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SOILS FAMILIES - HAWAII

REPORT

Team Evaluation of S&T/AGR Project 931-0582

January 1983

Team Members

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PROJECT EVALUATION SUMMARY (PES) - PART II

ENTITY: University of Hawaii

PROJECT TITLE: Soil Families - Hawaii

PROJECT NUMBER: 931-0582

13. Summary

The Benchmark Soils Project was given a final in-depth review January 16 through February 6, 1983 to determine status of the project.

The basic purpose of the project was to test a pre-determined hypothesis that agrotechnology transfers among tropical regions may be made by use of soil families classification as defined in Soil Taxonomy. This hypothesis would need to be tested under rigorous scientific and statistical methods in at least four countries. All results were to be carefully analyzed and disseminated to the widest extent possible.

The review team found that the project had indeed reached all proposed goals but the final compilation and analysis of results.

The project was troubled by many minor problems such as slow staffing, country arrangements, slow arrival of support material, etc. All of these were overcome but required a slightly longer time frame than at first envisioned.

14. Evaluation Methodology

The in-depth project review/evaluation conducted January 16, February, 1983 was carried out by Michael Leamy, Director of the New Zealand Soil Bureau; Robert Gast, Dept. of Agronomy, University of Nebraska; and Ralph J. McCracken, Deputy Chief, Natural Resource Assessment, USDA/SCS.

Their purpose was to determine if the program/project hypothesis was sound and had been properly tested. They concluded that the methodology used was sound, had been properly conducted and in fact had advanced the use of agrotechnology transfer by using soil families of Soil Taxonomy to a position of being ready for action programs.

The team found a wide-ranging interest in the project and a large number of cooperating organizations were involved. These ranged from active participants to interested observers and included:

1. The University of Hawaii
2. Philippine Council for Agriculture and Resource Research and Development
3. Indonesia - Center for Soil Research
4. Cameroon - Office of Scientific and Technical Research
5. ICRISAT
6. F.A.O.
7. I.I.T.A.
8. NSDA/SCS
9. I.F.D.C.
10. CIMMYT - Mexico
11. USAID Field Missions

EXECUTIVE SUMMARY

The Benchmark Soils Project (BSP) was given a final review Jan. 16-Feb. 6, 1983 by a team composed of Michael Leamy, Director of New Zealand Soil Bureau; Robert Gast, Head of the Department of Agronomy, University of Nebraska; and Ralph J. McCracken, Deputy Chief, Natural Resource Assessment, USDA Soil Conservation Service. The team visited BSP sites in Cameroon, Indonesia, Republic of the Philippines and Hawaii--studying soils and field plots and holding discussions with host country personnel, cooperators, consultants and Project staff.

The team concluded that the basic BSP hypothesis that agrotechnology transfer may be made by use of soil families of Soil Taxonomy (ST) was sufficiently tested by rigorous scientific and statistical methods for AID and others to use in "action" programs for country development. (Soil Taxonomy is a universal system of soil classification for the making and interpretation of soil surveys, introduced by the Soil Conservation Service in 1975 and now used in many countries.) This usage has the potential of saving millions of dollars and accelerating technology transfer by eliminating or reduing the need to conduct adaptive research and on-site field trials for transfer of agrotechnology previously developed elsewhere. BSP also has provided, and will continue to provide, numerous "spin-off" and accessory benefits--training of host country personnel; collection of information on crop-soil matching, cropping systems, nitrogen-fixing trees and fuelwood production; meteorological and soil temperature-moisture data; soil erosion indexing and other information for soil conservation, introduction of ST to host countries as a useful means of inventorying land resources, and information which will lead to improvement and modification of ST.

The team found that BSP has already had significant impacts on host country programs, that agricultural administrators and technical personnel in these countries are very enthusiastic and supportive of the BSP concept and are already following up on it vigorously. They are very much interested in participating in the next phase--the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT).

BSP has made several important scientific and technical discoveries and accomplishments. These include the first quantitative test of Soil Taxonomy as a technology transfer vehicle, and development of a new methodology and statistical test for analyzing, interpreting and scientifically testing technology transfer models.

The team commends the University of Hawaii project staff for their successful completion of rigorous, detailed experiments on-site with enthusiastic host country partnership and for their visionary and innovative approach. The team also commends the AID Office of Agriculture, Bureau of Science and Technology, especially Dr. Tejpal Gill, for good judgment in funding and otherwise supporting this type of activity. They also express appreciation for the active participation and support of BSP by AID country mission personnel, especially in Indonesia and Republic of the Philippines.

INTRODUCTION

Truly innovative and visionary research is an uncommon but invaluable commodity in any field of endeavor. To be innovative, the research should test new concepts. If it is visionary, the research will generate discoveries and correlations which were not anticipated in the original design. The BSP has tested concepts and principles which will allow transfer of agricultural research on tropical soil families to be maximized successfully. The fundamental concept in this testing has been that soil families, as defined by Soil Taxonomy, are an effective vehicle for agrotechnology transfer. This is an innovative concept. Throughout the duration of the project new discoveries and correlations have emerged in the areas of crop modeling, cropping systems experiments, nitrogen-fixing fuelwood trees, phosphorus source and placement, occurrence of plant pests, soil testing, spatial variability of soils, soil erosion and the selection of soil taxonomic parameters. These are all marks of visionary research.

The stated objectives of the BSP are:

1. To determine scientifically the transfer of agroproduction technology among tropical and subtropical countries.

2. To assist tropical countries in assessing the potential of upland areas for intensive cropping and intensive soil mangement.

3. To demonstrate the value of soil and land classification in formulating agricultural development plans in selected areas.

The Project represents an innovative approach to testing agrotechnology transfer based on use of soil families which are defined with considerable precision by Soil Taxonomy, the comprehensive soil classification system introduced by the USDA Soil Conservation Service in 1975 for the making and interpretation of soil surveys. The transfer experiments were meticulously planned to generate data which could be used in statistical evaluations of the feasibility of agrotechnology transfer among sites in the tropics. It was expected that similar management practices would be required on similar soils (in the same soil family) to produce similar crop performance results, no matter where these soils exist. The experimental design of the transfer experiments used maize as the test crop and applied phosphorus (P) and nitrogen (N) as the treatment variables. Each transfer experiment was installed, maintained and harvested in as uniform a manner as possible in order to obtain data for statistical evaluation of the transfer model.

Traditional agronomic research in most countries has aimed to generate new data about crop behaviour which can then be transferred through adaptive research and trial plots and use of extension services to tracts of land other than that on which the experiment was conducted. Transfer on the basis of climate parameters has been relatively feasible because

of the availability of a substantial data bank of meteorological records and local knowledge of weather patterns. Transfer on the basis of soil properties has in the past generally been achieved using as a vehicle an imprecisely defined soil series or other loosely defined soil grouping, and local knowledge of soil conditions. What the BSP has so vividly demonstrated is that when soil and climatic factors can be precisely and logically identified, as they can be by using Soil Taxonomy, successful transfer can be confidently predicted without research and on-site trials. BSP has provided agronomists with an opportunity to utilize proven scientific methods, rather than having to rely in part on folklore.

The happy traditional assumption that a soil name combined with local knowledge of soil conditions can effect successful transfer has never been scientifically tested. BSP has demonstrated by rigorous scientific testing that the soil family as defined by Soil Taxonomy can be used to extend the soil test correlation for phsophorus and can transfer information on yield sensitivity to nitrogen levels. Neither of these pieces of data are required parameters for the taxonomic identification of the families tested. The correlation between these experimental parameters and the basic permanent soil properties inherent in the taxonomic identification has not yet been made. And clearly the soil family is not necessarily the only vehicle for successful transfer. The next logical step would appear to be to discern and match soil taxonomic properties with crop requirements.

GENERAL OBSERVATIONS AND COMMENTS

The comprehensive exposure to many of the experimental sites in the four countries involved in the study and to representatives from the many agencies and organizations associated either directly or indirectly with the project allowed the review team to gain considerable insight into the overall project. The team gave special attention to the objectives, general management and implementation and accomplishments. The following are some general observations and comments concerning the project:

1. The project has had the interest and support of all levels of administration within the College of Tropical Agriculture and Human Resources of the University of Hawaii. This was evidenced by the willingness of Dean N. P. Kefford to join the review team for the visit in Indonesia and the participation of Dean Kefford, Assistant Director Ada Demb and W. G. Sanford, Chairman, Department of Agronomy and Soil Science in the final review session.

2. The project has benefited from the full support, dedicated effort, and close teamwork of Dr. J. A. Silva, Principal Investigator, Dr. H. Ikawa and Dr. G. Uehara, Co-Investigators, and Dr. G. Y. Tsuji, Project Manager--all of the University of Hawaii.

3. Management of the project has been excellent at all locations visited, considering the many complex issues and problems that had to be dealt with. A great deal of credit should be given to Dr. Gordon Tsuji, General Project Manager, and Mr. Donald Berger, Mr. George Manuelpillai, and Dr. Martin Raymundo, Project Managers in Cameroon, Indonesia, and the Philippines respectively, and the Hawaii Agronomist, Mr. Patrick Ching, for their effective leadership in managing the project sites.

4. The initial objectives and experimental design for the project were vigourously adhered to in spite of pressures and temptations to adjust to approaches and/or procedures that might be considered more "typical" of, or relevant for, the local environment and situation.

5. Excellent rapport and enthusiasm was demonstrated by all of the support personnel at each site visited, indicating a real sense of partnership, again reflecting the effective leadership and management of the project.

6. There was evidence of excellent cooperation and working relationships with other organizations and agencies, including AID missions and national and regional or provincial research organizations, especially in Indonesia and the Philippines. There was also good rapport and cooperation with the Director and other respresentatives of the Institut de la Recherche Agronomique (IRA) in Cameroon. There was less evidence of such cooperation by the AID mission and with other AID-supported programs in Cameroon. This no doubt is due in part to transportation and communication problems.

7. The review team feels that it would be helpful to have available for all interested people detailed soil maps of the Benchmark sites and the immediately surrounding areas and data concerning the spatial variability of the soils within the immediate soil plot areas. (We have made a recommendation that this be accomplished later by other than BSP personnel.) It would also have been helpful if the complete analytical data for the soils at all of the soil pit areas could have been available at the time of the visits by the review team. These soil data should be made a part of the permanent record of the Project.

8. Essentially all of the recommendations made by the 1979 BSP review team have either been implemented or are planned for implementaion as part of the final phases of the project.

TESING THE TRANSFER HYPOTHESIS

Review of the project objectives (listed in Introduction) indicates the first objective is central to the project. Because it does contain the main issue, only it is discussed in this section. The other objectives derive from or are complementatry to the first one; they are discussed in the "Other Accomplishments" section of this report.

The requirement of the first objective that transferability of technology be scientifically determined resulted in the development of the postulation by BSP personnel that agrotechnology can be transferred by use of soil families of Soil Taxonomy (ST). The review team feels this to be appropriate and logical because this categorical level in ST was established on the basis of the concept that criteria for determining classes (families) within it should be on the basis of the contributions of selected soil properties to use and management of soils, especially those characteristsics most closely correlated with plant root growth and nutrient uptake. For example, soil moisture and temperature regimes were for the first time accepted as soil properties in ST. Ranges of these regimes together with selected stable and permanent mineralogical, chemical and physical soil properties were established as family criteria.

After some study and experimentation, BSP then developed a transfer model (derived from and delimited within the basic hypothesis) which postulates that yield response to an applied agrotechnology (in this case, applications of N and P fertilizers) can be transferred from specific experimental sites (of a specific soil family in this case) to new sites of the same soil family by predicting yield responses for the new sites, and that the accuracy of the transfer predictions can be statistically evaluated by comparison of actual yield responses at the new sites to the transfer predictions and to site-specific predictions based on analysis of the yields measured at the new site.

Understanding and acceptance of these major findings would be enhanced and the use of the scientific method demonstrated if clear and explicit formulations were made of the basic hypothesis, i.e., the soil family transfer hypothesis and the transfer model derived from these hypotheses. This is because an understanding of the hypothesis and the transfer model and of exactly what has been tested is the key, critical point of the whole project. However, we found the method used for testing the transfer model--especially the development and application of the "P statistic" for testing transfer hypotheses--to be a very innovative and significant development.

BSP personnel then proceeded to use the rigorous requirements of the scientific method for testing the transfer model. We believe this is the first application of scientific method to testing ST and regard this as a major accomplishment in itself. This is also the first instance of joint quantitative evaluation of pedological and soil test data and properties of which the team is aware. Use of the scientific method requires not only the formulation of a hypothesis but also the development of an exper-

imental design for use in systematically collecting data to which statistical tests of probability may be applied for testing of the model used and hence also the hypothesis.

The BSP leaders, with the aid of consultants and peer advice, scrupulously laid out what we judge to be an appropriate experimental design and rigorously implemented it throughout the global network despite many logistic and physical constraints and problems. The review team concludes that the experimental data from the various sites are generally reliable and credible and that the integrity of the experimental design has been preserved. This conclusion is based on on-site reviews of six primary sites and two secondary sites in four countries, study of the total data sets, and interviews with BSP personnel and cooperators.

The team feels that the statistical methodology developed by Cady and associates 1/ is appropriate for testing the transfer model as formulated and is relevant and significantly contributes to the total testing of the overall basic hypothesis. We accept and consider as successful the application of the P statistic (Cady et al.) to the scientific and quantitative testing of the transfer model as defined and described.

The successful quantitative testing of the transfer model involving N and P response prediction within the three soil families studied does lend support to the basic hypothesis. In our judgment, it provides sufficient basis for AID and all others interested in accelerating agrotechnology transfer to use the assumptions of the basic hypothesis in actual operations and programs. This is further reinforced by the qualitative findings of differences in downy mildew occurrence and of corp matching and mismatching of crops and soils which were observed. But we feel that we must point out that fully definitive conclusions from the BSP studies are limited by the following: (1) Use of N and P differential response data as a soil fertility criterion rather than drawing on permanent soil property, data, unless it can be assumed that these are proxies or surrogates for, or are correlated with, the permanent and relatively stable soil properties which have been selected as the basis for soil family definition and which have not yet been evaluated quantitatively as to their contribution to yield response similarities within families and

1/ Cady, F. B., C. P. Y. Chan, C. L. Garver, J. A. Silva, and C. L. Wood. 1982. Quantitative evaluation of agrotechnology transfer: a methodology using maize response to phosphorus on Hydric Dystrandepts in the Benchmark Soils Project. Res. Ser. 015, College Trop. Agric. and Human Res., Univ., Hawaii, Honolulu.

differences among families. 1/ In this regard, it is considered that the phosphate retention value (New Zealand Soil Bureau, 1968, p. 101), which will be used as a taxonomic parameter in the proposed new Andisol Order, and which reflects a permanent and relatively stable soil property, should have at least been investigated as a response criterion.
(2) The studies were confined to three soil families--though these do differ significantly in their physicochemical, mineralogical, and soil temperature properties (3) The sites were nonrandomly selected.

(4) Insufficient information is available on the spatial variability of key soil properties at each site by which to define and describe the soil map units on which the experiments were conducted, in relation to the abstract definitions of soil families contained in ST.

A further concern, although not a fundamental one, was the revelation that at three of the sites, all in the Philippines, soils were misclassified according to the data available to the team. The Tugbok soil at the Davao site (BPI) was classified by the team on the basis of original data and field inspection as a clayey, halloysitic isohyperthermic Rhodic Paleudult. Based on new data, presumably including percent of weatherable minerals, the National Soil Survey Laboratory of SCS has classified it as a clayey, halloysitic, isohyperthermic Typic Tropudult. It was noted with interest that the N and P data from this site differed from that of the Paleudults. The team appreciates that this site was withdrawn from the data used to test the transfer hypothesis.

Data contained in the Information Guide and Maps of experimental sites of the Benchmark Soils Project show the mean annual soil temperature at the PUC site and the PAL site to be 26.1°C and 25.9°C respectively. These values are too high for the current definition of isothermic, and would need to be classified as isohyperthermic. The team was interested to note that, with the possible exception of downy mildew occurrence, experimental results closely matched those from Dystrandepts with correctly identified isothermic regimes. The team considers this to be an example of one of the many BSP benefits--indication of the need for modification of a taxonomic parameter on the basis of quantitative data and crop performance. It would seem that consideration of future modifications of iso temperature regimes should include adjustments of the lower and upper limits of isohyperthermic, and introduction of a very warm, isomegathermic regime.

These points are not made to criticize BSP procedures nor to suggest that there is insufficient evidence for use of the soil family agrotechnology transfer concept in operational development, planning and extension programs. Rather, we bring out these points to indicate the nature and extent of additional testing and research needed in order to strengthen the generality and power of the transfer concept, to identify the nature and extent of additional work needed on the basis of the BSP experience

1/ Ref. N. Z. Soil Bureau 1968, Soils of New Zealand, Part 2. N. Z. Soil Bureau Bulletin 26(2).

and to recognize the original contributions to methodology in this new and important area which have been made by the BSP and finally to again emphasize that results from the BSP experiments indicate that both soil fertility evaluation data and pedologic information (as embodied in ST) are needed for agrotechnology transfer relative to crop yield improvement.

The BSP findings that yield responses were predictable within the groups of sites identified as being within the same family through there are some ranges in their properties--plus our intuitive feeling that some closely related soil families do not differ significantly in properties influencing response to a particular technology application (such as P application)--leads us to suggest that a concept of "spheres of similarity" or groups of similar soil families may sometimes be used for agrotechnology transfer where appropriate. Also, it should be remembered that the soil family need not be the only transfer vehicle.

OTHER ACCOMPLISHMENTS

As indicated earlier in this report, the general objectives and experimental approach to the project were rigorously adhered to in order to meet the primary purpose of testing the transfer hypothesis. Like most experiments, however, the project has led to many additional acomplishments and benefits, some purposefully planned for and some unexpected and are a mark of sound research design and the vision of the researchers. Some of the more important of these are listed below:

1. Perhaps most importantly, the project has greatly increased the visibility of and appreciation for the potential use of soil taxonomy for transferring agrotechnology and other land use and management information.

2. Observations resulting from the project and subsequent analysis and interpretations will lead to further refinement of soil taxonomy in general and its application to tropical soils in particular.

3. The development of the methodology for evaluating the adequacy of the transfer concept has been a major contribution of the project.

4. The project has included a major training component involving both formal graduate training for a number of students and the training of a number of soil scientists concerning the nature and potential use of soil taxonomy through several two to four week workshops at different locations in the various countries involved in the project.

5. In addition, a large number of professional staff in these countries has gained a greater appreciation for soil taxonomy and its potential use for agrotechnology transfer through direct association with the project.

6. The project has also resulted in a sizable number of support staff who are much better acquainted with the scientific process and the requirements for carrying out a well managed experimental field study.

7. The nitrogen fixing tree and cropping systems component of the project has provided additional information concerning the adaptability of the several species involved to the three soil families and their associated environments.

8. The extensive and detailed meteorological data collected in connection with the project will be useful in the future for both refining the soil taxonomy of tropical soils and for other soil management and agricultural purposes.

9. Observations from the project have led to the recognition of the importance of agro-environmental zones as evidenced by the occurrence of downy mildew problems in the warmer isohyperthermic zones but not in the isothermic zones.

10. Participation in the project has contributed to the institutional development of the College of Tropical Agriculture and Human Resource of the University of Hawaii, making it more effective in International development activities, at the same time enhancing its capabilities to attack Hawaii's agricultural problems. This is partly because Hawaii participated in the BSP test sites program and has soil characteristics similar to those of many of the developing countries. This institutional development is also due to the University of Hawaii having been able to bring qualified professional people to the campus in connection with the project and because of the additional experience and perspectives gained by the Hawaii participants in the BSP.

GENERAL IMPLICATIONS

Probably the most pervasive implication of BSP to emerge from the review team's study is the resolve of agricultural research agencies in Cameroon, Indonesia and the Republic of the Philippines to utilize the Benchmark concept in planning their own future agronomic research and in inventorying their soil resources.

Discussion with officials of the Institut de la Recherche Agronomique (IRA) in Cameroon made it clear that BSP has impacted on that organization in many ways. There was an expressed desire to join the IBSNAT network, which is tangible evidence of the perceived benefits of BSP for Cameroon. There was a resolve to establish a multidisciplinary National Center for Soils and it was clear to the team that this aspiration had been considerably fueled, if not sparked, by the consciousness-raising about soils resulting from BSP. It was of interest that FAO soil team at the Ekona Research Station was fully supportive of this concept. A decision has been taken and will soon be implemented to perform detailed soil surveys, using Soil Taxonomy, of all research stations in Cameroon. In discussion with both Dr. S. N. Lyonga, Chief of the Ekona Research Station, and Dr. J. P. Eckebil, Director of IRA, it became clear that they were united in a desire to incorporate the Benchmark philosophy into the Cameroon agronomic research strategy. The recently concluded Soil Taxonomy Forum had been an outstanding success, dominating the media in Cameroon for a number of days.

The successes of BSP in Cameroon have been achieved despite some apparent lack of positive support and participation of the USAID Mission. There was a striking contrast between the very limited contact with and participation of AID personnel in Cameroon and the vigorous and positive participation in the team's visit by USAID personnel in Jakarta and Manila.

Full discussions were hold in Bogor, Indonesia with the Director (Dr. Muljadi) and officials of the Center for Soil Research (CSR), and with USAID officers--Walter Tappan, Allan Hurdus, and Kenneth Prussner. BSP has clearly had a positive impact on both parties. The Director considered that it has helped in systematizing their approach to agronomic research, had improved their research capability, had accelerated the adoption by Indonesia of Soil Taxonomy, and had important implications in supporting development planning in agriculture particularly for the Transmigration Program. USAID officials considered that BSP had been a very successful tripartite program between CSR/UH/AID, and that it has led to the establishment of a network of 10 experimental stations throughout Sumatra, thus assisting in the desired decentralization of agricultural research in Indonesia. AID personnel in Indonesia not only participated in this discussion but also accompanied the team on field inspections.

In the Philippines a meeting was held at the headquarters of the Philippine Council for Agricultural and Resource Research and Development (PCARRD). This was also attended by the Director of the Bureau of Soils (Mr. G. Alcasid). Again the list of beneficial impacts resulting from BSP was impressive. The 10 agricultural research centers under PCARRD

administration have been surveyed and classified according to Soil Taxonomy. The Prime Minister has instructed the Bureau of Soils to undertake a Land Response Evaluation Survey of the whole country, and the soils are to be mapped by use of Soil Taxonomy with the Benchmark concepts to be used as far as possible. The Director of the Bureau of Soils made the observation that unlike many other technical aid programs, no strings were attached to the BSP and SMSS programs. A faculty member from the Department of Soils at the University of the Philippines Los Banos (UPLB) observed that they would have appreciated being even more involved in BSP. He also stated that he had initiated a program to reclassify Philippine soils using Soil Taxonomy. Dr. Ed. Rice, USAID Mission, accompanied the review team on all field inspections, even over the weekend. He showed a deep understanding and enthusiasm for BSP, a most impressive and professional AID officer.

Furthermore, it is significant that countries which have not been directly involved in BSP are seriously considering a commitment to the Benchmark concept as a philosophical underpinning to their own agronomic research strategy. An example is Fiji, where the Ministry of Agriculture and Fisheries in collaboration with the New Zealand Soil Bureau through a bilateral technical aid project has undertaken detailed soil survey and taxonomic characterization of soils on the national network of experimental stations. This will be followed by a crop experiment and management program which will use Benchmark concepts to extend crop trial results to farmers' fields on the basis of the soil family.

Another implication, common to any successful research, is posed by the question: what next? The team has been exposed to, and very interestd in comments about IBSNAT. The team is inclined to take the view that a meticulous analysis of the Benchmark experience should be one of the dominating factors in the design of the IBSNAT strategy. For instance, there is little doubt that the pedological dimension of BSP could have been more professional and complete. Characterization of each site for mapping unit variability; more precise taxonomic identification; and more precise correlation of subsidiary but potentially important morphological features, are all aspects which should not be neglected in any future project of this type, including IBSNAT.

GENERAL RECOMMENDATIONS

1. AID, and organizations and individuals working within AID funded programs, as well as others interested and involved in accelerated agrotechnology transfer, should consider the principle of agrotechnology transfer by soil families to have been sufficiently tested by BSP to use it operationally. However, this usage should be with an awareness of the limitations of the tests conducted to date and thus with appropriate caution in its general application. Correlations of response to fertilizers and crop yield with permanent, stable soil properties diagnostic of soil families should be more fully established as soon as possible--though such is beyond the time limits of the BSP.

2. AID and the organizations participating in BSP should widely publicize the findings and conclusions of BSP to date, and at the same time identify the additional data collection, testing and analyses needed for a more complete quantitative and scientifically-based testing of agrotechnology transfer. These additional tests and studies should include close multidisciplinary collaboration of pedologists, other soil scientists, agronomists, statisticians, plant scientists and social scientists.

3. AID, personnel of participating and cooperating agencies and consultants to BSP are urged to publish the methodologies and results of the BSP studies in refereed journals as soon as possible, as these are major findings and concepts of which the scientific community should be aware and which should be discussed, evaluated, tested and developed further by all who can contribute. A suggestion is to approach the editor of Soil Science about devoting an entire issue of that journal to BSP and similar activities.

4. Future studies should include efforts to determine quantitatively the effects of agrotechnology transfer, and the use in transfer models of the permanent soil properties diagnostic for the respective soil families.

5. Efforts should be made by SMSS and host countries to obtain detailed soil maps, prepared according to Soil Taxonomy, of the BSP sites and of the immediately surrounding areas.

6. Any future testing of the agrotechnology-soil family transfer hypothesis should include studies of spatial variability of key soil properties of the sites, analyzed by geostatistical methods and geographically located by kriging techniques. This type of activity is beyond the time span available to BSP and therefore must be followed up by others.

7. AID and others interested and involved in agrotechnology transfer should remain aware of other means of agrotechnology transfer, specially while the soil family-agrotechnology transfer technique is being strengthened and the ranges of its further applicability determined.

8. In evaluation of the benefits and contributions from BSP, the accessory, complementary and other spin-off benefits resulting from BSP should be fully considered and exploited. This should include--but not be confined to--the testing and resultant improvements in soil family classification in ST, development of quantitative methodology for testing transfer models, generation of extensive soil temperature and moisture and meteorological data at the sites, training of host country personnel, N-fixing fuelwood tree data, crop-soil matching, soil erosion indexing, and testing of soil management systems.

9. To maximize the benefits from experiences in the BSP and from similar activities funded and conducted by AID and others now and in the future, a chart shoultd be completed for each country in which there is significant activity showing the relationships among and responsibilities of each group to be involved in the agrotechnology transfer process and associated inventories of soil resoruces. This chart could have headings along the lines of the following:

	Reconnaissance & Generalized Soil Maps	Descriptions & Analysis of Reference Pedon	Soil Mapping Evaluation	Soil Fertility	Testing for Agro-technology Transfer
Organizations(s) Responsible					

This could be similar to the analyses and charting of South Pacific countries done by the New Zealand Soil Bureau for the South Pacific Commission in 1976 and updated in 1982 (Reference: Morrison, J. and D. M. Leslie. 1982. Proceedings of the South Pacific Forum in Soil Taxonomy, Suvd, Fiji, 1981).

10. Carefully designed data bases and data banks should be established as soon as possible for storing and accessibility of data collected by BSP and related projects. This should include maximization of compatibility of data collection, entry into storage data base sharing and networking of information systems. The activity should also include pedon data and descriptions. Provision for starting this activity could be made within the BSP closeout, but the bulk of the work will need to be done through subsequent projects. (This could be accomplished with the aid of the International Board of Soil Research and Management (IBSRAM) when that entity becomes operational).

11. Brief, practical application and agronomically-oriented summaries of results of the BSP studies of the three soil families including the transfer, management and cropping systems experiments, should be prepared as soon as possible for use by participating host countries. These could be models for similar guides to be prepared for other soil families for use in all developing countries, as appropriate. These "writeups" should include descriptions of those properties of the soil families found to be most important in their use, management and conservation. These should also include available soil

temperature and moisture data as well as meteorological data from the sites. They should include interpretations as to crop suitability, soil potentials, soil fertility problems and needs, moisture-supplying capacity and soil conservation needs. The interpretations should draw as much as possible on the information contained in the SCS Form 5 files.

12. The nature and scope of the transition to IBSNAT from the BSP should be outlined as information for host countries, those involved with SMSS and the Soil Management CRSP, and other interested agencies and persons.

SPECIFIC RECOMMENDATIONS

1. The BSP activity in Cameroon at the Barombi Kang site should be continued through at least one more cropping season to provide a more complete and usable set of data. The collection of data and wrap-up work in the Naga location of the Philippines should continue through June, 1983 to assure greater completeness and usefulness of the data. Additional time beyond the present May 31, 1983 closing date should be granted for analysis and other wrap-up of the project, up to one year. A reasonable amount of additional resources should be made available to ensure this summarization of the project results as needed, and for completion of other aspects of the project as identified in the General Recommendations.

2. Detailed soil maps should be prepared for each primary and secondary site and immediately surrounding area, using the procedures of Soil Taxonomy. This activity could be carried out by SMSS and the host countries.

3. The classification of the site at Davao should be changed based on all available data, as it does not appear to be a Typic Paleudult. The classification of the Naga sites in the Philippines should be changed from isothermic to isohyperthermic based on soil temperature data. The classification of the Hydric Dystrandept site at ITKA in Indonesia should be re-examined when 15-bar water data become available.

4. Pedon data analyses for each primary site should be added to the BSP record file and archieved for future reference--some are not now available for some of the Philippine sites.

5. Consideration should be given by AID to designating Cameroon as a West African Regional Center for soil programs and related activities--based on our observations that it is an "Africa in miniature" relative to soil patterns and environments, there is strong interest and support in the Cameroon IRA for such activities, the country is both Francophone and Anglophone, and the political situation seems stable there.

6. Any additional soil taxonomy, fertility and soil management activities in Cameroon should be coordinated with the National Cereals Project and the FAO and ORSTOM soils activities there.

7. AID should give encouragement and support to acceleration of the completion of the inventorying of the soil resources of Indonesia.

8. AID and projects funded by it, should encourage and support the followup of BSP activities by the host countries, including soil erosion measurements and indexing, management and cropping experiments collecting additional data on N-fixing trees, and workshops emphasizing utilization of BSP findings and data.

9. The observations during the BSP field activities concerning crop-soil matching and mismatching and occurrences of downy mildew in the isothermic and isohyperthermic soil temperature areas sugges the need for SCS and the appropriate International committees to re-examine the ranges and numbers of classes in the iso-soil temperature environments in the intertropical regions. This should be followed up by Soil Management Support Services (SMSS) with the aid of BSP data and observations of BSP personnel.

Review Panel
January 16 - February 4, 1983

Date	Day		Itinerary
Jan 16	Su	AM/PM	Gast and McCracken depart from U.S. Leamy arrive in Paris with Tsuji. Accommodations at Penta Hotel.
17	Mo	AM	McCracken and Gast arrive Paris (ORY) via PA 114 at 9:00 AM. Arrive at Penta Hotel at 10:30 AM.
		PM	Meeting of members with Tsuji.
18	Tu	PM	Depart Paris (CDG) via UT 709 at 12:30 PM after 2 hr delay. Arrive Douala (DLA) at 6:50 PM. Met by Don Berger and contingent involved in Soil Taxonomy Forum--Uehara, Ikawa, Eswaran, R. Guthrie, and G. W. van Barneveld. Accommodations at Mountain Hotel in Buea.
19	We	AM	Travel to Barombi Kang. Inspect soil profile and experiments at both primary and secondary sites in company with Berger, Tsuji, Uehara, Ikawa, Eswaran, J. C. Griesbach (FAO-Ekona), and Moukam (Ekona-Res.) Met by Kinge David and Mbonde Paul. Lunch at Kinge's house in Kumba.
		PM	Visit soil profiles used in Forum at Upper Farm and Bokwango on slopes of Mt. Cameroon. Both are Typic Dystrandepts. Accommodations at Mt. Hotel.
20	Th	AM	Meet with personnel at Ekona Research--Dr. S. N. Lyonga, Chief of Center; Griesbach, FAO Team Leader; Jan Hof, FAO expert; Kinge, Berger, and Tsuji. Lunch at Don Berger's home.
		PM	Travel to Douala to Yaounde; Hotel in Yaounde. Travel Douala to Yaounde via UY 540 departing at 3:00 PM and arriving at 3:30 PM. Accommodations at Hotel Sofitel in Yaounde.
21	Fr	AM	Met briefly with Dr. A. Moustafa at 8:30 AM at USAID office. Travel to N'kolbisson. Met with C. Tobias and ORSTOM staff at 9:00 AM, with H. Talleyrand of IITA/AID National Cereals Program at 10:00 AM and met with Dr. J. P. Eckebil, Director, and J. Maimo, Deputy Director, IRA.
		PM	Panel Meeting with Berger and Tsuji at Sofitel in Yaounde. Dinner with Eckebil, Maimo, and Moustafa at Le Central Hotel. Travel to Douala via UY 759 at 10:35 PM, arriving at 11:00 PM. Accommodations at Sawa Novotel Hotel.

Date	Day		Itinerary
Jan 22	Sa	AM	Travel to Paris via UT 706 at 10:30 AM.
		PM	Arrive Paris at 4:35 PM. Travel to Geneva via SR 729, arriving at 8:15 PM. Accommodations at Alba Hotel, Geneva.
23	Su	PM	Travel to Bangkok via SR 198 at 1:40 PM
24	Mo	AM	Arrive Bangkok at 8:30 AM. Accommodations at Sheraton Bangkok. Rest and sightseeing.
		PM	Dinner with Lec Mancheran and wife from Soil Survey Division of the Land Department.
25	Tu	AM	Travel Bangkok to Jakarta via TG 413 at 11:00 AM arriving at 3:30 PM. Met by J. A. Silva and R. G. Manuelpillai.
		PM	Travel Jakarta to Bogor. Accommodations at Bogor Botanical Gardens (Kebun Raya). Dinner at Dr. Muljadi's home with Dr. Sudjadi of CSR, A. R. Hurdus of USAID and Dr. N. P. Kefford, Dean, HITAHR, University of Hawaii.
26	We	AM	Tour of Botanical Garden from 8:00-9:00 AM. Meet with CSR, USAID, and other agency staff in Bogor from 9:00 AM - 12:00 PM. Lunch at CSR hosted by Muljadi.
		PM	Travel to LPH site (Hydric Dystrandepts) with Muljadi; Hurdus (USAID), Kefford, and Subagio. Travel to Jakarta. Arriving at Sahid Jaya Hotel at 7:00 PM.
27	Th	AM	Travel to Telukbetung via GA 200 at 7:30 AM accompanied by Hurdus and Ken Prussiner of USAID arriving at 8:00 AM. Met by Dr. Sudjadi. To Nakau site by van arriving at 9:30 AM. Inspection of soils and site at Nakau from 9:30 AM - 12:00 PM. Lunch at BSP office.
		PM	Return to Jakarta via GA 209 at 2:00 PM. Panel Meeting at hotel (Sahid Jaya) with Silva, Tsuji, and Manuelpillai.
28	Fr	AM	Meet with Deputy Director of USAID mission, Walter Tappan, Hurdus, and Prussiner in Jakarta.

Date	Day		Itinerary
Jan 28	Fr	PM	Travel to Manila on PR 538 arriving at 5:50 PM. Met by M. E. Raymundo of BSP and A. Maglinao of PCARRD. Accommodations at the Silahis International.
29	Sa	AM	Travel to Davao via PR 113 at 9:20 AM accompanied by Maglinao, Raymundo, and Dr. E. Rice of USAID, arriving at 10:50 AM. Met by E. Fernandez.
		PM	Lunch at BPI site. Inspection of soils and site. Return to Manila via PR 118 arriving at 8:50 PM. Accommodations at Silahis International.
30	Su	AM	Travel to Legaspi at 9:30 AM via PR 177 with Rice, Raymundo, Maglinao, and C. Alcalde of the Bureau of Soils. Met by P. Vicente and A. Pago. Visit SOR site. Lunch at site.
		PM	Travel to Naga. Accommodations at Aristocrat Hotel in Naga City.
31	Mo	AM	Inspect both PUC and PAL sites.
		PM	Travel Naga City to Manila via PR 264. Dinner at Swiss Inn hosted by G. N. Alcasid, Director, Bureau of Soils. Travel to Los Banos. Accommodations at SEARCA Guest House, UP Los Banos Campus.
Feb 1	Tu	AM	Meet with PCARRD, Bureau of Soils, UPLBCA, and USAID at PCARRD offices in Los Banos. Met by Raymundo, Maglinao, Alcasid, and Betty del Rosario, formerly UH/BSP graduate student and currently at PCARRD.
		PM	Lunch at PCARRD hosted by Dr. Ramon Valmayor, Executive Director of PCARRD. Visited IRRI facilities. Met with Dr. Dennis Greenland of IRRI, Dr. Bruce Miller of New Zealand, and Dr. Armand van Wambeke of Cornell.
2	We	AM	Travel to Manila.
		PM	Travel Honolulu via Tokyo on PA 012/830.
2	We	AM	Arrive in Honolulu at 8:30 AM. Check-in at Princess Kaiulani. Inspection visit of soils and experiments at Waipio site from 11 AM to 12:30 PM. Met by Uehara, Ikawa, Eswaran, P. Ching, Hawaii agronomist; Lori Murai and Val Ah Loy; Tsuji, Cagaunn, Silva, Gill and Bertrand, graduate students Awemo and Varde.

Date	Day		Itinerary
2	We	PM	Rest
3	Th	AM	Meet with UH staff/administration at 9 AM in St. John 106 including Dean Kefford, Assistant Director Ada Demb, and Wallace G. Sanford, Acting Chairman, Dept. of Agronomy and Soil Science, and Foster Cady, BSP consultant.
		PM	Meet with BSP staff.
4	Fr	AM	Prepare draft of final report.
		PM	Panel presentation of final report at 3:45 PM in Gilmore 112.
5	Sa		Panel depart from Honolulu and return home.

attachment #2

MAR 18 1983

University of Hawaii at Manoa

College of Tropical Agriculture and Human Resources
Benchmark Soils Project
Department of Agronomy and Soil Science
2500 Dole Street • Krauss Hall 22 • Honolulu, Hawaii 96822
Telephone: (808) 948-8858 / Cable Address: UNIHAW

March 10, 1983

Dr. T. S. Gill
Chief, Renewable Natural Resources
Office of Agriculture
Bureau for Science and Technology
Agency for International Development
Washington, D.C. 20523

Dear Dr. Gill:

RE: CONTRACT NO. AID/ta-C-1108

This is a request to extend the termination date of the abovementioned contract from May 30, 1983 to May 31, 1984 without any additional funding. The additional period will allow us to complete the scope of work originally planned in the Schedule.

These include the following activities:

- Collection of final sets of data from transfer experiments in the Typic Paleudults in Cameroon, Indonesia, and the Philippines and in the Hydric Dystrandepts in the latter two countries. The last set of experiments are scheduled to be harvested in late May to June.

- Analyses and interpretation of data for inclusion in the statistical testing of transference.

- Compilation of soil, weather, and crop data sets in computerized format.

- Publication (including typesetting and printing) of manuscripts, proceedings, and reports currently in press.

- Preparation and publication of the final report.

- Resolution of equipment inventory and transfer and settlement of expenditure reports from Cameroon, Indonesia, the Philippines, and Hawaii.

- Collection of additional height and girth data of NFT tree trials in Cameroon, Indonesia, the Philippines, and Hawaii.

- Collection and compilation of cropping systems experiments planted throughout the 3 family network.

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The remaining funds will be used to support these activities in terms of salary, travel, supplies, computer time, and publication costs.

If there are further questions regarding this request, please contact me at your convenience.

With kind regards.

Sincerely yours,

Gordon Y. Tsuji
Project Manager

GYT:nm

cc:J. A. Silva
G. Uehara