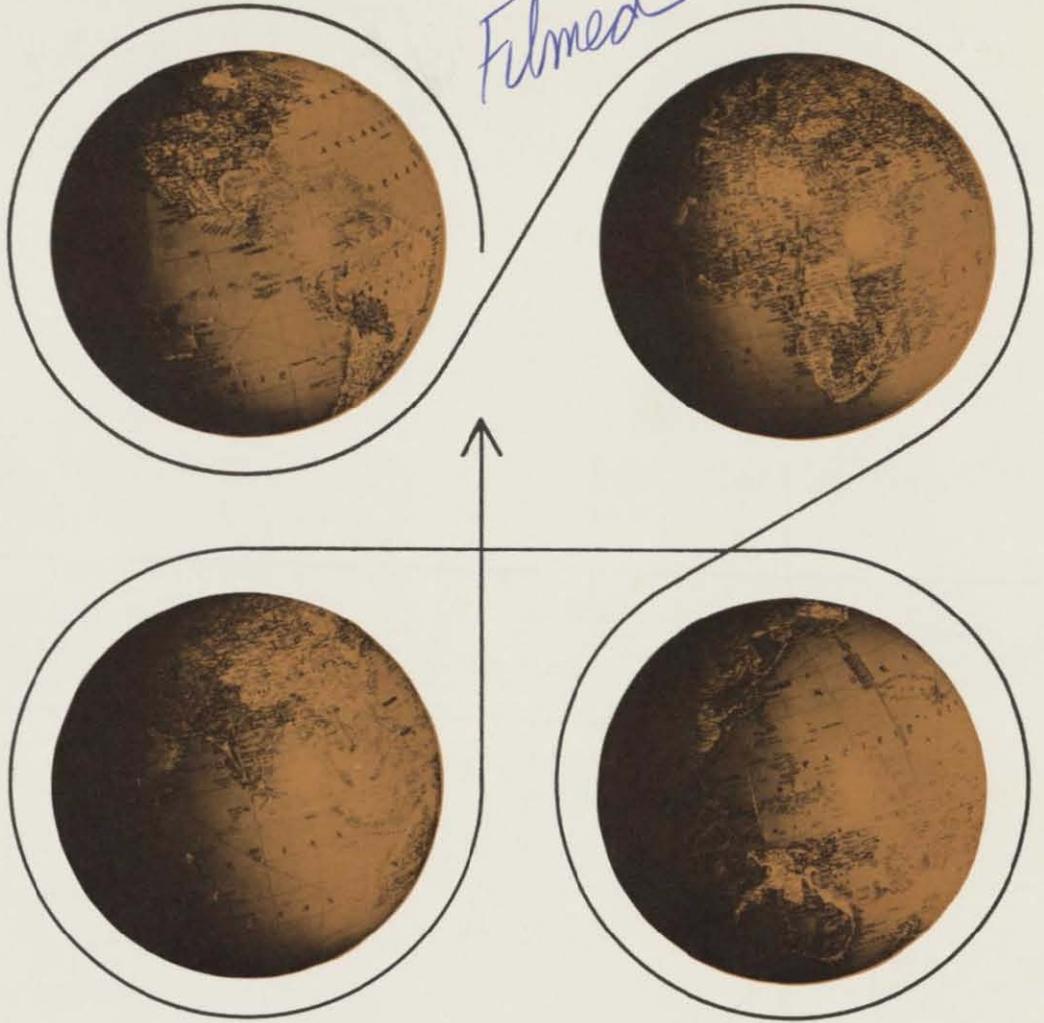


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DISSERTATION ABSTRACTS

Relating to

INTERNATIONAL AGRICULTURE

AND RURAL DEVELOPMENT

Volume 8 : 1980

PROGRAM IN INTERNATIONAL AGRICULTURE

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International Agricultural and
Rural Development

VOLUME 8: 1980

Compiled by John J. Mitchell

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PRODUCTION OF CANNED MOIN-MOIN: THERMAL STUDIES, ACCEPTABILITY, NUTRITIONAL AND STORAGE PROPERTIES

Moin-moin is a very popular cowpea dish in Nigeria. It is eaten by all segments of the population except infants. Typically moin-moin is prepared by soaking the dry cowpea seeds in water for various time intervals, usually between 1 to 4 hours. After soaking, the seed coats are manually removed from the cotyledons and separated by repeated washing and decanting. The cotyledons are then ground with water into a slurry. Ingredients such as tomato paste, salt, ground onions and oil are added and the mixture thoroughly mixed. Portions of the mixture are wrapped in special glossy, non-absorbent leaves and steamed for about 1-1/2 hours or until the contents solidify.

The moin-moin preparation, like many other cowpea dishes, requires a high labor and time input. These requirements and urban pressures in a developing country like Nigeria have diminished the consumption of moin-moin in recent years. Furthermore, the availability of cowpea throughout the year is restricted by inadequate storage facilities and severe weevil infestation.

The present study was undertaken to produce moin-moin as a nutritive, convenient, ready-to-eat food, in a form that will be stable to storage and distribution; and also to determine the acceptability and nutritional potential of the product.

A moin-moin ingredient composition suitable for canning was derived after a series of preliminary tests. The heat penetration parameters of the product in 303 x 406 cans were determined and the values obtained were employed in designing a process adequate to produce a safe and shelf-stable product.

The proximate chemical compositions of the moin-moin puree and the canned moin-moin were determined. The characteristics of thermal destruction of thiamine in the product were established. The effects of the thermal processing and two storage temperatures for a 6-month storage period were separately determined chemically on the retention of thiamine, lysine, tryptophan and methionine. Changes in the nutritional quality of protein in the products were determined by rat feeding studies.

The organoleptic evaluations and acceptability of the products were tested in a taste panel consisting of 10 Nigerian students.

The heat penetration studies indicate that the product is a conduction heating food. A process designed to deliver a sterilizing value of $F_0 = 10.2$ minutes was adequate to produce a safe and shelf-stable canned moin-moin. The values describing the thermal destruction of thiamine in moin-moin were established as $D_{250} = 179.5$ minutes and $z = 48.2^\circ\text{F}$.

Evaluation of the thiamine retained in the product immediately after processing and at the end of the 6-month storage period indicated that the canned moin-moin was still a good source of thiamine. Chemical assay of the three essential amino acids retained in the product after processing and the storage did not show any apparent destruction of the amino acids. However, the rat feeding studies indicated that the thermal process caused some reductions in protein quality and palatability for the rat. Storage did not have any influence on the protein nutritional quality of the canned products.

Organoleptic evaluations indicated a very favourable acceptability of the fresh and stored products.

* * *

Bailey, L. Conner

Development Sociology

SOCIAL AND ECONOMIC ORGANIZATION IN RURAL MALAY SOCIETY

Rice farming, fishing and rubber tapping, the three most important economic adaptations found among rural Malays, are compared in this study. It is argued that production processes and relationships shape and influence a wide range of non-economic relationships, and that many of the differences found between the three communities studied may be traced to the dictates and demands of production. It is suggested in this study that analysis of production processes and relationships provides a useful means of understanding a systematic source of sociocultural diversity among rural Malays. The image of rural Malay society which emerges is more complex than that usually offered in the academic literature or even that perceived by officers of the Malaysian government working in the rural areas. This study is designed to be of interest to both audiences.

Chapter One is devoted to the discussion of basic questions and approaches adopted in this study. An introductory discussion of rural Malay society is presented in Chapter Two. Three lengthy Chapters (Three, Four, and Five) are focused primarily upon production processes and the social relationships which these processes engender. This material provides the basis for two analytical Chapters which follow. Differences between the three communities studied regarding the access to and availability of natural and technological resources are analyzed in Chapter Six. In Chapter Seven important differences in the social organization of production are analyzed, including varying degrees of dependence upon reciprocal labor exchanges and the scale of labor organization in each of the three communities studied. The policy implications of this study are discussed in Chapter Eight, with particular reference to the encouragement and organization of popular participation in the design and implementation of rural development policies and programs.

This study follows a comparative case study approach based on eighteen months of field research using a mix of participant observation and both structured and unstructured interview techniques. The study is a contribution to the literature available on rural Malay society and was designed to benefit both academicians and rural development specialists.

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Bastos, Edinaldo Gomes

Agricultural Economics

FARMING IN THE BRAZILIAN SERTAO: SOCIAL ORGANIZATION AND ECONOMIC BEHAVIOR

This study analyzes farming in Northeastern Brazil. The particular concern is to evaluate public policies related to agriculture, and how they influence the development of farming. Three co-existing systems of farming based on the social division of labor are identified, a capitalist system relying on wage labor, a latifundia group based on sharecroppers, and a campones form depending on family labor.

Underlying the analysis is a conceptual framework asserting that the social organization of labor influences farmers' economic behavior. Differences in farm types, resource endowments and farmers' preferences involve differentiated decision making processes. Decision making as the external expression of economic behavior, may be interpreted within the framework of random choice behavior.

Tabular and variance-covariance analyses indicated that marked differences in farm performance resulted when farm-level sample data were stratified according to labor categories. Probabilities of decisions on cropping patterns, cost composition, budget shares and output distribution were obtained using multinomial logit models of choice. These estimates were then used to predict farmers' likely reactions to changes in the explanatory variables imitative of public policies. Simulation and sensitivity analyses addressed the issues of land redistribution, agricultural financing, livestock expansion, and labor relationships.

The results showed differentiated responses to policy interventions depending on the distinct social organization of production. Since labor is the crucial element in farm production processes in Northeastern Brazil, the way in which the labor supply is secured characterizes the particular farming system. Choices in cropping pattern, cost composition expenditures allocation and output distribution show consistent patterns within each farm category; they differ, sometimes markedly, between systems. Simulations of several altered land distributions were carried out which showed likely welfare gains for the landless laborers and urban consumers. However, unless there were shifts in relative prices the change would also reduce farming profitability. Such changes would be contrary to the established pattern of capital accumulation.

Agricultural credit, a second policy instrument in the region, would not dramatically change the production and marketing practices for any of the three established farming systems. In particular, the traditional latifundia system is insensitive to increased credit. The expansion and improvement of the livestock enterprise, a third policy intervention studied, could be disastrous from a social perspective if it is undertaken within the capitalist subsystem. Here expansion of livestock enterprises would compete for land now planted to cash crops, and would displace

laborers dependent on jobs in the cash crop subsectors. This negative effect would not be felt in the case of livestock expansion in the latifundia system because there are under-used pasture and crop lands. The effects of changing the size of the resident labor population (a fourth possible policy intervention) would be a powerful influence toward a radical change in production patterns. Total labor supply is crucial in the decision function. Cropping patterns, income distribution, marketed surplus, farm profitability, and overall land and labor productivity are all influenced by the size of the resident farm labor force.

In conclusion, this study has indicated the relevance of the social organization of production in explaining distinct rational farming decision making. The farmer's choice behavior is shown to be conditioned by institutional factors such as property, credit, and the social division of labor. The manner in which these factors take shape at the farm level is influenced by a public policy which is implemented within the current overall process of capital accumulation.

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Bhuiyan, Nurul Islam

Agronomy

A STUDY OF NITROGEN IN SOIL-PLANT SYSTEM IN RELATION TO GROWTH AND YIELD OF WETLAND RICE AS INFLUENCED BY N-SUPPLY AND CROP MANAGEMENT

Two greenhouse and one field experiments were conducted during December 1978 and January 1980 at the International Rice Research Institute to study the behavior of nitrogen in soil-plant system and thus to explore some possible means to improve N-fertilizer use efficiency in wetland rice culture.

Current research has demonstrated that placement of ammonium sources of nitrogen several cm below the soil surface at planting is usually a very effective way to fertilize flooded rice, at least under conditions of continuous flooding where seepage losses are not excessive. However, there

are social, economic, and agronomic situations where such placements are not practical. The objective of this thesis was to examine some alternatives to deep placement at planting.

In the first greenhouse experiment, 5 rice soils varying in physico-chemical properties were air-dried, crushed and passed through a 5 mm sieve. A 10 kg sample of air-dry soil per pot was thoroughly mixed with 4 levels of N (0, 40, 80 and 120 ppm) using $(\text{NH}_4)_2\text{SO}_4$. Variety IR36 was grown until maximum tillering stage (45 DAT). In the second greenhouse experiment, wet soil collected directly from a fallow rice field was partly treated with ammonium nitrogen to create low (~ 40 ppm) and high (~ 140 ppm) inorganic nitrogen soil. A 9.0 kg sample of wet soil containing 145% moisture was used per tray. A single rate of N (60 kg/ha) from $(\text{NH}_4)_2\text{SO}_4$ was applied by best split (N_B) and modified split (N_M) method. An untreated control (N_0) treatment was also included. Variety IR36 was grown at 2 plant densities (2 hills and 4 hills/tray) until maturity. In the field experiment, graded amount of basal N (0, 20, 40 and 60 kg/ha) from $(\text{NH}_4)_2\text{SO}_4$ was applied and thoroughly incorporated in addition to one untreated control- $\text{N}_{0(C)}$ treatment. Except $\text{N}_{0(C)}$, all other treatments received 30 kg N/ha in two splits after maximum tillering stage. Two varieties (IR36 - high tillering, Kaohsiung - low tillering) were grown at 3 plant densities (20 x 20; 20 x 15 and 20 x 10 cm spacing).

Inorganic nitrogen - N_1 (2NKCl extractable NH_4^+ -N) in wet soil, total N in plant tops, tillering pattern and dry matter production were measured periodically. Leaf area index (LAI) at flowering, yield components and grain yield at maturity were also measured.

Increase in tiller number and dry matter production at maximum tillering stage (45 DAT) was associated with an increase in inorganic N at 0 DAT in some soils only. Addition of nitrogen did not benefit the plant at the early stage of growth (0-30 DAT) if the soil contained about 50-60 ppm N_1 during that period. Nitrogen content (%) in plant tops at early growth stage (0-15 DAT) was not a useful tool in predicting tiller number at maximum tillering stage (45 DAT) and N-fertility of the soil. Nitrogen loss and N-supplying capacities varied considerably among soils.

"Modified split" application of N-fertilizer (20 kg N/ha at 25 DAT + 20 kg N/ha at 32 DAT + 10 kg N/ha at 37 DAT + 10 kg N/ha at 54 DAT) was

superior to "best split" (40 kg N/ha basal + 20 kg N/ha at 32 DAT) in LAI, all aspects of yield components and grain yield. Nitrogen recovery rate and the productive efficiency of the applied N was much higher in the modified split than the best split. Increasing plant density did not increase grain yield.

* * *

Bohnen, Humberto

Agronomy

CALCIUM, pH AND ALUMINUM IN SOLUTION AND CORN GROWTH

The effects of calcium, aluminum and pH on the growth of corn seedlings (inbreds W182BN and A554) in solutions containing only these ions as Cl^- salts together with 0.0025 M NaCl, were determined. Corn seedlings grew very well in these solutions for at least five days using only seed reserves for other nutrients. One ppm of calcium with no aluminum in solution was sufficient to produce maximum rate of root growth at pH 5.0 in both inbreds but at pH 4.6, inbred A554 needed 3.2 ppm of calcium to get the same rate of root growth as it had at higher pH.

Inbred A554 always produced longer roots than inbred W182BN when growing in solution without aluminum. When 0.050 ppm aluminum were added to the solution, inbred W182BN increased the rate of root growth and inbred A554 decreased it. With 0.20 ppm of aluminum and 1.0 ppm of calcium in solution, both inbreds decreased their rate of root growth but inbred W182BN produced longer roots than inbred A554. A highly significant interaction between calcium and pH, calcium and aluminum, and pH and aluminum in solution, indicated that the rate of root growth of the corn seedlings studied is a complex function of pH, calcium and aluminum.

Studies on the location of aluminum in roots of corn seedlings (inbreds W64A, W182BN, A554 and C0113) indicated that its concentration was 4 to 11 times greater in the cytoplasm than in the cell walls and 2.6 times more concentrated in the epidermis and cortex than in the stele of the same

inbreds. Using eriochrome cyanine R as an indicator of aluminum in the corn roots, it was shown that this element was more concentrated in the epidermis than in the cortex in the regions near the root tip. One visible effect of aluminum on the roots is the rupture of the cell walls of the epidermis with only 0.40 ppm aluminum in solution acting for 44 hours or more on the roots of corn seedlings.

A screening procedure for the response of corn inbreds to the effects of aluminum in a solution with 5 ppm calcium, pH 4.6 and 0.0025 M NaCl is proposed. This method uses a flowing solution. Plants are grown in glass tubes permitting a constant monitoring of the rate of root growth of corn seedlings when aluminum is added or taken out of the solution. The apparatus proposed makes the control of the level of aluminum and of pH very simple, and the simplicity of rate of root growth measurements permits the detection of small variations of the growth of corn roots under the effects of added aluminum in solution.

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Brand, Donald Vincent

Development Sociology

THE PHILIPPINE INDEPENDENT CHURCH: A SOCIAL MOVEMENT

The primary focus of this dissertation is to prove, through investigation and analysis, that the Philippine Independent Church is an historically emergent social movement with an underlying religious belief system. It is particularly related to Philippine culture, society and personal social/psychological needs which produced enduring societal change.

Initially, a social movement is defined, its characteristics noted and its overall theoretical framework presented.

A general historical portrait of the Philippines is painted by giving a geographical description of that part of the world. Included are important multi-developmental descriptive factors which help the reader gain an appreciation of the nature of the Philippine Spanish Colonial church-state

bureaucracy. By contrasting present day Philippine social structure with past Philippine history, an evaluation of their differences is made.

The reader is given important information about the Philippine Independent Church through a three part historical presentation. The first section includes the main events and dates of the church's founding, its dissemination, and its final containment. The second section presents the pertinent facts of the founder's life from the time of his birth until the actual founding of the P.I.C. The third and final section raises the point that Gregorio Aglipay may have been a reluctant founder, if a founder at all.

Criteria for a social movement are then applied to the P.I.C. A perspective of historical materialism prevents human preoccupation with abstractions, a human tendency to freeze the progression of social change, and it helps to avoid the presentation of a deceptive picture of change as a mere series of discrete segmentalized alterations.

The P.I.C. is presented as an outgrowth of its own reaction to its emergence, namely, it is organized with differing reactions. It distinguishes itself from a variety of related phenomena and is unique in reflecting its members' understanding of Philippine society. It is truly a social reform movement particular to the Philippines in its inconsistencies with Spanish church-state colonialism, the Catholic Church, Nationalism and American occupation.

As a religiously based social movement, the P.I.C. is particularly related to Philippine culture, societal structure, and human social/psychological needs. Although religion embraces cultural fact and has inherent values, it usually cannot be understood without relationship to a particular society or culture. Born in reaction to church-state society, the P.I.C. accented Filipino values.

The writer recognizes the social/psychological needs of individual Filipinos as religiously based. Desire for religious autonomy, however, must be untangled from other human desires. The P.I.C. responded to particular Filipino aspirations.

This dissertation has considered social change in general terms. Inquiries have been made about the type of future action people desire, the degree of which such action takes place, and how long a period of time the action lasts. When considering religious/social change, distinction

is necessary between religious change which leads to social change and social change which leads to religious change. The bias of this dissertation considers human social aspirations among religious people as influencing religious change. This is especially true of the P.I.C. which never became the Philippine national church, but which remains today despite the decrease of the nationalism which initiated it.

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Brooks, Russell Markham

Nutrition

THE PROBLEMS OF MALNUTRITION WITHIN THE AGRICULTURAL ECONOMY OF BOJONEGORO,
EAST JAVA

This study investigated the nutritional status and factors related to malnutrition in a sample of 876 households, representing the regency (kabupaten) of Bojonegoro, East Java, Indonesia. Collected in early 1978, the data consisted of weights and heights of all household members, hemoglobin levels of those older than 15 years, and information about household incomes, expenditures, land tenure, agricultural production, employment, sanitation and water supply. In addition, subjects were examined for signs of iodine and vitamin A deficiencies. The purpose of the study was to determine the prevalence of malnutrition in Bojonegoro and to identify factors related to the causes of protein-energy malnutrition (PEM) and iron deficiency anemia.

Survey results showed that PEM was a major problem, especially in pre-school children (40% had mild to moderate and 9% severe PEM), with the highest prevalence in children aged two to three years. For adults, many showed signs of nutritional wasting. In general, men were thinner than women and people above 55 years were more malnourished than adults below this age. Based on WHO standards, 40% of women and 50% of men were anemic. Again, adults over 55 years old tended to be more anemic. Goiters, caused

by iodine deficiency, were found in isolated areas of Bojonegoro. The study failed to find any significant signs of vitamin A deficiency.

This study used indices of household weight-for-heights and hemoglobin levels as indicators of PEM and anemia, respectively, to identify factors related to these types of malnutrition. Both the amounts of land owned and incomes were associated with household PEM. In general, those households below the median income (\$240/household/year) and median size of land owned (0.5 hectare) had lower weight-for-heights. Within these sample halves, PEM rates showed no significant trends. No significant association was found between amounts of land and anemia rates. However, 30% of the households with the highest incomes had less anemia than those with the lowest 20% of incomes.

Sample households were divided according to location in four economic subregions of Bojonegoro, according to extent of economic development as defined by local government. The urban region had the lowest rates of anemia and PEM. There were no differences in rates of household PEM in the three rural subregions. The least-developed subregion had the lowest amount of anemia of all three subregions.

There was a detailed investigation of land-tenure patterns, incomes, employment and agricultural production. Many sample households were engaged in complex patterns of farming their own land, sharecropping or renting land, and working in low-paying jobs, both in agriculture and trading. For major crops (rice, corn and cassava), small farms had higher yields than medium-sized farms, which in turn had yields greater than households with the largest land holdings. This was felt to be due to larger labor inputs of small farms, since this group used fewer modern agricultural inputs than large farms. Furthermore, members of households with no land or less than one-third hectare were employed in a wide variety of low-paying jobs throughout the year.

Path analysis was used to identify the causes of household PEM. Results showed that income and value of food purchased were both directly associated with PEM. Land tenure, education and employment variables were related to PEM through income and value of food purchased.

The final discussion recommended improving nutrition by emphasizing increased production of corn and cassava and policies which would increase

productive employment for the poor in Bojonegoro, along with targeted programs for PEM and anemia.

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Byrne, David Hawkins

Plant Breeding & Biometry

STUDIES OF RESISTANCE TO THE MITES Mononychellus tanajoa (Bondar) AND Mononychellus caribbeanae (McGregor) IN CASSAVA, Manihot esculenta Crantz.

Resistance in cassava (Manihot esculenta Crantz) to Mononychellus tanajoa (Bondar) and M. caribbeanae (McGregor), major pests of this crop in Africa and the Americas, was studied. Three aspects were investigated: the reliability and utility of selection using a mite damage scale, characterization and preliminary mechanism work, and the influence of a mite attack on a series of varieties on crop growth and harvest data.

Selection using a damage scale was reproducible and consistent over several field sites and in the greenhouse evaluations, with the main limitation being the level of mite infestation. Under low mite pressure the major error involved the misidentification of intermediate and susceptible clones as resistant. The damage scale is related to both mite populations in the field and percent yield loss. The efficiency of the damage scale in identifying resistant varieties which suffer little or no yield loss due to mite infestation is reduced by the presence of tolerance. In these trials the broad sense heritability for mite resistance was estimated to be between 30% and 66%.

The leaf disk method was used to study mite development and behavior on several cassava varieties. Two distinct responses were found on the resistant varieties. Mites on M Col 1434 had lower fecundity, slower development, greater larval and nymphal mortality, shorter ♀ adult life span and lower acceptance as compared to the susceptible control. On M Bra 12 mites exhibited intermediate acceptance and shorter ♀ adult life

span. Since both resistant varieties reduce mite population growth to a similar degree in the field and greenhouse, other factors are probably involved in the M Bra 12 resistance. At least two biology and behavior altering mechanisms are indicated. Leaf pubescence is also associated with mite resistance. The implication of tolerance, several mechanisms altering mite development and pubescence in resistance to the Mononychellus mites suggests that it is a rather complex character.

In the field trials a prolonged cassava mite attack on mite resistant and susceptible cassava clones had differential effects on leaf size, leaf life, leaf formation rate, plant height, root yield, stake yield, harvest index, root weight, root number and percent marketable roots. The resistant varieties were less affected than the susceptible ones. The average yield loss for the susceptible varieties was 73% for roots and 67% for stakes and for the resistant varieties it was 16% for roots and 19% for stakes. Three of the four resistant varieties did not have significant yield losses.

These results suggest that a breeding program to develop good mite resistant cassava varieties, which suffer no significant yield losses due to a prolonged mite attack, is feasible. Since the local varieties were well adapted but susceptible to mites, a crossing program involving both local varieties and the better adapted resistant material is recommended for the development of well adapted mite resistant varieties for this and similar areas.

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Chang, Suk-Hwan

Plant Breeding & Biometry

AN ALTERNATIVE MODEL FOR DETERMINING THE OPTIMAL FERTILIZER LEVEL ON RICE

Linear models, with and without site variables, have been investigated in order to develop an alternative methodology for determining optimal fertilizer levels. The resultant models are:

(1) Model I is an ordinary quadratic response function formed by combining the simple response function estimated at each site in block diagonal form, and has parameters $[\gamma_{m\ell}^{(1)}]$, for $m=1, 2, \dots, n$ sites and degrees of polynomial, $\ell = 0, 1, 2$.

(2) Model II-1 is a multiple regression model with a set of site variables (including an intercept) repeated for each fertilizer level and the linear and quadratic terms of the fertilizer variables arranged in block diagonal form as in Model I. The parameters are equal to $[\beta_h \gamma_{m\ell}^{(2)}]$ for $h=0, 1, 2, \dots, k$ site variables, $m=1, 2, \dots, n$ and $\ell = 1, 2$.

(3) Model II-2 is a classical response surface model, i.e., a common quadratic polynomial model for the fertilizer variables augmented with site variables and interactions between site variables and the linear fertilizer terms. The parameters are equal to $[\beta_h \gamma_{\ell} \theta_{h'}]$, for $h = 0, 1, \dots, k$ $\ell = 1, 2$, and $h' = 1, 2, \dots, k$.

(4) Model III has the same basic structure as Model I, but estimation procedure involves two stages. In stage 1, yields for each fertilizer level are regressed on the site variables and the resulting predicted yields for each site are then regressed on the fertilizer variables in stage 2.

Each model has been evaluated under the assumption that Model II-2 is the postulated true response function. Under this assumption, Models I and III give biased estimators of the linear fertilizer response parameter which depend on the interaction between site variables and applied fertilizer variables. When the interaction is significant, Model II-2 is the most efficient for calculation of optimal fertilizer level. It has been found that Model III is always more efficient than Models I and II-1, with efficiency depending on the magnitude of λ_m , the m th diagonal element of $\tilde{X}(\tilde{X}'\tilde{X})^{-1}\tilde{X}'$, where \tilde{X} is the site variable matrix. When the site variable by linear fertilizer interaction parameters are zero or when the estimated interactions are not important, it is demonstrated that Model III can be a reasonable alternative model for calculation of optimal fertilizer level.

The efficiencies of the models are compared using data from 256 fertilizer trials on rice conducted in Korea. Although Model II-2 is usually preferred, the empirical results from the data analysis support the feasibility of using Model III in practice when the estimated interaction term between measured soil organic matter and applied nitrogen is not important.

Crawford, Eric Winthrop

Agricultural Economics

A PROGRAMMING-SIMULATION STUDY OF CONSTRAINTS AFFECTING THE LONG-RUN INCOME-EARNING ABILITY OF TRADITIONAL DRYLAND FARMING SYSTEMS IN NORTHERN NIGERIA

This study examines the economic constraints which affect the survival and income-earning ability of small farm households, especially those living in the dry savanna zone of northern Nigeria where climate and crop yields are highly variable. A stochastic simulation model of the farm household system is developed to investigate the effect of variable yields and resource constraints on incomes and on the household's ability to accumulate capital.

Data used in the simulation model were obtained from a survey conducted during 1974-75 by Peter Matlon in three villages of southwestern Kano State. The households covered in the survey produce both for home consumption and for the market, using traditional hoe technology. Principal crops (grown in mixtures) are millet, sorghum, groundnuts, cowpeas, onions, sugar cane, and vegetables. Off-farm activities are an important source of income.

The model was used to examine the effect of physical resource limitations and family size on the growth of income and consumption. The possibility of a poverty trap affecting resource-poor farmers is explored. Particular emphasis is given to seasonal cash and subsistence food requirements, and the interaction of these constraints with weather-induced variability in crop yields and returns over time. Resource endowment is measured in relation to family labor supply and consumption requirements, which are a function of family size.

By altering family size and resource characteristics, a range of household types is simulated. The model integrates farm production, household consumption, off-farm wage employment, and investment on and off the farm. Decisions are made partly in an optimizing framework, and partly by satisfying specified goals in priority sequence. There are two principal model components. First, a stochastic production/marketing model is constructed which maximizes net revenue subject to resource availability and basic consumption needs. This is solved in two stages each year using multiperiod linear programming (MLP). Second, a two-part simulation component is

developed. This component generates stochastic crop yields, prices, harvest labor requirements, investment returns, and special consumption expenditures; allocates surplus income among consumption, savings, and investment; and uses the final solution for each year to update the prices and resource availabilities used in the production/marketing model for the following year.

Special emphasis is given to model evaluation and experimental design. Three household types are examined over a six- to ten-year period in twenty-five deterministic runs of the full simulation model where the stochastic variables are included as pre-set sequences of good and bad events. Analysis of variance is applied to evaluate the impact of key experimental factors on income and consumption. The worst- and best-endowed households are then each examined in twenty replications of the full model using randomly determined stochastic variables.

Several conclusions emerge. Exogenous events affecting returns and expenditures, and the availability of land and labor relative to family size, are more important determinants of financial performance than crop production opportunities or consumption preferences. The ability to adjust to external circumstances may therefore be an important household characteristic. Land is a more limiting resource constraint than family labor in the MLP model; however, the cash constraint becomes significant in the full simulation model. Income and consumption are significantly lower when returns fluctuate randomly than when they are held at average levels. This suggests that models using average coefficients tend to overestimate long-run growth prospects. The poorly-endowed households experience lower income and consumption, slower income growth, more emergency borrowing, and greater income variability over time than the better-endowed households. Given the simplifications inherent in the model, however, one should be cautious in concluding that poorly-endowed households using traditional technology are irrevocably trapped in poverty.

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A BROADER CONCEPT OF DEVELOPMENT AND THE ROLE OF NON-FORMAL EDUCATION:
ANALYSIS OF THREE RURAL DEVELOPMENT PROJECTS

The pressing problems of food production, unemployment, over-population, poor health conditions, high dropout rate from schools, rural-urban migration and ineffective curriculum are among the causes of underdevelopment, particularly in the rural sector. In view of that, this thesis attempts to do the following:

1. To examine the potential role of non-formal education in human resource development of the rural sector and its place in the process of national development.
2. To identify essential characteristics of non-formal educational and developmental activities and see the degree in which their presence or absence may affect the function of non-formal education projects.
3. To generate themes and researchable questions which can be investigated further in future studies.

To do these, this study examines three different species of non-formal education projects, namely the Basic Village Education Project in Guatemala, which is geared to increase the agricultural productivity of small farmers without requiring literacy; the Mothers' Club in South Korea, which has the objective of reducing fertility and improving the health and living conditions of rural women; and the Village Polytechnic movement in Kenya, which intended to provide rural youths with skills that would enable them to find employment or self-employment in their communities.

Organizational structure (sponsor, bureaucracy, staff and leadership), content (mission, curriculum), time, method, control, cost, reward, participation and integration are identified as essential characteristics of non-formal educational and developmental activities from the literature review. These, in turn, have been used to form an analytical guide for examining non-formal education.

Several major themes emerged from the analysis of the three case studies representing international, national, and locally funded projects. Projects which have strong local organization and control, tend to be less

rigid and more responsive to local needs than those directed from a national or international level. They attract participation and support - especially when indigenous leaders and staff are used - and are thus more apt to sustain services over longer periods of time. Costs are generally lower, and the problems with a high degree of bureaucratic structure and responsiveness can be offset by local organization. Internationally or nationally sponsored programs tend to be better funded than local ones, but operate at higher costs. On-the-job training and group and individual discussions were found to be useful methods to specific skills and disseminate information at lower costs. The top-down approach, which tends to have standardized curriculum, may bring quick results, but is not likely to respond readily to local conditions, especially in the absence of local organization. Efficient use of local resources helps project to adopt to local conditions better and leads to extension of such projects in other areas.

Participation seems to be directly related to the presence or absence of local organization. The greater the level of participation, the lesser the cost and the more the tendency for a project to be self-sufficient. Obtaining rewards among participants is fundamental for a project to achieve its objectives. Coordination of services with government and other similar development agencies tends to avoid duplication of services and lowers project costs.

In all, its ability to perform diverse tasks, to meet the needs of a community, and to cultivate the untapped human resources of the rural sector, make non-formal education a legitimate and formidable strategy in the process of national development.

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STATUS, PROBLEMS AND PROSPECTS OF RURAL LAND TENURE IN KADUNA STATE AND SOME REFLECTIONS ON LAND TENURE POLICIES IN NIGERIA

This study provides information about the current status of the land tenure system in Zaria area of Kaduna State, Nigeria. It is intended as an overview of the land tenure system and has the objective of defining the nature, origin and magnitude of land tenure problems in the area and their implications for land reform in Nigeria. The study describes how rural land is acquired, held and transferred in the area, and explores the individual farmer's relationship to land - specifically his access to land and the security of that access.

Both empirical and secondary data have been used to describe the land tenure system and the social organization of agriculture and to develop and support arguments for alternative land reform policies. Specifically, the analysis is based on data collected from a sample of farmers randomly selected from four villages, discussions held with knowledgeable public officials and local farmers, and extensive review of agriculture-related institutions and historical materials.

The study reveals that significant adjustments have occurred over the years among persons controlling and using land in the area. Nevertheless, access to land is still predominantly gained through inheritance and gift, the traditional forms of tenure. Although a comparison of the study villages shows that there is much pressure for change towards commercialization of interests in land near urban centers or where there seems to be greater population pressure on land, a striking feature of the land tenure system is the limited extent of change - that is, the predominance of the traditional methods of land acquisition and transfer over land that is purchased, rented or pledged. Other remarkable features are the existence of minimal inequality in landholding, a general smallness of holdings, and the subdivision of holdings into scattered and tiny fragments.

The review of the background features of history, land policies, and the whole strategy of agricultural development provides a contextual

framework for understanding this seemingly paradoxical situation. For example, although the local communities have long been integrated into the world capitalist economic system, there has been no corresponding transformation of the productive forces. The farmers remain part subsistence and part commercial producers, still limited by natural conditions and lack of capital, agricultural inputs, appropriate technology, an efficient transportation system, etc.

However, the study indicates that a breakdown of the spirit of communal ownership inherent in the tenure system in response to changes in the mode of production, and the resultant individualization and unregulated transfer of land, are adversely affecting social relationships as well as economic opportunity and security of the farmer. Furthermore, local inheritance custom also results in land fragmentation and constantly diminishing size of holdings and thus creates unfavorable conditions for agricultural development.

On the whole, the security of the farmer needs to be strengthened by land tenure policy that takes into account the fact that the land tenure system is in a transitory stage between communal rights and exclusive individual ownership and that a haphazard introduction of capital and technology could lead to a disintegration of the land tenure system and seriously undermine the social and economic security of the farmer. It is contended that the Land Use Decree recently promulgated by the Federal Government does not seem to be based on a careful review of the present land tenure patterns and problems. Thus, the decree cannot ensure the farmer's security to earn income in agriculture or establish a basis for the transformation of the agricultural sector. The study concludes with recommendations for modifications in the Land Use Decree.

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Ender, Gary Peter

Agricultural Economics

THE DEVELOPMENT OF ROAD TRANSPORTATION IN NEPAL AND ITS RELATIONSHIP TO
AGRICULTURAL DEVELOPMENT

This study examines road transportation in Nepal, and its relationship to agricultural development. Road transportation is crucial in Nepal's development because most villages are isolated and roads are the dominant mode. There have been large outlays on road construction, yet little was known about road traffic. In this study, paved road traffic is analyzed thoroughly. The relationship between roads and agriculture, the leading sector, is also analyzed. Appropriate strategies for future road construction are recommended.

Previous studies on roads in Nepal did not consider road-related problems from a national perspective. In this study, certain extensions of central place theory are employed. Friedmann (1966) provides a dynamic qualitative model of the process of spatial integration based on increasing and decreasing ascendancy of a primate city. This model is examined as a vehicle for the analysis of nationwide transportation issues in Nepal. For the local road analysis, central place theory is augmented by the use of a cumulative scale.

The traffic data collected describe in detail important long-distance traffic on paved roads, including seasonal fluctuations. These data reveal the dominance of Kathmandu in all types of traffic. Historical and demographic evidence corroborate the primacy of Kathmandu. It is concluded that the Friedmann model is relevant to Nepal. The concentration on construction of highways and feeder roads (many serving Kathmandu) and the neglect of local roads are thus understandable, although not justified.

Yields of rice and maize in Nepal have not increased over the past 15 years, although improved seed and fertilizer are available in district centers. In the Tarai the potential for rapid agricultural development exists, but the lack of an all-weather local road network has been a major bottleneck, restricting access to improved inputs. It is recommended that the government of Nepal administer a vigorous program of local road improvement in the Tarai.

The process of development in the hills will be more difficult than in the Tarai. In the near future the north-south feeder road will best serve the hills. Such roads will join the hills to the rest of the country (via the east-west highway in the Tarai) and permit trade on the basis of regional comparative advantage, the hills eventually specializing in horticulture. The surplus grain of the Tarai will also become more affordable in the grain-deficit hills.

It is also recommended that priority not be given to the proposed, extremely expensive mid-hills east-west highway. The Kathmandu-Pokhara highway, which would become part of the proposed highway, has the lowest traffic and the lightest truck loads of the roads surveyed. It is unlikely, moreover, that significant benefits would be derived from a highway connecting hill areas with similar development problems.

Given a highway and feed road construction strategy, one must choose among similar investment possibilities. To conserve scarce resources, a benefit/cost analysis using the traffic data presented herein should be performed. The benefit/cost analysis should be part of a decision-making framework which takes account of the spatial distribution of roads. This study also provides an analysis of the relationship between road tax statistics and actual traffic, obviating the need for repeated traffic counts.

A method is also developed in this study to optimize the location of improved, local roads based on the hierarchical distribution of periodic markets. It assigns priorities to the markets, which can then be connected to the paved road network by improved, local roads in accordance with these priorities.

The analysis of road user charges and maintenance reveals sensible taxation policies and that road revenues cover about one-quarter of costs.

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Ferroni, Marco A.

Agricultural Economics

THE URBAN BIAS OF PERUVIAN FOOD POLICY: CONSEQUENCES AND ALTERNATIVES

During the past several decades, the objective of Peruvian food policy has been to provide cheap food (wage goods) to the urban population in support of industrial growth. The need for a stable food supply led to growing reliance on normally subsidized imports of food (mostly wheat) and selective promotion of a small, capitalist agricultural subsector near urban consuming centers. Given high population growth and a declining land/man ratio, the near-exclusion of peasantry--40 percent of total population largely residing in the Andean Highlands--from production and marketing assistance schemes caused negative growth of national per capita food output and increasing foreign food dependency, as well as peasant pauperization and poverty-induced rural-urban migration.

The political economy of peasant income under "urban biased development" is analyzed theoretically and forms the framework for empirical investigation of rural food consumption patterns and nutritional well-being. The data base used is a subsample (1958 households) of the 1971/72 Peruvian National Food Consumption Survey which was processed and computerized for the identified research purpose. The investigation is multidisciplinary, focusing on household food budgets from both a nutritional and economic (demand) point of view.

Peasant pauperization is viewed as deriving from growing incorporation into the market economy at unfavorable terms. Incorporation derives from declining on-farm income possibilities and aspirations due to limited demand for peasant-produced food in the face of imports, new consumption goals, and population growth. Real wages paid to peasant labor, by definition low, are expected to be decreasing over time because of congestion of labor markets and capitalist tendency to remunerate partial subsistence labor up to the difference between subsistence needs and the home-produced proportion of subsistence.

Incorporation implies growing market demand for (imported) food and changing dietaries, but, from the analysis, the extent of peasant poverty created by low food prices exceeds the potential of cheap food to alleviate

poverty in real terms. Consumer behavior of partial subsistence households is theoretically related to its determinants, i.e., labor allocation between subsistence and wage activities in dependence of prices and assets, but data constraints imposed the use of a simpler consumption model in which income is treated exogenously. Consumption function analysis, emphasizing the subsistence proportion of family income, is performed jointly with analysis of product characteristics to determine study population demand preference.

On the basis of 1973 FAO/WHO energy requirements calculated for the observed family member body weights, 37 percent of the study population are found to be calorie deficient, the incidence of deficiency rising sharply with the proportion of income derived from wage employment. Sixteen percent are "at risk" of calorie deficiency defined by intake levels between the mentioned energy requirement and an "ideal" requirement calculated for nutritionally "ideal" family member weights for age and height which are identified after a search for population-specific anthropometric standards. Diets are found to be grossly deficient in vitamin A. No protein deficiency is detected independent of calorie shortages.

Through migration, rural poverty is exported to the urban areas. As a consequence of the low labor productivity linked to "overpopulation" and the characteristics of profit-dominated capitalist labor demand, wage employment paying at least subsistence needs cannot be offered to all of the labor force. Programs to alleviate poverty in Peru must therefore concentrate on improving income and nutritional well-being of rural residents as a prerequisite for reducing migration and urban poverty.

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GENETIC EVALUATION OF DAIRY GOATS USING BEST LINEAR UNBIASED PREDICTION PROCEDURES

Age-season adjusted records of dairy goats on DHIA test from 1965 to 1976 were analyzed with the objective of providing goat breeders with predictions of the relative genetic values of their bucks. The data comprised 6,452, 1,730, 6,897, 2,759, and 4,007 lactation records from Alpine, LaMancha, Nubian, Saanen, and Toggenburg goats. Components of variance for milk yield, fat yield, and fat percentage were estimated using a four-way model that included random effects of herd, year-season, sire, doe, and a residual error term. The year-season and sire effects were nested within herd effects and doe effects were nested within sire effects.

The estimates of the herd component of variance accounted for between 22% and 25% of the total variation of milk and fat yields and for 15 to 25% of the variation in fat percentage. The herd components of variance were large enough to indicate that herd effects must be considered in genetic evaluations of these traits. Year-season effects accounted for 8 to 12%, 10 to 13%, and 9 to 14% of the total variation in milk yield, fat yield, and fat percentage. Estimates of the sire component of variance were relatively larger than for dairy cattle and accounted for 8 to 10% of the variation in milk yield, fat yield and fat percentage. Some of the variation attributed to sire effects may have arisen because of differential use of some sires relative to others or from possible confounding of sire effects with other effects. Estimates of the component of variance due to doe effects accounted for 16 to 25% of the total variation in milk yield, fat yield and fat percentage. These estimates suggest that there are large differences among does in genetic and permanent environmental effects which offer substantial potential for doe selection. The residual variance accounted for about 34% of the variation in milk and fat yields and about 40% of the variation in fat percentage.

Estimates of repeatability for milk yield, fat yield, and fat percentage obtained for the various breeds varied from 0.39 to 0.55, whereas the paternal half-sib estimates of heritability obtained on a within herd-year-season basis ranged from 0.51 to 0.62. The heritability estimates were

considered high for dairy goats and were larger than the estimates of repeatability which indicate a possibility of confounding that may have inflated estimates of variance components attributed to sire effects. Consistently high phenotypic and genetic correlations, averaging 0.94 and 0.86, were obtained between milk and fat yields in the breeds studied. Milk yield and fat percentage were negatively correlated both phenotypically and genetically, whereas fat yield and fat percentage showed positive genetic correlations averaging 0.18.

These variances were then used in Henderson's Best Linear Unbiased Prediction procedures to predict the relative genetic values of bucks. The sire evaluation model contained fixed effects for herd-years and genetic groups, and random effects for sires. The data used for sire evaluation comprised 1651, 449, 1419, 609, and 939 first lactation records from daughters of 388, 139, 398, 179, and 221 Alpine, LaMancha, Nubian, Saanen, and Toggenburg sires. The final step was to rank sires in order of their predicted genetic values.

Some caution should, however, be exercised in the practical application of the results presented here. Ideal evaluations usually involve breeding structures in which genetic exchanges between herds and regions are reasonably frequent and random with respect to sires exchanged and their mates. Unfortunately, the dairy goat populations used in this study do not represent such a system. There was an extreme lack of ties among the sires. For this reason the comparisons among sires as presented here will not assume a national or regional character. Their validity is best restricted to intra-herd comparisons although extended use of the superior sires identified from this study would create more ties and eventually result in more accurate inter-herd comparisons and identification of sires which are nationally best.

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King, Jack Winfield

Agronomy

ANALYSIS OF PRODUCTION POTENTIAL AND MAINTENANCE OF PRODUCTION FOR SELECTED IRRIGABLE SOILS BY THE CHARI RIVER IN THE SAHEL REGION OF CHAD

During the 1970's there were several attempts to establish irrigated agriculture on the alluvial soils along the Chari and Logone rivers in the Chad basin south of N'Djamena. Inconsistent responses to nitrogen, phosphorus and potassium, and, in some cases, rapid decline in yield indicated a need for a study of both the production potential of soils of this region and of cultural systems which would maintain satisfactory yields.

In the primary experiment field experiments with irrigation were conducted starting with the first cropping season on newly developed lands. Response to nitrogen, phosphorus and potassium and the effect of hyacinth bean (Lablab purpureus) in a rotation with irrigated sorghum were tested on two soils. One was a light upland soil of the type traditionally used in this region for rainy season millet production. The other, lower in the topography, was a clay soil of the type traditionally used for winter sorghum production.

Because of problems with emergence the first three trials did not produce significant results. After a procedure involving transplanting young sorghum plants was used at two new but similar locations significant results were obtained. This experiment was set up in a randomized complete block design. There were six replications of five treatments: 0-0-0, 0-240-240, 480-0-240, 480-240-0, 480-240-240, at the two locations. Sorghum crops were harvested in the fall of 1978 and the spring of 1979. There were responses to the three macronutrients and to the rotation with hyacinth bean which had the effect of compensating for missing nitrogen and phosphorus in treatments where these nutrients were not applied as inorganic fertilizer and reducing the availability of potassium.

In the first of two secondary experiments samples were taken across three typical soil series at the project site. The precise location and elevation of each sampling site was established by means of a transit and a level. Samples were taken to a depth of 140 cm with the soil from twenty centimeters being included in each sample. Analyses were made for organic matter, pH, P, K, Mg, Ca, Mn, Fe, Al, NO_3 , NH_4 , and soluble salts. The

nutrient status of these soils was then characterized relative to their location in the topography.

The same set of analyses were performed for the second of these experiments which was designed to compare the effect of traditional agriculture with that of a long-term fallow. Near the project about 50 hectares of land which had not been cleared for forty years lay next to, and on the same soil type as, an area which had been used for winter sorghum production for 10 years. Six random transects were made perpendicular to the fenceline dividing the cleared and forested land. Samples were taken at twenty-five meter intervals to a distance of 100 meters on each side of the fence. At each sampling site, three samples each taken from fifteen centimeters of soil were collected making a total of 45 cm of surface soil tested. The results of this experiment showed that the soil which was forested had larger quantities, at least at one depth of OM, K, Ca, NH_4 , and soluble salts as well as a higher pH than the cleared land but the results for Ca and soluble salts could not be explained relative to differences in land use. The cleared land had a higher Fe content than did the forested land.

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Lazin, Michael Brett

Vegetable Crops

SCREENING FOR HEAT TOLERANCE AND CRITICAL PHOTOPERIOD IN THE POTATO
(SOLANUM TUBEROSUM L.)

In cooperation with the International Potato Center in Lima, Peru, the Cornell potato breeding program is utilizing the germplasm resources of Andigena populations to increase the adaptation of the potato to the lowland tropics and to advance the process of breeding superior cultivars for the temperature zone. The basic goal of this investigation was to evaluate a method of identifying heat tolerant genotypes in these populations. The techniques developed in pursuit of this goal were employed to explore the

implications of photoperiodic and temperature effects in adapting this germ-plasm to various environments.

Breeding clones and seedling populations were exposed to high temperatures (40°C day and 30°C night in some experiments) and long photoperiods (16 or 18 hours). After at least two weeks of treatment, stem cuttings were taken. Cuttings which tuberized after 12 to 14 days in a mist bench indicated heat tolerance in the mother plant. Clones selected by this procedure showed heat tolerance based upon yielding ability in a warm greenhouse and in a preliminary field trial in the lowland tropics at San Ramon, Peru. Further field trials failed to show a yield advantage for the selected clones. However, a beneficial result was detected in the earlier field maturity of the selections compared to the controls.

The cutting technique was also used to screen segregating populations for critical photoperiod (CPP). Clones were identified which required photoperiods shorter than 12 hours to initiate tubers, while others were found with the ability to tuberize under continuous light. Experiments under controlled environments with 20 *Tuberosum* cultivars established a strong correlation between early field maturity and long CPP, as measured by the cutting technique.

Progenies of reciprocal crosses between an Andigena clone (short CPP) and a Neo-*Tuberosum* clone (long CPP) were screened for tuberization on cuttings under various photoperiods. The results indicated an influence of the maternal parent on the inheritance of CPP. The maternal effect was exaggerated under warm temperatures. Progenies of reciprocal crosses between heat tolerant and sensitive clones demonstrated a maternal influence on the inheritance of heat tolerance. A mechanism of maternal rather than cytoplasmic inheritance is proposed as an explanation for this effect.

In trials conducted under long photoperiods in warm and cool greenhouses, the behavior of progenies of clones selected for heat tolerance or long CPP indicated an association between long CPP and tolerance to warm temperatures. This was supported by the "Tuberosum-like morphological traits exhibited by clones identified as heat tolerant by the selection procedure. Experiments under controlled environments with heat tolerant and sensitive clones demonstrated an interaction of temperature and photoperiod on tuberization of cuttings. The association between heat tolerance

and long CPP is explained on the basis of a shift in CPP under warm temperatures.

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Lee, Seon

Agricultural Economics

BUFFER STOCK RULES FOR WORLD COMMODITY MARKETS: AN APPLICATION OF OPTIMAL CONTROL THEORY

The instability of world primary commodity markets has been a subject of concern for both developed and developing countries, primarily because frequent and uncertain price fluctuations hinder the market mechanism of resource allocation. To cope with the problem, international commodity arrangements, including the United Nations Conference on Trade and Development's (UNCTAD) Integrated Program for Commodities (IPC), have been proposed. The International buffer stock is suggested as the most efficient and feasible policy instrument for price stabilization in most cases.

The purpose of "neutral" buffer stock management is to eliminate stochastic fluctuations from the long-run equilibrium price trend. A methodology is developed to decompose an historical price path into systematic and random parts; the systematic path is then adopted as a neutral stabilization target in a policy objective function. On the basis of a dynamic commodity model and the price target thus obtained, an optimal storage rule is derived through optimal control theory.

As case studies, two agricultural products: cocoa and coffee, and two mineral commodities: tin and copper, are selected from the ten "core" commodities of the IPC. Under neutral price stabilization, optimal buffer stock sizes for these commodities are estimated as -- cocoa : 315 to 375 long tons; coffee : 200 to 300 hundred thousand 60kg. bags; tin : 55 to 75 thousand metric tons; and copper : 325 to 525 thousand metric tons. These results suggest that previous estimates obtained by UNCTAD for coffee and

tin are too low, and that for copper is too high. The combined costs of separately operated buffer stocks for these commodities could range from \$3.85 billion to \$5.62 billion at 1971-75 average prices.

Limitations on buffer stock operations created by the availability of financial resources or storage capacity can be reflected by modifying the objective function. In addition, dual policy goals of price and revenue stability and the trades-off between these can be reflected by adopting a multi-objective approach. Policy preferences on the two objectives are represented through different weighting schemes.

It is determined, as UNCTAD has stressed, that economies exist in pooling financial resources across commodities. According to the results derived, total financial requirements for the four commodities could be reduced by 40 to 45 percent through pooled buffer stocking operations. Benefit/cost analysis indicates, however, that a larger proportion of the capital requirement for such a pooled scheme be financed by direct contributions instead of interest-bearing loans than suggested by UNCTAD.

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Lyman, Judith Mapes

Plant Breeding & Biometry

ADAPTATION AND BREEDING STUDIES ON THE LIMA BEAN, PHASEOLUS LUNATUS L., AS A FOOD LEGUME FOR LATIN AMERICA

Grain legumes are important in Latin American diets but production is falling behind demand. Current production of the lima bean (Phaseolus lunatus L.) is limited, even though it is better adapted than the common bean to tropical conditions. Studies were undertaken in Colombia to evaluate the potential of the lima bean as a food legume for Latin America.

Objectives of an adaptation study were to examine plant development and productivity under varying conditions, and to identify major production constraints. Thirty-six climbing lima bean lines were grown on trellises

with minimum chemical inputs in five trials at four Colombian sites. The mean dry seed yield of all lines was 2.8 t/ha. The mean yield at the least favorable site was 1.7 t/ha; at the most favorable site it was 5.1 t/ha. Although growth was adversely affected on a soil with pH 4.2, the mean yield was 2.3 t/ha.

Mean daily dry seed productivity rates of all lines ranged from 15.2 kg/ha/day to 47.3 kg/ha/day for the several locations, exceeding rates reported for common beans and other legumes at the same locations.

Mean yield and number of pods per plant varied significantly between sites. Days to flower and to dry seed harvest were relatively stable. No relationship was found between yield and seed coat color. Major production constraints were common bacterial blight and leafhoppers.

Breeding studies focused on the constraints mentioned above. Lines with high and low levels of resistance were crossed to determine the mode of inheritance. Growth habit and seed coat color traits were the most useful marker traits for verification of hybridization but seed size was not useful.

In the bacterial blight study, reciprocal crosses were made between a moderately resistant and a susceptible accession. Continuous segregation for bacterial blight reaction in F_2 plants indicated quantitative inheritance for this trait in lima beans. The resistant reaction was dominant. Screening should be carried on to identify additional resistant lines so that present resistance levels may be improved.

In the leafhopper study, leafhopper resistant lines were identified by a visual rating system. Nymph populations were highly and positively correlated with damage. Trichome density on the leaf undersides was highly and negatively correlated with damage. Reciprocal crosses were made between a resistant and a susceptible line. Continuous segregation for reaction to leafhoppers was observed in F_2 plants, indicating quantitative inheritance of the trait in lima beans with dominance of the susceptible reaction. The low trichome density trait was dominant. Regression of parental and progeny damage on trichome density revealed a highly negative correlation, confirming an important role of trichomes in leafhopper resistance.

In the cyanide study, cyanide levels in seeds of 83 accessions were low and non-toxic. Two lines had contents exceeding the limit permitted

by U.S. legislation (200 ppm) but not approaching the level of 4000 ppm reported for wild lima beans. No relationship was found between cyanide level and seed coat color, nor with yield.

These studies demonstrated high productivity of lima beans under adverse and favorable climatic and soil conditions and in the presence of an important insect pest. Increased resistance to common bacterial blight and adapted bush types are needed. Greater efforts must be made in tropical lima bean research and extension programs to realize the potential of this crop as a food legume for Latin America.

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McCarty, Thomas R.

Agricultural Engineering

A FIELD STUDY OF WATER FLOW OVER AND THROUGH A SHALLOW, SLOPING, HETEROGENEOUS SOIL

A 0.2 hectare field plot containing coarse, loamy, mixed, mesic aqueptic fragiudalf soil was studied in order to determine the cause of seepage zones, their effect on storm runoff, and the flow path of surface runoff originating on them. The plot was studied under saturated steady state conditions. The soil in the plot was physically characterized by an auger hole profile study and piezometer study; the soil was hydraulically characterized through a study of water table behavior and field and laboratory conductivity studies. The flow path of surface runoff was deduced from irrigation studies where calcium chloride was added to the irrigation water.

The seepage zone was found to be caused by a restricting layer which was not parallel to the soil surface. The upslope extent of the seepage zone between rainfall events was correlated with the hydraulic conductivity pattern as determined from the auger hole method. The flow path of the surface runoff could be visualized as a sine wave with an amplitude equal

to the depth to the impermeable layer and a period on the order of a meter. The water following this path was mixed with the surrounding soil water. The result was described mathematically by a series of completely mixed tanks.

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Mijindadi, Ndanusa Braimah

Agricultural Economics

PRODUCTION EFFICIENCY ON FARMS IN NORTHERN NIGERIA

A growing concern with the capability of Nigerian agriculture to satisfy the food needs of a growing population has surfaced in recent years. The study was designed to assess and explain the potential for increasing agricultural production on farms in northern Nigeria using existing technology.

The specific objectives of the study were: first, to isolate factors which determine farm level productivity; second, to estimate the level of technical efficiency of individual producers; third, to identify factors which contribute to variations in technical efficiency within and between areas; and fourth, to draw implications for agricultural policy.

The data used in the study were obtained from farm management studies carried out by the Rural Economy Research Unit of Ahmadu Bello University in Kaduna, Sokoto and Bauchi states of Nigeria between 1966 and 1968. The study areas centered around the towns of Zaria, Sokoto and Bauchi. Within each area, three villages were selected, and a random sample of farm families was drawn from them. The entire sample consisted of 340 farmers who were interviewed twice weekly throughout a cropping year. Information was obtained on such factors as labor use, farm expenses, crop yields, income and family structure.

Several techniques were utilized in an attempt to ascertain what factors were associated with more successful farms. Farms were first grouped on the basis of gross value of output per man and per acre. An attempt was

then made to determine in what ways more successful farmers differed from those less successful. Two types of production functions also were fitted to the data for each study area. First, a conventional Cobb-Douglas production function was estimated using Ordinary Least Squares techniques. Second, a frontier production function was fitted to the data for each area using linear programming procedures. The latter function was used to estimate the output that individual farms might have achieved if they had been able to attain the level of performance of the most efficient farmers.

The results of the analysis revealed significant differences in output per man within each area as well as between areas. The principal factors contributing to differences in output per farm were total area cultivated, the imputed cost of seed and cuttings (which reflects both the crop mixture and the density of planting), and the amount of labor employed. Significant inter-area differences in marginal productivities for a number of factors (measured at the mean level of factor use) were revealed by the Cobb-Douglas production functions.

The results obtained from the analysis of farm-level data from northern Nigeria are not entirely consistent with the prevailing view that no appreciable increase in agricultural production can be obtained from traditional farms without introducing new technology. The analysis makes clear that there are substantial variations in technical efficiency among farms. Efficiency scores based on the frontier production function ranged from .67 to 1.00. Appreciable deviations from optimal factor combinations also were found for land and hired labor. Technical efficiency is closely associated with farm size, labor use, crop mixtures and the proportion of fallow land.

The results suggest that it is possible to obtain modest increases in output by drawing on the experiences of more efficient farmers -- without major investments, at least in the short run.

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THE OLD ORDER AMISH AS A MODEL FOR DEVELOPMENT

The Old Order Amish have been routinely invoked as an example of the unreflective folk society. The thesis argues that such a view of the Amish is fundamentally incorrect. The Amish may be more accurately characterized, in Weber's terminology, as a value rational society; that is, they self-consciously formulate the ultimate values governing action and self-consciously evaluate alternative modes of action with respect to their consistency with ultimate values. The use of unsophisticated technology does not indicate an unself-conscious or uncritical approach to existing social institutions. In the context of the contemporary United States, its use represents the very essence of self-conscious choice.

Data from five Old Order settlements in New York State were collected using unstructured interviews, an examination of deed, mortgage, and tax records, and letters from community "scribes" published in a national weekly newspaper. Magazines, pamphlets, and books published by Amish from settlements outside of New York were also used where relevant. The thesis focuses on the process of migration, the nature of community organization, and the nature of Amish agriculture. The analysis indicates that in all of these areas the Amish display a rationality that is totally at odds with the defining attributes of a folk society.

A second function of the thesis is to explore one implication of viewing Amish society as self-conscious and rationally selective. If the Amish can no longer be dismissed as an anachronism, a social order that is irrelevant to the problems with which modern society is faced, they arguably become a potential model for our own development. In making that argument, two subsidiary arguments are put forward. The first is that development is a pervasively normative concept. Regardless of how development is defined, it represents an attempt to achieve a valued end state. The definition of development will vary depending on the values implicit in particular objectives. The thesis draws on historical evidence to indicate the range across which definitions of development have in fact stretched.

The second subsidiary argument consists of a demonstration that no complex of values has ever been demonstrated, in a positivistic sense, to be self-evidently true or universally accepted. In order to establish this point, part of the thesis argues that attempts to derive normative statements from descriptive statements (i.e. to derive an "ought" from an "is") have failed. The thesis concludes that no single normative orientation is "true" or verifiable as compared with others.

If no normative framework is self-evidently true and if, in turn, development is a pervasively normative concept, then no definition of development is self-evidently true. The implicit and explicit values of Amish society may be treated as legitimate development objectives no less than economic growth or the redistribution of wealth. Specifically the thesis identifies the restoration of meaning and identity as development goals that might be derived from the Amish model. The thesis concludes with the argument that these goals, themselves expressions of an end to the process of disenchantment, are likely to be essential to the survival of humankind.

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Pachico, Douglas Henry

Agricultural Economics

SMALL FARMER DECISION MAKING: AN ECONOMIC ANALYSIS OF THREE FARMING SYSTEMS
IN THE HILLS OF NEPAL

This study explores the potential for improving agricultural productivity and raising the incomes of small farmers by developing new technologies or by investing in the skills of farmers to increase their efficiency of decision making. The middle hills of Nepal provide a highly heterogeneous environment from economic, cultural, and natural resource perspectives. In order to make the results of this study more representative of the diversity prevailing in the hills of Nepal, data were

gathered from a systematic random sample of 332 farms in three distinct situations including a mid-altitude valley at 4,800 feet that is well served by economic infrastructure; a ridge environment at 6,000 feet where infrastructure is poor; and a sub-tropical valley at 3,200 feet.

The decision making of small farmers is examined in this study both through marginal analysis in a production function framework and also through the consideration of how farmers make particular choices among currently available enterprises. Farmer evaluations of alternative technologies were obtained from a sub-sample of key informant farmers on such topics as labor requirements, suitability to soil and moisture conditions, price of output and susceptibility to damage from pests. Enterprises are also compared by observing the present patterns of use among farms of different resource bases and through partial budgeting.

This analysis indicates that in all three farming systems farmers adopt new technologies where their characteristics are compatible with the specific needs of farmers. For example, in the mid-altitude valley there is a high rate of use of a labor intensive, high yielding nitrogen responsive coarse rice, but a very low rate of use of a high yielding nitrogen responsive maize variety which reduces yields of millet that is commonly intercropped with maize. On the other hand, in the sub-tropical valley most farmers use the high yielding maize variety while none use the labor intensive rice.

Moreover, within a particular farming environment, the technologies used on farms of different resource endowments are found to differ even when farms of less than half a hectare are compared with farms in the range of one to three hectares. Thus, the diversity of types of technology found to be suitable for farms of different sizes in the different environments in this study, emphasizes the need for detailed micro studies of current farm practices in order to focus the attention of agricultural scientists on the development of technologies that can be integrated into the farming systems of particular groups of farmers.

To examine whether investments in human capital can improve farmer decision making, a model was constructed that estimates the impact of numeracy and knowledge of modern agricultural technologies on allocative

and techno-allocative efficiency. Allocative efficiency is the ability to equate marginal value products of resources among competing uses and techno-allocative efficiency is the ability to equate the marginal value product of resources with marginal cost. The model utilized in this study, comprised of production functions and input demand functions, introduces the capacity to estimate allocative and techno-allocative efficiency in the use of individual inputs. The empirical results indicate that while farmers' behavior is fairly consistent with efficiency, human capital can make a small but statistically significant contribution to efficiency.

Since there is evidently little scope for increasing output by improving the efficiency of management of presently available resources, this study concentrates on characterizing what currently constitutes appropriate technologies for different groups of farmers in order to identify priorities for investment in agricultural research.

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Richmond, Daleen Diane

Agricultural Economics

AN EXPORT COMMODITY MARKETING COMPUTER SIMULATION GAME

U.S. agricultural exports grew sharply in the last decade and assumed a key role in the U.S. economy. This growth was attributable to the rising incomes of foreign consumers, crop shortfalls in various regions of the world, reductions in the value of the U.S. dollar, and political decisions which affected the accessibility of foreign markets. Another factor which had a positive impact on the expansion of U.S. farm sales abroad was American businessmen's increased awareness and willingness to take advantage of sales opportunities overseas.

An important barrier to U.S. firms' willingness to sell to foreign markets is a lack of understanding of the mechanics of export transactions. The lack of knowledge stems from the uniqueness of exporting skills as well as inadequate export marketing literature. Few textbooks, research

publications, case studies or other educational materials have been written which examine the documents, marketing channels, financial instruments, and sales procedures which are involved in international agricultural trade.

This study is designed to supplement the existing literature. The major objective of the study was to develop and document a management game which would facilitate instruction of export marketing skills. The author initiated game design by studying gaming and the existing export marketing literature. Educational goals were then established for the exercise and efforts were made, utilizing relevant literature and the author's judgement, to construct a game which would accomplish these objectives. Due to the complexity and importance of exporters' pricing responsibilities, this function was selected as the focal point of the game.

The resulting export marketing game is to be played by individual, as opposed to teams of, students. Each student acts as a U.S. orange exporter who competes with other American and foreign firms for sales. Every period of play, the student receives quotation requests from different groups of foreign buyers. In turn, he must select an origination point, an exit port, an inland and ocean carrier, a financial instrument, and a price for prospective shipments.

The student's decisions and those of his competitors are then weighed by the appropriate customer groups. As a result, preliminary sales figures and requests for negotiation of initial offers are received. Final sales, cost, and profit figures are acquired as soon as the student has examined and revised his initial offers.

The student obtains price quotation and negotiation requests for eight periods of play. His success during the game is evaluated by comparing his profits to those of his competitors.

Students obtain the information needed to participate in the exercise throughout game play. At the beginning of the exercise, participants are handed players' manuals which contain a description of the exporting firms they represent; an explanation of the nature, import regulations, and environments of students' major customers; the costs associated with various marketing judgements; a steamship schedule; participants' initial quotation requests; and a set of decision forms. Buyer's environments and exporters' transaction costs, however, change during the game. As these variations

occur, students are handed memos which explain the changes in the appropriate periods of play.

Essential to the success of the game are the administrator's willingness to supplement game play with discussion sessions and further testing and modification of the exercise. In addition to examining the nature and development of the game, this study specifies the timing and content of the discussion sessions which should accompany game play. In addition, it lists questions which should be answered during testing of the exercise. Finally, the dissertation suggests modifications which may be undertaken to increase the complexity of the existing form of the export marketing game.

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Sada, Guillermo

Food Science

EFFECTS OF DIFFERENT CONDITIONS OF STORAGE ON GERMINATION, TEXTURE, NUTRITIONAL QUALITY AND CHEMICAL COMPOSITION OF LIGHT RED KIDNEY BEANS (Phaseolus vulgaris)

The experiment using light red kidney beans (var. Redcloud) was designed as a 3x2x2 factorial, with 3 temperatures (0°, 15°, 30°C), 2 relative humidities (30%, 80%) and 2 storage periods (4, 8 months). Germination test was conducted using the rolled towel test, and the results showed the effect of a 3-way interaction, relative humidity (R.H.) being the most critical factor. At 80% R.H. germination was 9.26% at 30°C in beans stored for 4 months, the rest of the treatments not being significantly affected. After 8 months of storage, germination was reduced at all temperatures and 80% R.H., being 0.0% at 30°C. However, at 30% it was affected only at 30°C (78.86%).

Texture measurements were performed on cooked beans using the reverse extrusion cell and the Instron Universal Testing Machine. Results showed

that beans increased in firmness from 3 to 4 fold when stored at 30°C - 80% R.H. as compared to low temperature - low R.H.

Total nitrogen as determined by the AOAC (1978) method for total Kjeldahl nitrogen and available protein as determined by the method outlined in the Agriculture Handbook No. 379, both showed increases with increasing temperatures, the maximum difference between treatments being about 9% and 6% for total and available N, respectively. Amino acid determinations were performed according to the method by Penke et al. (1974) and results showed that tryptophan decreased about 45% in raw beans stored from 4 to 8 months, the remaining of the amino acids were not affected. In cooked beans histidine, valine and tryptophan showed the same trend for 4 months. At 30% R.H. these three amino acids were about 20 to 30% higher at 15°C than at either 0° or 30°. At 80% R.H. histidine was lower at 15° and 30° than at 0°C by 14%, however valine and tryptophan did not show any differences at any temperature. At 15°C histidine, valine and tryptophan were 24%, 17% and 35% lower respectively at 80% R.H. than at 30% R.H.

Lipid determination was made by extracting lipids with a 2:1 chloroform-methanol solution for 1 hour twice in a 1:10 ratio (w/v). Fatty acids were determined according to the procedure outlined in the Supelco bulletin No. 724 and subsequent GLC analysis. Total lipid content was 23% higher in beans stored at 80% R.H. than in those stored at 30% R.H. after 4 months of storage, however, after 8 months of storage at 30% R.H. the content was 17% higher than the comparable 4 months treatment. At low R.H. there were no differences in lipid content with different storage temperatures, but at high R.H. lipid content was higher in beans which had been stored at 0°C than in those stored at either 15° or 30°C. No significant differences were observed in lipid content of cooked beans. Linolenic, linoleic and oleic acids showed the same pattern in raw and cooked beans. At 30% R.H. acid contents were highest at 15°C and lowest at 0°C. At 80% R.H. higher values were associated with low temperatures and fatty acids content was in general slightly higher than in those treatments at 30% R.H. At low R.H. fatty acids content was higher in beans stored for 8 months than in those stored for 4 months. After 4 months of storage the content was higher in beans stored at 80% R.H. However, in beans stored for 8 months, fatty acid content was lower at 80% R.H. than at 30% R.H.

Carbohydrate content was determined colorimetrically and results showed a 3 way interaction in total soluble carbohydrates (TSC), stachyose and raffinose, having lowest values in beans stored for 8 months at 30°C - 80% R.H. This effect of high temperature - high relative humidity was also present in cooked beans stored for either 4 or 8 months.

Starch content was lowest (511 mg glucose/g) in beans stored for 8 months at 30°C. No difference was observed in the rest of the treatments or in the cooked beans.

Nutritive quality of beans was performed according to the AOAC (1978) method for P.E.R. and results showed a very strong detrimental influence in beans stored for 8 months as compared to those stored for only 4 months. No definite influence of temperature or R.H. was observed in beans stored for either 4 or 8 months.

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Snipper, Reuben

Development Sociology

DETERMINANTS OF SOCIAL CHANGE IN THE MUNICIPIOS OF MEXICO, 1950-1970: AN
EXPLORATION OF THE POTENTIAL OF OFFICIAL STATISTICS

The general objective of this study was to delineate the major dimensions of socio-economic organization in the 1,781 Mexican municipios and to use these dimensions to account for three major social change phenomena: population growth, shifts in agricultural employment, and improvements in a measure of level of living, percent wearing shoes. Lacking empirically based, sociological theory which identifies dimensions of socio-economic organization relevant to key indicators of social change within an entire country, an alternative approach combining principal components factor analysis with relevant middle-range explanation was used to derive dimensions of socio-economic organization. The initial data base consisted of 210 diverse social, economic and agricultural indicators -- a comprehensive

selection of official data available on Mexican municipios for 1950, 1960, and 1970. Factor analyses of the data for each of the three time periods produced sets of factors measuring urban differentiation, air communications, locally and multi-municipio initiated changes to municipios, agricultural production systems and agency specific measures -- 69 factors in all. These dimensions were then interpreted in light of previous research on Mexico.

Multiple regression was used to assess the independent contribution of these dimensions in predicting the social change indicators. Because it is possible that the method for measuring change might affect the results, two different, but complementary techniques were used: lagged regression and the relative change method. Unexpectedly, the two techniques yielded very similar findings in this case. These analyses included dummy variables for the five major regions of Mexico. The effect of region was strong and significant with the Southern region generally being the most divergent from the others.

Overall, the set of dimensions accounted for a significant proportion of the variance in the change indicators and each indicator of change was differentially related to the dimensions. However, the pattern of relationships between the dimensions and the indicators of change was quite complex. The most important relationships with the change measures were those between the urban differentiation, agricultural production systems and agency specific sets of factors. In particular, the two urban differentiation factors were associated with more rapid declines in agricultural employment, but only weakly with population growth and not at all with improvements in level of living. The agricultural production systems factors were associated most consistently with population change and shifts in agricultural employment but only weakly with improvements in level of living. The agency specific factors were negatively associated with agricultural employment which reflects the Mexican government's emphasis on urban and industrial, not agricultural, development. The factors measuring air communications and locally and multi-municipio initiated changes to municipios were only weakly associated with the measures of social change.

Over and above the specific analysis of relationships, this thesis presents an alternative approach to the description of an entire country. The combination of a comprehensive initial data set that is reduced to a broad range of socio-economic dimensions, the selection of three important criterion variables, all in the context of sub-national comparison, provide a picture of Mexico that is both encompassing and analytic. This approach articulates easily with and expands upon the more familiar ethnographic and census-based descriptions.

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Soetrisno, Loekman

Development Sociology

THE SUGAR INDUSTRY AND RURAL DEVELOPMENT: THE IMPACT OF CANE CULTIVATION FOR EXPORT ON RURAL JAVA 1830 - 1934

This dissertation examines historically the expansion of capitalism in Java by evaluating the nature and extent of the impact of the introduction and expansion of sugar estates on the development of sugar villages in Java during the colonial period. The expansion of capitalism under the framework of colonialism was based on the transformation of the subsistence agriculture into agricultural production for export and mining. In the Javanese case the major export commodity during the colonial period was sugar. The production of sugar for export in Java was done by interphasing it with food production for local consumption. The colonial sugar estates had to rent land from the landowning peasants, and planted their canes in rotation with food crops grown by the local peasants.

As Javanese peasants in general were reluctant to lease their land to the sugar estates, "extra economic methods" were used by the colonial authorities to force landowning peasants to lease their land cheaply to the sugar estates. Such extra economic methods included the appropriation by colonial state of all land which was not owned by the natives, and leased

it to the private Dutch capital; the introduction of landlease regulation that forced Javanese peasants in the sugar villages to lease their land to the colonial sugar estate; the obligation to pay taxes in money form so that the Javanese peasants were forced to go and sell their labour power to the colonial sugar estates; cooptation of the village bureaucracy and using them as intermediaries to appropriate land for the colonial sugar estate; and changing the land tenure system in the sugar villages so that it could better serve the technical demands of the sugar cultivation. We have examined the impact of all these changes on the development of the sugar villages in Java during the period in question.

There are three basic findings presented. First, despite its economic contribution to the village economy, in balance the presence of colonial sugar estates in rural Java was only successful in transforming sugar villages from a condition of "undevelopment" to one of "underdevelopment." For within the colonial sugar system itself, there were structural factors which prevented the socio-economic development of sugar villages. Second, the growth of sugar cultivation for export and the subsequent integration of Java into a capitalist world economy had subjected the island economy to a "boom or bust" economy which complicated further the process of development of Java. Finally, the stagnant sugar economy in Java during the colonial period has led to increased rigidity of government. The latter was necessary to prevent the outburst of peasant rebellion in Java which saw the colonial sugar estates as the symbol of injustice.

The post-independence experience of Java, however, suggests that Indonesian accession to political power alone is not enough. Fundamental restructuring of the country's political economy is essential to end the persistent underdevelopment of Java.

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ROOT MORPHOLOGICAL STUDIES OF DRY BEANS (PHASEOLUS VULGARIS L.)

The relationship of root size to seed yield and lodging of two black bean cultivars, 'Black Turtle Soup' (BTS) and 'Strain 39' was compared with that of four black-seeded lines, 70001, 70002, 70003, and 70004 under field and greenhouse conditions at different growth stages. Root and shoot weights of the four lines were significantly higher than for the two cultivars in most field trials, but not in the greenhouse. Shoot:root ratios were significantly lower for the four lines than for 'BTS' in both environments and for 'Strain 39' under field conditions. Uprooting resistance, the amount of force required to uproot a plant, was significantly higher for the four lines than for the two cultivars in three field trials, except for 70002 compared with the two cultivars in 1979. Total root weight and uprooting resistance was significantly correlated in two field trials. This suggests that uprooting resistance is an appropriate indirect method for evaluating root weight of dry beans.

Total root biomass of the same genotypes was partitioned into adventitious, basal, taproot, and lateral root components. Basal root weights were significantly higher for the four lines in three field trials and for 70001 and 70002 in the greenhouse when compared with the two cultivars. Taproot weights were higher for the four lines than for 'BTS' or 'Strain 39' in most field trials, but not in the greenhouse. Genotypes did not differ for adventitious root weights in both environments and lateral root weights did not differ in the field.

Stem, hypocotyl, and taproot diameters were significantly larger for the four lines when compared with 'BTS' or 'Strain 39' in most field and greenhouse trials. Basal root diameters were significantly larger for the four lines than for the two cultivars in all environments. Genotypes did not differ in basal root numbers in most field trials.

In the field, most root parameters increased up to seed initiation followed by a significant decrease or no further increase during the full pod fill growth stage. Differential response in most significant growth

stage x genotype interactions was restricted to either within the four lines or within the two cultivars.

Seed and biological yields of the four lines were significantly higher than for 'BTS' or 'Strain 39' in three field trials. No differences in harvest indexes were measured among the six genotypes. The four lines lodged less than the two cultivars in four field trials. The erect plant types of the four lines may be attributed to the larger basal roots and somewhat to the taproots.

The influence of artificial lodging and support on seed parameters of black beans were evaluated. Artificial lodging significantly lowered seed and biological yield when compared with artificially supported or naturally growing plants.

Root morphological characteristics of 'Redkote' and 'Redcloud' kidney beans were measured at two growth stages at 5, 10, 15, and 20 cm within plant row spacings under field conditions. Generally, most root morphological parameters increased as within row spacing became greater. All root parameters were significantly larger for 'Redkote' when compared with 'Redcloud', except for no differences in adventitious root weights, basal root diameters, and uprooting resistance. Seed yields were higher at 15 cm spacing although not significantly more than at 5 cm spacing.

The influence of plant type on root morphological characteristics of dry beans were evaluated. Two bush, 'Redkote' and 'Redcloud', two semi-viny, 'Aurora' and 'BTS', and one viny, 'UI-111' cultivars were used in this study. Generally, bush and semi-viny cultivars had larger root biomass components than the viny cultivar. Seed and biological yields did not seem related to plant type. The harvest indexes of bush and semi-viny cultivars were significantly higher than for the viny cultivar.

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AN APPROACH TO THE ANALYSIS OF THE ORGANIZATIONAL COMPONENTS ASSOCIATED WITH THE OUTREACH FUNCTION OF UNIVERSITI PERTANIAN MALAYSIA

Few universities in developing countries have a clear mandate for an outreach function. Universiti Pertanian Malaysia is one case in which a commitment toward this function was made at its establishment.

With the general purpose of elucidating the role of a university in outreach and national development, a case study was conducted on Universiti Pertanian and its outreach program. The study's objective was to analyse the university's goals with respect to its outreach function and how well it is planning and designing for the future. An analytical model was conceptualized to examine the future university outreach aims and to analyse the transitional needs and the adequacy of university efforts, if it is to strengthen its future outreach role. Concepts found in general systems theory were incorporated into the model.

Information needed to be gathered from several perspectives and from knowledgeable persons within the outreach system. Responses from linkage agents, extension agents and farmers were factor analysed to uncover factors associated with outreach program success. These factors, together with the university goals reported by informants (including university policymakers), constituted the first element of analysis. Second, the present state of the program with respect to those aims and needs were synthesized, by examining the present roles, goals, structure, leadership and program needs-response.

Finally, the transitional factors of staff development, institutional development and adaptiveness were examined to determine their adequacy in meeting future and transitional needs.

With respect to university staff development, there was found to be an overall need for system-wide appreciation of the primary university roles and for greater competence in fulfilling and strengthening the university roles. University staff development policies need to be implemented so that the university's three missions support one another. In its research efforts, the university must choose its desired fields it wants to excel in,

to enable better utilization of resources. In teaching, the university needs a clear policy to limit student numbers to protect the allocation of faculty resources into research and outreach. Concerning outreach, the university staff development efforts should reflect what kinds of knowledge the university can offer its environmental linkages, so as to strengthen the relationships the university has with them.

With respect to institutional development, there was a need for more resources to be committed to research so that faculty talents could be retained to promote excellence in the appropriate fields. The university requires the establishment of viable relationships between the outreach division and the other faculties in order to promote faculty involvement and strengthen the outreach programming and functioning. Another is the management of this transitional effort for increased faculty participation and recognition of their contributions, thus further strengthening the outreach role of the university.

With respect to its adaptiveness, the university has the needed leadership style for the future functioning of the outreach program. However, the outreach program style needed programming procedures that allow more involvement of clientele and linkage agencies than at present, so that the clientele demands can be better met and the program more likely to succeed.

The conceptual model that was developed for the study may be used for future studies in other universities as well. Other pertinent concepts that may be included are those of "organizational climate" and "environmental forces."

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Yazman, James Alan

Animal Science

INFLUENCE OF SUPPLEMENTARY FEEDING ON GROWTH OF HEIFERS AND MILK YIELD OF LACTATING COWS IN A TROPICAL ENVIRONMENT

During a 2-year period in Puerto Rico 5 tropical grass species, under heavy fertilization were grazed by Holstein heifers. Species effects were

non-significant in average daily gain (ADG). There was, however, some evidence of grass-season interaction effects on ADG and total gains. B. brizantha was highest in carrying capacity at 5.87 head per ha but D. melijiana was best for total gain. Under the stocking management used, estimated pasture grass dry matter intake (PGDM) averaged 3.0% but utilization of available PGDM was low (3.9-5.5%).

In another series of trials, season effects significantly interacted with treatment to influence ADG of Charbray or Holstein heifers grazing mixed grass pastures when supplemented daily with 1.4 kg corn (T₂) or molasses (T₃), 1.8 kg corn (T₄) or 1.8 kg 14% CP bulky (T₅), and 1.4 or 2.7 kg bulky with no pastures (T₆, T₇). Supplementation resulted in depressed PGDM intake, ranging from 11.5% of the level for grazing only for T₇, to 40.9% for T₄. Feeding bulky concentrate when pastures were low in quantity (T₆ and T₇) resulted in gains approaching an additive supplementation model while molasses supplementation (T₃) did not, indicating an effect of protein level. Weight gains attributable to PGDM were more variable among periods for T₂ than for T₃ indicating an interaction of type of supplement and season. Use of supplements (corn, molasses) tended to depress intake of PGDM resulting in less rate of gain than expected. Supplement with protein, even with content of 14% or higher was better (T₅, T₆, T₇) but close attention to stocking rate is required for high utilization of PGDM.

Four hundred seventy two lactations of 312 Holstein and Brown Swiss were used for comparison of 7 feeding systems over a 5 year period; grazing alone (T₁); grazing plus 1 kg molasses per 2 kg milk yield above 10 kg daily (T₂); corn as in T₂ (T₃); commercial concentrate (20% CP, 75% TDN) at the rate of 1 kg per 2 kg milk regardless of daily yield (T₄); T₅, commercial concentrate as in T₂; and T₆, urea-molasses as in T₂. Cows in T₁ through T₆ grazed at the rate of 2.5 cows per ha. In (T₇), cows were supplemented as in T₄ but grazed at the rate of 5.0 head per ha.

Supplementation had a significant effect on most production and reproduction parameters (P .05). Fat percent tended to parallel dependence on forage intake. Supplement was also positively correlated with length of lactation. High supplement levels (T₄, T₇) were highest in weight gains, time to reach peak yield, and persistency of milk yield but lowest in breeding efficiency. Cows on low supplement (T₂, T₃, T₅, T₆) consumed 24

to 29% less PGDM than T_1 cows (14.26 kg/day) but cows on high supplement (T_4 , T_7) ate nearly 60% less grass. Supplement type (corn, molasses, urea-molasses or concentrate) had little effect on PGDM intake.

Interaction effects of season-of-calving and treatment were significant for milk yield, fat percent, days in milk, time to reach peak yield and milk yield first 50 days of lactation but non-significant for reproduction, persistency and body weight. Cows calving May-June had longer calving intervals, fewer days to reach lactation peak, lower persistence and less body weight gains. On medium levels (T_3 , T_5 , T_6) efficiency (Mcal/kg DM) of utilization of supplement for milk production was good but not so with high supplement (T_4 , T_7). Supplements as high or higher than the grasses in non-protein nitrogen or protein (concentrate) gave better efficiency than either corn or molasses.

When the genetic potential for milk yield of cows exceeds 3,000 kg, supplementary feeding appears economically feasible. Even on fertilized grazing, there will be a linear response to level of protein supplement. Supplementary feeding with grazing of tropical pastures will cause a high substitution rate; hence, lowering efficiency in PGDM use. Highest lactation yields are with the T_4 system but maximization of returns from land, labor and material inputs come with higher stocking rate (T_7).

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Yousif, Kahil Sobahi

Pomology

HYPOBARIC STORAGE OF BANANAS: IMPLICATIONS FOR STORAGE AND DISEASES

Three aspects of studies on hypobaric storage of bananas (*Musa* spp.) were carried out. 1) The effect of intermittent low pressure (ILP) on the preclimacteric life and quality of bananas. 2) The effect of low pressure (LP) on in vitro and in vivo growth of Botrytis cinerea and Fusarium moniliforme and on fungal stimulated ethylene production of bananas.

3) Effects of inoculating B. cinerea spore suspension and of injecting B. cinerea crude enzyme preparation on the ethylene production and tissue degradation of bananas at different temperatures.

ILP at 100 mm and 170 mm Hg for 21 minutes in every hour significantly prolonged the storage life of bananas at 21-24.5°C in 3 out of 5 experiments. An 170 mm Hg at 13°C was more effective than similar ILP at 24.5°C or constant atmospheric pressure at 13°C in extending the preclimacteric life of bananas. The ILP stored bananas had acceptable eating quality, but showed some desiccation and browning on their skin.

LP and ILP at 100 mm and 170 mm Hg had no appreciable effect on in vitro mycelial growth and spore germination of B. cinerea and F. moniliforme. LP at 40 mm Hg caused a lag period in mycelial growth of B. cinerea for 2 days before resumption of slow growth. There was a lag period in spore germination for both fungi at 40 mm Hg. B. cinerea infection caused an increase of internal ethylene concentration of bananas. LP and ILP at 100 mm and 170 mm Hg did not curb the rot of bananas inoculated with B. cinerea, but reduced their internal ethylene concentration. LP at 40 mm Hg reduced the internal ethylene concentration of B. cinerea inoculated bananas to levels comparable to non-inoculated bananas. The former remained green despite extensive rot two weeks after inoculation. There was a build-up of internal ethylene after the release of vacuum in ILP system, however.

B. cinerea stimulated ethylene production in banana fruit, but F. moniliforme did not. The optimum temperature for B. cinerea infection as well as for its stimulation of ethylene production was 15°C. Injection of crude enzymes extracted from bananas inoculated with B. cinerea also induced ethylene production of bananas. The optimum temperature for the enzyme action employed was 30°C which was higher than the optimal temperature for B. cinerea infection and its infection stimulated ethylene production. However, even at low temperature (12°C), there was a significant build-up of internal ethylene in enzyme treated bananas 24 hours after the treatment. The internal ethylene concentration in these bananas eventually declined to normal levels at 72 hours after the enzyme treatment. Commercial pectinase enzyme treatment produced similar results. Both enzyme preparations had the same enzyme composition polygalacturonase, pectin methylesterase and cellulase (C_x). Cellulase did not significantly stimulate ethylene production in banana fruits, but the other two enzymes did.

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