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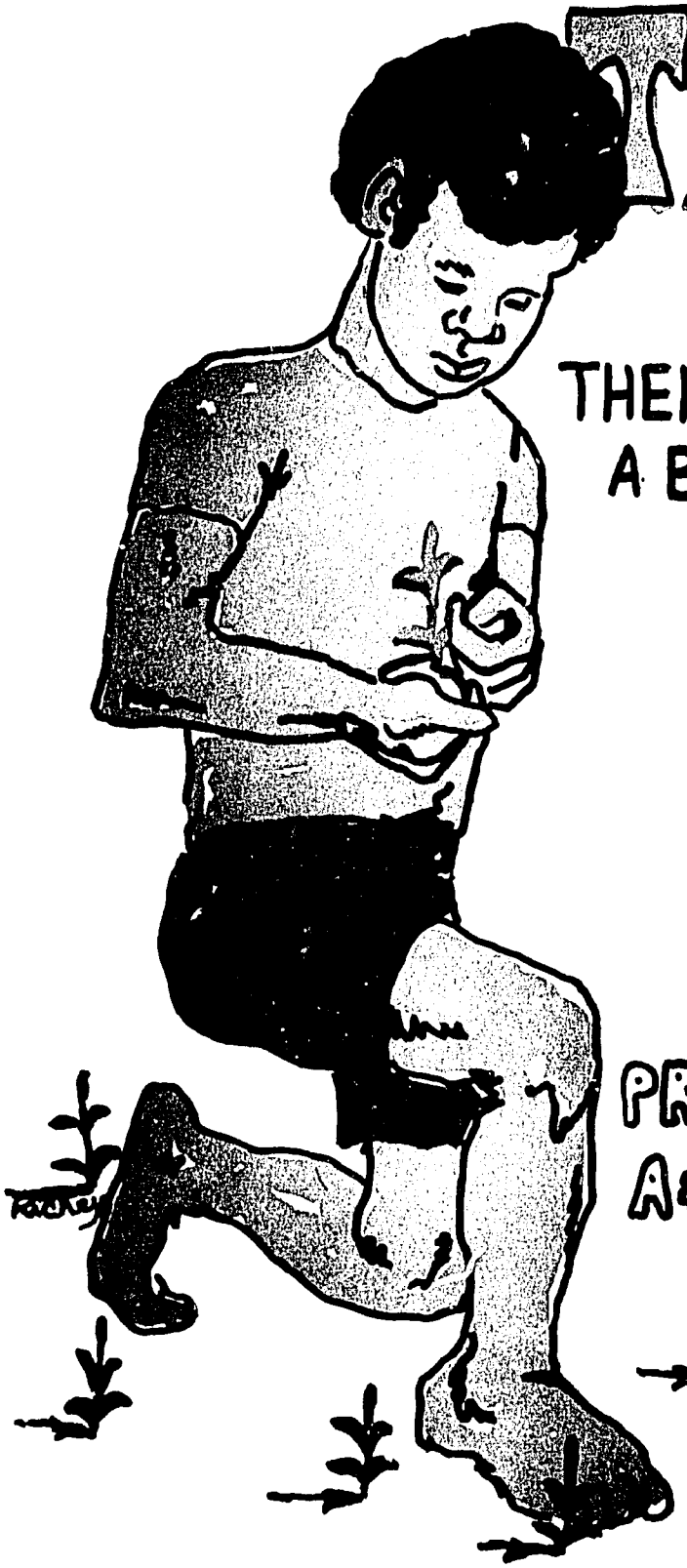
SOILS OF THE TROPICS:

THEIR UTILIZATION FOR A BETTER RURAL LIFE



PRAIRIE VIEW
A&M COLLEGE
1972

Bulletin No. 2

" There are, really, but two great sources of national wealth- the soil and the mind of a nation. Where do we find the most prosperous individuals, communities, and nations? Where the mind and the soil are most cultivated. If, then, the cultivation of these adds wealth, power, and prosperity to a nation, the lack of either, where it might abound, is so much waste of national capital.

Isaac Newton, Commissioner
of Agriculture
First Annual Report
of the U.S. Department of
Agriculture to President
Abraham Lincoln - year, 1862

"SOILS OF THE TROPICS - THEIR UTILIZATION FOR A BETTER RURAL LIFE"

Proceedings of a Workshop
School of Agriculture
Prairie View A&M College
Prairie View, Texas
October 2-6, 1972

Series I: Characteristics and Utilization of Savannah Soils

Bulletin No. 2

Our sincere appreciation is extended to Dr. Humphrey Ezumah, of the Tropical Soils Staff, for his efforts in organizing and editing the information contained in this bulletin.

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For editorial convenience, the papers are divided into two sections as follows:

Section I

Contributions of participants whose manuscripts were available during the workshop.

Section II

Summary of pertinent commentary made by participants who did not present manuscripts.

Editorial Committee:

Dr. J. I. Kirkwood (Chairman)

Dr. E. Brams

Dr. J. B. Collins

Mr. O. E. Smith

Mr. Y. P. Chang

Mr. C. E. Lopez

A C K N O W L E D G M E N T

Sponsors of the workshop wish to thank Dr. A. I. Thomas for his warm welcome, Dean J. C. Williams for his cooperation and guidance, Mr. J. I. Kincaid for escorting the visitors through Houston, Mr. O. E. Smith for his splendid tour of the Experiment Station, Mrs. J. I. Kirkwood for her hospitality at the Workshop Bar-B-Q, and the secretarial staff for their continued conscientious efforts - all contributing to the success of the meetings.

Special thanks are given to Dr. Curtis Godfrey of Texas A&M University, Mr. Wayne Williams and Mr. Vince Hare of the Soil Conservation Service, and Mr. Engbrock and Mr. Poole, Waller County Agricultural Agents.

Our thanks are also expressed to all the many other individuals and organizations who contributed to make the workshop a successful endeavor.

AIMS OF THE WORKSHOP

A workshop, "Tropical Soils - Their Utilization for a Better Rural Life," was sponsored by Prairie View A. & M. College, School of Agriculture on October 2-6, 1972 under the 211 (d) grant of the Foreign Assistance Act. Contributors included staff of the USAID Consortium for Tropical Soils (Prairie View A. & M., Cornell University, University of Hawaii, North Carolina State University, and the University of Puerto Rico) and Texas A&M University, the Soil Conservation Service of the U. S. D. A., Texas A&M University Experiment Station, and USAID. Participants included faculty members from Florida A&M University; Alcorn A&M College, Mississippi; Texas Technical University; Sam Houston University; Texas A&I University; students of Prairie View and others.

The aims of the workshop were three-fold:

1. To conceptualize the overriding problems of agricultural development in the tropics, particularly as they relate to soils.
2. To promote concern by U. S. universities for these problems and to share ideas for their solution.
3. To examine the opportunities for agronomists to serve in international agricultural development with a commitment to aid directly the rural poor in the U. S. and in tropical areas worldwide.

Three major areas of concern were reflected in the papers. First, papers were presented concerning management aspects of tropical soils;

specifically soil classification for land use planning, cultural systems on tropical soil, and physical and chemical properties of tropical soils as related to plant nutrition. Secondly, a group of papers were presented which reported on programs for the rural poor in Texas; and on programs for developing nations, dealing specifically with the utilization of soils in West and East Africa, Hawaii, Southeast Asia, and the Caribbean area. The contributors' experiences in these areas were valuable and enriching inputs. The third concern was the education of agronomists to meet the needs in tropical regions, - a part of the USAID thrust in developing the expertise and fostering innovations in the teaching of soil science.

In addition to the formal presentations of papers, there were informal discussions and field trips. The workshop provided an ample opportunity for the participants to draw from the diverse experience of one another. It was, therefore, considered worthwhile for a follow-up workshop to be arranged in the near future.

OPENING REMARKS

Dr. A. I. Thomas, President
Prairie View A&M College

President Thomas welcomed the group and told them of his faith in the co-operative efforts of the consortium on Tropical Soil by the participating universities: Cornell and North Carolina State Universities and Universities of Hawaii and Puerto Rico, and Prairie View A&M College. The group was challenged to use their combined efforts to help solve the problems of hunger, disease and ignorance throughout the world.

Dean J. C. Williams, Dean
School of Agriculture
Prairie View A&M College

Dean Williams welcomed the group of consultants and participants and thanked them for coming to participate in the workshop. He said that his office and facilities were open for the visitors' unlimited use during their stay for the workshop.

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*These summaries were recorded by Prof. O. E. Smith of Prairie View A&M College

SECTION I

"PRAIRIE VIEW'S THRUST FOR THE RURAL POOR IN TEXAS AND WORLD-WIDE"

James I. Kirkwood
Prairie View A&M College

Rural poverty and the problem of no or low income of people who live in open country, small towns and villages is a problem not only of a rich nation such as ours; but rural poverty, particularly in the tropics, is a problem of world-wide dimensions. From the agronomists' point of view, although cultural differences tend to mask the similarity of the causes of the poverty of millions who subsist on the land, this poverty can be accounted for by common underlying causes. Such causes as soil erosion, depletion of nutrient reserves, deterioration of soil structure, increased incidence of soil-borne diseases, weed infestation and the use of low-yielding varieties are the main contributors.

The basic thrust of the Agricultural Research Program at Prairie View A&M College is directed toward improving critical life chances, social conditions, and economic resources of the rural poor in Texas and in tropical countries through a common approach.

In resolving the problems of the low-income populations, and in order to facilitate the development of human resources and potentials for constructive self-realization of individuals, these problems are being viewed from at least three different perspectives.

<u>Demographic</u>

1. Viewing problems in aggregate populations relative to crucial life chances, deographical mobility, and distribution or location of these populations.

Individual and Family

2. Viewing problems from the perspective of individual values, motivations, attitudes, capabilities, social orientations, and life experiences.

Community structure

3. Viewing problems in terms of the community structure, because regardless of life chances of individual attributes, and the nature of family circumstances, the rural poor are either limited or facilitated in the development of their potentials by larger external, social and economic forces inherent in the community of residence or some larger unit.

It is obvious that any broadly significant long-run solution to basic problems facing the rural poor in any part of the world will require analysis and synthesis of all these perspectives to ameliorate negative conditions for development of individuals, families and communities.

The report by the President's National Advisory Committee on Rural Poverty, The People Left Behind, clearly documents the need for this kind of understanding of the problems of the rural poor and for applied, experimental research and action programs that will help The People Left Behind to alleviate these problems and improve their critical life chances.

At Prairie View, the increasing concern for the "people left behind" and their problems is currently being translated into planned research programs and projects with a multi-disciplinary approach involving Home Economics, Social and Natural Sciences, and Agriculture. This program is being supported by funds allocated to the Prairie View Cooperative Research Center under the research programming of the Cooperative State Research

for the 1890 land-grant colleges.

The over-all program at Prairie View encompasses three main areas or thrusts:

Program No. 1 is entitled, "IMPROVEMENT OF THE ENVIRONMENT IN RURAL AREAS CLOSE TO URBAN CENTERS (HOUSTON, GALVESTON, BEAUMONT TRIANGLE OF SOUTH TEXAS)".

The primary objective of this program is to help alleviate conditions that contribute to the degradation of the environment in rural communities. Prairie View A&M College will address itself to the solution of the following: (1) Waste disposal including crop residues in the soil, (2) land use planning in rural areas affected by urban encroachment and (3) pest management.

One project submitted for approval under this program is entitled:

"Heavy-Metal Pollution of Soils: Effects on Agricultural Produce of Areas Adjacent to Urban Centers."

Justification: The production of vegetables and other farm products under intensive farming methods is a developing industry in the areas adjacent to the large urban and industrial centers along the upper Texas Gulf Coast. This is an area of large industrial complexes, and indications are that metal fallout from these industries is contaminating the agricultural soils in proximity to the city, and constitutes a serious and potential hazard to the health of the consumer of product from these farms. For example, concentrations of lead, cadmium and arsenic in the agricultural soils of the area is not known, nor is the degree of contamination of the produce from these soils under field conditions.

This project will (1) determine the

concentration of Pb, As, Cd, as well as Zn, and Hg in soil, farm ponds, and domestic water supplies in rural areas in proximity to large urban centers during different periods of the year. (2) Determine the concentration of Pb, As, Zn, and Hg in crops taken from soil under intensive agriculture near urban centers and (3) develop methods by which Pb, As, Cd, Zn, and Hg can be made unavailable to the plant or immobilized in the soil.

Program No. 2 is entitled, "IMPROVING CRITICAL LIFE CHANCES OF DISADVANTAGED MINORITY POPULATIONS AND COMMUNITIES IN TEXAS."

The objectives of this program are: (1) To develop research aimed specifically at resolving problems of low-income populations, particularly those involving racial and ethnic minorties; in order to facilitate the development of human resources and potentials for constructive self realization of individuals; and simultaneously, (2) to improve the prospects for community growth and improvement.

The approach we have taken in developing this program and projects involves collaborative relations with Texas Agricultural Experiment Station Staff for assistance in developing and implementing projects that can give quick visibility, as well as plan for long-term needs. Priority has been placed on recruitment of competent research staff and graduate assistants to be trained to implement the research projects established and to project new ones. The projects currently funded under the program are as follows:

(1) "Food Choices and Nutritional Health of the Older Age Group."

The objectives are:

A. To identify potential for modification of food choices to improve nutritional health.

B. To contribute to refined methods of measuring nutritional status in nutritional health.

C. To correlate food choices with nutritional status of individuals in selected population groups with emphasis on age 60 or over.

The study will focus on males and females 60 years and older. The goal is to involve 250 males and 250 females for a total of 500 subjects to make a statistically ratio test. Subjects will be selected to provide 250 in each ethnic group: white (Euro-American), black (Afro-American), and to get a representative sample of lower income levels according to the 1970 census. Subjects will be selected on the basis of their willingness to cooperate. Expected stability of location of residence will be considered. Family members may be included for certain elements of the research.

The School of Home Economics has acquired some special research equipment for reliable and valid measurement of a food's volume, character, acidity of food systems, and quality variables of meats among other nutritional characteristics of foods.

(2) "Factors Affecting Patterns Living of Disadvantaged Families."

The specific objective of this proposal is to utilize both the Texas and interstate regional data already collected, to investigate how Black families and other ethnic subpopulations are influenced by individual members who are either mentally, emotionally, or physically handicapped with reference to two areas:

A. Differentials in incidence and degree of family disability among different social groupings, particularly Blacks and others ethnic minorities.

B. Differential associations of presumed causal factors of family disability and presumed effects on magnitude of family stress, patterns of internal family processes, and how the family relates to other external social units.

Utilizing the knowledge gained from analysis of the data mentioned above, additional data, related specifically to Texas families experiencing member disability, will be collected and analyzed to provide a more detailed set of information and more precise measures of nature and degree of disability and how this relates to availability of community facilities, programs, and services that might ameliorate family stress.

The initial phase of the project, "Black Families Under Stress: A Metropolitan-Nonmetropolitan Comparison of Human Disability in a Southern Area" has been completed. Findings indicated that, for the population studied, education, income and occupation had more significant effect on family disability that did M-NM residence. The families affected by disability generally had one disabled member and that tended to be the homemaker or one of her children; and, when disability existed in the family, the degree of disability for the individuals involved tended to be acute.

Future projections for home economics research include a continuation of studies of the critical life chances and social conditions of disadvantaged minority populations and communities in southeastern Texas counties. Specific broad research problem areas to receive consideration are: social-emotional development of families;family structure and function; family planning; nutritional status; housing and environs; human needs and psycho-social-cultural aspects; clothing; resource development, allocation and use; levels of living; community program needs; and family influence on and response to public programs.

(3) "Change in the Nature, Composition, and Socio-Economic Conditions of Black Families in Texas."

The objectives of the proposed research is to describe the patterns of family life among Black families in metropolitan areas, to assess the level of living among these families at various stages of the family life cycle, and to evaluate the trends and conditions emerging from the analysis in reference to comparable groups of nonwhite families.

The emphasis will be on a comprehensive description of the Black family and will rely primarily on U. S. census data. It will focus on the Black family as a unit of analysis and attempt to project in time some trends and patterns relevant to urban development and socio-economic needs.

Program No. 3 is entitled, "ECONOMIC OPPORTUNITIES FOR RURAL FAMILIES IN SOUTHEAST TEXAS TO IMPROVE THEIR INCOMES."

The objectives of this program are: (1) to determine ways to generate and improve incomes for rural people based upon production and marketing of farm products from small low-income farms, (2) to investigate opportunities to combine off-farm employment with farming operations and (3) to develop a research capability at Prairie View A&M College that can provide practical assistance in resolving low-income problems in rural areas. The specific projects are:

(1) "Analysis of Technical and Economic Problems in Alternative Systems of Producing and Marketing Selected Vegetables." The objectives are:

A. Determine the retail market demand for vine-ripened tomatoes and fresh sweet corn in alternative fresh vegetable consumer outlets.

B. Determine the alternative methods of delivering tomatoes and sweet corn from the farm to the consumer market.

C. Determine the production systems and cultural practice that provide the desired type of tomato and sweet corn demanded by the consumer.

D. Determine the various costs of on-farm production under various resource situations, including operator management capabilities.

Alternative packaging display in various types of markets will be tested; weekly patterns of consumer demands will be determined. Evaluation will be made of the potential means of delivering the vegetable products to market. Technical inputs will be determined.

(2) "Economic Feasibility of Pre-Broiler Production by Low-Income Farm Families." The objectives are:

A. Determine the market potential for pre-broilers in the Texas Gulf Coast area.

B. Determine the most efficient methods of marketing the birds, including producer-buyer arrangements, processing, and distribution to market outlets.

C. Analyze the costs of producing live birds under various technical production methods.

D. Evaluate the comparative efficiencies of the cage and litter pen types of bird confinement.

E. Investigate nutritional and confinement management factors in production.

F. Evaluate meat strains of birds most suitable for pre-broiler production.

Three hundred 1-day old commercial bred broiler chicks will be randomly divided into lots. Half the lots will be grown under litter-pen management and half under cage management to market age of 3, 4, and 5 weeks. Chicks under each system will be of 4 different stocks and exposed to two rations. Daily observations will be collected. All data will be computerized. Analysis of costs will be made. Market potential will be determined.

(3) "Alternative Technical and Economic Systems of Swine Production and Marketing on Small Farms in The Texas Gulf Coast Area." The objectives are:

A. Determine the most effective alternative marketing of feeder pigs, including contractual arrangements and specialized feeding-out of the pigs.

B. Analyze the costs of production, under different systems of production, with special emphasis upon the various on-hand farm resources on small farms.

C. Evaluate the technical effects in the Texas Gulf Coast areas, of:

1. The optimum level of protein for the growing stages.

2. Kinds and levels of protein upon lean-cut yield and efficiency of gain.

3. Confinement systems.

D. Evaluate the technical and economics of waste disposal in feeder pig production under various systems of confinement.

Field survey and interview of small farmers who have small swine enterprises will be used to obtain basic data regarding technical and economic factors involved in production and marketing swine. Cost returns analysis of the field data will be performed.

A small-scale controlled experiment on the Station for evaluation of the technical and economic results of producing feeder pigs and slaughter hogs, and marketing "finished" hogs under alternative systems will be tried. Alternative means of waste disposal will be evaluated.

COOPERATIVE EFFORTS WITH TEXAS A&M UNIVERSITY

A number of current research efforts are aimed at problems related to human rural development, but they do not include the holistic, interdisciplinary focus or emphasis on disadvantaged minority groups and their intergroup relations described here. The report by the President's National Advisory Commission on Rural Poverty, The People Left Behind, clearly documents the need for this approach.

In addition this program will offer significant, close, formal cooperation between predominantly white and predominantly Black Land Grant Institutions for mutual benefit.

The expanded funding to Prairie View A&M College by the CSRS under PL 89-106 in 1971-72, made possible a continuation of the cooperative approach enjoyed between the two institutions. At the request of the President of Prairie View A&M College, administrative and scientific personnel from the Station cooperated with Prairie View Staff (both College and TAES) in developing the research programs which were submitted to CSRS. Several members of the Station staff at the Main State Experiment Station at College Station were requested by Prairie View A&M College to accept joint appointments to initiate the research programs. In the development of the programs, previous and on-going Station research in the areas of interest to Prairie View were reviewed to avoid duplication of effort. This cooperative approach to research planning and resource allocation has enabled rapid development of a quality research program at Prairie View A&M College. Continued cooperation of this nature is planned as the programs evolve.

A spin-off from the research program for the "People Left Behind," supported by the 211 (d) Grant in Tropical Soils Research, has enabled our staff to initiate and conduct the following line of research presently under investigation.

A. Interaction of Pesticides with Soil Microorganisms and Subsequent Effects in The Ecosystem.

B. Mineral Nutrition of Soybeans in Relation to Fertilization and Plant Growth Regulators.

C. Movement of Pesticides in Soil and Water As Related to Rainfall Runoff and Infiltration.

D. The Absorption and Strength of Bonding Zinc in Texas Soils.

E. The Mineralogy of the Clay Colloids of Savanna-Prairie Soils, A Correlation of the Mineralogical Properties of Savanna-Prairie Soils of Diverse Tropical Areas.

F. Management of Soil Fertility Under Grassland Farming As It Affects Soil Properties, Forage Yields and Quality.

G. Residual Effects of Hirbicides and Insecticides on Forage Yields and Production of Orgaric Matter and Microbial Population in Surface Soils.

H. The Influence of Soil Treatments Such As, Hirbecides, Clay Amendments, Lime, Fertilizer, and Manure on Availability of Soil Al, Fe, P, and Micro-nutrients as They Affect Nutrient Uptake, Plant Yield and Quality.

I. Evaluation of Tropical Legumes under Savanna Ecology.

J. Development of Grouping Systems For Prairie-Savanna Soils and Their Effects on Crop Yields, Soil Properties, Fauna and Flora of the Ecosystem, and Their Economic Development.

Several scientiest on the Prairie View Agricultural Research Team have focused their efforts on helping to improve the chances of the rural poor and on solving basic agronomic problems which contribute to rural poverty. As one solution, a program of intensive cultivation of fruits and vegetables by rural people living close to large urban centers is being tried as a means to improve the quality of their lives; and perhaps induce some migration from distressed urban centers to the countryside where a productive life is possible. These scientists have extended their concern to the impoverished areas of other countries as well; and have extrapolated their experiences to the tropical and sub-tropical areas of the Caribbean and West Africa.

Increases in national revenues of most tropical countries depend on greater agricultural production achieved through the family unit which, with certain inputs, can undergo change from subsistence farming to modified commercial production. This change process is very slow and major emphasis must be placed on increasing productivity, however small, of the subsistence farmer now.

Tropical soils differ markedly from temperate soils in morphology, properties, and response to treatments. In fact, they differ markedly from each other, reflecting the diverse environments and geomorphology of these regions. The diversity can be grouped into large biomes, or similar environmental units, such as high forest, upland swamps, arid and humid savannah etc.

The Soils Team of Prairie View A&M College has extensive experience with range soils situated on the Prairie Soils of South Texas. Because of its locale and specialization, it was given responsibility to accumulate information and develop competency in managing Savannah soils of the tropics by the Agency for International Development under a 211 (d) Grant.

These agronomists, who have had several years of experiences in agricultural programs is tropical countries, will show graphically the efficacy of small, hand powered tools for clearing, the use of varieties developed from indigenous plants adapted to harsh ecosystems and simple practices, weed control through chemicals or culches, the use of indigenous fertilizer materials and building techniques. They will show how innovations can be introduced by demonstration-education methods through the joint endeavor of the farmer and the change agents.

CULTURAL SYSTEMS ON TROPICAL SOILS

M. Drosdoff

Cornell University

Systems of soil and crop management in the tropics can be divided into three categories:

1. Traditional systems which have little or no benefit of modern technology or goods and services of modern industry.

2. Transitional systems which have incorporated into traditional farming systems some of the benefits of modern technology.

3. Modern systems such as commercial plantations which are able to take full advantage of available scientific knowledge and the products of modern industry.

TRADITIONAL SYSTEMS

The traditional systems may be divided into two broad categories: (1) extensive systems of shifting cultivation and (2) intensive systems of irrigated cropping, particularly flooded rice.

Shifting Cultivation

Shifting cultivation, sometimes called slash and burn agriculture, refers to the systems in which land is cleared by hand, most of the vegetation burned, and the land cropped by hand operations for one to three years. The land is then allowed to revert to natural vegetation for a period of five to twenty years before being cleared and cropped again. Meanwhile the cultivator shifts to another site and repeats the procedure. After a certain number of years of shifting from field to field, the cultivator begins the rotation cycle again on the field which

has been allowed to lie fallow and be regenerated by the natural vegetation. Sometimes the term "shifting cultivation" is applied to the practice of shifting the homesite or village periodically but more generally the term is now used to refer to shifting of fields around a more or less permanent site.

The practice of shifting cultivation or slash and burn agriculture is certainly not unique to the tropics. Modern agriculture in every civilization, whether in the tropics or in the temperate regions, has evolved from the traditional practices of some type of shifting cultivation. Letting the land lie fallow to regenerate its productivity after a period of cultivation was a common practice not so many decades ago in Europe and North America; and indeed is not uncommon today in some localities on these continents.

At present the practice of shifting cultivation is widespread over large areas of the tropics and in many regions, expecially in tropical Africa, where it is the predominant way of life for most of the people. There are a great many variations in the systems of traditional agriculture. Different names are used locally which are included under the general term of shifting cultivation. A few examples are: kaingin, Philippines; chena, Ceylon ; milpa. Central America; roca, Brazil; chitememe, Zambia.

Though these subsystems and many others come under the general designation of shifting cultivation, there are substantial differences in detail depending on the local conditions. Soil and climate, vegetation, settlement and land tenure patterns, population pressure, and many other factors influence the way in which shifting cultivation is practiced. For example in the

chitememe system on the sandy soils in Zambia in the dry forested areas, a small area is cleared and branches of trees from the surrounding area are brought in, piled up, and burned. A cereal crop such as millet is seeded broadcast with little or no preparatory cultivation and small amounts of other crops such as beans, sweet potatoes, and cassava are planted around the millet. The land may be abandoned after the first year or the cropping may be continued for another year or two depending on the conditions. Even within the chitememe system there are local differences in detail in the management practices. The area cleared may be no more than 30 feet in diameter or it may vary from place to place depending on the local conditions.

With the great range of soil and climatic conditions in the tropics and the social and cultural patterns of local communities, the possibility exists for an almost infinite variety of cultural systems within the broad category of shifting cultivation. The practices in the forested zones of humid tropics will be different than those in the open woodland or savanna areas of the lower rainfall areas; the indigenous communities in the Amazon basin have developed cultural systems different from those in Southeast Asia or West Africa. For those interested in more detailed information on the many kinds of practices included under shifting cultivation, suggested readings are listed at the end of this paper.

Despite the wide variety of systems of traditional agriculture in the tropics, there are certain important features which are common to all of them:

1. The primary objective is to supply the food needs of the family and the community; all other considerations are secondary. The provision of food dominates the life of the cultivator so that the traditional soil and crop management practices are an integral part of the whole social, cultural, political, and economic life of the community. As a way of life, it is difficult to modify or improve the system without a full understanding of the social and cultural aspects of the people. In many instances the introduction of better tools, improved seed, fertilizers and other benefits of modern technology have not succeded in modernization of traditional agriculture, because of a lack of understanding of the physiological and structural factors in the economic and social life of the cultivator, his family, and the community.

2. Shifting cultivation is an extensive system of farming and as such can only support a relatively low population density. The actual numbers will depend on several factors, of which, the kind of soil is an important one. On sandy infertile soils, a farm family may require 200 acres or more to maintain a stable system to provide a subsistence living. On the fertile alluvial soils, only 20 or 30 acres may suffice to support a farm family. In the acres in the tropics where land is still abundant, the practice of shifting cultivation provides adequate food and only at times are there temporary food shortages. The quality of the diet may not always be adequate, expecially in protein, but for the most part there are no serious deficiencies.

3. The traditional systems of shifting cultivation evolve in balance with the ecological environment. They are natural systems which have been developed by the cultivators through generations of trial and error to attain

and maintain a stable existence with nature. Shifting agriculture has often been criticized as being wasteful and inefficient but this criticism is hardly warranted. Given the conditions and the tools and resources available to him, the shifting cultivator has evolved an efficient way of life which has sustained him and his family for many generations. Though there have been many suggestions on how to improve the practice of shifting cultivation, it is difficult to find any documentation that a better system could have been developed given the resources and technology available.

4. Shifting cultivation is a flexible system in which the cultivator is continually adapting to his needs within the constraints imposed upon him by the environment and the resources at his disposal. The length of the cropping period, the kinds of crops grown, the length of the fallow period, and the timing of other practices are adjusted to meet the needs of the cultivator. The common practice of mixed cropping permits the growing of a variety of crops at the same time on the same field; and there is usually considerable flexibility in the choice of crops for a perticular set of conditions. In addition to food crops which take procedence, it may be possible at times to grow a cash crop which can be marketed locally.

5. Contrary to some critics, shifting cultivation is not necessarily detrimental to the conservation of soil and forest resources. As a matter of fact, one of the advantages of the practice is that it involves the minimum disturbance necessary for the production of a crop. The soil is only lightly cultivated with hand implements and many stumps and roots from which the forest regenerates are left in the ground. With a short cropping period, the forest can regenerate rapidly and any harmful effects of cropping

are relatively small. Thus the soil is conserved against erosion and the buildup of weeds, pests, and diseases is controlled. The cultivated fields are usually in patches and large areas are not normally cleared. Consequently there is good protection against erosion of a watershed. The organic matter is built up during the fallow period and this provides nutrients for subsequent crops well as it benefits the physical conditions of the soil. During the regeneration of the forest soil organisms are active and good structure of the surface soil is maintained.

It has been asserted by some that large losses of nutrients occur under shifting cultivation systems but the evidence for this is meager. Certainly losses do occur when the vegetation is cleared and burned and the land is cropped; but the magnitude of these looses is probably not very large unless the cropping period is unduly prolonged and the soil is bare for too long a period. But generally with the kind of clearing and land preparation practiced under shifting cultivation and with mixed cropping for a short period the nutrient losses from leaching and erosion are probably very small. With cyclic regeneration of nutrients in the relatively rapid vegetation regrowth, any nutrient losses are probably compensated for by the accumulation in the vegetative fallow.

It is commonly thought that the cultivator shifts to another field after one, two, and three years of cropping because of loss of fertility. This one reason and may be the principal one on poor soils; but in many instances it may not be the most important causal factor for shifting. Often it takes more labor to control the weed growth during the cropping period than it does to clear a field that has been in fallow for some years.

Sometimes there is no agronomic reason for shifting,but rather social or religious customs, quarrels among the cultivators, redistribution of the community property, etc.

Some writers with a limited understanding of shifting cultivation systems have claimed that these systems are responsible for the gradual formation of hardened laterite or ironstone through the so-called process of laterization. They believe that the soils of much of the tropics will turn brick if the practice of shifting cultivation continues. This is absurd and there is no evidence that traditional practices of shifting cultivation are mainly responsible for the formation of laterite. Most of the hardened ironstone which occurs in the tropics is a relic of former geological processes and is exposed by natural erosion except in a few areas where man's activities have accelerated the process. Under the traditional system of shifting cultivation, however, the amount of soil deterioration is minimal except where population pressures and other factors have forced a shortening of the fallow period and/or a lengthening of the cropping period. This would have serious detrimental effects on the physical and chemical properties of the soil.

6. The productivity of the soil under shifting cultivation is low. The native varieties of crops generally have a low yield potential and the traditional methods of land clearing, planting, cultivating, and harvesting put a ceiling on production. The lack of fertilizer, improved seed, pesticides, modern equimpent, and other inputs of modern technology limit greatly the productivity of the soil. Though the crop yields are generally quite low, they vary considerably depending on the characteristics

of the soils. The cultivator knows which crops respond best on which soils and is guided by experience in knowing how long the cropping period should be on particular soils.

In summary, the traditional system of shifting cultivation is widespread over large areas of the tropics and in many regions it is the predominant way of life. There are a great many variations and differences in the subsystems of shifting cultivation but there are certain important features which are common to all of them. The primary objective is to provide a food supply and the soil and crop management practices which are integrated into the whole fabric of the life of the family and the community. Shifting cultivation is an extensive system of farming in which substantial acreage is required to support a farm family. Systems of shifting cultivation have evolved in balance with the ecological environment and are efficient systems considering the resources and technology available to the cultivator. They are flexible systems and under good management provide for conservation of soil resources and protection against erosion of watersheds. The production of crops is low in these systems because of the traditional land preparation and cultivation practices and the lack of inputs of modern technology.

Flooded Rice

This is an intensive system of traditional agriculture which has been widespread in many tropical countries, expecially in Asia, for many centuries. It is a permanent farming system which has supported high densities of population in contrast to the traditional systems of shifting cultivation.

The traditional system of flooded rice is most widely practiced in the fertile alluvial soils of the flood plains of the great rivers of Asia. However, in some countries where the population densities are very high like parts of Ceylon, Java, and the Philippines, terraced fields were constructed on the hillsides for cultivation of flooded rice.

There is a great variation in the traditional methods of providing water for flooded rice cultivation: Impounding natural rainfall by embankments or bunds; relying on seasonal flooding; building small dams and ditches for water control; and construction of irrigation systems. Though little or inadequate water control is common in traditional practices, efficient irrigation systems for flooded rice have been used for centuries in places like China and Ceylon.

The traditional method of planting rice is to sow seed in nurseries and transplant to the field after about six weeks. In some areas, however, seed is broadcast but the yields are usually lower. During the period the seedlings are in the nursery, the fields are flooded and puddled by cultivation usually with oxen or buffaloes drawing various types of crude plows or harrows, depending on the locality. For good weed control, reducing water losses by drainage, and ease of planting, thorough puddling by repeated plowing is usually done preparatory to planting. The seedlings are transplanted by hand to the field which is kept waterlogged during the growing season of four to eight months. Harvesting is generally done by hand primarily because the indigenous varieties mature unevenly.

In most areas the water supply is adequate for only one crop of rice and the rest of the year the land lies fallow. However, in certain

areas in some countries where the population is very dense, a double crop of rice is obtained where there is sufficient water and the cultivators have organized an irrigation scheme and are able to time the land preparation, planting, and harvesting for a second crop. Where it is not possible to get a second crop of rice, a short season annual crop is often obtained, provided the rice fields can be drained and there is an adequate moisture supply to mature a crop.

The maintenance of fertility in rice paddies for intensive cultivation is much less of a problem than in the uplands. Regeneration of fertility by the flood waters are usually adequate to meet the needs for a good crop of rice. Often the irrigation waters provide a substantial amount of plant nutrients. Losses of nutrients by erosion or leaching are generally small. Organic matter additions from crop residues and weeds and animal manure provide a source of nitrogen. In addition there is some nitrogen fixed by blue-green algae in the flooded fields. Also there may be some nitrogen fixed by free living organisms such as Azotobacter.

In summary, traditional cultivation of flooded rice is a permanent system of intensive cultivation which permits a much higher density of population than shifting cultivation. In many places, a good crop of rice and sometimes two crops, can be produced annually, and the fertility can be maintained with traditional practices. As in the case of shifting cultivation the yields are much lower than could be obtained with imputs of modern technology; but the productivity varies considerably depending on the kind of soil, available water supply, and social and economic factors.

TRANSITIONAL SYSTEMS

As indicated above, traditional systems of soil and crop management have generally provided adequate food for the cultivator and his family. However, as the population pressure increases where the land resources are limited, there is a greater need for increasing the productivity of the soil and the quality of the diet. Also, demands for more health, educational, and transportation services require a shift from the traditional subsistence economy to a more market oriented economy. This means that some of the benefits of modern technology need to be incorporated into the traditional systems or the systems modified to meet the increased requirements.

It should be emphasized that the modernization of traditional agriculture require not only technical changes in soil and crop management practices; but also requires adjustments in social and cultural patterns and in the psychological outlook of the cultivator, his family, and the community. There have been many failures as well as success in the transition from traditional farming to modern agriculture. The failures generally result from insufficient attention to factors other than technical, although lack of understanding the technical consequences of applied technology have contributed. For example, the introduction of an improved high yielding grain variety into a shifting cultivation system may not be successful because other associated inputs have not been provided. On the other hand, in areas where improved high yielding varieties of oil palm have replaced the indigenous varieties, substantially increased yields have resulted. It is certain, however, that the traditional cultivator will be reluctant to accept any innovation unless he is sure his basic food needs will be met.

There is controversy over whether it is possible to modify gradually

the systems of shifting cultivation in order to meet the rapidly increasing demands for food and fiber in the tropics. Some believe that it will be necessary to develop a continuous cropping system, expecially in the forested areas, in order to meet the needs. In order to do this successfully, much more technological knowledge has to be developed than is now available on how to manage economically the many kinds of soils in the tropics, considering the available resources. Others feel that there must be a gradual evolution from the traditional practices to modern systems; and of necessity this is a slow continuous process. Not only must the agronomic and economic value of new techniques be demonstrated; but the cultivator has to be educationally and psychologically prepared to accept them. Sibsistence agriculture has to be integrated gradually into a market economy in harmony with the social progress of the cultivators. Some of the failures of the Belgians in the Congo have been attributed to excessive haste or lack of adjustment to local conditions in the application of new practices.

In an effort to establish a transitional system to improve the traditional patterns of shifting cultivation, Belgian scientists in the Congo, over a period of years, developed the corridor system of forest fallow from the native Bantu system. They adjusted the fallow and cropping cycles to the kinds of soils and other factors, and systematized the rotation by laying out corridors of perhaps one kilometer in length and one or two hundred meters wide. They determined how long the natural fallow had to be to maintain a permanent system with optimum productivity under the particular soil and climatic conditions. It could be three years of cropping and twelve years of fallow or five years of cropping and fifteen years of fallow, etc. Each

year one corridor would be cleared and one would be returned to fallow. Mixed plantings of crops were usually used such as corn, upland rice, peanuts, cassava, bananas or others. Where compost or fertilizer was available, one food crop such as peanuts might be grown. Occasional corridors were left in permanent crops like oil palm or fruit and nut trees. Improved crop varieties and fertilizers were gradually introduced into the system and also other improvements were made. Whether this slow gradual approach to the development of a modern intensive system of soil and crop management is the most appropriate still remains to be determined.

In many instances, the length of the fallow period has been successfully reduced where fertilizers and pesticides were available to maintain a longer and more productive cropping period. This has permitted the introduction of industrial cash crops once the food requirements are met. Edible legumes for both food and green manuring have been successfully introduced in some shifting cultivation systems.

MODERN SYSTEMS

In many areas of the tropics, there are soil and crop management systems which make full application of both modern scientific knowledge and the products of modern industry. These systems usually involve large holdings under a plantation type of operation, generally under a single administrative unit concentrating on one commercial crop. The crops grown are both industrial and food crops such as sugarcane, bananas, coffee, cacao, rubber, cotton, pineapple, etc. These large plantation type operations require a high level of managerial skill and business acumen. The most successful conduct substantial research activities with a skilled staff directed toward a continual

improvement of production practices for increasing yield and quality of the crop.

The crops produced in these large commercial operations are largely for export. Markets, transportation, government policies, and other social and economic factors are as important as the technological inputs for successful enterprises. Ordinarily the best soils available with a favorable topography for mechanized operations are selected. However the natural fertility of the soil is much less important in modern cultivation systems than in traditional agriculture. The availability of goods and services and the effective use of modern technology minimizes the dependence on natural conditions. The necessary nutrients can be supplied by fertilizers; any water deficiency can be corrected by irrigation; weeds, insects, and diseases may be controlled by pesticides; land preparation, planting, and harvesting are largely mechanized.

In contrast to the traditional or transitional systems of agriculture, the productivity of commercial plantations is high. Crop yields may be five to ten times as much as those in the other systems. The high yields obtained in the modern systems are a result of putting together under good management the best combinations of practices with adequate resources to take advantage of the available technical knowledge and the products provided by industry. The high productivity demonstrates the possibilities of modern technology for developing the agricultural potential in many areas of the tropics. There is still much that needs to be learned in the application of the principles of biological and physical sciences for effective exploitation of the natural resources in the tropics. Equally important, if not more so, are the economic, social, educational, and political problems which need to be solved before the knowledge

that is available can be applied effectively.

Concluding Statement

It should be emphasized that there are many important agricultural systems or subsystems in the tropics, both traditional and modern, other than those discussed above; extensive and intensive livestock production in the savanna areas, combinations of crops and livestock, and forestry enterprises to name a few.

Another point that needs to be be stressed is that the grouping of the systems which have been discussed were grouped for convenience of discussion and are rather arbitrary. Actually there is a wide range of systems or subsystems grading from the simplest of the traditional to the most complex and sophisticated of the modern. The combinations of practices are almost infinite and the choice of one is dependent at any one site on a great number of factors including environmental, economic, social, and political.

SUGGESTED READINGS

Allan, W. 1965. The African Husbandman. Oliver and Boyd, London. 505 p.

Gourou, P. 1966. The Tropical World. 4th Ed. Translated by S. H. Beaver and E. D. Laborde. Longmans, Green and Co. London. 196 p.

*Jurion, F., and J. Henry. 1969. Can Primitive Farming Be Modernized? Institut National pour l'Etude Agronomique du Congo, Brussels. 467 p.

*Nye, P. H. and D. J. Greenland. 1960. The Soil under Shifting Cultivation. Tech. Comm. 51, Commonwealth Bureau of Soils, Harpenden, England. 156 p.

Miracle, M. P. 1967. Agriculture in the Congo Basin. University of Wisconsin Press, Madison. 355 p.

Moss, R. P. (ed.). 1968. The Soil Resources of Africa. A Symposium of the African Studies Association of the United Kingdom. Cambridge University Press, London, 226 p.

National Academy of Sciences. 1972. Soils of the Humid Tropics. National Academy of Sciences, Washington, D. C. 219 p.

Bunting, A. H. (ed.). 1970. Change in Agriculture. Gerald Duckworth and Co. London. 1970. 813 p.

Watters, R. F. 1971. Shifting Cultivation in Latin America. FAO Forestry Development Paper No. 17. Food and Agriculture Organization of the United Nations. Rome. 305 p.

Conklin, H. C. 1957. Hanunoo Agriculture. FAO Forestry Development Paper No. 12. Food and Agriculture Organization of the United Nations. Rome. 109 p.

*Sanchez, P. A. (ed.). 1972. A Review of Tropical Soils Research in Latin America. Soil Science Department, North Carolina State University, Raleigh. 263 p.

Turk, K. L. and L. V. Crowder (ed.). 1967. Rural Development in Latin America. New York State College of Agriculture, Cornell University. Ithaca, N. Y. 446 p.

Webster, C. C. and P. N. Wilson. 1966. Agriculture in the Tropics. Longmans, Green and Co. London. 488 p.

DISCUSSION

Dr. Nehr - What is the effect of burning in the promoting volatilization losses of soil nitrogen and phosphorus?

Dr. Drosdoff - Yes, there are losses, but only a very small portion of the top soil is affected. There is enough left in the soil to produce satisfactory yields for subsistence culture under those conditions. The low yields under shifting culture are not primarily a soil fertility problem, but the large incursion of weeds.

Dr. Smith - Why is the plantation system so successful and why was good production achieved in a relatively short time?

Dr. Uehara - Plantation organization took on an infrastructure including researchers, technicians, cultural experiments, building, roads, marketing system etc.

Dr. Drosdoff - Plantations owners chose the best land for their operations realizing maximum output for minimal expenditure.

Dr. Uehara - Many countries (LDC's) are moving too fast from traditional to modern systems and some way should be found to slow the transition.

UTILIZATION OF SOILS IN THE DOMINICAN REPUBLIC

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GEOGRAPHIC LOCATION

The Dominican Republic occupies the eastern two thirds of the island of Hispaniola and lies roughly between latitudes 17 and 20 degrees north. It has a common border of 193 miles with Haiti and an Atlantic and Caribbean Sea coastline in excess of 1,000 miles. The country extends about 240 miles from east to west and 170 miles from north to south and has a total area of slightly over 19,000 square miles. The country is crossed from east to west by two major mountain ranges. Smaller paralled ranges extend for shorter distances from Haiti into the Southwestern portion of the country. There are plains, tableland and valleys. The altitude ranges from over 10,000 feet in the mountains to 144 feet below sea level at a lake in the Southwest. Rainfall varies widely over the country ranging from 98 inches annually down to about 13 inches. Fairly large areas average 55 inches of rainfall, 35 inches of rainfall and 20 inches of rainfall. Irrigation is widely practiced in the regions of low rainfall and for such crops as rice in the rainfall area.

SOILS, RAINFALL AND MAJOR CROPS

Very little information is available on the soils of the Dominican Republic. Commercial producers of bananas and sugar have conducted some soil survey work in parts of the Cibao Valley and parts of the Southern Plain. The Organization of American States has done a general study, which forms the basis for a natural resource survey. Except for these two sources,

there exists only meager and very generalized soils information. However, from studies of geological maps, aerial photographs and some random sampling done during the course of this study, it is possible to make fairly accurate statements of a general nature about the soils found in agricultural areas of the Republic.

Roughly 75% of the total area of the Dominican Republic is underlain with sedimentary parent material which is mostly limestone, calcareous coral and unconsolidated or partly decomposed marine sediments of recent origin. About 25% of the island is underlain with igneous or metamorphic rock, almost all of which is combined to the Central Mountain Range and the mountains of the Samana Peninsula. Soils which are agriculturally useful can be characterized as follows:

1. The Northern Coastal Plain

The topography of this area is flat to rolling. The soils are nearly all alluvial types derived from the weathering and subsequent erosion of tertiary limestone of the Nothern Mountain Range. There are a few igneous outcroppings in this range of mountains and these have added to the complexity of the alluvial soils of the region. A good example is the narrow coastal strip whose soils are recent alluvium of intermixed igneous and sedimentary materials. Annual rainfall in this area varies from 28 inches at the western end, to about 80 inches at the eastern end. This rainfall is fairly well distributed throughout the year with no pronounced dry season. June, July, and August are the driest months, but even in these months rainfall is usually not reduced by more than one half of that received during the wet months. Cattle, swine and

sugar cane are of major importance and this is the only area of the country where corn is produced in quantity as a primary crop.

2. The Southern Coastal Plain

Topography in this area is flat to rolling. The soils are residual types derived from recent marine calcareous materials. The numerous parallel drainage systems and scattered sink holes which show clearly in aerial photographs are typical of this soil type. These soils are generally thin, often with unconsolidated parent materials showing at or near the surface, poorly drained, and not highly productive. There are, however, some deeper soils (perhaps 10% of the area) that are now being used for sugar cane production or for pastures where distance from the sugar mills makes sugar cane uneconomical. Sugar and cattle are the two major agricultural activities and nearly all of the land is in large holdings. Annual rainfall averages 40 inches at the eastern tip of the island to 55 inches at the western end of the zone near Santo Domingo. This rainfall is fairly well distributed throughout the year. The "dry season" is from December through March but even these months received more than half the average rainfall of the wet months.

3. The Cibao Valley

This valley is the most productive and most intensively cultivated area in the Dominican Republic. It lies between the calcareous Northern mountains and the igneous Central Mountain. Natural drainage is both east and west from a low central plateau. Topography is flat to rolling. Cibao valley soils are both alluvial and residual. The residual types are found along the bases of the two mountain ranges which

from the valley and in the low central plateau. These are derived from the tertiary limestone strata which underlie the valley floor. Alluvial soils are widespread in the valley and these have been deposited by the Yaque del Norte and the Yuna rivers and their tributaries. These alluvial soils are intermixed and complex, being derived from both sedimentary and igneous materials. Nearly all crops found in the Dominican Republic are found in this valley, but major crops are rice, tobacco, bananas, plantain, beans, sugar cane, cacao and coffee. Cattle and swine are also important. Annual rainfall averages from 28 inches at the western end of the valley to more than 85 inches at the eastern end. There are salinity problems in the dry part of the valley, particularly where irrigation is practiced, and serious drainage problems in the heavy rainfall eastern end of the valley. The dry season is from December through March. This dry period is significant in the western low rainfall part of the valley; but it represents relief from excessive rainfall in the eastern high rainfall part.

4. <u>The San Jaun Valley, the Azua Plain and the Enriquillo Basin</u>

The topography of these three areas varies from flat or rolling to rough and broken. Both residual and alluvial soils occur. The alluvial types, which are the most important, have been deposited by the principal streams of the area and are complex mixtures of both sedimentary and igneous materials. Residual soils are limited to low parallel ridges, scattered outcroppings and to the rolling hills which seperate the San Juan Valley from the Azua Plain. There are serious salinity problems in the Enriquillo Basin, the soil of which are derived from very recent marine sediments. Annual rainfall varies from 24 inches in the Southern

and Western parts of this area to 55 inches in the Northern and Eastern parts. The dry season is from November through April and rainfall in these months drops for 1/2 to 1/4 of the annual monthly average. This is significant dry period and it is much more serious in the southern and western portions of the area. In the irrigated parts of this area the major crops are rice, bananas, plantain, corn, and sugar cane. In the unirrigated portions the main crops are peanuts, and beans. Cattle are also raised.

FARM LAND UTILIZATION (1960 CENSUS)

	TAREAS	TAREAS	ACRES	ACRES
Annual Crops	4,447,405		691,587	
Fallow	5,342,204		830,732	
Perennial Crops	7,180,106		1,116,532	
Total Cultivated		16,969,715		2,638,852
Cultivated Pasture	8,986,000		1,397,355	
Natural Pasture	4,795,483		745,715	
Total Pasture		13,781,483		2,143,070
Forests		4,554,048		708,171
Waste Land		592,174		92,085
Undeveloped Areas*		41,609,780		6,470,471
Total Area		77,507,200		12,052,649

* Mountains, Swamps and Semi-arid lands.

LAND UTILIZATION

Very poor economic use is now being made of the land resources of the Dominican Republic as indicated below:

1. Yields are meager due largely to poor cultural practices, low yielding varieties, and inadequate market incentives. At least a 50% increase could be achieved with minimum effort; but should only 25% increase be realized, the added value of production would be about $33 million.
2. Less than half of the arable land on farms is being cropped every year. All of this should be in production, but if only 50% of the idle acres could be put into use, the added value would be about $33 million.
3. At least 10% of the land now in sugar cane is suitable for that crop. If this land could be diverted to other crops such as beans, pasture, or sorghum, (since it is not high quality land), expected yields would be only 2/3 of the country average, the added value would be about $1 million.
4. At least 10% of the permanent pasture land is suitable for intensive cropping. If this land could be utilized as in 3 above, the added value would be about $4 million.
5. There are about 250,000 acres of farm land capable of producing two crops per year that is not being so used. Assigning these lands only 1/2 average yields the added value would be $4 million.
6. a. Most of the potential irrigation water of the Republic now runs into the sea. Since adequate control of this water depends upon

large reservior construction, no added value can be estimated at this time - $0.0.

b. Existing irrigation systems are operating 25% to 30% below rated efficiency due to poor maintenance and faulty engineering.

When this situation is corrected, the added value of farm production from additional acreage irrigated would approximate $4.0 million.

c. Irrigation water now being applied could be spread over 25% more land. If properly applied to adequately levelled land, added value would be about $4.0 million.

By the above practices, water logging and salt accumulation could be reduced on land already being irrigated. If this resulted in only a 10% yield increase, the added value would be over $1 million.

7. The land reform program has a potential of settling 60,000 families on about 1,000,000 acres of public land. About 4,000 families have been settled on some 42,000 acres leaving a residual of over 900,000 acres. Undoubtedly, some of this area is already in some kind of unofficial use, but large areas are idle. Getting the idle land settled, even if it is all unirrigated, would add a value of about $14 million.

8. There are perhaps between 500,000 and 1,000,000 acres of dry land brush having 25 inches or more rainfall per year that is not being used for any crop. Sorghums for livestock or for export, (a world market for feed grains exists) could be produced on this land. Expecting only one crop per year on only 500,000 acres and sold at $36 per ton (farm price) the added value would be $27 million.

9. Extensive areas, perhaps in excess of 100,000 acres, do exist, which if drained, could produce further additions; but since this, like the reservoirs mentioned above, would be a long-range program, no added value is assigned - $0.

- Expected increases in all farm production, exclusive of sugar cane and livestock due to improved land use as above ....$125 million. Present value of all farm production exclusive of sugar cane and livestock approximate .....$131 million.

The above estimates are based on farm prices with no value added for cleaning, processing or packaging. The estimates are very conservative and in most cases represent only about 1/2 the production increases which might logically be expected. Nevertheless, it appears evident that production of farm crops would be about doubled where these land use changes are put into practice.

SOCIO-ECONOMIC PROBLEM

The present population may be approaching about 4,000,000 people. Approximately 1,500,000 people are estimated to be in the labor force. Of this number it is said that 500,000 are currently employed. Only about 43% of the population is literate. Above the age of 15 only about 27% is literate. Two thirds of the population are rural and only about one third of the rural people are literate. The annual growth rate of the population is at least 3.5%, one of the highest in Latin America.

Fifty percent of the farmers, one third of the nation's total population, have one hectare or less of land to support a family of 9 people. Here mal-

nutrition is at its worst. Because of the extreme poverty, some of the health-building foods such as poultry, pork, and eggs are sold to provide a small amount of cash so sorely needed. Elsewhere malnutrition does exist to a much greater extent than is generally reconized, based upon visual body weights. A more valid measure is the amount of energy that can be expended in a day. Being tired is often mistaken for laziness in this country. This is better understood when it is recognized that animal protein intake needs to be incresed about fifty percent in order for the population as a whole to achieve a minimum nutritional diet. Present diets are too heavily weighted in plantains, yautia, yucca, and bananas.

With one third of the population, 1,150,000 people, barely existing on very small farms, and another one-seventh, 500,000 unemployed, nearly on half of the nation's population is barely contributing to the economy of the country. The human resource is a country's greatest resource and when wasted in staggering amounts, as is the case in the Dominican Republic, the situation is indeed serious. The social problem has become to great that the whole situation has resulted in political instability to the extent that ugly revolutions have occured. Consequently, a tense socio-political situation now overshadows the economic base of which this nation's society rests, and greatly endangers the future of this Republic. It threatens to continue to do so until it is ameliorated.

The pressure of an increasing population on the cultivated land, makes it necessary to find new areas for cultivation. For the same reason, new sources of production and means of food supply and clothes for this rising

population need to be found. Science must solve several enigmas before opening new opportunities which could lead to greater food production and land productivity. One of those enigmas is whether, in reality, there is a potential for high agricultural production for the savanna soils of the Dominican Republic and South America. Will these areas, someday, reach a level of development similar to that already obtained in the temperature prairies of the world?

Many legends have surrounded these savanna lands. Some people describe them as future sources of wealth, presenting them as "promised lands," or as only a short term possibility to solve the increasing problem of feeding the Latin American people. Others hold the opposite view that the Savanna areas of Latin America are illusions which capture the imagination of those who see those lands for the first time; and the fantasy could never be a reality. Confronted by these opposing views we should ask which are correct? Maybe somewhere in between?

Before science gives its final verdict about the potential of the Savanna soils in Latin America, it would be beneficial to briefly mention some evidence for and against the use of the soils in those regions. With a better understanding of these soils, it would be possible to develop systems which might lead to a greater agricultural development of the area.

Advantageous Conditions

Most of these lands have a favorable topography, with a smooth gradual slope which permits easy mechanization. The high temperature and precipitation, in combination with other factors, could be utilized for an intense and rapid production of vegetable materials, which, by means of modern technology, could serve as raw material for industrial use, which would have a

great impact on the economy of tropical areas. Also, high quality forage produced could be converted by animals into meat and dairy products to improve nutrition.

Besides good topography, such soils have a suitable physical condition (good texture, and natural drainage), especially around the alluvian of the Meta river in the Oriental region of Columbia. In general, these soils have adequate organic matter, if we compare them with other soils found in the tropics. The subsoils are red or yellow, rich in iron, with good moisture holding capacity.

The native forage species may be improved or gradually substituted by more productive ones, which can be adapted for more efficient management.

Negative Factors

Nevertheless, these regions have great limitations. The following resume describes the limiting factors specifically with respect to those soils of the high plains of the Meta river

1. Soil Fertility:

   a. There are very low levels of available phosphorus and exchangeable Ca and Mg, and N, S. and K.

   b. Frequently, these soils are low in Zn, and marginal with respect to Bo, and possibly other micronutrients.

   c. These soils are extremely acid and high in exchangeable Al; for this reason, problems may result from P fixation. The good texture and drainage capacity of these soils, which is a favorable factor for crop production, may also facilitate the leaching of nutrients during heavy rainfall in season.

2. Soil Management

   Many of these soils may be eroded easily by wind or water if sound soil conservation practices are not used. Some summer crops could be produced

in three months using irrigation from rivers or wells to obtain adequate levels of production.

3. Biological Agents:

Among those affecting the agricultural activities, it is important to mention the rapid multiplication of:

a. Pathogenic organisms which cause disorder in plants and domestic animals, producing losses in agriculture and cattle business respectively. Among the first group, several epidemics have been found in rice caused by fungi, some of which are *Pyricularia oryzae* (causing agent of blast disease of which there exist several strains) and *Helminthosporium*. In areas where the precipitation is less, these agents if present, multiply less.

b. Insects.

c. Weeds. The absence of infrastructures and social incentives contributes to slow down and interfere with the development of human agents. There is no base for the spontaneous colonization of these lands in absence of the technology and adequate resources to utilize them.

Due to these problems, the present utilization of many savanna areas are very inefficient. Crop production as well as livestock production are practiced in very primitive ways -- a waste of the extensive savanna. In short these are both advantages and disadvantages regarding the possible development of these lands.

One area in the Dominican Republic, the Savanna Quabatico, if put into production, could possibly make a tremendous contribution to the agricultural development and economy of the country. In this area, the average rainfall is about 70 inches per year; the average temperature is 25°C (77°F) during the winter months, 29°C (84°F) during the summer, and 27°C (80.6°F) during the spring and fall. Day and night temperature changes are quite drastic. The dry season is December to March. The population of the area approximates 10 people ml^2 which is very low. The area produces sugarcane (30%), rice

and improved pasture (10%), but 60% is in unimproved pasture. The total area averages 400,000 acres.

The experiments which have already been done with respect to soils and yields of some subsistence and forage crops suggest that the possibilities for economical agricultural development in the near future is good. With the development and application of production systems suitable to the Oriental plains of Columbia and other similar regions of the Tropics, it would be possible to achieve socioeconomic progress in these zones. The true potential of these regions however is still unknown. As investigations continue and with the results already obtained, the predictions are that development can be successfully achieved and that these regions presently almost uninhabited and misused, could someday contribute generously to the world's food supply.

References:

Report of Study Team on Dominican Republic Agriculture, March 14, 1966.

Atlas of Existing Basic Information and Guidelines for Planning of the Integrated Development of the Dominican Republic - Alfred Obiols and Rodolfo Perdomo, Quatemala: August 1966.

Reconnaisance and Evaluation of the Natural Resources of the Dominican Republic. General Secretariate, Organizatior of American States, Washington D. C. 1971.

EXPERIENCE IN AGRICULTURAL DEVELOPMENT IN THE DOMINICAN REPUBLIC: EFFORTS OF THE CHINESE MISSION

Y. P. Chang
Prairie View A.&M. College

I had an opportunity to lead the Chinese Agricultural Technical Mission in the Dominican Republic (D. R.) That mission was requested by the D. R. Government under a program between the D. R. and Chinese Government to improve the rice production in the D. R.

After a thorough study and investigation, the Chinese Agricultural Technical Mission was assigned to cover rice, breeding, cultural practices, soil and fertilizer, pest control, agricultural engineering and seed improvment. Members were all college graduates with 4-6 years practical experience in their special fields. They were selected from either agricultural research institutes or experiment stations of other governmental organizations.

The original plan was that the Chinese Mission would be established in 1962 in D. R. and continue no longer than 4-5 years. The main projects were:

1. Set up a Rice Research Institute
2. Improve the rice production
3. Train the D. R. technicians

The work was divided into several stages:

First Stage:

A. Establish the Rice Research Station; survey and line up both the field plots and the irrigation system.

B. Survey and investigation of the main rice production areas in D. R.

Second Stage:

A. Selection and purification of native rice varieties

B. Introduction of foreign varieties

C. Make recommendations of basic cultural practices such as right spacing, adequate fertilizer requirement, proper pest and weed control, and introduction of effective agricultural machines.

D. Training local technicians in rice culture.

E. Establishment of sound seed multiplication system

Third Stage:

A. Make rice crosses to meet the special area needs

B. Set up the sub-station for regional adaption test

C. Extension of improved seed

Due to various reasons, primarily political, progress has been slow; therefore, the mission is still there and continuing the work.

I would say the work which the Chinese mission has done so far is successful. Rice production has risen from insufficient rice production several years ago to surplus rice production at the present. The main reason is that the Dominican farmers have confidence in the Chinese mission. They used the seeds released from the station; they adopted the cultural practices which the station recommended; they came to the station periodically to ask for help. Therefore, the unit yield increased tremendously. The farmers made large profits and more acreage was put into rice production. Also the climatic condition, generally speaking, favors rice growth.

Surplus rice, and how to dispose of it, has become a problem, but this will be only temporary for a land reform program is underway in the D. R. this year which will divide the farm land to the poor farmers.

In 1973, they are planning to change to owner/opeaator on 350,000 hactares (approx. 1/3 of the total rice area) of the extensive more productive rice farms and replacing them with 5,800 farm families (approx. 34,4000 people).

The land reform program is predicted to reduce the rice surplus for the following reasons:

1. During this transition period, the land may not be in production for one or two crops. Some serious difficulties are likely to occur, because they are trying to distribute large acreages among many people who do not have the experience needed to operate rice farms; and, secondly time log is too short for them to gain the necessary experience.
2. When the small farmer is settled, he likely will neither have the technical knowhow nor the financial means to maintain previous levels of production.
3. The small farmers are not likely to plant rice on much of the areas. Instead, they will diversify to other crops.
4. The people that are settled on the land are likely to increase their local consumption of rice.

The D. R. government is expecting a decline of 10 - 15% in rice production in crop year 1973, and possibly 1975.

In conclusion, the transfer of technical assistance from a developed country to a developing country, I think, is very difficult. Besides the technical input, as Dr. Drosdoff pointed out yesterday, political, social, and economical input must be considered and neglect of one of these factors will result in a failure of the project.

SOME DATA ON THE ENVIRONMENT OF WEST AFRICA

Dr. E. Brams
Prairie View A.&M. College

West Africa is taken here as the area lying west on the boundary between Nigeria and Cameroon and includes the political divisions listed in Table I (1969).

The Geology-Soils of W. Africa

West Africa, like most of the African continent, consists mainly of an exposed mass of very old rocks, the Pre-Cambrian basement complex over 2,000 million years old. Later formations consisted of conglomerates, limestones, sandstone, and shales derived from sediments of shallow seas which covered parts of the complex. Quaternary (recent) period formations were marked by violent climatic and land changes from which were formed the coastal alluvium of Sierra Leone and Nigerias and sheets of ironstone which mark savanna country, and vast areas of loose sand that covers much of the interior of W. Africa. Many of the present soils of W. Africa had their genesis in this period.

Generally, the soils derived from the ancient rock; the basalts, granites, schists, phyllites, quartz, and gneisses--are more fertile than soil developed from reworked and weathered sediments of later formations. For this reason, West African soils are very diverse and can vary over very small distances, sometimes within 100 meters.

Long periods of weathering and leaching under a wet and warm climate have removed much of the mobil bases, leaving higher ratios of kaolinitic

clays, quartz, sand, silt, and hydrous oxides of aluminum and iron. Iron oxides may coat and impregante clay and larger particles, binding them into ironstone concretions or indurate iron-rich horizons. In the dryer areas, like the savannas, the 2:1 lattice clays are more prevalent, particularly if the parent material is basic rocks; but extensive wet and dry periods of time will eventually convert the expanding clays to the 1:1 kaolinitic type. Organic matter and cation exchange capacities are higher in the forested soils than under grassland savanna.

The Climate of West Africa

West African Rainfall

Most of West Africa enjoys high temperatures which vary relatively little throughout the year; so that differences in climate are largely differences in the amount and distribution of rainfall. Climatically, West Africa can be divided into a number of distinct rainfall belts, and these are related to broad soil and vegetation zones.

West African rains are caused by the seasonal movements of two main air masses: a dry, continental air mass to the north, and a moist body of tropical or equatorial maritime air to the south. These masses move north and south with the apparent movement of the sun. As the sun moves northwards and approaches the Tropic of Cancer, so does the southern, moist body of air move northwards, bringing rain with it; and it is this seasonal north-south movement which is responsible for the wet seasons of West Africa.

South of about 8° to 9° N, (that is, in the southern and coastal areas of the Ivory Coast, Ghana, Togo, Dahomey, and Nigeria) there are two distinct wet seasons. The first and more important wet season occurs between

April and July when the sun passes northwards. There is then a short break in the rains in August when the main wet areas are to the north. With the apparent movement of the sun south again, there is a second rainy season in October and November as the moist southern maritime air mass again makes its influence felt. In December to March this moist body of air is too far south to have much effect on West African rainfall; and the dry body of air from the north is the dominant influence; so that this is the major dry season.

North of latitude 8° to 9° N, the two distinct wet seasons so characteristic of the areas, just discussed, merge together into a single wet season, separated by a single long dry season.

Vegetation of West Africa

The vegetation follows this rainfall pattern. Generally, two biomes are recognized, the drier savannas and the wet, forested belt.

The savanna develops where the annual rainfall is under 45". Soil leaching is not pronounced and the base saturation and pH are relatively high; but the dearth of organic matter (low cycling quantities and high oxidation rates), the presences of hardpans near the surface, and low water holding capacities create problems for intensive cropping. The savanna consequently is used under a pastoral culture.

The forested zones are biomes of wetter climes than the savanna. Rainfall averaging 60 inches per year does not exceed evapotranspiration except for 3 months during the year. Soils are not strongly leached, the pH lies

near neutral, base saturation is high and the soils are quite productive. In very wet regions where rainfall exceeds 70"/year, the soil becomes thoroughly leached, the soils are acid, low in bases and require careful management when cleared to produce adequate yields.

Soil management in the tropics is quite different than in temperate climates. Transfer of cultural practice from temperate to the tropics can often lead to disastrous results.

The priority agronomic problems facing agricultural development in the W. African tropics involve the following:

1. Soil mapping interpretations in terms of soil capabilities for agricultural production.
2. Soil organic matter and availability of phosphorus
3. Soil acidity and liming
4. Ecological factors that enhance agricultural production
5. Soil water (irrigation, drainage, and storage)

DISCUSSION

An interchange of ideas on the question or agricultural development in humid W. Africa followed the presentation.

Dr. Drosdoff pointed out misconceptions concerning the formation of indurated laterite surfaces arising from cultivation. He asserted that these misconceptions were diffused throught the early literature on tropical soils. Dr. Brams indicated that hardened crusts develop when soft lateritic materials in lower soil horizons are exposed by truncation of the soil profile usually of geological erosion, but could also be induced by cultural practices.

SECTION II

Responsibility for mispresentation and/or other errors in the summaries presented in this section are solely those of the editors and not of the original contributors. The presentations by Kasumbein, Collins, Sanchez, Uehara, Ekern, Pietri, Malcolm and Milford were summarized by Mr. C. E. Lopez of Prairie View A. and M. College.

UTILIZATION OF SOILS IN UGANDA, EAST AFRICA

Summary of Contribution by
P. Kasumbein
Prairie View A.&M. College

UGANDA

Mr. Kasumbein presented general information about his country, Uganda, its climatic conditions, and land utilization.

Uganda is a country in East Africa with a population of 9.76 and an area of 93,981 sq. miles. The capitol is Kampala.

The climate is tropical equitorial but modified to warm and mild temperatures on the plateau. Average yearly high temperature is 85°F, with a low of 60°F. Rainfall varies from 40 to 60 inches annually. The country's topography consists of plateau 4000 ft. above sea level, and two mountainous areas, the Revenzoin Mts. at 16,783 ft., and snow capped, and Mt. Elgon at 14,178 ft. The vegetation is in general tropical, with some savannah grassland.

Land Utilization: Land utilization is currently restricted to the following categories:

Major Tree and Cash Crops

Coffee - Robusta - 220,000 met. tons.

Arabica - 21,000 met. tons

Cotton - 450,000 bales

Tobacco - 2,500,000 lbs.

Tea - 24,700,000 lbs.

Sugar - 180,000 met. tons.

Food Crops

Bananas, cassava, finger millet, sweet potatoes, corn, rice, fruits, vegetables, and wheat.

Timber production - essentially from neutral forests.

Livestock production - cattle (4 million heads), sheep and goats (3 million heads) and poultry.

Wildlife Reserves - National Game preserve and parks - Queen Elizabeth National and Murchison Falls National Parks.

SOIL CLASSIFICATION FOR LAND USE PLANNING

Summary of Contributions by
Dr. J. B. Collins
Prairie View A.&M. College

Dr. Collins gave a brief discussion on the relationship of soil to the activities of man - crop production for food and fiber, livestock production, as a base for building cities, highways, airports, recreation areas, etc. He presented some general aspects of soil classification, as well as more specific factors involved in soil formation and the criteria on which classification is based. It was indicated that the 7th approximation (U.S.D.A.) is a natural soil classification, and is a system based on the properties of the soil.

Six different categories of the soil classification system were described: order, suborder, great group, subgroup, family and series. Dr. Collins presented a monolith of a Hockley fine sandy loam and classified that particular pedon as follows:

Order - Alfisol

Suborder - Udalfs

Great group - Palendalf

Subgroup - Plinthilic Paleudalfs

Family - Plinthitic Paleudalf: fine loamy, mixed, thermic

Series - Hockley

Soil type - Hockley fine sandy loam

Slides of soil profiles were presented showing several soil orders followed by an explanation of the name which is based on the properties of the soil.

Dr. Collins explained the importance of basic soils information in land-use planning. Dramatic slides showing cases where construction had been done on soils without consideration of the soil properties and the suitability of the soil for such construction, resulting later in cracking and sliding of the building were presented. It was pointed out that this could have been avoided if proper information about the soil had been available to the builders.

In conclusion, a knowledge of soil properties is needed by those who use the land if sound decisions are to be made on how to allocate the soil best suited for agriculture, housing, recreation, industrial sites, roads, and other purposes.

DISCUSSION:

Dr. Nehr suggested that construction companies should be responsible for guaranteeing the suitability of the soil for any specific construction.

Dr. Pietri commented that Dr. Nehr's suggestion had already been implemented in Puerto Rico where a state planning board must approve any use of the soil, particularily before construction is started.

Mr. Curtis McGuire and Mr. Gordon McKee indicated that three bills are pending in the Texas State Legislature requiring that a land-use plan-

ning board approve any use of the soil. It is a challenge to soil scientists to make the need for such legislation clearly understood and in the public interest. He strongly urged that soil information also be made available to planning corporations and public agencies as a part of their development programs.

Dr. Drosdoff indicated that information gleaned for reconnaissance survey can be used to direct settlement projects in developing countries.

Dr. Godfrey said that an educational program should be developed to carry the concept of soil survey as a part of the public domain to people.

Dr. Uehara pointed out that Hawaii has the "green belt" law to protect agriculture land form urban and industrial encroachment.

PHYSICAL AND CHEMICAL PROPERTIES OF TROPICAL SOILS AS RELATED TO PLANT NUTRITION

Summary of Contribution by
Dr. Pedro Sanchez
North Carolina State University

The organization and philosophy of the tropical soils program being developed at North Carolina State University was presented. North Carolina State University has been providing technical assistance to Peru for some years and now has 6 faculty members in Latin America. The university has a graduate program in Tropical Soil Science in which the students are required to complete formal course work, including graduate level courses in soils of the tropics, and a knowledge of the language of the country where the student plans to conduct his research. A significant portion of the research for the thesis would be conducted in tropical regions under senior faculty supervision and in areas where North Carolina State University has cooperative arrangements with local institutions. Emphasis is placed on researching practical problems of tropical soils. Presently, the University has 13 graduate students enrolled in Tropical Soil Program. The University has published "A Review of Soils Research in Tropical Latin America" which is also a compilation of the work done in tropical soils of Latin America. It is conducting studies in the Utilization and characterization of Soils "Llanos Orientals de Colombia", a tropical savanna, and the Amazon Basin. These soils have been found to be similar to some soils in Southeastern United States. Research projects being developed by faculty members and graduate students are directed toward cropping systems such

as shifting cultivation and sustained farming in selected areas. Dr. Sanchez, in his work in Peru introduced rice varieties from IRRI which showed interesting relationships to soil and cultural practices. Many of these varieties produced twice the yield of the local varieties in a rain-forest environment under certain cultural conditions.

For example, close spacing (25 x 25 cm^2) as compared with 80 x 80 cm^2 doubled the yields. As a result of this work, Peru in 3-1/2 years rose from a 30% rice deficiency to 25% surplus. Now with a surplus development, emphasis is being changed to crops like soybeans that can be used for cattle production. Liming has been found to give good responses in corn in a study in the Campo Cerrado, a savanna area near Brasilia, Brazil.

DISCUSSION

With respect to rate of development, contrary views were expressed by Dr. Brams, who indicated development must be a graded process, and Dr. Sanchez who advocated crash programs for any meaningful improvement in production. The consensus of the participants was that development is a many-sided proposition where both thrusts can be employed.

A spirited interplay of ideas concerning development plans in the Amazon Basin brought consensus that the program could bring disaster to to the ecosystem and real agricultural production would decline in the long run unless efforts were made to conserve the ecosystem.

UTILIZATION OF SOILS IN HAWAII AND SOUTHEAST ASIA

Summary of Contribution by
Dr. G. Uehara
University of Hawaii

Dr. Uehara presented an informative lecture accompanied by slides of the specific areas and topics discussed. First, he considered Hawaii, a state 41 times smaller than Texas. Agriculture accounts for 10% of the total income of the state. With regard to soil utilization, he pointed out that there are two kinds of constráints limiting maximum production:

a. Constraints controlled by man

b. Constraints not controlled by man

Some of the constraints that cannot be controlled by man are volcanic action, which in some cases make utilization of the soils in the vicinity of the volcano impossible and rough topography, which makes the utilization of some excellent soils economically unfeasible if mechanization has to be used.

Agriculture is being shifted from alluvial plains to higher plains (uplands) and higher yields are being obtained because of better cultural practices and better knowledge of the soils.

With mechanization, irrigation, and use of fertilizers, a good crop can be obtained in Oxisols. Corn has responded to silica application in the soils.

He showed unique profiles of lithosols in Hawaii. These soils are being used extensively for papaya, flowers, and other crops.

Because of the high cost of labor, mechanization must be practiced; and this is probably the most important problem of agriculture in Hawaii. Another serious problem is competition of urban areas encroaching on arrable agricultural lands.

SOUTHEAST ASIA

Dr. Uehara discussed problems of agricultural development in Southeast Asia. Due to a difference in mores and agricultural techniques, Hawaiian agricultural experience is not directly transferable to situations in Southeast Asia. Data from the literature indicates that production records of wheat, corn, and rice decline as proximity to the tropics increases, inferring that the tropics has poor fertility. Dr. Uehara refuted this position with data and slides indicating exceptionally high yields obtained by Dr. Bradfield at the International Rice Research Institute, Phillipines, for vegetables and small grains by the use of a multiple cropping system.

Water control is one constraint in Southeast Asia which limits fertility and crop production. The rainy season brings huge amounts of water which flood large areas. Research at the IRRI is not applicable to these flooded areas,although the use of high yielding varieties demands water control. Methods are needed for these specific problems of water control during the rainy season, and further study is needed about management practices for these soils.

Unrest may be a persistent plague in Southeast Asia, because of the high ground rate (population) and the immigration of farmers to cities accentuating economic disparity of the population.

DISCUSSION

Dr. Uehara questioned the group as to the most unique property of tropical soils. Surprisingly, the answer was soil temperature. Uniform temperature, varying not more than 5°C over a 12 month period, permits utilization of the soil for the entire year.

Dr. McKee asked about the importance of Bradfield's work.

Dr. Uehara illustrated his answer with a graph where multiple cropping added increments to income after the basic crops were harvested. Intercropping is in an intensive system of utilizing the soil between rows of plants - for example, planting yams between maize or cabbage rows alternately with rice.

Dr. Kirkwood inquired which soils are most extensively cropped.

Dr. Uehara's interesting answer was alluvial soils; but he strongly feels that the breadbasket of SE Asia lies in the Oxisols because of their excellent physical properties.

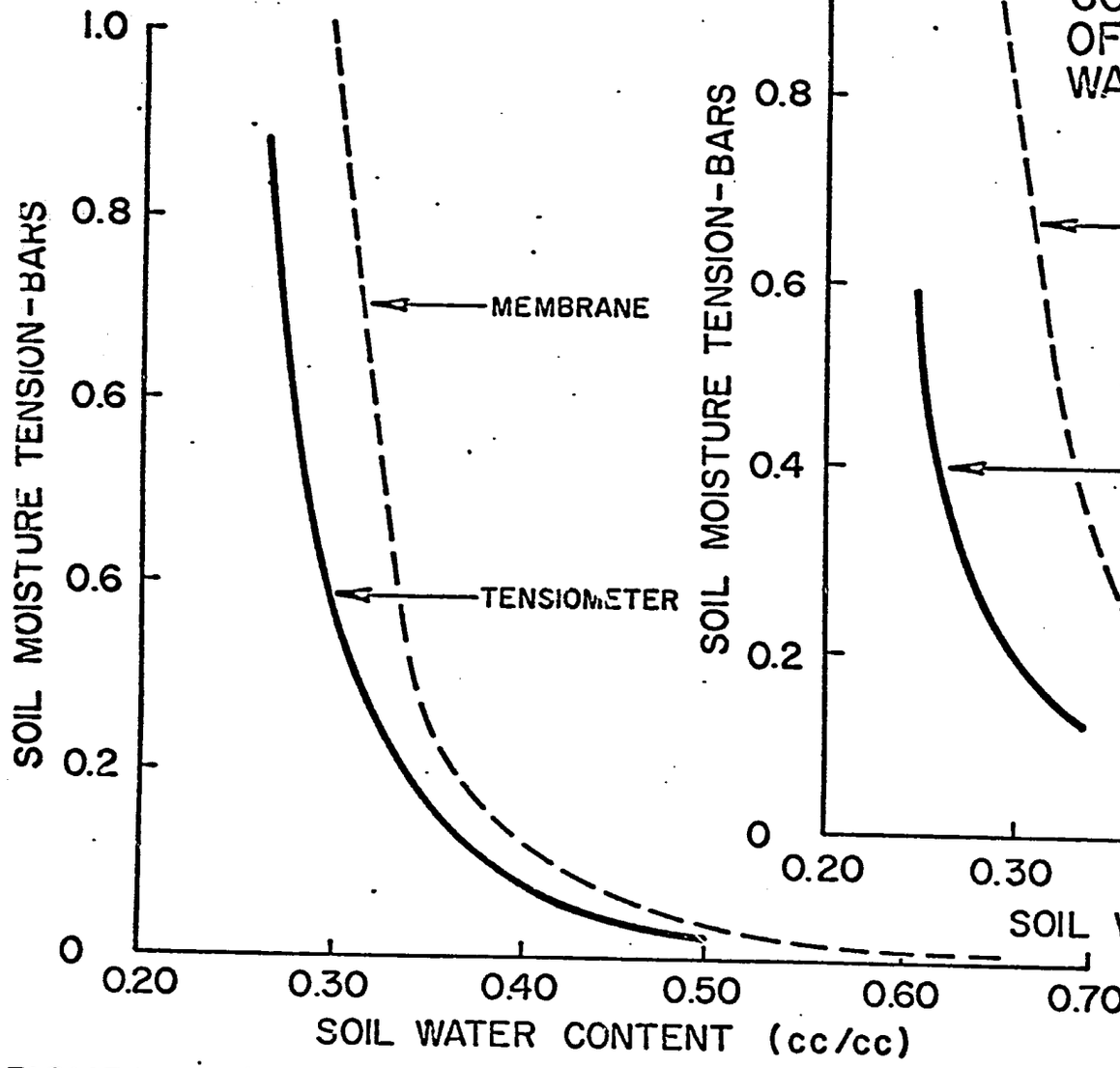
UTILIZATION OF SOILS IN HAWAII

Summary of Contribution by
Dr. P. C. Ekern
University of Hawaii

Dr. Ekern's lecture dealt with the physical characteristics of Hawaiian soils under sugarcane and pineapple. He discussed the effect of different tillage operations as they affect soil compaction and soil temperatures. He pointed out that heavy machinery will compact the soil and form a tillage pan. Water will not penetrate adequately but will move horizontally.

He described plastic mulches that are being used to stabilize soil temperature. Black plastic mulches can increase soil temperature up to 15°F. Lowering soil temperature markedly reduces growth of pineapple plant. Below 60°F in soil, the growth of the pineapple plant is only 1/10 of its potential. Soil temperature below 70°F by plants restricts NO_3 uptake so that during winter time 400 lbs. of NO_3 may move through the profile, rather than be absorbed for plants.

Some information concerned with moisture relationship in these soils was presented, as well as a reference list of literature pertinent to the effect of soil structure on crop yields.



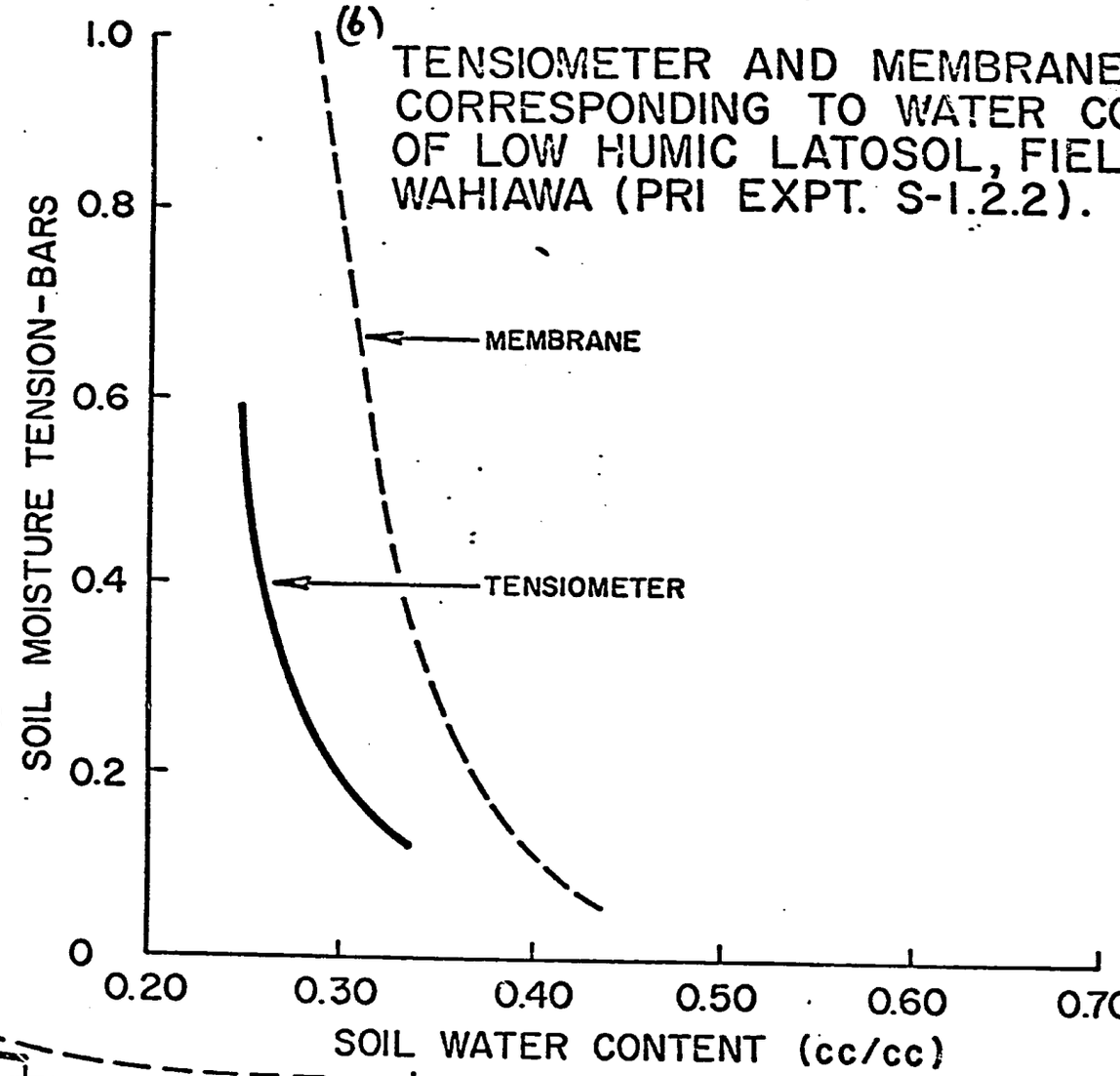


FIGURE 5(a) TENSIOMETER AND MEMBRANE STRESS CORRESPONDING TO SOIL WATER CONTENT, BERMUDA GRASS IN POT CULTURE IN GREENHOUSE (PRI EXPT. 12.2.A7).

CITED REFERENCES

Yamamoto, T. 1963. Soil Moisture Constants and Plysical Properties of Selected Soils in Hawaii. Pac. SW Forest and Range Expt. Stn. Res. paper PSW P-2, 10pp.

Wood, H. B. 1971. Land Use Effects on the Hydrologic Characters of Some Hawaiian Soils. J. Soil and Water Conserv. 26:158-160.

Yokoyama, J. 1956. Soil-Air-Water Relationships in Hawaiian Soils MS Thesis 773. UH.

Sharma, ML and Uehara, G. 1968. Influence of Soil Structure on Water Relations in Low Humic Latosols. 2. Water Movement. Soil Sci. Soc. Amer. Proc. 32:770-773.

Ekern, P. C. 1966. Evaporation from Bare Low Humic Latosol in Hawaii. J. Appld. Meteor. 5:431-435.

Robinson, F. E. 1963. Soil Moisture Tension, Sugarcane Stalk Elongation and Irrigation Interval Control. Agron. J. 55:481-484.

Ekern, P. C. 1970. Consumptive Use of Water by Sugarcane in Hawaii. Water Res. Center Tech. Report 37. 93 pp.

Briones, A. A. 1969. Physics of Drained Paddy Soils. PhD Thesis. UH 188 pp

Trouse, A. C. and Humbert, R. P. 1961. Some effects of Soil Compaction on the Development of Sugar Cane Roots. Soil Sci. 91:208-217.

Ekern, P. C. 1965. Evapotranspiration of Pineapple in Hawaii. Plant Physiol. 40:736-739

Ekern, P. C. 1966. Evapotranspiration by Bermudagrass Sod in Hawaii. Agron J. 58:387-390.

Ekern, P. C. 1967. Soil Moisture and Soil Temperature Changes with the Use of Black Vapor-Barrier Mulch and Their Influence of Pineapple Growth in Hawaii. Soil Sci. Soc. Ameri. Proc. 31:270-275.

Ekern, P. C. 1972. Drip Irrigation in Sugarcane. Water Res. Center Seminar Series 1:68-72.

El-Swaify, SA. 1970. The Stability of Saturated Soil Aggregates in Certain Tropical Soils as Affected by Solution Composition. Soil Sci. 109: 197-202.

Uehara, G., Ikawa, H and Sato, H. H. 1971. Guide to Hawaii Soils. Hawaii Agr. Expt. Stn. Misc. Pubn. 83:32 pp.

UTILIZATION OF SOILS IN THE CARIBBEAN AREA

Summary of Contribution by
Dr. R. Pietri
University of Puerto Rico

Puerto Rico has an area of approximately 2 million acres, which is 80 times smaller than the state of Texas. Only 250,000 acres of low land can be mechanized. The landscape consists of 19% rugged low land, 37% hill land, and 41% mountainous area. The northern low lands are limestone derived. Mountain chain patterns determine the rainfall in the island which ranges from 15 in. in the southeastern tip to 250 in the northwestern tip. Climate is controlled by ocean currents from the North African Coast. The annual mean temperature is 78°F, 65°F being the lowest temperature.

Land use in Puerto Rico has been determined by export crops (sugarcane, coffee, and tobacco) and subsistence crops. Dr. Pietri explained how the history of Puerto Rico has determined the direction and extent of agricultural development. The island became a U. S. Protectorate in 1898. With this came some innovations that helped agriculture: (1) protected preferential market of the eastern seaborad of the U. S., (2) availability of U. S. capital, and (3) mechanization which has since been available to Puerto Rico. However, around 1950 a survey indicated that approximately half of the island showed severe erosion. Only 27.6% of the island was suited for cultivation.

Since 1950, sugarcane has trippled production constituting 30% of the income of the island. In addition to degradation of agricultural

land, the population rapidly grew. Many young male farmers, from rural areas migrated to the mainland cities of New York, Chicago, Philadelphia; young females migrated to big urban areas in Puerto Rico.

The government simultaneously started a tax exemption program to attract manufacturing and industrial companies to utilize some of the labor force.

Now, as a result, the main interest of the island economy has changed from agricultural to industrial and tourist emphasis.

In 1970 the land utilization in Puerto Rico looked this way:

Crops	Acres	% of Total Farm Land
Sugar	188,775	10.4%
Coffee	130,000	7.2
Tobacco	5,100	0.3
Other crops	163,000	9.0
Idle land	100,000	5.5
Pasture	830,000	45.8
Brush		12.5
Other		4.2
Total Farm Land	1,809,835	

Although the agricultural emphasis has changed, the island still will have to produce its own food supply and some export crops, which is the direction of current research.

THE USAID PHILOSOPHY FOR PREPARING AGRICULTURAL SCIENTISTS FOR OVERSEAS SERVICE

Summary of Contribution by
Dr. J. L. Malcolm - USAID

Dr. Malcolm outlined the attributes to be necessary for students who plan to work in the tropical areas in agriculture, based on his own experience in foreign service especially to the aspects of behavior expected of professionals working in LDC's.

Dr. Malcolm commented that for a person serving as an Agronomist in a foreign country, social and political factors are sometimes more significant than technical ones. He said, "The agronomist is supposed to put these factors together in a practical way; you need to think in terms of the whole picture" He added, "We need to develop professional traits. We don't want to stop at the cookbook level. Be observant and listen to what people say if you are going to be a good agronomist."

Dr. Malcolm said that interested students should aspire for higher degrees. To serve overseas, the person should have a M. S. and preferable a PhD. He added that U. S. students had to be very competent because of competition from other countries, where professionals, in most cases, accept a lower salary than American professionals. He said that the United Nations and AID Programs were not expanding and therefore competition was keener. From those interested to serve, only the best qualified could be chosen.

He encouraged students to acquire a practical knowledge of French and Spanish in addition to English, since these are the commonly used languages in tropical countries.

In summary, Dr. Malcolm advised, "People are interested in getting some gain out of your service, whether an individual or an organization. You need a real sense of value; don't sell yourself cheap; your opinions are valuable so are your observations, and your skills."

DISCUSSION

Dr. Malcolm's talk stimulated many questions from the students. A lively exchange of comments ensued, particularily concerning the value of a PhD degree to serve effectively in agricultural development overseas.

Dr. Nehr questioned whether a student should serve overseas before he is invested with any advanced degree in agriculture.

Dr. Malcolm suggested that graduate students interested in foreign service should conduct some research and continue their studies in the country they wish to serve before the degree is granted.

EDUCATION AND TRAINING OF AGRONOMISTS TO MEET THE NEEDS IN TROPICAL REGIONS

Summary of Contribution by
Dr. M. Milford
Texas A&M University

Dr. Milford has had ten years of experience teaching an introductory course in soil science. He discussed his experiences teaching Soils at Cornell University and Texas A&M University. He opened the lecture by stating "the process of learning involves reacting, doing, and experiencing." The products of the process are socially useful patterns of action, values, attitudes, abilities, and skills. "The teacher, "he said, "should seek the following goals: (1) to guide the learning process, (2) to motivate the learner-that is, develop a desire for learning, and (3) to "mature" students". Dr. Milford then described specific methods which he used in his early teaching, and those aspects of the course that have since been changed. Some of the "unchanged" inputs of which he has retained in the course are: (1) To learn each student's name, (2) supply the assignment sheet for semester work, and (3) include lecture outlines by topics. Innovations he has added: (1) Lectures have become more extemporaneous, (2) more use of (hardware) equipment, (3) audio-tape material and slides, (4) instructional objectives made public. This means that if a student is asked to name, construct, identify, or demonstrate something, and is aware of what is expected of him, then it would not be unfair to ask him to name, construct, identify, demonstrate something in a test because he was told at the onset that those were the objectives of the class-in other words, the student becomes competent.

Dr. Milford pointed out that student evaluation of the course had not changed much throughout the period he has been teaching. Respect and personal interest are important. Knowing the students as individuals enhances the students' attitude. "If you have more people than you can learn names, you have too many students," he said. Of course, some will be motivated, many will not because the students may be in a class only to fulfill a perequsite. In planning for future semesters, he said his goals were these:

1. Guiding Learning Process
   (a) Write instructional objectives.
   (b) Select methods and techniques.
   (c) Assessment of student accomplishment.
2. Motivation of Student
   (a) Enthusiam.
   (b) Relevant goals.
   (c) Recognition.
3. Maturation of Student
   (a) Provide discipline for development of self.
   (b) Reinforce natural development of self.
   (c) Have clarity of purpose explicit values.

The changes he described from his own experience represent a teacher's effort to personalize the student--teacher relationship and maintain specific goals which lead to accountable learning.

TOUR OF PRAIRIE VIEW A&M COLLEGE
EXPERIMENT STATION

Summary of Contributions

by

Professor O. E. Smith

A field trip around the farm of the Prairie View Experiment Station was conducted by Mr. O. E. Smith (See attached report). The tour took the participating soil scientists to the following locations:

First Stop:

Kenny Pit - Grossarenic Palendalf: loamy, mixed, thermic, (siliceous). A hand-out with specific information about this soil was given and discussed.

Second Stop:

Hockley pit - Plinthic Palendalf: Fine-loamy, mixed, thermic (siliceous) with specific information about the soil was given and discussed. Many unanswered questions were raised about the morphology and genesis of the Kenney profile. It was the consensus of the group that further study of this soil would be valuable. A graduate student, under Dr. J. B. Collins' supervision, is working on the problem.

Third Stop:

The Peach Orchard

Mr. Chang, from the School of Agriculture, Prairie View A&M College, explained that the two-fold purpose of the new peach orchard is to try different varieties of peaches, and as a fertilizer trial for one variety (June Gold), as part of an intensive farming alternatives for rural poor

on small acreages. Some varieties were developed at the Texas A&M University Experiment Station.

Fourth Stop:

Tomato Experiment

The participants were taken to an experiment being carried out by a graduate student under the supervision of Dr. E. A. Brams, School of Agriculture, Prairie View A&M College, in which different fertility levels of phosphate (using rock phosphate and super-phosphate) and cultural practices are being studied. Dr. Brams pointed out that the system studied, will, hopefully, be used by small farmers in tropical areas as well as in Texas.

TEXAS A&M UNIVERSITY-PRAIRIE VIEW A&M COLLEGE
CO-OPERATIVE
RESEARCH CENTER

Dr. J. B. Collins

The Experiment Station is located at Prairie View A&M College. It is in Waller County, 46 miles northwest of Houston, 1 1/2 miles north of U. S. Highway 290 on Farm Road 1097. The College Farm consists of about 1,260 acres of state-owned land that are available for research purposes. The farm is representative of the better drained, more sandy interior portion of the Gulf Coast Prairie. This area is sometimes known as the Hockley prairie, and is 5 to 30 miles wide and more than 100 miles long. The topography of the area is nearly level to gently rolling, weakly dissected plain. The elevations are 150-300 feet above sea level.

Average annual rainfall is 40 inches. The average growing season is 274 days. The mean annual temperature is 69°F.

The climax vegetation of the Gulf Coast prairie is largely grassland (tall grass prairie) or post oak savannah. The principal climax grasses include little bluestem (Schizachyrium scoparium var. frequens), big bluestem (Andropogon garardi), Indiangrass, switchgrass (Panicum virgatum) and purpletop (Tridens lavus). The overstory is primarily post oak (Quercus stellata) and blackjack oak (Quercus marilandica). Some invading plants are red lovegrass (Eragrostis oxylepis), broomsedge bluestem, splitbeard bluestem (Andropogon ternarius), green briar, smutgrass,

western ragweed and mesquite (Prosopis glandulosa).

The major soils of the substation are not represented on any other substation. Hockley fine sandy loam, and Kenney loamy fine sand are the most important soils, both in extent and suitability for experimental use, on the Texas A&M University-Prairie View Agricultural Experiment Station. These soils are classified as Alfisols in the current Soil Classification System of the United States. Alfisols are soils with a moderate to high base saturation and significant accumulation of silicate clay in the subsoil. (Descriptions of these soils are attached)

The soils of the station have developed from acid sandy clays or clay loam parent materials under a coarse grass vegetative cover on gently sloping to nearly level surfaces. The soils are more sandy, more rapidly drained, and more leached than the soils of the nearly level somewhat lower lying part of the prairie farther south. The soils of the station are slightly acid to acid in the surface horizon. These soils are of moderate to low productivity, and yields decrease rapidly under continuous cropping unless practices are used to maintain and improve their productivity. However, these soils are responsive to management and capable of intensive use.

The major agricultural enterprises of the station include peanuts, watermelons, sweet potatoes, corn, soybean, forages, fruits and vegetables, beef cattle, dairy cattle, swine and poultry. In general, crops produced on the soils of the station respond to nitrogen, phosphorus and potassium fertilizers and lime.

Much of the area is still in native or improved pastures, although small farms are quite common. Improved pastures are commonly seeded to Bermudagrass, Dallisgrass, Vaseygrass, Carpetgrass and Clovers. All classes of livestock are grazed but cattle are the most common. The total economy of the interior portion of the Coast Prairie is changing rapidly. As a result of the increasing opportunities for farm people to earn a livelihood in urban areas, many people either leave the farm or farm on a smaller scale or on a part-time basis. Also developing in the area is a buildup of urban population, a greater demand for land for housing, recreation and as a place for rural living financed by urban earning or retirement incomes.

Thus the continuing goal of research on the station is to develop programs for using people, soils, plants and animals in combinations that protect the environment and are most profitable to land owners and land users in an area of urban and industrial expansion.

On July 13, 1946 the Board of Directors of the Texas A&M College System ordered that "a Branch Agricultural Experiment Station be established at Prairie View University, and that the Texas Agricultural Experiment Station be instructed to proceed with such details as are necessary to accomplish this action...." It was designed as Substation No. 18 in 1947. It's objectives were (1) to provide opportunities for the teaching of technical agriculture, (2) to conduct demonstrations in agricultural techniques and procedures and (3) to conduct research in the various agricultural sciences. Research was conducted on the farm of the then Prairie

View Normal at Hempstead as early as 1889, just a year after the Texas Agricultural Experiment Station was established.

Research now includes projects in plant and soil science; soil chemistry and fertility, soil microbiology and biochemistry, soil genesis, morphology, classification and soil mineralogy, land use planning, environmental quality, forages, corn, peanuts, potatoes, watermelons, vegetables and fruits; animal science; swine growth and nutrition, beef cattle management systems, poultry marketing and product development and environmental studies of larger animals for biochemical research; socio-economic problems; human nutrition, rural development and poverty, human resource development, economic and social patterns of rural minorities, and marketing problems.

HOCKLEY SERIES

The Hockley series comprises deep, brownish soils having thick fine sandy loam surfaces and sandy clay loam subsoils containing plinthite.

These soils are well to moderately well drained. They absorb water readily, but have only a moderate capacity to hold available water. They also have a moderate fertility holding capacity.

A representative pedon is 75 feet east of turnrow, 1,000 feet north of paved road on south side of farm, from a point 0.8 mile east of intersection of paved road and Farm Road 1098.

Ap	0 to 5 inches, very dark grayish brown (10YR 3/2) fine sandy loam, few fine faint yellowish brown mottles; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; strongly acid; clear smooth boundary.
A1	5 to 9 inches, very dark grayish brown (10YR 3/2) fine sandy loam; fine faint strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; few fine weakly cemented ferromanganese concretions in lower three inches of horizon; medium acid; clear smooth boundary.
A2	9 to 25 inches, dark brown (10YR 4/3) fine sandy loam; common fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few fine pores; few wormholes and casts; few fine weakly cemented ferromanganese concretions; medium acid; clear smooth boundary.
B21t	25 to 31 inches, yellowish brown (10YR 5/4) sandy clay loam: common medium distinct brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; thin clay films; hard, friable; slightly sticky and slightly plastic; few fine roots with dark brown stains along some root channels; common fine pores; few worm holes and casts; few medium, rough, strongly cemented ferromanganese concretion; medium acid; clear smooth boundary.

B22t 31 to 50 inches, yellowish brown (10YR 5/6) sandy clay loam; many medium prominent red (2.5YR 4/8) mottles; weak course prismatic structure breaking into moderate medium angular blocky; thin clay films; hard, friable, slightly sticky and slightly plastic; few fine roots; 30% plinthite; common fine strongly cemented iron concretions; medium acid; gradual smooth boundary.

B23T 50 to 63 inches, brownish yellow (10YR 6/6) clay loam; many medium prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; thin clay films; hard, friable, few fine roots 30% plinthite; few fine strongly cemented iron concretions; medium acid.

The solum ranges from 70 to more than 100 inches thick. The depth of horizons containing more than 10 percent plinthite ranges from 30 to 60 inches. Reaction throughout the soil ranges from slightly to strongly acid. The clay content of the upper 20 inches of the Bt horizon ranges from 18 to 35 percent. The A horizon ranges from 20 to 40 inches thick. The A1 horizon ranges from very dark grayish brown to brown, with the A2 horizon being 1 or 2 units of value higher. Texture of the A horizon ranges from fine sandy loam to light loam or very fine sandy loam. Strongly cemented to indurated iron oxide concretion range from few to many in the A and Bt horizons. The Bt horizon ranges from sandy clay loam to light clay loam. The Bt horizon contains 20 to 30 percent plinthite, but the B21t horizon contains less than 10 percent plithite. Gray mottles are absent in the B21t horizon, but are present in the remainder of the Bt horizon of some pedons.

KENNY SERIES

The Kenney series comprises deep, pale brown soils having thick loamy fine sand A Horizon over sandy clay loam subsoils.

The soils are well drained. They absorb water rapidly, but have a low capacity to hold available water. They also have a low fertility holding capacity.

A representative pedon is 800 feet north and 350 feet east of the southwest corner of the Farm.

Ap — 0 to 6 inches, pale brown (10YR 6/3) loamy fine sand, brown (19YR 5.3) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; medium acid; clear smooth boundary.

A12 — 6 to 17 inches, pale brown (10YR 6/3) loamy fine sandy, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, loose; few fine roots; slightly acid; clear smooth boundary.

A21 — 17 to 48 inches, very pale brown (10YR 7/4) loamy fine, sand, yellowish brown (10YR 5/4) moist; structure-less; very friable; few fine roots; medium acid; gradual smooth boundary.

A22 — 48 to 65 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; structureless; loose, very friable; two very thin lamalla of yellowish red (5YR 4/6) sandy clay loam in lower part; medium acid; clear smooth boundary.

B2t — 65 to 88 inches plus, prominently and coarsely mottled strong brown (7.5YR 5/8) and red (2.5YR 4/8) light sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and reddish yellow (5YR 4/8) mottles; weak fine subangular blocky structure slightly hard; friable, slightly sticky and slightly plastic; few fine, weakly cemented ferromanganese concretions;sand grains coated and bridged; strongly acid.

The solum ranges from 65 to more than 100 inches thick. Combined thickness of the A horizons ranges from 40 to 72 inches. The A horizon ranges from brown to very pale brown. Texture of the A horizon ranges from loamy fine sand to loamy sand. Reaction of the A and Bt horizons ranges from slightly to strongly

	Suitability as Source of		Soil Features Adversely Affecting						
				Farm Ponds					
	Topsoil	Roadfill	Highway Location	Reservoir Area	Embankment	Agricultural Drainage	Irrigation	Sewage Lagoons	Limitations for Sewage Disposal Filter Fields
Kenney (Knob)	Poor	Fair	Loose Sand Hinders Hauling Operations Fair to Poor Stability		Fair to Poor Stability; Piping Hazard	None	Low Water Holding Capacity; Rapid Intake Rate	Permeability; Poor Berm Material	Slight

Soil Series and Map Symbols	Reaction	Shrink Swell Potential	Corrosivity of Uncoated Stell	Hydrologic Group
Kenney (KeB)	5.5 - 6.5 5.5 - 6.5	Low Low	Moderate	A

Soil Series and Map Symbols	Depth to Sea Sand High Table (Feet)	Depth from Surface of Typical Profile (Inches)	Classification			Percentage Passing Sieve				Permeability (Inches per Hour	Available Water Capacity (Inches per Soil)
			USDA Texture	Unified	AASHO	No.4	No.10	No.40	No.200		
Kenney (KeB)	8-10	0-65 65-88	lfs scl	SM Scor CL	A-2 A-4or	98-100 98-100	98-100 95-100	95-100 95-100	15-30 45-55	2.0 - 6.3 0.63-2.0	.07 - .09 .12 - .14

acid. The Bt horizon ranges from yellowish brown to red. Texture of the Bt horizon ranges from sandy clay loam.

	Soil Features Adversely Affecting								
	Suitability as Source of		Highway Location	Farm Ponds		Agricultural Drainage	Irrigation	Sewage Lagons	Limitation for Sewage Disposal
	Topsoil	Roadfill		Reservior Area	Embankment				Filter Field
Hockley (HoA; HoB; HoC)	Good	Good	None	None	Fair	None	None	Slopes	Slight
					Stability				

Soil Series and Map Symbols	Reaction	Shrink Swell Potential	Corrosivity Of Uncoated Steil	Hydrologic Group
Hockley (Hoa; HoB; HoC	5.5 - 6.5	Low		
	5.5 - 6.5	Low	Moderate	
	5.5 - 6.5	Moderate		C

oil Series nd Map Symbols	Depth to Sea Sand High Water Table (Feet)	Depth from surface of Typical Profile (inches)	Classification			Percentage Passing Sieve				Permeability (Inches per Hour)	Available Water Capacit (Inches per Inch of Soil)
			USDA Texture	Unified	AASHO	No.4	No.10	No.40	No.200		
ockley (HoA;HoB; oC)	5-10	0-25	fsl	SM	A-4	95-100	95-100	90-95	40-50	0.63-2.0	.12 -.15
		25-50	scl	CL	A-6	95-100	95-100	90-95	50-60	0.63-2.0	.14 -.17
		50-63	cl	CL	A-6	95-100	95-100	90-95	50-65	0.2-0.63	.07 -.09

COUNTY AGRICULTURAL TOUR FOR TROPICAL SOILS WORKSHOP

October, 1972

by

Professor O. E. Smith
Prairie View A.&M. College

This tour was designed to acquaint the participants and the consultants with the intensive and extensive operations that characterize the farming and ranching population in Waller County, Texas. This tour also pointed out some farm and forest lands that are being converted into housing developments.

The tour started at Prairie View A.&M. College and proceeded north of the campus observing farms classed as no-income, low-income, medium-income, and high-income farming enterprises.

The first stop was a turf nursery where dwarf strains of Bermuda grass are grown commercially for golf courses, lawns, parks and playgrounds. Following this, the group visited a housing development in a forested area just north of the Coast Prairie. Much of the forested and savanna areas near Houston are giving way to such developments.

The Springer Brothers' farming and ranching operations was the third stop. These brothers operate a very extensive cotton, grain, and sorghum rotation system under irrigation and dryland practices. They also run a herd of mixed-bred cattle to utilize the forage from the uncultivated land and the coastal bermuda hay which they grow and harvest.

The fourth visit was Didorio's vegetable and fruit stand. This operation represented an integrated as well as a highly intensified family operation where both home grown fruits and vegetables are produced, processed and sold as well as produce purchased from other local and valley area growers.

The fifth and lunch stop was at Hamner's "Safari" Camp grounds. Weekly and over-night camping facilities are available. Areas are provided for fishing and recreation along with some rental acreage for peanut farming, as well as sources of income for this operation. The operation also produces catfish in ponds under controlled conditions. Most of the fish are sold to retail sources in Houston.

The sixth stop was Pfeffer's rice farm and ranch. Rice, soybeans, and cowpeas are grown while coastal bermuda grass and native bluestems are grown for pasture and hay for the cattle operations.

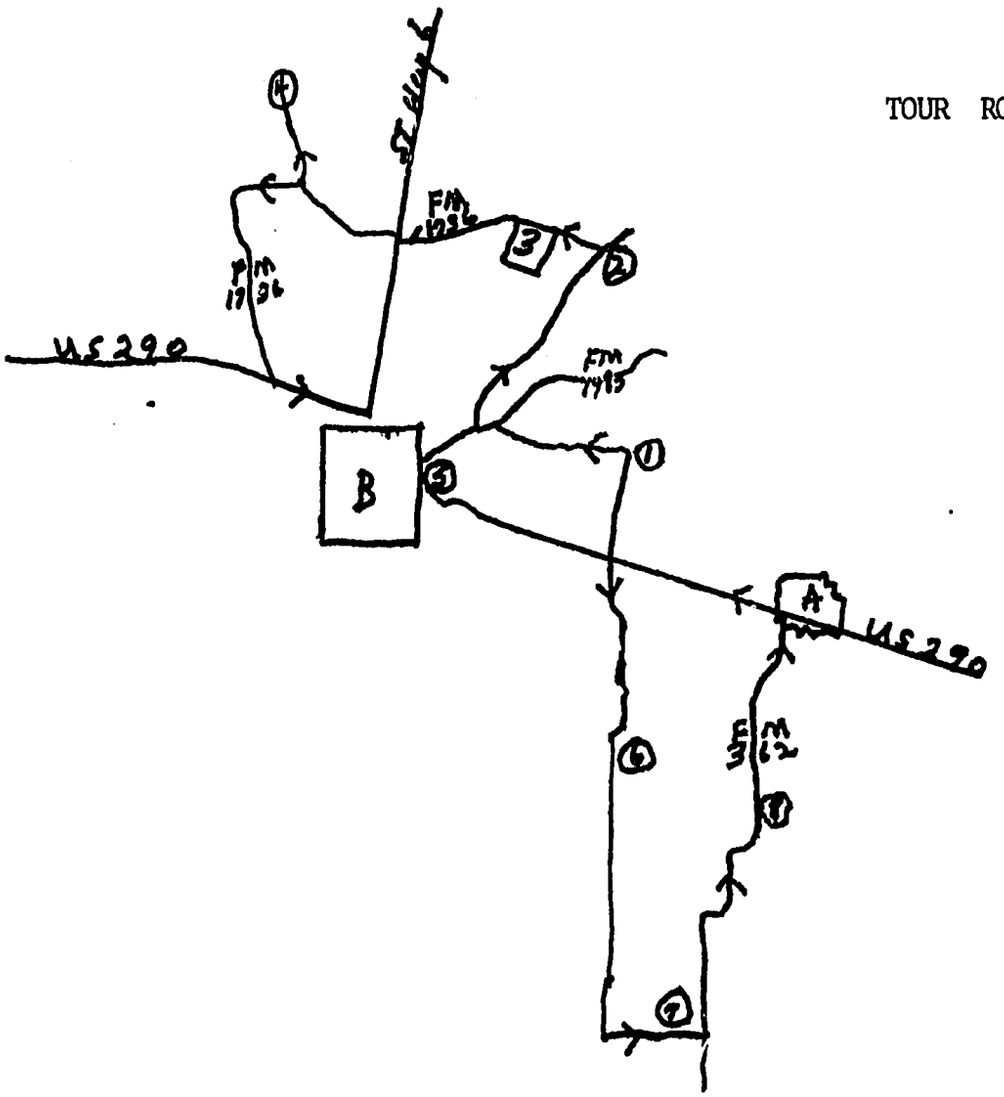
The Marcus Cantrell ranch was the seventh visit of the tour. Here purebred cattle are raised and grazed on coastal bermuda pasture. These coastal pastures are also harvested for hay, using a haybaler which produces round bales each weighing approximately 3,000 to 4,000 pounds that are left in the field at selected sites.

The eighth stop was at Prairie View A&M College's Research and Demonstration farm where field and harticultural crops, swine, poultry, beef cattle, and dairy operations are conducted by staff members.

The ninth and last stop was at the picnic area where a question and answer period from the participants and consultants took place along with the juicy consumption of ample cold water-succulent melons.

The tour was closed by J. I. Kirkwood, Research Coordinator for Prairie View A&M College, who thanked the group for their participation and hoped for another successful tour next year.

TOUR ROUTE



A- Waller town

B- Hempstead

1. Tour starts
2. Texas turf nursery
3. Rolling Hills sub-division
4. Frans & Springer farm
5. Dilorios vegetable stand
6. Lunch- Safari Camp Grounds
7. A. Pfeffer rice farm
8. Round hay bales

TOUR DESCRIPTION

1. Tour starts at Prairie View--Along Wyatt's Chapel road and Laneview road, we can see examples of low-income or no-income farm. Here the land owner lives, but works off the farm elsewhere.

2. This man has about 25 acres here. He raises new Bermuda Turf grass used to sod golf course greens and fairways. He has installed an irrigation system and also custom-plants the golf courses. Income for this man comes from and through the grass he raises.

3. Rolling Hills Colony- Much of the wooded areas near metropolitan Houston is being developed as home sites. Many of the people buying here commute the 45-50 miles to Houston to work.

4. Frank & Alfonse Springer make their living from this farm. They irrigate cotton and dryland farm maize. They have cattle on good pasture of Coastal Bermuda. A large lake for recreation was constructed several years ago.

5. Billy Didorio's vegetable and fruit stand. Much of the produce sold here is produced locally by Didorio's or other farmers.

6. Lunch stop - Glenn Hamner's "Safari" Camp grounds. Recreation is entire source of income.

7. A. Pfeffer's rice farm. Large irrigation reservoirs are used as wildlife sancturies as well as irrigation water. Rice, soybean, cowpeas and cattle are raised here.

8. Marcus Cantrell's Coastal Bermuda pasture. Here a round bailer is used to bail 3-4,000 pounds of hay that is left in the field until needed.

CLOSING REMARKS

The participants of the workshop indicated that the exchange of diverse ideas concerning the utilization of tropical soils from teachers of soil science, research scientists, government representatives from AID and USDA, pooling their experience in the United States and abroad - resulted in new information, perspectives, and awareness for all persons involved. It is hoped that this enrichment of experience will increase concern and expertise and lead to agricultural programs and innovations which will increase the quality of life of the rural poor in tropical areas everywhere.

APPENDIX

LIST OF PARTICIPANTS

1.	Dr. M. Drosdoff	Cornell University
2.	Dr. Goro Uehara	University of Hawaii
3.	Dr. P. Ekern	University of Hawaii
4.	Dr. Pedro Sanchez	North Carolina State University
5.	Dr. R. Pietri	University of Puerto Rico
6.	Dr. J. L. Malsom	USAID, Washington
7.	Dr. Murray Milford	Texas A&M University
8.	Dr. C. B. Owens	Florida A&M University
9.	Mr. J. F. Mills	Texas A&M University
10.	Dr. Curtis Godfrey	Texas A&M University
11.	Dr. Richard W. Weaver	Texas A&M University
12.	Dr. Suresh C. Tiwari	Alcorn A&M College
13.	Dr. Gordon S. McKee	State Soils Scientists
14.	Dr. B. L. Allen	Texas Tech University
15.	Dr. David D. Neher	Texas A&I University
16.	Mr. Edward J. Simpson	Sam Houston State University
17.	Mr. Vance Hare	U.S.D.A. - SCS
18.	Mr. James Englebrock	County Extension
19.	Mr. J. M. McQuire	U.S.D.A. - SCS
20.	Mr. Dewayne Williams	U.S.D.A. - SCS
21.	Mr. W. B. Clark	Extension Service
22.	Mr. U. S. Wallace	Prairie View A.&M. College
23.	Dr. Don Knotts	Prairie View A.&M. College

24.	Dr. Rao	Prairie View A.&M. College
25.	Dr. J. L. Brown	"
26.	Dr. I. C. Gordon	"
27.	Dr. Sam Darruvalla	"
28.	Dr. A. I. Thomas	"
29.	Mr. J. C. Williams	"
30.	Mr. Paul Kasumbien	"
31.	Mr. Henry Wambiji	"
32.	Mr. John Kincaid	"
33.	Miss Susan Chan	"
34.	Miss Willie Waddy	"
35.	Miss Arjurella Combs	"
36.	Mr. Robert Dixon	"
37.	Mr. Luis Tejeda	"
38.	Mr. L. Weatherspoon	"
39.	Mr. Eric Johnson	"
40.	Mr. H. A. Perkins	"
41.	Mr. J. J. Woods	"
42.	Mr. Alfonse Springer	Hempstead, Texas
43.	Mr. Ronald D. Harvey	
44.	Mr. Alex Alexander	

TROPICAL SOILS WORKSHOP
Prairie View A&M College
Prairie View, Texas

October 2-6, 1972

Sponsored with the cooperation of USAID Consortium for Tropical Soils (211(d) Grant)

TITLE: Tropical Soils-Their Utilization for a Better Rural Life

PROGRAM

MONDAY - October 2

9:00 - 10:30 a.m.	INTRODUCTION AND WELCOME a. Dr. A. I. Thomas, President Prairie View A&M College b. Mr. J. C. Williams, Dean School of Agriculture, Prairie View A&M College c. Dr. J. I. Kirkwood, Research Coordinator, Prairie View A&M College
10:30 - 11:00 a.m.	COFFEE BREAK
11:00 - 12:00 p.m.	SOIL CLASSIFICATION FOR LAND - USE PLANNING Dr. J. B. Collins, Prairie View A&M College

12:00 - 1:30 p.m.	LUNCH
1:30 - 5:30 p.m.	FIELD TRIP a. Examine Soil Profiles b. Collect Monoliths c. Tour of Experiment Station and College d. Refreshment Break
7:00 p.m.	TEXAS BAR-B-QUE

TUESDAY - October 3

9:00 - 10:30 a.m.	UTILIZATION FO SOILS IN WEST AFRICA a. Dr. E. Brams, Prairie View A&M College b. Mr. P. Kasumbien, Prairie View A&M, (Uganda, W. Africa)
10:30 - 12:00 p.m.	CULTURAL SYSTEMS ON TROPICAL SOILS Dr. M. Drosdoff, Cornell University
12:00 p.m.	TOUR OF HOUSTON, Mr. Chang & Mr. Kincaid a. NASA Center b. Free evening

WEDNESDAY - October 4

9:00 - 12:00 p.m.	UTILIZATION OF SOILS IN HAWAII AND SOUTHEAST ASIA a. Dr. Goro Uehara - University of Hawaii b. Dr. P. Ekern - University of Hawaii

12:00 - 1:30 p.m. LUNCH

1:30 - 3:30 p.m. PHYSICAL & CHEMICAL PROPERTIES OF TROPICAL SOILS AS RELATED TO PLANT NUTRITION

Dr. Pedro Sanchez - University of Carolina State

3:30 - 5:00 p.m. UTILIZATION OF SOILS IN THE CARIBBEAN AREA

a. Dr. R. Pietri, University of Puerto Rico
b. Dr. J. Kirkwood - Prairie View A&M
c. Dr. A. Mangaroo - Prairie View A&M
d. Mr. Y. P. Chang - Prairie View A&M

THURSDAY - October 5

9:00 - 3:00 p.m. FIELD TRIP

Soil Conservation Service USDA, and Agriculture County Agents, Waller Co. Cooperating.

FRIDAY - October 6

9:00 - 11:00 a.m. EDUCATION & TRAINING OF AGRONOMISTS TO MEET THE NEEDS IN TROPICAL REGIONS

a. Dr. J. L. Malcom - USAID, Washington
b. Dr. M. Milford, Texas A&M University

11:00 a.m. ADJOURNMENT

a. Mr. J. C. Williams, Dean
School of Agriculture
Prairie View A&M