

Workplans and Budget
Decision Aids for Integrated Soil Nutrient Management
January 1999

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

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 and amendments are needed for more than one nutrient. Decision support systems are available for diagnosis and recommendations on N (NDSS), P (PDSS) and lime (ADSS). Original versions ADSS and PDSS were recoded into Delphi, an object-oriented programming language. Recoding of NDSS, originally developed for New York agriculture, will be completed by the start of year 3 with algorithms modified and expanded to be applicable on a global basis. In recoding, each DSS was modified to operate within a single interface for integrated soil nutrient management (IntDSS). Due to the complexity of the combined system, interface screens are divided into 5 major sections: *Introduction, Geography, Diagnosis, Prediction* and *Guidance*. A uniform database design for all three DSSs approaches completion, as does a data dictionary for all variables and an editor to allow continued addition of data sets by software developers and users. International soil pedon data from NRCS has been added to IntDSS after screening for availability of information on pedon location. Discussions also began to define strategies and algorithms for integrating *Guidance* information across N, P and acidity recommendations - this activity will intensify during the coming year. The interface design is user-friendly yet flexible enough to accommodate future revisions of the initial prototype during the coming project years. The first IntDSS prototype will be distributed among collaborators at the beginning of year 3 for location-specific evaluation and feedback.

Field testing, initial evaluation and refinement of IntDSS is being performed by U.S. scientists and overseas collaborators at locations representative of three agroecological zones selected during travels in year 1: (I) a peach palm production area in the humid tropics of Costa Rica predominated by Andisols; (ii) a cowpea-millet production area in the semi-arid region of Mali predominated by acid, sandy Alfisols; and (iii) an upland rice production area in the wet-dry region of Luzon, Philippines with Oxisols and Ultisols. Baseline surveys of each testing area were completed at the start of year 2 and provide detailed characterization of socio-economic settings and decision-making processes used by farmers in each region. A series of field, laboratory and greenhouse investigations were implemented at each intensive testing area to acquire information on knowledge gaps about soil nutrient management. These information gaps were collectively identified by U.S. and overseas project members during a 3-day workshop in year 1. During year 2, seven

project-sponsored travel events by U.S. team members to testing sites provided backstopping assistance to collaborators in development of experimental designs, research protocols and monitoring progress.

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 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1 Intermediate release of IntDSS	Continue activities from year 2: 1. Continue incorporating agronomic and soils data for all crops based on input from Objective 2. 2. Continue incorporating country-available data from collaborators. 3. Reformat latest U.S. soil taxonomy information for incorporation into the data tables.* 4. Develop code that translates older versions of U.S. soil taxonomy.* 5. Collect georeferenced information when available and incorporate into data tables. 6. Collect and incorporate pictures of plant nutrient deficiency symptoms.*	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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Initial prototype of Nutrient Management Guidance Module	<ol style="list-style-type: none"> 1. Research 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. 5. Begin IntDSS evaluation with extensive evaluation network (<i>see Objective 3, output 1</i>) 	Osmond (NCSU)	Yost (UH), Reid (CU), Smyth (NCSU)	February 2000

* Completion of task initiated in Year 2; not included in Year 3 funding request.

Budget:

OBJECT	AMOUNT IN US\$
Personnel	38,123
Supplies	1,074
Equipment	4,386
Travel	5,873
Domestic	5,873
International	0
Other Direct Costs	74,188
Total	123,644

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:

Computer - \$3,000 (UH)

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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 in year 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Continue study on peach palm residue decomposition/nutrient release.	Soto (UCR)	Hue (UH), Wagger (NCSU), Alvarado (UCR)	December 2000
	2. Complete greenhouse/laboratory studies on peach palm acidity tolerance and Ca/Mg requirements.*	Salas, Uribe, Molina (UCR)	Hue (UH), Smyth (NCSU), Alvarado (UCR)	June, 1999
	3. Complete ongoing greenhouse and laboratory studies on soil chemical effects of organic inputs; initiate new studies if deemed necessary.*	Uribe, Salas, Alvarado (UCR)	Hue (UH), Smyth (NCSU)	June, 2000
	4. Continue field trial on lime and gypsum effects on mature peach palm plantation.	Molina, Salas (UCR)	Alvarado (UCR); Hue (UH), Smyth (NCSU)	June, 2000
	5. Continue field trial with biomass and nutrient accumulation with peach palm plantation age.	Alvarado, Molina, Salas (UCR)	Hue (UH); Smyth, Wagger (NCSU)	June, 2000
	6. Continue field work on P diagnosis methods for mature peach palm plantations.	Molina, Alvarado (UCR)	Ares, Yost (UH)	February, 2000

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Costa Rica (continued)	7. Mid-term impact assessment survey of intensive testing site; progress assessed in terms of knowledge development process and by comparison with baseline survey.	Smith (NCSU), Alvarado (UCR)	Soto, Molina, Uribe, Salas (UCR), Smyth (NCSU)	February, 2000
	8. Initiate on-farm trials to evaluate IntDSS software diagnosis and recommendation for peach palm plantations.	Alvarado, Salas, Molina (UCR)	Ares, Hue, Yost (UH); Smyth, Osmond, Wagger (NCSU)	June, 2001
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 in terms of knowledge development process and by comparison with baseline survey.	Smith (NCSU)	Coulibaly, Doumbia (IER); Hons, Hossner (TAMU);	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. 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 in terms of knowledge development process and by comparison with baseline survey.			

* Completion of task initiated in Year 2; not included in Year 3 funding request.

Budget:

OBJECT	AMOUNT IN US\$
Personnel	31,108
Supplies	0
Equipment	0
Travel	11,500
Domestic	0
International	11,500
Other Direct Costs	150,000
Total	192,608

International Travel Events:

TRAVELER	DESTINATION	COST IN US\$
Corton (PhilRice)	Honolulu	2,500
Bajita (PhilRice)	Honolulu	2,000
Friday (UH)	Philippines	3,000
Smith (NCSU)	Philippines	4,000

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

Equipment:

No major items.

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Complete study on peach palm residue decomposition/nutrient release.	Soto (UCR)	Hue (UH), Wagger (NCSU), Alvarado (UCR)	December 2000
	2. Complete ongoing greenhouse and laboratory studies on soil chemical effects of organic inputs.	Uribe, Salas, Alvarado (UCR)	Hue (UH), Smyth (NCSU)	June, 2000
	3. Complete field trial on lime and gypsum effects on mature peach palm plantation.	Molina, Salas (UCR)	Alvarado (UCR); Hue (UH), Smyth (NCSU)	June, 2000
	4. Complete field trial with biomass and nutrient accumulation with peach palm plantation age.	Alvarado, Molina, Salas (UCR)	Hue (UH); Smyth, Wagger (NCSU)	June, 2000
	5. Complete field work on P diagnosis methods for mature peach palm plantations.	Molina, Alvarado (UCR)	Ares, Yost (UH)	February, 2000
	6. Continue on-farm trials to evaluate IntDSS software diagnosis and recommendation for peach palm plantations.	Alvarado, Salas, Molina (UCR)	Ares, Hue, Yost (UH); Smyth, Osmond, Wagger (NCSU)	June, 2001

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
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
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. Continue 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		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Costa Rica - peach palm production on acid Andisols in a perudic moisture regime	1. Continue on-farm trials to evaluate IntDSS software diagnosis and recommendation for peach palm plantations.	Alvarado, Salas, Molina (UCR)	Ares, Hue, Yost (UH); Smyth, Osmond, Wagger (NCSU)	June, 2001
	2. Final impact assessment survey of intensive testing site; progress assessed by comparison with baseline and mid-term survey.	Smith (NCSU), Alvarado (UCR)	Soto, Molina, Uribe, Salas (UCR), Smyth (NCSU)	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 3 - February 11, 1999 to February 10, 2000

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 experiments began in year 2 to evaluate Ca and Mg movement in Alfisols of Cinzana, Mali. These are planned to continue in year 3 and a third comparison will be established in Nigeria with IITA. All members of the ADSS group continue to collect and synthesize published and unpublished soil, plant and management information on Al and Mn toxicity, Ca and Mg deficiency, lime movement and organic amendment effects. Acidity information is included in a comprehensive review of sub-Saharan nutrient management prepared by team members at Texas A&M University. We have collectively prepared a template spreadsheet file that is sent to authors of candidate lime studies, requesting their input of data pertinent to refinement of ADSS.

Field, laboratory and greenhouse work in Hawaii indicated that Ca:Mn ratios in plant tissues are helpful indicators of Mn toxicity problems and that alleviation of such soil constraints involves both a reduction in Mn solubility (by liming) and improved Ca availability. We continue to determine lime equivalence values for various types of organic amendments. Laboratory protocols and root growth bioassay techniques for these tests were also used during the year as the basis for initiation of studies in Costa Rica to investigate (a) peach palm tolerance to soil acidity factors, and (b) lime equivalence of pruned residues in heart of palm harvests. Complementary laboratory investigations for on-farm trials with millet in Mali included incubations for lime requirement studies with three soils in the region and three potential lime sources. Members of the ADSS group continue to monitor treatments on liming, Ca and Mg movement, and organic inputs in core experiments at Mali and Philippines.

Experiments were initiated during year 2 and should begin to provide meaningful soil and plant data during year 3.

Nitrogen - during the past year considerable published literature was summarized in computing N requirements for maize and millet. This analysis led to development of computation protocols for calibration of N transfer coefficients for crops under different soils and climatic regimes. Predictions of N requirements were initiated for upland rice. Collection of similar data will continue or begin next year for corn, millet, sorghum, upland rice and sugarcane. However, these data do not exist for peach palm.

Core experiment studies were initiated in Costa Rica with peach palm to characterize biomass and nutrient accumulation with plantation age and predict nutrient release from crop residues under different climatic regimes. These studies will continue next year. Likewise, BNF estimates for cowpea, soybean and peanut were outlined and initiated in the core experiments in Mali and Philippines. Measurements of legume-fixed N also are being collected from IRRI's Long-Term P Experiment network in Asia.

Published information on N losses applicable to core experiments has been reviewed,

but lacks consensus of opinions as to quantity of losses or environmental causes. Search of the literature on this topic will intensify during the coming year.

Phosphorus - Peach palm plantations for heart-of-palm production undergo frequent harvest, have considerable residues recycled and limited accumulation of aboveground biomass. These features make the diagnoses of P deficiency and prediction of P responses unique to this crop when compared to other perennial tree species. Review of literature on peach palm throughout Latin America revealed a paucity of clear responses to P beyond the crop establishment phase. Peach palm fields in Costa Rica are currently being surveyed to identify sites with low soil P for use in further fertilization-diagnostic studies. Distribution of available soil P is being evaluated with sampling depth, as is the organic P fraction. Usefulness of soil and foliar P tests in predicting peach palm response to P will be evaluated in subsequent studies.

We continue to investigate methods to improve the prediction of soil P buffer coefficients (PBC), the increase in extractable P to the amount of applied P. PDSS predictions for PBC are being compared with estimates derived from field P response experiments in Asia and Latin America, as well as short-term laboratory incubations. Soil clay content is currently used in PDSS as a predictor of PBC, but current results are not satisfactory for across soils with a wide range of mineralogy and high in clay. Efforts to improve prediction of PBC focus on use of other characteristics, such as mineralogy, surface area and aggregation.

Core field experiments in Mali and Philippines are being used to test the diagnosis and prediction of P response for cowpea, millet, upland rice, peanut, soybean and corn. On-farm trials in Mali also are looking at the influence of composting practices on P availability to millet from local phosphate rock.

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 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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 and Juo (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 and Hossner (TAMU)	Doumbia, Coulibaly, Kouyate, Sidibe (IER); Hossner (TAMU); Smyth (NCSU)	June 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

Budget:

OBJECT	AMOUNT IN US\$
Personnel	29,351
Supplies	0
Equipment	0
Travel	7,900
Domestic	900
International	7,000
Other Direct Costs	4,730
Total	41,981

International Travel Events:

TRAVELER	DESTINATION	COST IN US\$
Hue (UH)	Costa Rica	3,000
Niino (TAMU)	Nigeria	4,000

Equipment:

None

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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 and Juo (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		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		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. Continue reviewing literature for data sets to compute the N coefficients for contributions of leguminous crops in rotations prior to non leguminous crops as influenced 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 at Mali and Philippines; evaluate NDSS predictions for each site after each harvest	Reid (CU)	Hons (TAMU), George (IRRI), Corton (PhilRice), Coulibaly, Doumbia (IER), Osmond (NCSU)	February 2002
	4. Continue evaluation of N recycling in pruned peach palm litter in heart-of-palm plantations, Costa Rica	Waggoner (NCSU)	Soto (UCR), Smyth (NCSU), Hue (UH)	December 2001

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Calibrating N coefficients (continued)	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 lime, N and P trials in newly established and mature peach plantations in Costa Rica	Reid (CU)	Salas, Soto, Molina (UCR); Yost (UH); Wagger, Smyth (NCSU)	February 2002
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),	June 2000
	2. Compare 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. 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)	July 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.	Israel (NCSU), Juo (TAMU) in Mali; George (IRRI) in Philippines	Wollum (NCSU); Hons (TAMU) Coulibaly, Kouyate, Sidibe (IER); Corton (PhilRice), Reid (CU)	February 2001
	2. Estimate N carryover from cowpea (Mali) and peanut (Philippines) residues in year 1 crops to succeeding non leguminous crops in year 2			
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

Budget:

OBJECT	AMOUNT IN US\$
Personnel	108,292
Supplies	3,568
Equipment	3,811
Travel	12,320
Domestic	3,320
International	9,000
Other Direct Costs	10,154
Total	138,145

International Travel Events:

TRAVELER	DESTINATION	COST IN US\$
Israel (NCSU)	Mali	3,000
Hons or Juo (TAMU)	Mali	4,000
Soto (UCR-Costa Rica)	Raleigh	2,000

Equipment:

Desktop computer (CU) \$3,118.

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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	Reid (CU)	Israel, Wagger, Wollum (NCSU); Hons (TAMU), George (IRRI)	February 2002
	2. Add assembled information to IntDSS Guidance module			

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
3. Predicting BNF contributions	<ol style="list-style-type: none"> 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		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	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	<ol style="list-style-type: none"> 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 3 of the project.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		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

Budget:

OBJECT	AMOUNT IN US\$
Personnel	48,795
Supplies	2,879
Equipment	2,187
Travel	27,972
Domestic	3,472
International	24,500
Other Direct Costs	41,829
Total	123,662

International Travel Events:

TRAVELER	DESTINATION	COST IN US\$
Hossner (TAMU)	Mali	4,000
Ares (UH)	Costa Rica/Brazil	4,000
Friday (UH)	Mali	4,000
Kablan (UH)	Mali	4,000
Cox (NCSU)	Australia	4,600
Cox (NCSU)	Guatemala/Costa Rica	1,900
Cox (NCSU)	Ecuador	2,000

Equipment:

No major items.

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		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 3 - February 11, 1999 to February 10, 2000

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: IntDSS must be piloted under a variety of location-specific conditions to ensure that is user-friendly and has high user value. We intend to do this via an extensive evaluation network. The network contains individuals with (a) knowledge that should be incorporated into the software, (b) field and laboratory data sets that could be used to evaluate the software, and (c) established networks that are interested and benefit from testing our products in their programs. Through meetings and travel several members of the IntDSS team made world contacts viz-a-viz IntDSS and participation in the network. During visits to intensive testing sites, team-members presented seminars at multi-institutional meetings organized by our collaborators, and visited with other interested organizations. Valuable information and suggestions for IntDSS software improvement were received at each of these meetings. Team members have also visited and recruited network evaluation members during travels to participate in national and international conferences in various countries. Organizations willing to participate in the extensive evaluation network include the IRRI Rice Consortium; UPLB, PCAR and SEARCA in the Philippines; CIMMYT Regional Maize Programs in Central America; IBTA in Bolivia; Potash & Phosphate Institutes Andean Programs; INIAP in Ecuador; EMBRAPA in Brazil; ICRAF in Peru; FONAIAP and PEQUIVEN in Venezuela. During the year contacts with other individuals and organizations were also maintained via correspondence and e-mail. Funds were set aside during year 2 for U.S. team members to travel to selected meetings of network member organizations to initiate evaluation and feedback on IntDSS software performance. These travels would only begin upon the release of an IntDSS software prototype for use by network members. Instead of these individual travel events, we propose to combine these funds with additional funds in year 3 to sponsor the first workshop for evaluation of IntDSS software. Collectively, we would have the necessary core funding to sponsor participation in the workshop by representatives from various network member-organizations throughout Africa, Asia and Latin America. A workshop venue would allow the opportunity to seek other sponsors for broader network participation, and provide a better structure for software evaluation, feedback and eventual refinements into future IntDSS prototypes. Auxiliary tools complementary to IntDSS software are developed as we perceive their need among users. Tools currently under development are a lime material and cost integrator, and a nutrient balance calculator. Yost and colleagues developed an spreadsheet optimization routine that determines locally-available lime materials based on quantities, cost, lime quality, and transportation. Before testing in a variety of global conditions the spreadsheet needs to be translated into Spanish, Portuguese and French. Development continues on the nutrient balance calculator, intended to allow user to determine inputs, outputs and balance of major nutrients at various

scales (field, farm or farms). Base algorithms for the calculator were developed. Data for the calculator will come from different modules in IntDSS. Completion of the initial prototype for IntDSS allows this activity to be completed during the next year, at no additional cost to the project.

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 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Attend Central American Annual Crop/Animal Production Meeting	<ol style="list-style-type: none"> 1. Develop a project-based presentation on conceptual approaches to nutrient management in IntDSS. 2. Present document at meeting as invited participant to panel on “Tropical Soil Use and Management” 	Smyth (NCSU)	Osmond (NCSU); Reid (CU); Yost (UH)	April, 1999
2. IntDSS evaluation workshop for selected network participants from Africa, Asia and Latin America	<ol style="list-style-type: none"> 1. Network member-organizations identified. 2. Workshop location selected. 3. Individuals from network organizations identified to participate in workshop. 4. Workshop held 5. IntDSS evaluated, feedback elicited. 6. Feedback analyzed/discussed and strategy for incorporation into IntDSS is developed 	Osmond (NCSU)	George (IRRI) Reid (CU), Pratt, Smith, Smyth (NCSU); Yost (CU); others as needed	July, 2000

Budget:

OBJECT	AMOUNT IN US\$
Personnel	3,224
Supplies	1,170
Equipment	3,341
Travel	54,176
Domestic	424
International	53,752
Other Direct Costs	127
Total	62,038

International Travel Events:

TRAVELER	DESTINATION	COST IN US\$
Reid (CU)	Venezuela	2,000
Zavala (CU)	Venezuela	2,000
Smyth (NCSU)	Guatemala, Guatemala	1,752
Yost (UH)	Mali	4,000
Yost (UH)	Philippines/Vietnam	4,000
Multiple, yet to be identified participants from U.S., Africa, Asia and L. America to IntDSS workshop	Philippines (pending further negotiations with on-site collaborators); otherwise Costa Rica is an alternative venue	40,000*

* An additional \$38,816 targeted for this output in year 2 will be carried over and combined with travel funds budgeted for year 3. Collectively, this provides minimum core funding necessary to sponsor the workshop. Failure to carry forward year 2 funds or obtain the requested year 3 funds, eliminates this planned activity.

Equipment:

Computer (UH) - \$3134

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
Evaluation workshop for 2 nd IntDSS prototype with incorporation of research updates and revisions recommended by 1 st evaluation workshop	<ol style="list-style-type: none"> 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 workshop 	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		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Final IntDSS evaluation and release	<ol style="list-style-type: none"> 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

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 in year 3.

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Lime Material and Cost Integrator.	<ol style="list-style-type: none"> 1. Develop instruction sheet for a pre-existing lime calculator spreadsheet* 2. Translate spreadsheet and instructions into Portuguese, Spanish and French* 3. Disseminate and elicit feedback from users. 4. Revise/modify if necessary. 5. Continue disseminating 	Yost (UH), Smyth (NCSU)	Smith (NCSU), George (IRRI), Hue (UH), Bouldin (CU), Juo (TAMU)	February 2000
2. Nutrient balance calculator	<ol style="list-style-type: none"> 1. Program Nutrient Balance Calculator* 2. Begin evaluation of Nutrient Balance Calculator with existing data sets. 3. Field test the tool; revise if needed. 4. Disseminate and elicit feedback from users. 5. Revise if necessary 	Osmond (NCSU)	Reid (CU), Smyth (NCSU), Yost (UH), others as needed	February 1999

* Activities carried over from year 2 to year 3 with no additional cost to the project.

Budget:

OBJECT	AMOUNT IN US\$
Personnel	2,665
Supplies	140
Equipment	170
Travel	351
Domestic	351
International	0
Other Direct Costs	9,002
Total	12,328

International Travel Events:

None

Equipment:

Computer software

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

SUBOUTPUT	ACTIVITIES	INVESTIGATORS		ESTIMATED
		RESPONSIBLE	CONTRIBUTORS	COMPLETION
1. Lime Material and Cost Integrator	<ol style="list-style-type: none"> 1. Elicit feedback from users 2. Revise/modify if necessary 3. Continue disseminating 	Yost (UH), Smyth (NCSU)	Smyth (NCSU), George (IRRI), Hue (UH), Bouldin (CU), Juo (TAMU)	February 2002
2. Nutrient balance calculator	<ol style="list-style-type: none"> 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
3. Other tools	<ol style="list-style-type: none"> 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