment	500
Travel	2,817
Domestic	317
International	2,500
Other Direct Costs	13,253
Total	21,087

International Travel Events:

TRAVELER	DESTINATION	COST IN US$
Osmond (NCSU)	Costa Rica	2,500

Equipment:
Computer software

PROJECT YEAR 3 - February 11, 1999 to February 10, 2000

		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 2000
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 2000

PROJECT YEAR 4 and 5 - February 11, 2000 to February 10, 2002

		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. Continue to disseminate 2. Elicit feedback from users 3. Revise/modify if necessary	Osmond (NCSU)	Reid (CU), Smyth (NCSU), Yost (UH), others as needed	February 2002

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. 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. Incorporate feedback and revise if necessary 10. Continue disseminating and eliciting feedback 11. Repeat steps 9 and 10 until achieve desired performance	Team members as needed	Team members as needed	February 2002