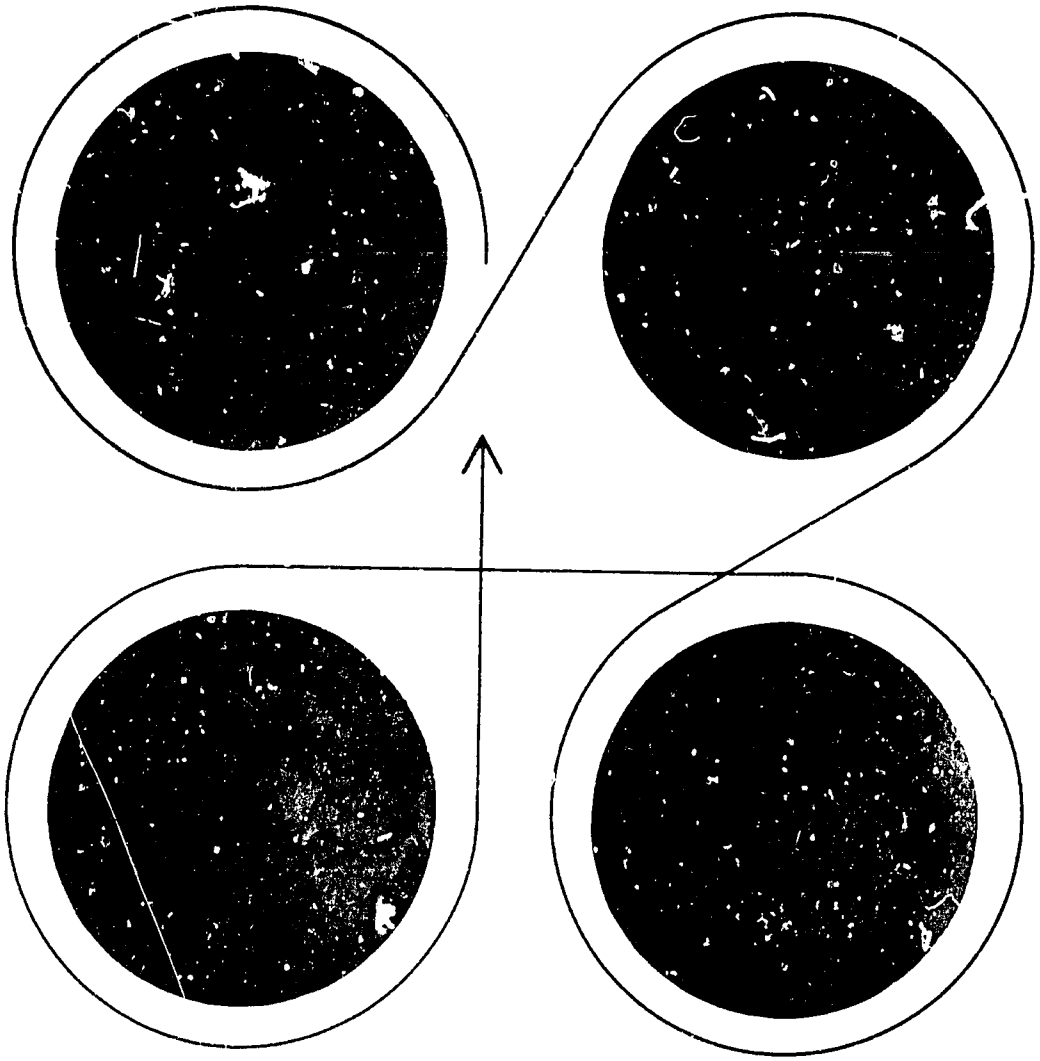

DISSERTATION ABSTRACTS

Relating to

INTERNATIONAL AGRICULTURAL AND RURAL DEVELOPMENT

Volume 5 : 1977

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ABSTRACTS

Akratanakul, Pongthep Entomology

THE NATURAL HISTORY OF THE DWARF HONEY BEE, *APIS FLOREA* F. IN THAILAND

The dwarf honey bee, *Apis florea* F. is the most primitive species in the genus *Apis*. It constructs a single, fully exposed comb. The comb is usually arboreal. The organization of the food and brood pattern in the combs of the dwarf honey bee is similar to other *Apis*; the food is stored above the brood. The comb is covered by a blanket of worker bees, "the protective curtain". The dwarf honey bee deposits bands of propolis, i.e. "the protective (sticky) bridge" on the substrate branch from which the comb is suspended to serve as a physical barrier to prevent ant invasions. Several unusual nests of *A. florea* were studied: These include two multiple comb nests, a nest built without the broad top area, and several queenless nests.

Observations on the activity and behavior of the queens, the workers, and the drones of the dwarf honey bee indicate that, in general, the behavior of *A. florea* is similar to that of other *Apis*. The queen lays her eggs in a concentric pattern. The workers perform their house duties under the protective curtain. Foraging and recruitment of the workers takes place at the broad top area. When the colonies of *A. florea* are dequeened, the workers can rear the new queens, given the presence of worker eggs or young worker larvae. The drones of *A. florea*, while at the nest, are passive and are not usually seen when not actively flying. Drone flight activity begins at about 12:30 to 14:30 hr. and ceases at about 16:00 hr. in Thailand.

A colony of *A. florea* can regulate its nest temperature by adjusting the thickness of the protective curtain, fanning, and distributing water in the nest.

The swarm behavior of *A. florea* is essentially the same as other *Apis*. Drones are sometimes present in the swarm. Drones in a swarm cluster show the same behavior as they would in their parental nest. Absconding is common in colonies of *A. florea* in Thailand. Lack of food and the serious threat by natural enemies are the usual factors responsible for absconding. Queenright colonies of *A. florea* will not abscond without their queen.

The scouts of the dwarf honey bee announce their discovery of food by a dance language and giving a food sample to the recruits. Workers of the

honey bee can distinguish between high and low sugar syrup concentrations provided at a feeding station. Recruitment behavior of A. florea takes place on the broad top area of the comb. The workers can communicate by means of the dance language when they dance on the horizontal platform only. At nest 25 (an unusual nest built without the broad top area) the colony existed successfully without being able to dance (communicate) in the normal manner.

Variations in gentleness and aggressiveness are found in colonies of the dwart honey bee in Thailand. The alarm behavior and aggressiveness of the honey bee are described in detail. The responsiveness of the dwarf honey bee toward stimuli such as smoke, human breath, and light flashed on the comb surface during nighttime are recorded. The reaction of the honey bee in response to a synthetic alarm substance iso-pentyl acetate is reported.

Observations were made on the parasitic bee brood mite Euvarroa sinhai Delfinado and Baker, two species of wax moth Galleria mellonella L. and Acroia grisella (F.), ants, other insect pests, and man. No microbial diseases of the dwarf honey bee were seen and none have been reported by other researchers.

* * *

Anusionwu, Emmanuel Chukwuma Economics

A FRAMEWORK FOR A REGIONAL STUDY OF AFRICAN AGRICULTURAL RURAL ECONOMY: A CASE STUDY OF KIGEZI DISTRICT IN WESTERN UGANDA

Problem: Observable economic problems of a predominantly agricultural rural region are interwoven with the physiological, ecologic, environmental, social, cultural, political and institutional characteristics whose impacts and dimensions are purely regional even in a given country. From an adequate analysis of the above factors, the real problems of the region, if any, would emerge. The appropriate analysis can then be made, leading to prescriptions for the most effective and lasting solutions of the problems.

We used the above framework to study Kigezi district in Western Uganda. The district is predominantly agricultural and suffers from low regional and household income levels. Some of the most important features of the district are high population density relative to available land resources, heavy outmigration (especially of the younger population) and low level and inappropriate social infrastructure facilities and services. The two main sources of the dominant problems in the district are public policy and institutions, and low household income levels.

Methods, and Procedures Used in Gathering Data: The data was gathered using trained interviewers and the unit of inquiry was the household. Household selection was by two-phase sampling procedure: The first was by cluster sampling, with subcounties as units and the second by systematic sampling of households (with a random starting point) yielding approximately one percent of the households in the district (1,133 households). A separate survey obtained the relevant macrolevel information from community leaders in the district and government officials at the district and national levels.

Main Results and Conclusions: The impact of most public policies and institutions are inimical to the Kigezi region and to its households. The land shortage is exacerbated by devoting over 22 percent of the available land in the district to game parks and forest reserves.

The government efforts to solve the problem of land shortage by encouraging outmigration and swamp reclamation are inadequate and costly and create more problems for the district. The taxation is regressive, extortionate and punitive and ensures continuous flow of income from the rural sector to maintain a largely redundant administration at the county urban centers. Most of the social services do not reach the larger part of the population. The agricultural and educational services are irrelevant to the needs of the most of the people.

At the household level, cash crops are the main sources of cash income, since nonfarm opportunities are highly limited. Non-cash crop producers are handicapped by lack of adequate land, labor and the cash income to hire workers to augment family labor. An econometric analysis of cash crop production structure among households revealed the following: The relationship between household hours of labor actually applied on the farm and household members participating in farm activities has locational variations. There is shortage

of farm labor within the household, especially during the peak farm seasons. Household application of hired labor is suboptimal, primarily due to shortage of cash income to pay for it. Nonfood cash crops generally suffer most from allocation of the limited farm labor available to households.

There is variation in the productivity of the major factors of production (land, household labor, and hired labor) between counties, crops, and different categories of households. The nonexport cash crops are more profitable in terms of cash income for a given level of inputs.

Households in Kigezi are reaching the limit of their adjustment and efforts to cope with the agricultural problems. There is a need for a redirection of public policies as they affect the district, and in the short run the provision of medium and short-term credits to farm households to increase farm labor input is crucial.

* * *

Bidinger, Francis Robert Agronomy

YIELD PHYSIOLOGY UNDER DROUGHT STRESS: COMPARATIVE RESPONSES OF WHEAT AND BARLEY

Growth and yield processes were studied in two cultivars each of wheat and barley in the absence and presence of a terminal drought stress arising slightly before flowering in the earliest cultivar. The object of the study was twofold: to compare the physiological responses of the two crops to stress during flowering and grain filling, and to attempt to determine the basis of the apparently superior adaptation of barley to such stress conditions.

Among the four cultivars, reductions under stress in total dry weight, grain dry weight and photosynthetic area duration, were proportional to differences in date of flowering, indicating the importance of early flowering under stress. Reduction in grain yield was due to reduction in both grain number and grain weight, with reduction in the latter being due almost entirely to reduction in the length of the grain filling period.

The barleys outyielded the wheats by approximately 20% under stress and had a significantly different species by treatment interaction than the wheats in total dry weight, grain dry weight and grain number m^{-2}, but not in weight per grain. Differences in the ear structures of the two species, as well as differences in flowering date, may have caused the differential reduction in grain number.

Cultivar differences in mean minimum daily water potential under stress were influenced by both the stage of growth of the cultivar and by the length of time the crop had been under stress. When ψ_l was expressed as a function of days from the final irrigation, the latest cultivars were under the least stress on any given day of measurement. When the same data were expressed as a function of days from anthesis, however, the latest flowering cultivars were under the greatest stress.

Crop photosynthetic rate and total crop carbon assimilation (as estimated by $^{14}CO_2$ uptake) were related to crop PAI and PAD, respectively, although there were both species and treatment differences in the relationship. Grain yields under stress were related to total crop assimilation after anthesis. The higher post-anthesis assimilate totals in the barleys under stress were a function of both the normally higher PAI in the barleys (control treatment) and of a lesser reduction due to earlier flowering, suggesting that normal growth habit as well as earlier flowering were responsible for higher yields in the barleys under stress.

There was a greater decrease in stem dry weight during the latter half of the grain filling period in the stress than in the control treatment, and in the wheats than in the barleys, suggesting a greater use of pre-anthesis assimilates in grain filling in the stress than in the control, and in the wheats than in the barleys. ^{14}C labelling data, however, indicated that while pre-anthesis assimilates made up a larger percentage of the grain weight under stress, there were no significant differences in absolute amounts in the grain between the wheats and the barleys, and there was an absolute increase in pre-anthesis assimilates in the grain under stress in only one cultivar.

It was concluded that early flowering, and hence drought escape, was the primary reason for the superior yields of the barleys under stress. There was some evidence, however, that the normally greater photosynthetic area of

the barley crop was partly responsible for the barley's greater carbon assimilation and therefore greater yield under stress, and that the apparent difference between the two species in sensitivity of grain number to stress may have also been a factor in the observed yield differences.

* * *

Buyukcolak, Unal — Education

TRANSFER OF TECHNOLOGY: FACTORS INFLUENCING SMALL FARMERS IN THE ADOPTION OF MODERN AGRICULTURAL TECHNOLOGY RELATED TO HIGH-YIELDING VARIETIES OF WHEAT PRODUCTION IN TURKEY

The central focus of this study was to investigate and determine the major factors influencing small farmers' adoption of new agricultural technology. High-Yielding Wheat Package practices were selected as the representative of the new agricultural technology transferred to Turkey from Mexico and the United States. The data were collected through personal interviews, using a field instrument originally designed at Cornell University and later modified in a field setting, by the author from a random sample of 220 small farm operators in 42 villages under the same extension program, in the Mediterranean Region of Turkey.

The investigation included six major variables which were grouped under (a) independent variables: socio-economic resourcefulness, communication, and risk-taking tendency, (b) intervening variables: incentive perception and disincentive perception, and (c) the dependent variable consisting of the composite score of three indicators: use of high yielding seed variety, use of commercial fertilizer, and application of recommended field practices. The theoretical framework of this study was structured by using the complementary components of the "behavioral differential theory" of Leagans and the "theoretical framework of reference" of Reeder. The data analysis techniques included chi square, Pearson correlations, domain sampling, scalogram, indexing, factor analysis, multiple regression, and path analysis.

On the basis of actual field application of the total package practices, 65 percent of the farmers showed a very low adoption potential and the remaining proportion varied from medium to high. Descriptive analysis further indicated that among the operationalized indicators of the independent variables farmer's age and institutional contacts were negatively related, while education, operation size, farm implements owned, visiting relatives, perception of market prices and returns, and credit source utilization were not significantly related to the dependent variable. Multiple regression analysis showed that when intervening variables were regressed, with the independent variables, on the dependent variable a total of 57.4 percent variance was explained where 52 percent of this was accounted for by the incentive and disincentive perception variables together. Path analysis further indicated that direct effects of the independent variables did not contribute much to the total cause. However, when incentive and disincentive intervention effects were introduced their contribution to total cause was increased up to 65 percent. On the basis of these findings and the theoretical considerations, perceived valences of incentives and disincentives were established as the most influential predictors of adoption behavior of the farmers.

Among the incentive perception indicators the following incentive valences accounted for 9.2 percent of the total variance explained: increase in yield, input availability, high procurement prices, more income, guidance availability, use by big farmers, and low input prices. Among the disincentive perception indicators the following disincentive valences accounted for 42.8 percent of the total variance explained: inadequate supply of inputs, low disease resistance, low prices, non-use by big farmers, lack of credit, and lack of market.

It was observed that after the introduction of HYW package program a variance in the valences of perceived incentives and disincentives occurred. On the basis of this, incentives and disincentives were grouped as (a) primary influencers and (b) secondary influencers. The primary influencers were then submitted to further considerations for the planners and policy makers.

In light of these findings and the previous relevant research, conducted in five other cultures, a comparative study was employed to establish the cross-cultural and interdisciplinary validity of the theoretical framework

of this research, leading to generalizations and designs of theoretical, research, and problem solving models.

* * *

Chotesawang, Vinit Education

THE TECHNICAL COMPETENCIES NEEDED BY THAI AGRICULTURE TEACHERS IN THE SUBJECT MATTER AREAS OF POULTRY, SWINE, AND CATTLE

Problem. A shortage of qualified teachers has been a continuing problem of agricultural schools in Thailand. The purpose of this study was to develop a rationale for the improvement of the technical competencies of Thai agriculture teachers of Poultry Production, Swine Production, Feeds and Feeding, Dairy Production, and Beef Production. The specific objectives were to: (1) identify the technical competencies needed by the agriculture teachers in these areas; (2) suggest needed in-service training programs; (3) indicate changes needed in pre-service training programs; and, (4) prioritize needed instructional materials.

Method. Questionnaires were utilized to obtain ten experts' ratings of the importance of each of 242 technical competencies in the five subject matter areas. One hundred and fifty-five teachers were requested in a second questionnaire to rate (on a five-point scale) their competency for teaching each of the 239 important items. Only the competencies having mean ratings of 4.0 (high) or above were considered adequate. The rank order of the importance of the competencies with mean ratings below 4.0 was used in determining in-service training priorities. Needed changes in pre-service training programs were determined from a review of the teacher education curriculum and the lack of needed competencies in the areas being taught. Instructional materials were assigned priorities on the basis of the reverse rank order of the competencies lacked by the teachers.

Findings. Two hundred and thirty-nine competencies (or 99 per cent) in the five subject matter areas, were found to be needed by the agriculture teachers. The distribution of competencies needed by the teachers in each

area was: Poultry Production, 46 of the 48 competencies (96 per cent); Swine Production, all 46 competencies (100 per cent); Feeds and Feeding, all 50 competencies (100 per cent); Dairy Production, 55 of the 56 competencies (98 per cent); and, Beef Production, all 42 competencies (100 per cent). The teachers adequately possessed only 89 (or 37 per cent) of the 239 important competencies. These competencies were distributed as follows: Poultry Production, 13 of the 46 competencies (28 per cent); Swine Production, 21 of the 46 competencies (46 per cent); Feeds and feeding, 17 of the 50 competencies (34 per cent); Dairy Production, 21 of the 55 competencies (38 per cent); and, Beef Production, 17 of the 42 competencies (40 per cent).

Conclusions. In-service training priorities were established for Poultry Production, Swine Production, Feeds and Feeding, Dairy Production, and Beef Production. It was concluded that required courses in the five subject matter areas should be included in the baccalaureate curriculum at Bangpra. Priorities of instructional materials needed by teachers were likewise identified for each of the five areas. Exemplar instructional materials including operational, managerial, and informational units were provided.

* * *

Christiansen, Jorge Alfredo Vegetable Crops

THE UTILIZATION OF BITTER POTATOES TO IMPROVE FOOD PRODUCTION IN THE HIGH-ALTITUDE OF THE TROPICS

The bitter potatoes, Solanum juzepczukii Buk. and Solanum curtilobum Juz. et Buk. are indigenous to the Altiplano of Peru and have been cultivated there since pre-Columbian times. The high glycoalkaloid content of the tubers makes the raw potato bitter and inedible but simple processing methods remove the glycoalkaloid and produce dry products which can be stored for several years if necessary. After harvest the bitter potatoes are spread on the ground to freeze at night and thaw during the day. After 3 freezing-thawing cycles the liquid is expressed by trampling and the remaining tuber is dried in the sun to become black chuño. The most desired product is

white chuño which is produced by soaking the trampled tubers in cold river water for 4 weeks, trampling again to remove the peel and drying in the sun. A third and new product investigated was papa seca, produced by boiling whole tubers for 25 minutes, peeling, slicing and drying in the sun.

About 15,000 hectares of bitter potatoes are grown in Peru and the average yield is about 2.5T per hectare. The bitter potato crop is grown with few inputs and little attention but they always produce a crop even though other types of potatoes, wheat, and other crops are lost from frost. In such cases chuño may provide about 80% of the diet of the people of the Altiplano.

The use of good seed and fertilizer produced crops of bitter potatoes that were more than 10 times the average yield. The yield of the Piñaza variety increased linearly through the highest fertilizer application of 240-240-150 (kg/ha of N-P_2O_5-K_2O). The Ruckii variety increased in yield with 80-80-50 but did not respond to higher rates of fertilizer. Piñaza had a much higher yield than Ruckii but since Ruckii had a higher dry matter content than Piñaza the yield of dry matter from Ruckii plots exceeded those of Piñaza except at the highest fertilizer application.

Increasing the fertilizer rate increased the total nitrogen content of tuber from both varieties and increased the production of crude protein per hectare. The two varieties had about the same percentage of crude protein so the production of protein per hectare was higher with Ruckii than with Piñaza at the two lower fertilizer rates but higher with Piñaza than with Ruckii at the highest fertilizer rate, reflecting the differences in dry matter production per hectare.

White chuño was prepared from each fertilizer plot and analyzed for crude protein and biological value of the protein. The various fertilizer treatments did not influence the crude protein content of the chuño but Ruckii chuño had a higher crude protein content than Piñaza chuño. The crude protein in the Ruckii chuño was of better quality than in the Piñaza chuño as indicated by the higher biological value of the Ruckii protein.

The three dry products, white chuño, black chuño and papa seca were processed in the laboratory and each step was monitored for change in composition to determine losses of dry matter, protein and glycoalkaloids. Of the three products, the losses were greatest with white chuño, about 12% of the dry matter, 62% of the true protein, and 97% of the glycoalkaloids.

The least loss was with papa seca, almost all of the dry matter and protein was retained but about 93% of the glycoalkaloid was removed. The loss of dry weight and protein was intermediate with black chuño but only 89% of the glycoalkaloid was removed.

White chuño had a porous low density texture and closely resembled the original tuber. Flour made from while chuño was substituted for 10% of the wheat flour in bread and for 20% of the wheat flour in pasta without changing the quality of the product. Papa seca was hard, brittle and yellow. Black chuño was dense, black and only vaguely resembled the original tuber.

Several clones of S. juzepczukii were found that were resistant to frost or nematodes but only a few were resistant to both. Nematodes were collected from 4 locations in the Altiplano to screen for nematode resistance. None of the clones had resistance to the nematodes from Puno but a few clones had resistance to nematodes from two locations but none of the clones had resistance to more than two samples of nematodes.

Resistance to frost injury was increased by gradually reducing the temperature in the growth chamber. The frost resistance of S. juzepczukii and S. curtilobum was much greater than local varieties derived from other species. Fertilizing with high rates of potassium sulfate and restricting the water supply also improved frost resistance so that the four varieties of bitter potato plants withstood $-8^{o}C$ with little injury. A detached leaflet method of measuring frost resistance was not well correlated with whole plant studies.

* * *

Chung, Po

Animal Science

PRODUCTION AND NUTRITIVE VALUE OF A SPIRAL BLUE-GREEN ALGA GROWN ON SWINE WASTES

Methane generation has been proposed as a means of swine waste disposal. As a secondary treatment to recover nitrogen, carbon, and other nutrients

from the effluent of methane generator, Arthrospira platensis, a blue-green alga also known as Spirulina platensis, was grown and its nutritive value determined. This alga contained 60-65 percent crude protein and is easy to harvest. Three indoor culture ponds of .55 M^2 were designed and built at Cornell. The ponds consisted of a bottomless wooden frame lined with polyethylene sheet resting on a table top. Culture medium was kept circulating by a special aerator developed here. The medium prescribed by Holmes and Van Schoor which has been widely used was evaluated. It was found that when algal growth reached a saturation point, there was still 70 percent of NO_3^- and 10 percent of HCO_3^- left unused in the medium. Swine waste fermented at a hydraulic retention time of 10 days gave the highest ratio of NH_3-N to TKN (about 70%). NH_3 seemed to support best the growth of the blue-green alga, especially when the effluent was slowly infused. Organic acids in the effluent also provided a good source of carbon, a limiting factor when algae were intensively grown. Under the light intensity of 500 foot-candles, Arthrospira yielded about 5 g/M^2/day. 2,038 mg of NH_3-N produced 16,250 mg of dry algae, containing 9,750 mg crude protein of 1,560 mg N, giving an efficiency of nitrogen recovery of 76%. Rat feeding trials showed a PER of 2.3, nitrogen digestibility of 76% and nitrogen balance of 67.8%. No toxic effects were noted.

* * *

Contreras, Mario Ruben Plant Pathology

SOLUBLE SOLIDS, PITH SENESCENCE, AND STALK ROT DEVELOPMENT IN TROPICAL MAIZE POPULATIONS

Levels of soluble solids and development of pith senescence were recorded in six tropical maize populations at two CIMMYT experimental stations in Mexico: Poza Rica and Tlaltizapan. Low and inconsistent correlations were found between soluble solids levels and Diplodia stalk rot development. Positive and significant correlations were found between pith senescence and

Diplodia stalk rot development at both locations. Greater differences were observed between locations than among genotypes at comparable stages of development. Evidence is provided indicating similar stalk rot reaction to Diplodia maydis (Berk.) Sacc., and Fusarium moniliforme (Sheld.) Sny. & Hans., in the observed populations. All materials showed a high degree of susceptibility upon inoculation. There were no differences in stalk rot reaction among entries of Tuxpeno maize. It is concluded that no changes have occurred with respect to stalk rot in the population that might be correlated for other traits during selection. It is suggested that studies be made to determine the relation of nodal and internodal pith senescence to flowering under present CIMMYT selection practices. Furthermore, it is recommended that CIMMYT select on the basis of standability after physiological maturity of genotypes rather than on lower stalk rot scores. This would be combined with periodic observation of the maize stalk quality during grain filling to discard genotypes that develop rot before physiological maturity.

* * *

de Gwynn, Eunice Romero Education

FAMILY WELL-BEING, FERTILITY AND CHILD NUTRITION: A COMPARATIVE STUDY BETWEEN MIGRANT AND NATIVE FAMILIES IN GUADALAJARA, MEXICO

This research is one of the first studies focused on the investigation of the well-being, fertility and child nutrition among families who have migrated to a large metropolitan area of Latin America. Surveys were conducted among 135 migrant and 175 native families of the city living in the same poor areas of Guadalajara. All the items of these three dimensions were analyzed individually and compared among the two groups of families. Variables were built by means of factor analysis and factor scores. A path model was used to test the explanatory role of well-being and fertility on the nutritional status of children.

The results supported most of the hypotheses formulated for this research. Thus, even though migrant families felt they were much better off in Guadalajara than in their place of origin, they tended to have a lower level of well-being than the families reared in the city in three variables: education attained by the couple, level of wealth, and use of medical care. On the other hand, neither type of housing nor periods of economic crisis showed a statistically significant difference between the two groups of families.

Family fertility was one of the highest reported in the literature on this topic. Contrary to expectations, city-reared women did not consistently and significantly differ from women of rural origin in regard to fertility. Only contraceptive awareness was higher among the native group, particularly among the younger group of wives, indicating that if any change regarding fertility is to occur this is more likely to happen among the younger group of women born and reared in this large urban environment. Native women over 30 years old were as traditional regarding fertility as women coming from rural areas.

The nutritional status of the children as measured by six anthropometric indicators was quite low among the children of both groups of families, but particularly among the migrants. Only in head circumference did the migrants surpass the children from native families. The disadvantage was specially significant regarding height and leg circumference for age. Indicators of caloric intake, such as weight and arm circumference, were similar among both groups of children. When the six indicators were factor analyzed and put into a single index of nutritional status, migrant children showed a significant disadvantage in the overall measurement of nutritional status.

Breastfeeding was practiced by a larger proportion of the migrant women, and the duration of this practice was longer among them than among natives. Current food consumption measured by qualitative techniques was quite similar among both groups of children. The path analysis indicated that in both groups of families the nutritional status of the children was directly and significantly a function of the level of wealth of the family, followed, among migrants, by use of medical care and fertility in a negative direction. Education of the couple had an important indirect effect on child's nutrition through its significant effect both on family wealth and use of medical care, which in turn influenced child's nutrition. These results

suggest that in planning for the improvement of nutritional status first consideration must be given to non-nutritional variables having to do particularly with the improvement of the family well-being of the families, mainly with regard to a stable source of income, raising the level of education, and providing medical care services accessible to the poor. These priorities should be pointed out to policy-makers and planners for the prevention of malnutrition among children of poor families in Guadalajara.

* * *

Deutsch, James Andrew Plant Breeding and Biometry

GENETIC VARIATION OF YIELD AND NUTRITIONAL VALUE IN SEVERAL AMARANTHUS SPECIES USED AS A LEAFY VEGETABLE

The variability of yield and nutritional quality in Amaranthus was studied to determine the potential for improving this genus as a leafy vegetable. Nine species of Amaranthus, totaling 55 entries, were evaluated in 3 plantings in Taiwan and the Philippines. Yield, dry matter, protein, fiber, iron, oxalate and calcium content were determined at weekly intervals starting when the earliest entries showed flower stalk development. Leaf and stem characteristics for 12 entries were compared at successive harvests, also.

At the first harvest, fresh yield averaged 6.5 MT/ha with 80-90% edible matter; the best entries yielded 20 MT/ha. Dry matter content averaged 12%; dry matter yield averaged 0.8 MT/ha. Leaves had twice as much dry matter as stems.

Because temperature differences during the growth period of the planting caused days to first harvest to range from 25 - 38 days, mean fresh yield ranged from 180 - 320 kg/ha/day and mean dry matter yield ranged from 18 - 24 kg/ha/day.

Mean iron content of all Amaranthus entries at the first harvest was 112 mg/100 g dry matter in Taiwan and 99 mg/100 g dry matter in the Philippines. Mean calcium content was 3.0% in Taiwan and 1.2% in the Philippines. Entries with iron and calcium contents significantly higher than the grand mean were found. At the first harvest in all plantings, mean protein content was 27%, fiber content was 10% and oxalate content was 6%. Entries

with the highest protein content and lowest fiber and oxalate contents were not significantly different from the grand mean or the mean of varieties grown in Taiwan.

Although environmental factors affected yield and iron and fiber contents, entry ranks were similar in all plantings, suggesting a high probability for successful selection of better varieties. On the other hand, oxalate, calcium and protein contents showed what appeared to be large genetic x environmental interactions, suggesting a low probability for successful selection of lines which are predictable in many environments.

Mean protein production was 5 kg/ha/day at the first harvest. Best lines averaged 11 kg/ha/day. There was evidence that with higher fertility and plant density, protein production could be doubled.

The leaf had twice as much protein, iron, calcium and oxalate as the stem, but less fiber than the stem. As the plant matured, the leaf/stem ratio decreased causing a decrease in nutritional quality.

Amaranthus produced more edible yield than kale (Brassica oleracea, Acephalata Group), Chinese cabbage (Brassica campestris, Pekininsis Group), water spinach (Ipomoea aquatica) and sweet potato vine tips (Ipomoea batatas). Dry matter percentage in Amaranthus at the first harvest averaged 12% as compared to 9% in the Brassica species and 10% in the Ipomoea species.

On a fresh weight basis, Amaranthus had twice the calcium, iron and protein contents of the other leafy vegetables but oxalate and fiber contents were significantly greater, also.

The results suggest that Amaranthus varieties grown today have high nutritional value and good productivity along with sufficient variability to serve as a basis for future improvement.

* * *

Ejiga, Nathaniel Omatai Okoliko Agricultural Economics

ECONOMIC ANALYSES OF STORAGE, DISTRIBUTION AND CONSUMPTION OF COWPEAS IN NORTHERN NIGERIA.

The principal aim of the study was to describe the cowpea distribution

system and to identify any areas of significant loss or gross inefficiencies in the system. A second objective was to identify where in the distribution chain most cowpea storage takes place. A third phase of the study dealt with the potential effects of increasing urbanization and income on the demand for cowpeas.

Data were collected from an area in each of the two main ecological zones spanning Northern Nigeria. Each sample area consisted of a rural area and an urban area. The sampling units in the rural areas consisted of farmers and traders while the sampling units in the urban areas consisted of traders and urban households. The data were collected by means of questionnaires administered over a fifteen month period.

The cowpea distribution system in Nigeria appears to be highly organized with a substantial degree of specialization among middlemen. Traders often combine trade in other commodities along with cowpeas in an attempt to build a larger volume.

Farmers disposed of 25 percent of the cowpeas which were sold (excluding about 15 percent used on the farm) during the first 3 months after harvest. By the end of 6 months, approximately 75 percent had been sold. Cowpeas are not held over from one season to the next because of high insect damage and extreme price uncertainty. Farmers store substantial quantities during the early part of the marketing season. Since consumption is relatively stable from month to month (except during the last 4 months of the marketing year, July to October) substantial quantities must be stored by intermediate handlers during the early part of the season. Rural traders were found to be the principal storer of cowpeas. There is evidence that a few speculators in urban areas also store small amounts.

Data on the average level of use of storage capacities indicate that storage capacities for cowpeas are adequate even though the quality might be deficient. The flexibility in capacity expansion was indicated by traders erecting private facilities for rent and by the widespread use of dwelling houses for storage by farmers and traders when the need arises. Traditional storage facilities were found to be cheap to erect and maintain. Average total physical loss of cowpeas in storage was found to be about 3.5 percent by weight. Cowpeas stored from the time of harvest is not profitable unless held for some time (6 months for the 1972-73 crop). The high variability in

in seasonal price patterns from year to year makes this storage rule very risky.

Bivariate correlation coefficients of prices were calculated to indicate the level of market integration. The relationship between transport costs and price differences was analyzed and so was the relationship between average seasonal price rises and storage costs. The gross marketing margins for the participants in the distribution system were also estimated. The use of available information in the pricing of cowpeas was appraised by calculating the serial correlation of first differences in wholesale prices lagged up to five periods. All the pricing efficiency analyses showed no evidence of monopolistic or large scale exploitative practices. The bivariate correlation analysis among markets gave inconclusive results.

The consumption study was confined to two areas of Northern Nigeria. Consistent and statistically significant relationships between income and consumption of cowpeas were difficult to identify. The data indicate that growth in demand for cowpeas is likely to be influenced much more by changes in food consumption habits and by regional preferences than by growth in income.

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El-Hassan, Hassan Salim Vegetable Crops

EFFECT OF HOT DRY WIND ON FRUIT SETTING OF TOMATOES (LYCOPERSICON ESCULENTUM, MILL.)

This study was executed during the summers of 1974, 1975, and 1976 in Guterman Bioclimatic Lab of Cornell University. The objectives were to investigate the effect of high temperature and wind on flower shedding and fruit yield of tomatoes as related to plant water potential; to determine if the leaflet water potential is a good estimate of that of the flower cluster; to investigate the effect of drying on the stigmatic surface and pollen grains and to study the possibility of using growth regulators to

improve the fruit yield under hot wind conditions. Chico III, a heat tolerant variety and Valiant, a heat sensitive variety were used throughout and New Yorker, a low temperature tolerant variety was added in the 1976 study.

The high temperature (38° to 45°C) and wind (35 km/h) treatments of 1974 were conducted in polyethylene cage and tunnel respectively and compared with the control plants in the 16°/21°C greenhouse. Treatments started when one or two fully open flowers appeared on the first cluster and all the flowers were tagged and classified fully open, partially open and bud stage. The treatment period was eight hours per day for twelve consecutive days. Water potential (Ψ_π) of the leaflet close to the flower cluster was measured every other day, using the pressure chamber method, before the start (initial Ψ_π) and after the termination (final Ψ_π) of the daily treatment. Tomato leaflets were used to measure water potential throughout this study, since the leaflet water potential was found to be a good estimate of that of the cluster. The initial and final Ψ_π of this experiment decreased with increase in time of treatment but the rate of decrease slowed down with the time as the plants became adapted to the treatments. Generally, the high temperature and wind decreased the plant Ψ_π and they interacted so that high temperature plus wind treatment had the greatest reducing effect on Ψ_π.

Both high temperature and wind increased the percentage of flower shedding and reduced the total fruit yield of the first and second clusters. The highest percentage of flower shedding and the lowest fruit yield was obtained under the high temperature plus wind treatment.

The bud stage was the most affected by the high temperature and wind treatment as compared with the other flower stages.

While the yield of both varieties was reduced by the high temperature and wind, Valiant had a lower yield than Chico III. Valiant alone exhibited style exsertion and had more pollen sterility than Chico III at high temperature.

High temperature plus wind treatment reduced the rate of stem elongation and the rate of fruit growth during the treatment period in both varieties, but both of them recovered after the treatment was terminated suggesting that these temporary effects were mainly due to reduction in plant Ψ_π.

High temperature plus wind treatment increased the number of parthenocarpic fruits and reduced the number of fruits with blossom-end rot more than the other two factors acting separately.

In the experiment of 1976 hot wind (35° to 44°C temperature and wind speed of 30 km/h) rreated plants were compared with the control plants in the 16°/21°C greenhouse. The spraying of the first and second clusters with chlorflurenol and β-NOA increased the plant ψ_w, as a result of stomatal closure. Chlorflurenol treated plants had a higher ψ_w under hot wind treatment than β-NOA. The initial and final water potential followed a trend similar to the 1974 experiment, with the exception of the chlorflurenol treatment which maintained a stable plant ψ_w under both control and hot wind conditions.

Both growth regulators improved yield under hot wind conditions through their effect on the growth of dormant ovaries rather than prevention of flower shedding. Chlorflurenol was more effective in breaking the ovary dormancy than β-NOA. Both New Yorker and Chico III out-yielded Valiant under hot wind conditions, but the two chemicals had no significant effect on fruit yield of the varieties under the different treatments.

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Galt, Daniel Lee Agricultural Economics

ECONOMIC WEIGHTS FOR BREEDING SELECTION INDICES: EMPIRICAL DETERMINATION OF THE IMPORTANCE OF VARIOUS PESTS AFFECTING TROPICAL MAIZE

The objectives of this study were to

(1) Identify and measure the impact of yield-reducing pests on maize, on-farm and on-station in northern Veracruz, Mexico,

(2) Rank the effects of pests on yield, by destructive potential (on-station), and average damage (on-farm),

(3) Use these ranked yield losses as a set of economic weights to assist in determining plant breeding and extension service priorities, and

(4) Set forth some recommendations for further application of the on-farm damage assessment methodology for maize in different ecological regions, or for other basic food crops.

The study revealed that, within a given region, maize yield losses differ considerably from farm to farm, and from farms in general to experiment stations. Rankings of the yield losses changed significantly from the experiment station to the farming region. To determine a set of meaningful economic weights for such losses, several seasons of trials are necessary. Two to four seasons of such trials on randomly-selected farms are recommended.

Observations of pest damage must be frequent during the growing season to be meaningful. Such observations must be made at the proper stage of plant maturity. The minimum plant sample size, per observation or foliar damage rating, varied depending on the plant-to-plant variability of damage severity. Much time is required to quantify reliably the effects of maize pest damage on-farm.

On-farm in northern Veracruz, the average reductions in potential black layer yield due to all measured maize pests across all varieties and seasons (1976A and 1976B), were

(1) 23% to general post grain-filling pests, including
    (a) 14% to ear rots,
    (b) 6% to birds and rats, and
    (c) 3% to ear insects,
(2) 17% to foliar insects (mainly fall armyworm and stem borers),
(3) 5% to stunt, and
(4) 0% to foliar diseases and lodging.

On-station, the average reductions in black layer yield to all measured pests across the initial and final cycles of Tuxpeno 1 for 1976A and 1976B, were

(1) 28% to foliar diseases,
(2) 17% to fall armyworm,
(3) 9% to general post grain-filling pests, including
    (a) 5% to ear rots,
    (b) 3% to birds and rats, and
    (c) 1% to ear insects,
(4) 1% to stunt, and
(5) 0% to lodging and stalk rot.

Artificial infestations with fall armyworm were made in 1976A and 1976B. Stalk rot inoculations were made in 1976B.

On-farm, the average black layer yield was 1960kg/ha for 17 farms. Average black layer yield on-station was 3220 kg/ha for 260 parcels. Average

harvested yield on-farm was 1520 kg/ha. On-station it was 2940 kg/ha.

While the contrast between potential yields on farms and on the experiment station is obvious and large, many varietal differences were also observed. Damages by foliar insects and diseases were higher for the improved varieties than for the local variety. Losses resulting from post grain-filling pests --ear rots, birds and rats, and ear insects--were significantly higher in the improved than in the local varieties both on farms and on-station. These differences were related to husk coverage.

Nitrogen fertilizer added nothing to potential yield on-farm. Insecticide contributed about 23% to potential yield in 1976B when applied as insect damage became apparent. Weeds are a consistent problem on farms, but no association with yield reduction was observed. This study reiterates the continuous need to relate experiment station varietal development to evaluation and observation trials on randomly-selected farms in a relatively homogeneous region of potential HYV users.

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Gwynn, Douglas Bruce Rural Sociology

THE STRUCTURAL DETERMINANTS OF QUALITY OF LIFE: A COMPARATIVE STUDY OF MUNICIPALITIES IN JALISCO, MEXICO

This research focuses on the structural determinants of quality of life as measured by nutritional status, material possessions, and educational level in the state of Jalisco, Mexico. The 121 municipalities surrounding the metropolitan region of Guadalajara are the units of analysis.

The structural dimensions that are hypothesized to be the major determinants of quality of life are differentiation, centrality, and rigidity. Differentiation is roughly analogous to organizational complexity and indexes a social system's capacity to administer a range of services. Centrality refers to the degree municipalities are given symbolic recognition or special status by higher levels of government. A second type of centrality is locational centrality, measured by transportation flow. Rigidity is defined

as the degree to which institutions are combined into larger categories and impermeable "boundaries" are maintained between them. These structural dimensions are expected to determine the type and level of poverty in the municipality.

Over for measures of one or the other of these three dimensions were constructed for a diversity of areas including the agriculture, commercial, religious, and government sectors. These measures took the form of factor scores, Guttman scales, and typologies. They were based on a wide range of available data such as topographical maps, censuses, and institutional lists, as well as interviews in the field.

Correlation, factor, and regression analysis were used to test the hypotheses. In general the hypotheses were supported by the results. Quality of life varies directly with the level of differentiation and centrality and inversely with rigidity, although this third dimension proved weaker than the other structural dimensions. Also, for each of the quality of life measures (material possessions, nutritional status, education, and a general measure created from the previous three) in regression equations, the structural variables accounted for a much higher proportion of variance than did the geographic or farm level measures that were introduced as controls. Furthermore, when used simultaneously with structural measures in regression equations the non-structural measures drop out.

The structural dimensions assume importance relative to one another in predicting the different quality of life sub-concepts. Thus for material possessions, differentiation and centrality tended to be the most important. For nutritional status, locational centrality followed by differentiation and governmental centrality proved to be the most important. Rigidity was the most important predictor of education, followed by governmental centrality and differentiation. Explanations for each of these results are given, and policy implications for development are presented.

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Hochstetler, Harlan Wayne Poultry Science

NUTRIENT COMPOSITION AND BIOLOGICAL EVALUATION OF SOME FEEDS AND FOODS WITH AN ECONOMIC ANALYSIS OF A HIGH PROTEIN WHEAT

Nutrient composition of feedstuffs must be continually updated. Plant breeders have accepted increased protein content as a valid breeding objective and are releasing new high protein wheat varieties. Little information is available concerning other nutrient changes which may have occurred during the selection process, or the economic advantages associated with feeds containing high protein wheat.

Metabolizable energy content of feeds represents one of the most important characteristics that best indicate nutritional value; however, many experimental factors may influence its measurement. Some feeds contain compounds which exert deleterious effects by inhibiting the action of digestive enzymes.

Twenty-four feeds, 10 foods, and 15 wheat and triticale samples were analyzed for nutrient composition, metabolizable energy, and digestive inhibitors using White Leghorn chickens. Using the composition and metabolizable energy values obtained, a step-wise multiple regression technique was employed to study the usefulness of chemical composition variables as indicators of available energy content.

Of the nine composition variables considered, ash and neutral detergent residue were the first two selected which contributed most to energy prediction. Based on 29 cases which included grains, grain products, soybean meal, and two high fiber containing feedstuffs, the following equation was derived; M.E.n. (kcal/g) = 4.283 - 0.198 (ash g/g) - 0.022 (neutral detergent residue g/g). The equation had a standard deviation of 0.212 kcal/g and a multiple correlation of 0.95.

Metabolizable energy values determined with roosters, slightly exceeded values determined with growing chicks. Differing nitrogen levels of the reference diets did not appear to contribute directly to the difference. When metabolizable energy values were determined, feedstuffs containing high nitrogen were found to have greater nitrogen correction terms than did low nitrogen containing ingredients. The total excreta collection method was

found to result in slightly higher ingredient metabolizable energy values than did the chromium tracer method. Metabolizable energy determined by a feeding a single ingredient with no added vitamins or minerals produced a slightly lower energy value than the conventional substitution method.

Of the feeds and foods examined for digestive enzyme inhibitors (using radial gel diffusion techniques), isolated soybean protein, soybean meal, and rye were found to contain the highest levels of trypsin inhibitor. Wheat germ, red lentils, pearled barley, and 10 varieties of wheat and triticale contained lower amounts. Amylase inhibitor was found primarily in wheat and its products. An inhibitor of avian pancreatic lipase was found in many feeds and foods. Of all materials studied, wheat germ contained the highest level of lipase inhibitor. Future studies are necessary to determine the critical dietary inhibitor levels at which digestive efficiency becomes impaired.

Twelve wheat and 2 triticale varieties grown under similar environmental conditions, were found to contain 10.5% to 16.9% protein. Increased nitrogen was associated with increased ash and neutral detergent residue content. The amino acid and fatty acid profiles of wheat remained constant as nitrogen content increased. Increased nitrogen content of wheat was found not to have occurred at the expense of essential amino acids or fatty acids. A new soft, white wheat variety developed at Cornell University, termed NY6298-25, contained 13.6% protein, 0.44% lysine, 1.5% linoleic acid, and 3.85 kcal/g of metabolizable energy. Substitution of NY6298-25 for Yorkstar, a common New York wheat, in chick starter and laying hen diets enabled diet cost to be reduced 2.7% to 3.6%. This assessment of the nutritional and economic characteristics NY6298-25 provide evidence that this wheat will make an excellent addition to the commercial wheats presently grown in New York. Chicks fed Ticonderoga gained 18% more weight in 12 days than chicks fed Yorkstar or NY6298-25. Since the diets contained equal levels of energy, protein and essential amino acids, some unknown factor appeared to be involved.

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Ismail, Mohamad Salleh Food Science and Technology

ACCELERATED FERMENTATION OF FISH SAUCE, FISH-SOY PASTE AND FISH-SOY SAUCE

Fish sauce is an amber to dark brown colored liquid prepared traditionally by hydrolysis of fish protein in the presence of 20-25% (w/w) salt. This process takes about 1 year to complete. The product is consumed as a condiment on rice, as a dip for vegetables, and as a flavoring ingredient in vegetable and curry dishes.

The traditional method of production is a lengthy one and thus, a more rapid process is desirable. The following procedures were developed as rapid methods of production of fish sauce.

1) Deboned fish (fresh water suckers) were hydrolyzed with concentrated hydrochloric acid at 121°C for 2 hr. The excess acid was neutralized to pH 5.8 with 50% sodium hydroxide. The resultant sauce had a very mild aroma, closer to that of soy than to the aroma of fish sauce.

2) Deboned fish was hydrolyzed with 0.2% (w/w) papain at 30°C or 55°C for 4 hr, followed by the addition of 12% salt. The mixture was then inoculated with an unsterilized, 4-month old fish sauce (1% v/w) and incubated for 2 months.

3) A fish sauce was also produced by growing Aspergillus oryzae NRRL 1989 on soybeans at 30°C for 48 hr. and mixing the beans with 90% (w/w) deboned fish. Twelve percent salt was then added and the mixture was incubated at 40°C for 2-3 months. Hydrolysis reached the maximum level (90%) after 7 days. There was no change in the total nitrogen (2.12 g/100 g) during the fermentation process. When 25% (w/w) wheat was included in the mixture, the % hydrolysis achieved at 40°C was 89. The total nitrogen was also lower (1.96 g/100 g) though the product was similar in flavor and aroma to that prepared without wheat.

Two new products, fish-soy paste and sauce, were developed. The paste is similar in appearance to soybean paste (miso). The product was prepared by mixing 50% (w/w) unsoaked soybeans, which were then soaked, autoclaved at 121°C for 15 min. and overgrown with Aspergillus oryzae NRRL 1989 at 30°C for 48 hr, with 50% (w/w) deboned fish and 10% salt (based on the weight of the fish-soy mixture). This mixture was incubated for 3 weeks at 55°C. The

mixture was then aged at ambient temperature for another 2 weeks.

The following processes were developed for the production of fish-soy sauce.

1) The deboned fish-soy mixture was hydrolyzed with an equal quantity (w/v) of concentrated hydrochloric acid at 121°C for 2 hr. The excess acid was neutralized with 50% sodium hydroxide to pH 5.8.

2) Fish-soy sauce was also produced by mixing fish-soy paste with 15% salt solution and aging the mixture for 5 weeks. The liquid extract was then separated by filtration with pressing. The resultant dark brown or black liquid was similar in aroma and flavor to soy sauce. The flavor and aroma of fish-soy sauce produced by growing A. oryzae NRRL 1989 on an equal mixture of roasted wheat and soybeans, and then processed as above was equally satisfactory. More than 7 out of 10 taste panelists ranked these sauces as superior or equal to the reference sample, "Superior" brand soy sauce manufactured in Mainland China.

The amino acid compositions of the sauces and pastes were determined using a Beckman Spinco Amino Acid Analyzer. The essential amino acids of acid hydrolyzed sauces were generally lower than those of the raw materials. Tryptophan is known to be totally destroyed by this process. Thus, this rapid method of producing sauces is obviously unsuitable for use in developing countries unless it is followed by amino acid fortification. The essential amino acids of fish and fish-soy were better than those of soybeans alone. They were also higher than those recommended by FAO. The essential amino acid composition of fish sauce fermented at 30°C for 8 weeks was similar to that of the unfermented deboned sucker (within the 10% range) except for methionine, which decreased by 16.6%.

The essential amino acid composition of soybeans varied within the 10% range from that of soybeans which were overgrown with A. oryzae NRRL 1989 except for methionine, which increased by 26%. The fermentation of soy paste resulted in a further increase of methionine to 74.8%. This increase may have been due to synthesis of microbial protein. Threonine and lysine, however, decreased during the fermentation of soybeans.

The essential amino acid pattern of fish-soy mixture changed very little during fermentation, with the exception of threonine which decreased by 15%. The amino acid composition of fish-soy sauce was not determined because of a shortage of time.

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Kalifa-Assad, Salvador Economics

INCOME DISTRIBUTION IN MEXICO: A RECONSIDERATION OF THE DISTRIBUTIVE PROBLEM

The objective of this thesis was to carry out a detailed analysis of income distribution in Mexico, improving upon previous results, gaining new insights, establishing a methodology for comparative analysis of future data, detecting data gaps, and finally trying to relate the problem of income distribution to the economic policies followed since 1940.

We begin with a review of income distribution theories, classifying them according to the emphasis placed on chance, causal relationships, or on the relation between growth and distribution. We try to establish the relevance of such theories with respect to the problem of underdevelopment.

The studies on income distribution in Mexico reveal a series of incongruencies in their conclusions, principally due to the lack of a thorough and detailed analysis of the existing data, as well as to the use of certain methodologies which, although structurally correct, are not applicable to that data.

We present an analysis of the data and the methodology employed, choosing the family as the income recipient unit and describing the different concentration coefficients to be used. Data are presented at the national, urban-rural, sectoral, occupational and regional (state) levels.

Income concentration, as measured by the various coefficients used in the studies of income distribution, does not seem to have shown significant changes in the years covered by the study. We note, however, a strengthening of the middle and upper-middle classes, at the expense of the poor. It is evident that the disparity between the urban and rural areas is increasing, favoring the urban area which has experienced greater income growth. The disparity between the poorer 40 percent and the average income has grown in both areas, with the poor of the rural area showing an actual decrease in real income.

Forty percent of the population in the Agricultural, Construction, and Electricity sectors experienced growing disparities with respect to the average income of their sectors. There is also a widening gap between the average income of the agricultural poor and their counterparts in other

sectors. Forty-three percent of the families that show monthly incomes lower than 1,000 pesos in 1963 belonged to the agricultural sector. This group is made up of agricultural workers and the self-employed.

The fact that data cannot readily be compared is evident at the occupational level, where the data show owners suffered substantial income decreases between 1963 and 1968. In spite of this, it can be said that the agricultural laborers, the self-employed and the owners of informal businesses are the poor, showing decreases in their income and welfare.

The states with a high degree of industrialization and high income levels had a more unequal distribution in 1958 and 1970 than the other states. Almost two-thirds of the states increased their degree of inequality in the period under consideration, while at the same time there were relative improvements in the modern agricultural states. The states with the greatest decrease in welfare have a large proportion of their population employed as agricultural laborers and self-employed.

The poverty in which many Mexicans live is, in part, due to a group of policies in effect between 1940 and 1970. Policies during the period 1970-1975 were oriented toward redistribution; however, this is obscured by the hasty application of programs which were at times self-contradictory.

We tested the Kuznets' hypothesis; that is, that growth itself would generate a better distribution in the long run, but the Mexican data offer little support.

Relevant data must be gathered, especially regarding marginal groups, so that policy packages may be designed in accordance with the objectives of distribution, employment, growth and stability.

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Kumar, Shubh K. Nutrition

COMPOSITION OF ECONOMIC CONSTRAINTS IN CHILD NUTRITION: IMPACT OF MATERNAL INCOMES AND EMPLOYMENT IN LOW-INCOME HOUSEHOLDS

With nutrition becoming increasingly important in national planning of developing countries, attention must be focused on sharpening the tools of Nutrition Programing. An effort to integrate nutrition programs into economic development planning requires a better understanding of the system of causal factors in malnutrition. The present study attempts to measure a system of causal factors as it affects child nutritional status in low-income rural families in Kerala, India. The special problem of weaning-age nutrition (six to thirty month old children) in the region is examined both because of the magnitude of the problem and because of its physiological significance.

On the theoretical plane, attention is focused on two factors postulated to be major modifiers of child nutrition in the system:

1) Effect of income increments in influencing child nutrition, and
2) Maternal labor force participation.

The system under investigation is similarly dominated by causal mechanisms which are considered in Model I. This initial model was used to derive an analytical model used in the study (Model II). On the conceptual plane, two levels of relationships, the functional and the causal, are identified in Model II. At the functional level is the association between parameters of the Household-Economy Interface and Child Nutritional Status. At the causal level are changes in Within-Household Activity generated by actions at the Interface, which in turn have a differential impact on Nutritional Status.

Methodology consists of the selection of a low-income agricultural population from Kerala State in India, and the measurement of relevant variables over a nine month period. This period includes peak and slack periods of agricultural activity. Using multiple regression analysis, and two cross-sections of data points at peak and slack periods respectively, a set of equations has been estimated. These equations consecutively disaggregate household income by source and length of employment by maternal work status in explaining their separate effects on child nutrition.

Results of the multiple regression analysis indicate that individual components of the household income packet have stronger demonstrable impact on child nutrition than aggregate household income. Increments in income from employment in the labor market has a positive impact on child nutrition only when mothers are in the labor force, and during peak periods of agricultural work when employment of both men and women is high. However, in these peak employment periods, such as during harvesting, the increasing length of maternal employment introduces a negative time effect on child nutrition. This dual impact of maternal labor force participation results in a lower "net" income in terms of child nutrition. Length of male employment and own-farm product are the crucial variables in all families during slack employment. Own-farm product proved to be an important determinant of child nutrition at all times in families where women were not in the labor force, and in all families during the pre-harvest employment slump. This appears striking in light of the fact that the average size of holdings in these families was less than one-third of an acre, but had relatively good fixity of tenure. The foods grown were tapioca, vegetables and fruits, and were predominantly used for household consumption.

In conclusion, 1) opportunity for household cultivation, 2) availability of maternal incomes and 3) slack season employment seem important considerations in planning for improving welfare in the system observed. Adequacy of child care substitutes assumes significance during periods of peak labor employment. It is possible that the matrilineal traditions of the region have a bearing on some of the observed effects, e.g. that of household cultivation on child nutrition. It would be useful to test this association in other regions as well.

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Liburd, Osbert Wordsworth Plant Pathology

INTERACTIONS INVOLVING ROOT-KNOT NEMATODES, FUSARIUM OXYSPORUM F. SP. LYCOPERSICI, AND TOMATOES

The influence of the root-knot nematode, Meloidogyne incognita on the severity of Fusarium wilt, caused by Fusarium oxysporum f. sp. lycopersici, race 1 alone and in combination at known inoculum densities of both organism and under controlled environmental conditions was studied for both wilt-susceptible and wilt-resistant tomato cultivars. An increase in inoculum density of the fungus alone increased Fusarium wilt in the susceptible cultivar 'Willamette', but had no effect on the wilt-resistant cultivar 'Homestead 24'. At inoculum levels of 5×10^4, 5×10^5 and 5×10^6 conidia/plant, Fusarium wilt severity of Willamette was 23, 37, and 100%, respectively. Simultaneous inoculations with both organisms increased wilt severity in Willamette but had no effect on wilt resistance in Homestead 24. At inoculum levels 5×10^4 and 5×10^5 conidia/plant Fusarium wilt severity was 64 and 100%, respectively, in Willamette. Inoculating the plants with the nematode two weeks in advance of the fungus caused the highest percent Fusarium wilt in Willamette. At inoculum densities 5×10^4 and 5×10^5 conidia/plant 100% Fusarium wilt severity occurred. Fusarium wilt (17%) occurred in Homestead 24 only at the highest concentration of conidia/plant (5×10^6). Earlier and more rapid Fusarium wilt symptoms occurred in all treatments in which the nematode was present. In treatments with the nematode added two weeks before the fungus, wilt symptoms appeared earlier than with simultaneous inoculation with both organisms.

In growth chambers at 21 C and 29 C, 7 or 12 day old seedlings of Homestead 24 and Marglobe tomato were inoculated with 10,000 or 5,000 Meloidogyne incognita or M. javanica eggs alone or 8×10^6 Fusarium oxysporum f. sp. lycopersici race 1 conidia alone and with each nematode plus the fungus. With these treatments, Fusarium wilt developed only at 29 C. The incidence and severity of wilt was higher in treatments with the nematode plus the fungus than in treatments with the fungus alone. Addition of either nematode 2 weeks or 4 weeks prior to the fungus promoted earlier, more severe and higher incidence of wilt. At the higher initial concentration of nematode (10,000 eggs/plant) in combination with the fungus, the incidence, severity and rapidity of Fusarium wilt development was greater than in

treatments with the lower nematode inoculum level (5,000 eggs/plant). Symptoms occurred earlier in Marglobe than in Homestead 24. In Homestead 24 Fusarium wilt occurred only in treatments with nematodes plus fungi. Seedling age had no effect. The reduction of resistance in the two tomato cultivars did not vary with nematode species. All plants inoculated with F. oxysporum f. sp. lycopersici plus M. incognita or M. javanica developed extensive root necrosis.

In other growth chamber tests, six tomato cultivars with or without resistance to Fusarium wilt were inoculated with 10,000 eggs of root-knot nematode Meloidogyne incognita three weeks prior to inoculation with 7.5×10^6 conidia of Fusarium oxysporum f. sp. lycopersici race 1 with each organism alone. Non-inoculated plants served as controls.

In the wilt resistant cultivars, Manapal, Homestead 24, Beefmaster and Roma VF possessing the same major gene for resistance against the fungus, and in the polygenic moderately wilt resistant cultivar Marglobe, Fusarium wilt occurred only when plants were infected with root-knot nematodes (100% incidence of wilt). The wilt-susceptible cultivar Rutgers exhibited slight wilting (<10%) when inoculated with the fungus alone, but developed severe wilting in 100% of plants inoculated with both organisms. Top growth of all cultivars inoculated with nematode plus fungus weighed less than plants inoculated with either organism alone or controls. Roots of plants inoculated with nematodes plus fungi were severely necrotic as compared to roots of plants in other treatments. Of the 6 tomato cultivars included in the tests, Manapal was the most resistant in the presence of both organisms, Homestead 24 was next, followed by Roma VF and Beefmaster. There was no marked difference between Marglobe and Rutgers. More nematodes were recovered from roots and soil with M. incognita alone than from roots of plants inoculated with M. incognita plus F. oxysporum f. sp. lycopersici race 1.

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Matlon, Peter Joseph Agricultural Economics

THE SIZE DISTRIBUTION, STRUCTURE, AND DETERMINANTS OF PERSONAL INCOME AMONG FARMERS IN THE NORTH OF NIGERIA

Widening income disparities between the rich and poor in many low income countries during the past two decades has emerged as a major concern to development planners. The most recent National Development Plan of Nigeria reflects this concern by assigning priority to growth in the agricultural sector within the broader objectives of inter-regional and inter-personal equity. The inclusion of the equity objective in the design of production oriented agricultural policies has been constrained by lack of knowledge both regarding the dimensions of the rural income distribution and regarding the characteristics of the rural poor. This study provides a detailed profile of incomes for a sample of farmers in the north of Nigeria and identifies the determinants of income differentials.

The analysis is based upon data collected during a twelve-month period in 1974-75 from a sample of 140 farming households in three villages of Kano State. It is found that among the sampled villages the distribution of income is decidedly equitable relative to international standards and compared to Nigeria as a whole. The high degree of equity is attributed primarily to: available surplus land, an egalitarian land tenure system, inheritance practices which limit the accumulation of land and other fixed assets between generations, and the limited profitability of the generally traditional farming systems of the area.

Despite the narrow range of incomes, an econometric analysis identifies differences in the efficiency of land and labor utilization in farm production as the most important determinants of income variation. Differences in management underlying these efficiency differentials are examined through budgeting and production function analysis. It is found that low use of fertilizer combined with generally low levels of management skills account for the inefficient use of land and labor resources among poor farmers.

A set of poverty-trap relationships posited on a cash shortage observed among the poorest households is examined. These include: need for and cost of credit, choice of crop mix, timing of crop sales, selection of off-farm

occupations, and access to government extension programs. Individual components of the poverty-trap are verified, but their cumulative impact is insufficient alone to prohibit the upward mobility of even the poorest households.

It is concluded that the current distribution of income in areas typical of the survey villages is not a problem of sufficient magnitude to justify corrective government action. Evidence is presented, however, which indicates that the adoption of new technologies is likely to widen income disparities. To forestall this, modifications in observed extension programs are suggested. Emphasis on the development of low cost food grain production technologies is urged as an approach providing important improvement in the welfare of the poorest, grain deficit households. Because the marginal returns to fertilizer use are highest on the farms of low income producers, the specific targeting of poor households in fertilizer and instructional campaigns is identified as a strategy which satisfies both production and equity objectives.

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Mohamedali, Gaafar Hussein — Plant Breeding and Biometry

GROWTH ANALYSIS OF DRY MATTER, ECONOMIC BULB YIELD AND PROTEIN PRODUCTION OF SEVERAL VARIETIES OF ONION (ALLIUM CEPA L.)

Five field experiments were conducted in 1973-75 at East Ithaca and Freeville, New York with the objective of characterizing the yielding ability of several onion (Allium cepa L.) varieties by growth analysis. Seven varieties were chosen to cover a wide range of maturity, dry matter percentage, storability, and pungency. The varieties were Pronto S, Spartan Banner, Cornell Single Center Synthetic (53J), Italian Red, Amigo, Southport White Globe and Makoi (Hungarian).

Simplified growth analysis procedure was used, measuring the two component physiological processes that are all-inclusive and closest to final yield: net accumulation of photosynthate (biological dry matter yield) and partitioning of the photosynthate to the bulbs. The data collected were used to calculate: a) harvest index, i.e. percentage of biological yield that is economic, b)

efficiency of bulb dry matter production (kg/ha/day), and c) efficiency of total plant dry matter production (kg/ha/day).

The results indicate that the economic bulb yield of these onion varieties is not correlated with economic dry matter production or biological dry matter production. Varieties differ only slightly in rate of dry matter production in the whole plant and in the proportion of dry matter partitioned to the bulbs.

The economic yielding ability of the different varieties was found to be highly and significantly correlated with the moisture percentage of the bulbs. A highly significant, negative correlation of $r = -0.8572$ was found between the bulb yield and dry matter percentage of the bulbs, indicating that about 73% of the economic yield variations could be explained or attributed to differences in moisture percentage of the bulbs. Thus in breeding for high dry matter, which is of primary interest for dehydration, there is a strong probability of selecting for low bulb yield.

Protein determinations of onions grown in 1975 indicated that variety differences in protein yield were associated mainly with the dry matter yielding ability. Protein percentage on a dry weight basis showed little variability. Although the protein percentage of the bulbs is relatively low, total protein yield (kg/ha) and efficiency of protein production on a daily basis (kg/ha/day) are as high as those obtained for most legumes.

Evaluation of stored onions' pungency by mouth tasting suggested a decrease with progressive storage but determinations by threshold concentration technique indicated the opposite. Most probably the two techniques do not measure the same variable.

High correlations were obtained between the three variables; soluble solids, pungency, and dry matter percentage.

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Mongkolsmai, Dow

Economics

DISTRIBUTIONAL EFFECTS AND REIMBURSEMENT ANALYSIS OF AN IRRIGATION PROJECT IN THAILAND

The main emphasis of this study is the distributional impacts of public projects. Such impacts become important when the problem of income distribution is considered as one of the multiple policy objectives. In Thailand, one of the most important projects affecting the agricultural sector is the Chao Phya Irrigation Project in the Central Plain. Recent economic analyses suggest that the project achieved the efficiency objective in bringing about a substantial increase in rice production in the project area. No attempt, however, has been made to evaluate the distributional effects of the project costs and benefits among beneficiaries. Thus, the first purpose of this study is to examine how the different farm size groups have gained from the project in relation to one another. The data used for the analyses are secondary data obtained from Thai government departments in the Ministry of Agriculture and Cooperatives and their published materials.

The project benefits in the form of incremental net production values that accrued because of the project are estimated for each farm size class by comparing the project area with the without-project area. The project costs are distributed among classes according to their relative tax burden. The annual costs and benefits of the project allocated to each class are then discounted over a 25 year time horizon (1951-1975) at two alternative rates of interest (7% and 10%). The resulting benefit-cost ratios are high due to a small share of the project costs borne by the farmers in the project area relative to that of the rest of the taxpayers in the country. Among the classes, however, the distribution of project net benefits is skewed toward large farms, thereby keeping their position unchanged relative to the income distribution of the farmers in the Central Plain in 1963. While total rice production has increased significantly since project completion, the small and medium size farms which account for more than half of the total number of farms in the area received only a small percentage of the benefits.

The Chao Phya Project is now in the state of implementing land consolidation to improve water control in the area so that dry season cropping would be possible. It is, however, required that land consolidation costs be reimbursed by project beneficiaries. The second purpose of this study is to analyze and

evaluate the various possible methods of reimbursement that could be employed. The direct methods can be based either on the project costs or on the value of project benefits. On the benefit basis, the linear programming model was used to derive the optimal residual return to land that is expected to result at full development of the project. The maximum repayment ability of each cropping pattern assumed for each farm size class is then estimated as the difference between the optimal residual return to land with and without the project. The annual chargeable amount is below this maximum repayment ability by some specified margin in order to allow risks and to provide incentives to farmers. The indirect methods include the increase in rice premium and commodity group tax burdens that result from the project. The various methods are then evaluated according to the criteria of efficiency, equity, administrative feasibility, incentive and acceptability to farmers, and revenue production.

The results of the analysis suggest that either cost or benefit based charge would be effective in recovering the costs, since charges based on project costs do not seem to be excessive in comparison with farmers' repayment ability. While the annual charges should be based on project benefits, the total reimbursement should not exceed the project costs. The relative contributions of each farm size class should also be in line with its share of the project net benefits.

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Muchena, Samuel Cephas Plant Breeding and Biometry

EVALUATION OF PROGRESS FROM FULL-SIB FAMILY SELECTION FOR POTENTIAL YIELD IMPROVEMENT IN TWO TROPICAL MAIZE POPULATIONS

A modification (Hammond and Gardner, 1974) of the Gardner and Eberhart (1966) genetic model was adopted in two tropical open-pollinated maize populations: Tuxpeño and Mezcla Amarilla which had undergone 12 and 8 cycles of selection, respectively. The purpose of the study was to determine (1) process in improvement of plant height, ear height, grain yield, early maturity, number of ears per 100 plants, tassel size and stand percent; (2) inbreeding depression for

each trait; (3) changes in combining ability; and (4) the magnitudes of the components of genetic variation. The diallel mating design consisted of C_0, C_4, C_8, and C_{12} for Tuxpeño, and C_1, C_2, C_4, C_6 and C_8 for Mezcla Amarilla, all possible cycle crosses within each population, cycle crosses random mated, the cycles selfed and the cycle crosses selfed. Twenty-six entries of Tuxpeño and forty entries of Mezcla Amarilla were evaluated in two separate trials, in 4 environments. The randomized complete block design with 3 replications was used for each population. There were 3 plant densities in each plot: 1) low density of 32,000 plants/ha, 2) common density of 50,000 plants/ha, and 3) an estimated optimum density for each entry. The results indicated that: (1) Progress for potential yield improvement was satisfactory in Tuxpeño but was disappointing in Mezcla Amarilla, (2) While additive genetic variance for yield was of significant magnitude in Tuxpeño it was of no significance in Mezcla Amarilla. In Mezcla Amarilla the additive genetic variance was less than the dominance variance for all traits studied. In Tuxpeño the additive genetic variance was greater than the dominance variance for number of days to 50 percent anthesis, plant height, ear height, tassel length and tassel branch number, (3) Selection in Tuxpeño resulted in gradual elimination of materials that cause inferior stands, (4) Epistasis variability and over dominance were nearly always negligible compared to dominance and additive genetic variation, in both maize populations, (5) There was considerable heterosis for yield and other traits between cycles of selection of Tuxpeño, (6) Intropopulation selection also, improved the general combining ability of the Tuxpeño population for yield, (7) There was significant inbreeding depression in both populations for all the traits studied, (8) The days to 50 percent anthesis, plant height, ear heights, and tassel size were all reduced significantly in both populations.

From subsidiary studieswhich were established to determine changes in internode patterns and drought resistance in the same populations it was concluded that: a) Selection had drastically altered the internode pattern of the Tuxpeño plant and appeared to be leading to a similar conclusion in Mezcla Amarilla, b) The improved Tuxpeño was superior to its unimproved versions in drought resistance as measured by relative elongation rates and yield under moisture stress conditions. The improved Mezcla Amarilla did not show any correlated improvement for drought resistance.

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Mughogho, Spider Kajera Agronomy

THE EFFECT OF LIMING AN ULTISOL IN GHANA ON MAIZE (ZEA MAYS L.) YIELD AND SOME SOIL PROPERTIES

Liming is usually aimed at eliminating such effects deleterious to plant growth as low pH, low base status, aluminum and/or manganese toxicity, and P fixation. In the present study, field and greenhouse experiments were conducted to study the effect of lime application (as calcium hydroxide) on maize growth and some soil properties. The work was conducted on an Ultisol in the forest region of Ghana.

Results from both cultivated and uncultivated soil samples indicate that the subsoils were very low in available P, exchangeable Ca, Mg, and K when compared to the surface soils. On the other hand, P adsorption isotherms showed that the subsoils had higher adsorption maxima, an indication that the high clay content and aluminum saturation contributed to the high P fixing capacity of the subsoil.

Field results showed that liming did not have an effect on the bicarbonate-extractable P (Olsen), 0.1M HCl-extractable Zn, CEC, and exchangeable Mg of the top soil. pH and exchangeable Ca increased with increased lime application. The subsoil was not affected by liming the top soil, which may indicate that there was little or no leaching of Ca over the period of the experiment.

Lime application did not significantly increase maize grain yield in either the major or minor growing season. The first increment of lime (0.5 t/ha) increased grain yield economically in both seasons, but subsequent lime levels did not. A yield depression occurring at the highest lime rate (4 t/ha), when compared to the check plots where no lime was applied.

Short term greenhouse experiments showed that increased lime application significantly increased the bicarbonate-extractable P, 0.5M $CaCl_2$ at pH 1.5 extractable SiO_2 (Tweneboah et al.), pH, exchangeable Ca, and also effective CEC in both the top and subsoil treatments. Results showed that the effect of excess lime application was to depress maize growth and that the effect was accentuated when the soil had a lower buffering capacity, such as the subsoil in the present study.

Response of maize growth to applied P was significant, and the effect was greatest at the lowest P rate (45 kg P/ha). This may indicate that these

soils have a low P requirement, and this was reflected in their low P adsorption maxima. P application did not alleviate the depressing effect of overliming these soils. In fact highest P and lime rates caused zinc deficiency symptoms. Although nutrient uptake was increased with P rates, lime in general depressed nutrient uptake, except for Ca.

Zinc application increased maize growth significantly, more especially when lime was applied. In all treatments, Zn application did not alleviate the depressing effect of high lime rates.

Aluminum in these soils does not seem to be much of a problem, if acid soil infertility is associated with high Al saturation. From the results obtained so far, it can be assumed that liming should be restricted to those situations where Ca is limiting as a nutrient as opposed to the general theory in most Ultisols and/or Oxisols whereby the main aim is to neutralize exchangeable Al. Soils high in organic matter require more lime than thoes low in O.M. Therefore, soil pH per se is not a dependable criterion of lime need in this soil.

Since there was a modest response to first increment of lime in the field experiment, one would be led to conclude that the lime required for optimum plant grown for the Kumasi soil was low.

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Nor, Khalid Mohamad — Plant Breeding and Biometry

BETA RESPONSE AS A MEASURE OF WIDE ADAPTABILITY IN CROPS

A model is proposed to identify widely adaptable varieties from a population of entries grown over a range of diverse environments. The beta response model assumes that there is a linear relationship between the yield of a variety and an index characterizing the environment. A variety is defined to be widely adaptable if its beta response slope coefficient is equal to the beta response coefficient averaged over all the varieties. With this general formulation, the existing adaptability-regression techniques of Finlay-Wilkinson and Eberhart-Russell using site mean yield as an environmental index become special related cases.

Motivated by statistical problems associated with using the existing techniques, the site mean yield is replaced as an environmental index by one which is a function of physical factors measured at each site such as weather, soil or management. Multivariate statistical methods, including principle components and linear discriminant functions, are used to formulate an index so that a linear slope coefficient between varietal yields and index values for each site may be calculated. Several modifications were motivated by and developed from existing procedures.

The five techniques proposed for generating the physical indices presuppose that an experimenter has identified the causal environmental factors in relation to the crop being evaluated. The five techniques are:

(i) The principle component technique based on the correlation matrix of the environmental factors at each environment,

(ii) The principle component technique based on the pooled correlation matrix of all the environments assuming homogeneous variance-covariance matrices,

(iii) The pairwise linear discriminant function technique, which is a pairwise extension of Fisher's two-population linear discriminant function,

(iv) The multiple groups discriminant function technique, which is a direct extension of Fisher's two-population linear discriminant function, and

(v) The distance fromthe centroid technique, where the centroid is defined as the vector of overall means where distance is the difference between the vector of means at jth location and the centroid weighted by the pooled correlation matrix. The choice of the specific technique to be used for calculating the environmental index values depends on the specific purpose.

Numerical examples were calculated using available data from Cornell and the International Maize and Wheat Improvement Center (CIMMYT) and were easily handled through available statistical computer packages. The Cornell data set showed general agreement among the calculated indices.

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Olaore, Olatunji George City and Regional Planning

SIMPLIFIED METHODS FOR ESTIMATING GROSS REGIONAL PRODUCT AS A TOOL OF POLICY ANALYSIS: A DEMONSTRATION STUDY OF NIGERIA

This study is concerned with improving the information basis for decision making in third world countries. Primarily it tries to explore the problems involved in disaggregating national accounts to regions in developing countries where statistical information is scarce. The focus of the study is specifically limited to producing estimates of gross regional product, to create regional information systems of varying dimensions which would permit comparing regions, observing and analyzing changes that have occurred over time and space. As a result policy analysis and rational decision making could be advanced.

The procedure adopted for the study consists of devising a general methodology by modifying previous methods developed and applied elsewhere recognizing that the precise methodology must be worked out in the context of the economic structure of and the data sources available in the specific country for which regional estimates are being attempted. In essence the procedure allocates national estimates of sectoral product to regions through the use of reasonable and available allocators. Detailed allocators for substantially disaggregated industrial sectors are developed. The applicability of the method is demonstrated by constructing regional product estimates for four different points in time, 1958, 1962, 1966 and 1973 for twenty-five regions in Nigeria. This facilitates a time series analysis of gross regional product estimates and displays the nature and structure of the Nigerian economy in a way that was not feasible before. The result is to produce a spatially and sectorally detailed image of the economic changes taking place in a developing country during an important period of transformation.

The analysis reveals that Nigeria has not maintained a sustained growth both in total and by component over the fifteen-year period covered by the estimate. However, all the industrial sectors experienced substantial growth but at disparate rates. The structural shift in the economy that accompanied this growth changed the total product mix of the nation. Tremendous regional shifts in the production of the national output are also observable. The effects of these changes on the various regions were quite phenomenal. For example there

was an increasing tendency towards regional concentration in the production of the G.D.P. This represents a remarkable progress by Nigeria towards becoming a more mature economy. Tremendous regional shifts in the production of total national output also accompanied this process. This is the result of the cumulative effects of the divergent nature of development of various regional economies. Similarly, analyses of individual industrial sectors revealed that differential patterns of growth were prevalent within sectors and among regions as well as across sectors and regions. This resulted in regional concentration of production in some sectors while in others gross product was regionally dispersed. This development definitely altered the composition of gross regional product to such an extent that regional specialization of production began to emerge in some sectors. It is anticipated that this trend would continue as regional comparative advantages are explored in producing the national output of the various sectors.

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Pichard D., Gaston Robert Animal Science

FORAGE NUTRITIVE VALUE. CONTINUOUS AND BATCH IN VITRO RUMEN FERMENTATIONS AND NITROGEN SOLUBILITY

The purpose of this study was to investigate various aspects related with the nutritive value of forages.

A special apparatus for in vitro rumen continuous fermentation (1000 ml culture volume) was developed in which a sieving membrane (67 microns) was incorporated in order to selectively retain for longer time the fibrous material and microorganisms associated with it. Its design allowed independent regulation of solid and liquid flow rates while still allowing the interactions among digestion, passage and particle size to occur. The feeding frequency is variable over a wide range. The apparatus was tested with a semipurified diet. Dilution rate for liquid and fine particles was 0.083 hr^{-1}, and for large fibrous material 0.021 hr^{-1}. The ground substrate was fed every 12 hours at a rate of 11.7 gm/12 hr in a slurry of 5%.

The continuous fermentation was successfully carried for 18 days without problems. Ingesta composition was 20.21 and 12.95 gm dry matter/liter before and after feeding. Cell wall digestibility and true DM digestibility were 60.90 and 69.14% respectively. The CH_4:CO_2 ratio was 0.2:1.0. The microbes utilized up to 27 mg NH_3-N/100 ml. Yields of microbial true protein were 24.64 gm/100 gm organic matter. Approximate yields of cells were 44.40 gm/100 gm organic matter. Daily output of the fermentor was relatively constant. The fermentor allows the study of effects related to rate of passage, extent of digestion and yields of products.

Batch fermentations were studied in relation to the factors that affect the cell wall digestibility. The addition of nonstructural carbohydrates as a supplement or as a substitute affected the digestibility in different ways. Adding nonstructural carbohydrates usually depressed the initial cell wall digestibility. Large sample sizes were associated with lower pH and reduced extent of cell wall digestion.

Plant cell contents appear to affect cell wall digestibility by mechanisms other than their proportion in the substrate. The use of larger inoculum sizes resulted in shorter lag periods but did not affect digestion rate. Interaction among inoculum size, medium composition and quality of the substrate is shown.

A method of standardization was proposed that removed the effects of nutrients carried in the inoculum and permits study of the supplementation of energy and/or nitrogen substrates. The method is based on a preliminary incubation for 24 hr in large batch culture with adjustment of the nitrogen level.

The nitrogen availability in rumen conditions was studied using a wide spectrum bacterial protease from Streptomyces griseus (pH 7), pepsin (pH 2) and detergent fractionation. Bacterial protease gave the best estimate of nitrogen unavailability. The same enzyme was used for studies of rates of insoluble protein solubilization.

A model of nitrogen distribution in the forage is proposed based on its availability in rumen-like conditions. The nitrogen fraction "A" is soluble in mineral-buffer solutin. Fraction "C" is the insoluble unavailable nitrogen, and the fraction "B" represents the insoluble potentially available nitrogen with one pool (B_1) that is very rapidly solubilized in presence of the proteolytic enzyme ($K_{B_1} = 8.29 \pm 0.40$/hr) and a pool (B_2) that becomes unavailable at a slower rate ($K_{B_2} = 0.28 \pm 0.18$/hr). Fractions "A" and "B_1" can be considered together as the readily available nitrogen in the rumen. These two fractions account for

60-70% of the forage nitrogen. Silage fermentation varied the proportion of nitrogen in the fractions A and B_1 but their sum remained the same.

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Peairs, Frank Byers Entomology

PLANT DAMAGE AND YIELD RESPONSE TO DIATRAEA SACCHARALIS (F.) AND SPODOPTERA FRUGIPERDA (J. E. SMITh/ IN SELECTION CYCLES OF TWO TROPICAL MAIZE POPULATIONS IN MEXICO

Plant damage and yield losses from feeding of the sugarcane borer, Diatraea saccharalis (F.), and the fall armyworm, Spodoptera frugiperda (J. E. Smith) were determined in 4 selection cycles of the tropical maize population Tuxpeno-1, 5 selection cycles of Mezcla Amarilla, and IDRN Best 41 Families. The studies were made at 2 environmentally distinct research stations of the International Maize and Wheat Improvement Center: Poza Rica and Tlaltizapan, Mexico. The relative importance of the 2 insect species to yield varied with the maize population and the environment. Maximum yield loss to the sugarcane borer was 46.1 per cent in Cycle 8 of Tuxpeno-1 in Poza Rica, while that to the fall armyworm was 28.9 per cent in Cycle 0 of Tuxpeno-1 in Tlaltizapan. Yield reductions caused by the fall armyworm were similar at both locations, while those to the sugarcane borer were generally greater in the humid, tropical environment at Poza Rica. There was no apparent change in resistance or tolerance to the fall armyworm during selection for potential yield in the Tuxpeno-1 population. Susceptibility to the sugarcane borer and the fall armyworm appeared to have increased slightly in Mezcla Amarilla. Resistance to the sugarcane borer appeared to increase between Cycles 0 and 4 of Tuxpeno-1, but was lost between Cycles 4 and 8 owing to an increased susceptibility to some variable associated with sugarcane borer attack, possible ear or stalk rot. The IDRN Best 41 Families population, selected for sugarcane borer leaf feeding and stalk boring resistance in Tlaltizapan, did not show improvement in resistance, compared to the Tuxpeno-1 or Mezcla Amarilla populations. Until better methods of damage assessment are developed, selection for fall armyworm resistance should be based

on comparisons of yield in infested and non-infested plots. Number of ears per plant, percentage of rotted ears, leaf feeding and number of damaged internodes as determined by external inspection, were recommended as selection criteria for resistance to the sugarcane borer.

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Prasartkul, Pramote Sociology

PATTERNS AND DETERMINANTS OF INTERNAL MIGRATION IN THAILAND

This dissertation proposed to study the population movements in Thailand. The following objectives were set: (1) to establish the patterns of interprovincial population movements ; (2) to study the role of Bangkok as the primate city and its relation to migration; (3) to search for structural determinants of migration. Data employed were mainly from the 1960 and 1970 Censuses. The study focused on 5-year migration or the movements that occurred during the periods 1955 to 1960 and 1965 to 1970. At the macro-level of analysis, economic, social, and demographic structures of a province were considered as determinants of migration.

To establish the patterns of migration, the province of origin for in-migrants and the province of destination for out-migrants were identified for each province. It was found that interprovincial migration in Thailand was characterized by the dominance of short-distance movements or movements between adjacent provinces. The net migration rates for all of the possible pairs of provinces were employed to establish the direction of migration which was graphically shown.

The streams of migration between Bangkok and the other provinces were the second largest ones after the short-distance movements. The attractiveness of Bangkok was its degree of primacy. The primacy of Bangkok was analyzed both in terms of urban population and of urban functions or non-agricultural activities in the country. In both periods of study, most of the provinces in Thailand lost their population through migration to Bangkok. The population movements between Bangkok and the other provinces were found to be well explained by the combination of spatial distance and provincial population size.

On the determinants of migration, this study incorporated social, economic, and demographic theories and hypotheses and related them to the phenomenon of population movements. The conditions that might cause either social, economic, or demographic strains upon a provincial structure were viewed as push factors of migration. The determinants of migration were separately analyzed in two models: one concerned the directional flows of movements from one province to another, and the other concerned the analysis of net migration in each individual province.

Besides various socio-economic and demographic factors, the gravity model of migration which took distance and population size into account, was also included in the analysis of directional flows. In examining the effects of various determinants of migration, multiple regression was used for a 10 per cent sample of non-zero directional flows of the 1965-70 migration. It was found that people moved to a province: (1) under low population pressure as indicated by the expected increase in population who were entering the labor force market per 100 square kilometers; (2) having better economic conditions as indicated by rates of employment and of business investments; and (3) experiencing less degree of social structural disequilibrium as indicated by the discrepancy between provincial levels of structural differentiation and relative centrality, from a province characterized by the opposite conditions. The interaction among the above factors at the province of origin and of distination was found to yield a satisfactory explanation of the migration flows. However, more than half of the explanatory power was due to the effects of variables derived from the law of gravity, i.e., distance and population size.

In the analysis of net migration, multiple regression was also used for 69 provinces. It was found that a province which had any of the following conditions lost population through migration: (1) high population pressure; (2) poor economy; and (3) high social structural disequilibrium. Each of the above factors was not working separately, but jointly, in determining the net migration rate in a province.

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Ranade, Chandrashekhar G. Agricultural Economics

DISTRIBUTION OF BENEFITS FROM NEW AGRICULTURAL TECHNOLOGIES: A STUDY AT FARM LEVEL

Cereals production has taken a quantum jump in Asia after the introduction of modern varieties in the mid 1960's. This technology coupled with mechanization has directly benefited agricultural production in terms of growth and efficiency. The thesis analyzes distribution of these benefits among direct participants in rice production in two regions in the Philippines where technological change has been very rapid.

The approach is to compare distribution of output between traditional and new technologies from two perspectives; observed distribution and distribution estimated from production functions. The former perspective involves a partitioning of observed shares according to claimants called socio-economic classes, such as landlords, tenants and hired labor, and according to factors of production. The latter perspective involves estimation of production elasticities which also has two elements; first, comparison of factor shares and production elasticities, and second, measurement of input-substitution. In doing so, the thesis establishes Hicks coefficient as the criterion of changes in production elasticities and explores use of generalized CES and VES production functions.

The data are taken from two series of farm surveys carried out by the International Rice Research Institute for the same rice growing farmers before and after technological change. It contains information on inputs and output and institutional arrangements through which costs and returns of production are shared among the participants.

Analysis on observed income distribution shows that as new technologies increased production, all socio-economic classes gained in absolute shares. However, the relative share of landlords declined while that of tenants, chemical inputs, tractors and hired labor increased. It appears that as tenants' absolute as well as relative income increased because of land reforms and new technologies they substituted hired labor for part of family labor, and therefore employment as well as wages paid to hired labor increased and laborers benefited. The relative share of total labor, however, declined because total farm employment did not increase as much as increase in output. Tractorization prevented this

increase but if this innovation was discounted, the relative share of total labor increased.

Production function analysis shows that changes in production elasticities and relative shares are similar. For any individual technology, chemicals and inputs in land preparation are paid their marginal product. Although the production elasticity and relative share of land and labor for remaining operations differ substantially, the difference is less in modern technology than in traditional. It appears that the wage rate of laborers for harvesting operations was more than their marginal product in traditional technology.

Estimates of the direct and partial elasticities of substitution, and Hicks coefficients offer several exploratory implications on demand for inputs which were never tapped in previous research. Production elasticities of chemicals and labor are more sensitive to changes in chemical-labor ratio in new than traditional technologies; implying that the former is more flexible in terms of distributive bias. Within new technologies chemicals and labor are highly substitutable implying that the chemicals' price has a strong effect on demand for labor and so does the wage rate on demand for chemicals. However, compared with traditional, new technologies are more land-saving than labor-saving.

Various policy options for redistribution of income without revolutionary redistribution of assets are available due to the flexibility of the distributive bias of new technologies. Effective use of these options, however, requires a knowledge about changes in labor supply due to technological change. Still, from labor demand side the thesis shows that a limited redistribution of land towards tenants and some reorganization of landless labor for ownership of mechanical inputs are feasible conditions for redistributing benefits of new technologies towards rural poor, at least for the next decade.

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Rodriguez P., Mario Santos — Agronomy

VARIETAL DIFFERENCES IN MAIZE IN THE UPTAKE OF NITROGEN AND ITS TRANSLOCATION TO THE GRAIN

The objective of this research was to evaluate the ability of maize (Zea

mays L.) varieties to transform soil and fertilizer nitrogen into plant and grain nitrogen. Two principal characteristics were examined: a) The nitrogen accumulated in the aboveground dry matter. b) The nitrogen harvest index (NHI) i.e., the fraction of the nitrogen so accumulated which was found in the grain at maturity.

The total (grain + stover) nitrogen uptake at physiological maturity and the NHI were evaluated in 10 contrasting maize populations. The study was carried out at the Poza Rica and Tlaltizapan Stations of the International Maize and Wheat Improvement Center (CIMMYT), Mexico. The seasonal accumulation of nitrogen by the crop and its distribution among plant parts as well as the effect of plant density on the uptake of nitrogen and its translocation to the grain were studied in selected genotypes and under different levels of soil and fertilizer nitrogen.

At silking, the crop had accumulated a greater proportion of its total nitrogen (72-88%) than of its total (grain + stover) dry matter (44-63%); the proportion changed with variety and location. There was some apparent redistribution of dry matter from the stover to the grain, but about 50% of the nitrogen in the crop at silking was apparently translocated to the grain. It was concluded that in order to estimate the net total and grain dry matter and nitrogen uptake, the crop can be harvested when 50% of the ears have reached physiological maturity (full black layer development).

The relationship between plant density and the following variables: grain yield, grain nitrogen, grain + stover yield, and total nitrogen was described better by an exponential model (first proposed by Duncan and based on the log of output/plant) than by a quadratic model. There was a significant Variety x Density interaction for the variables grain yield, grain + stover yield, grain nitrogen, and total nitrogen uptake. The optimum densities for maximizing these variables changed with variety. Plant density also had an effect on the NHI. The maximum grain nitrogen and the maximum total nitrogen in the crop were satisfactorily estimated at the same density which maximized grain yield.

There were statistically significant differences among varieties in the maximum total nitrogen uptake, in the mean nitrogen uptake per day, and in the NHI. Varieties with higher total nitrogen uptakes did not always have higher grain + stover yields. The genetic systems which control the rate of nitrogen uptake and the NHI appeared to be relatively independent.

When the 10 varieties were grown under a low and a high nitrogen supply,

there was a highly significant Variety x Nitrogen interaction in the grain yield, the mean rate of nitrogen uptake, and the NHI. Thus, the relative performance of varieties under high nitrogen levels is not always indicative of their relative performance under low nitrogen levels. The variability in these characteristics among the varieties studied here indicates that there is potential for increasing grain and protein yields under low nitrogen levels by a selective breeding program.

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Saint, Jr., William Staver Development Sociology

THE SOCIAL ORGANIZATION OF CROP PRODUCTION: CASSAVA, TOBACCO AND CITRUS IN BAHIA, BRAZIL

An understanding of organizational and institutional arrangements inherent in crop production systems is necessary to develop agro-technologies which will not increase inequality. To gain such understanding, a methodology for the study of small farm agriculture was elaborated based on a combination of ecological and Marxian perspectives, the study of traditional agriculture, an understanding of limiting factors, and the creation of problem-specific typologies. In this context, a farmer's choice of crops is viewed as a major technological decision which has social, organizational and institutional ramifications. Therefore, crop production systems were defined on the basis of the farm's predominant crop in terms of arable land occupied.

The study was conducted in the Bahian Reconcavo area of Northeast Brazil and was based on 182 interviews from a stratified random sample of small farmers grouped according to crop production system. Three major crop production systems were identified: cassava--a subsistence crop, tobacco--an export crop, and citrus--a cash crop for domestic urban consumption.

Three hypotheses guided the study: (1) different crop production systems, as differentiated by the predominant crop, will be characterized by different modes of agricultural production, (2) differences in quality of life will exist among crop production systems, and (3) some crop production systems will display higher rates of emigration than others. All three hypotheses were confirmed by the study.

Social organization of crop production, also called the mode of agricultural production, was defined to include organizational and institutional arrangements contained in four relationships: producer-crop, producer-producer, producer-community, and producer-state. Producer-crop relations refer to each crop's requirements for labor, land, capital and technology as well as the various means employed to gain access to these factors. Producer-producer relations entail the social division of labor and the organization of work. Producer-community relations comprise both marketing systems and community social structure. Producer-state relations are reflected in the agricultural policies for each crop as they pertain to research, credit, extension, provision of inputs, marketing and processing. Marked differences in each of these relationships were observed among the three crop production systems studied.

The process of structural change in local agriculture was analyzed to determine its causes and possible future trends. Major causes were identified as government social welfare policy, introduction of a new forage grass, government agricultural policy, decreased isolation, and major changes in fertilizer supply. Some factors created a disequilibrium in the social relations and ecological balance of the traditional production system whereas other factors provided strong incentives for change once these weaknesses appeared. Present expansion of modern commercial agriculture has effected a shift in political power from rural landowning elites to urban commercial groups. Concurrently, local patron-client relations are being replaced by state patronism. In the future, it is expected that the tobacco export sector will become more capital intensive. On small farms, increased specialization of both labor and production is likely. As the above favorable conditions continue to stimulate the expansion of commercial agriculture, further proletarianization and land concentration seem probable.

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St. Louis, David George Animal Science

EVALUATION OF GRASS HAY AND SORGHUM, MAIZE, AND SOYBEAN FORAGE FOR SUPPLEMENTING PASTURES IN PUERTO RICO

Three experiments were conducted to make preliminary recommendations on the production and use of pelleted forages for dairy cattle in Puerto Rico.

Six varieties each of forage and grain sorghum (Sorghum bicolor (L.) Moench) and three varieties each of maize (Zea mays L.) and soybeans (Glycine max (L.) Merr.) were grown in plots on irrigated land at Lajas to determine forage yield and chemical composition when harvested at various stages and at 45 day intervals. Soybean plots were unsuccessful due to poor seed emergence. Differences in dry matter yield among harvests in the boot, flower and dough stages were nonsignificant for forage sorghum and maize, probably due to inadequate soil moisture, while stage differences were significant for grain sorghum, planted at a later date. The top three forage sorghum varieties (SX-16, SX-17, and Pioneer 988) yielded more dry matter than the top maize varieties (Pioneer 304B and Diente de Caballo). Grain sorghum varieties yielded significantly less dry matter at all stages than forage sorghum or maize.

Laboratory analysis ranked maize highest in nutritive value with forage sorghum and grain sorghum following in order of rank. Grain sorghum in the dough stage did not exceed 55 percent apparent digestibility.

At Gurabo, 48 cows were assigned to four treatments; pasture (T_1), pasture plus 5 pounds per head daily of maize forage pellets (T_2), pasture plus 5 pounds of good Stargrass (Cynodon nlemfuensis) hay (T_3) and hay ad libitum plus 10 pounds of pellets (T_4). All pastures were grazed at two head per acre and all cows were fed one pound of commercial concentrate for each two pounds of milk produced. A two week adjustment period started after 40 days of lactation and the test period was for eight weeks.

Analysis of covariance revealed significant treatment differences in milk production with pretrial production as the covariate. The adjusted treatment means were 53.0, 51.7, 51.1 and 50.7 lb/head/day for T_2, T_1, T_4 and T_3 respectively. Only T_1 and T_4 were not significantly different from each other. For T_2 there was a significant negative regression of milk production on estimated pasture digestibility. This was explained by the possibility of an inverse relationship between pasture digestibility and nutrient density in the rumen. No significant

treatment differences were detected in weight gains or percent milk fat.

At Corozal, sixteen young dairy heifers, were assigned to two treatments; grazing alone (T_1) and grazing plus 5 pounds per head daily of maize forage pellets (T_2). Each treatment had its own set of four pastures rotated every 5 to 7 days and stocked with 2 heifers per acre. Six quadrants of a square yard each were clipped from pastures before and after rotation. Animals were weighed after each rotation.

Pasture sampling was unsuccessful in determining the quantity and quality of forage consumed due to large sampling errors and failure to measure regrowth and losses during the grazing period. Visual observations revealed that pellets reduced pasture consumption, and the pasture then became more mature and of lower quality compared to T_1. Heifers on T_1 gained more than T_2 when pasture growth was abundant. However, a drought period reduced the quantity and quality of pastures on T_1 and heifers lost weight while heifers on T_2 continued to gain. The trial was temporarily terminated because overgrazing of T_1 pastures did not allow them to recover after the drought. Average daily gains after 139 days were .21 and .63 lb/head/day for T_1 and T_2 respectively.

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Terasart, Thanya — Education

INCENTIVES AND DISINCENTIVES FOR BEHAVIORAL CHANGE BY FARMERS RELATED TO ADOPTION OF DRY-SEASON CROPPING NORTHEAST THAILAND

The central focus of this study was the perceived adoption incentives and disincentives of farmers related to dry-season cropping practices in irrigated areas. Data were collected through personal interviews, using a semi-structured schedule, by the author from a stratified random sample of 200 respondents who have access to existing irrigation ditches.

Three kinds of variables were investigated. Adoption of dry-season cropping, the dependent variable, consisted of the composite score on seven indicators: growing crop(s) in dry-season, percentage of the respondent's irrigatable farm land under dry-season cropping, commercial tendency, use of fertilizer, use of

insecticides, practice of weeding, and use of appropriate irrigation methods. The independent variables included socioeconomic conditions, availability of water, irrigation organization, and communication factors. Perceived incentives and disincentives related to adoption were designated as intervening variables.

Design of this study was based on the Behavioral Differential Model advanced by Professor J. Paul Leagans. Data were analyzed through several statistical procedures: Pearson correlation, chi square, analysis of variance, and multiple regression.

Dry-season cropping was practiced by 55 percent of the farmers. Of the adopters, 79 percent used fertilizer, 88 percent did weeding, 75 used insecticides and 45 percent used appropriate irrigation methods. Seventy-six percent of the adopters sold more than one-half of their production of dry-season crops. Adopters used approximately 54 percent of their irrigable land for dry-season crops. Nearly one-third (29 percent) of the adopters were classified as commercial producers.

Among the independent variables the following served to explain 32 percent of the variance in adoption: availability of water, income, distance from home to farm, perceived price level of products, perceived profitability of available credit, holding an off-farm job, cost of transportation, communication with sources of knowledge in the village, and perceived availability of markets.

Adopters expressed thirteen reasons for their adoption behavior. When converted into an accumulated incentive valence score, these reasons were found to explain 81 percent of the variance in adoption. Among the thirteen incentives, four showed the highest accumulative valence score in the incentive structure: desire for more income, neighbor doing it, no other job, and water available.

The non-adopters expressed sixteen reasons for not adopting dry-season cropping. When converted into an accumulated disincentive valence score these reasons were found to explain 90 percent of the variance in the disincentives for adoption. Among the sixteen disincentives, five showed the highest accumulative disincentive valence score in the disincentive structure: low water, land is not suitable, not sure about water, have another job, and no neighbor doing it.

On the basis of the findings related to the perceived incentives and disincentives, agricultural development policy for increasing the rate of adoption of dry-season cropping should emphasize programs designed to increase the valence of incentives and, concurrently to reduce the valence of disincentives. To raise the valence of the incentives, programs should give high priority to intensifying the extension education system, improving the managerial skills

in irrigated agriculture, improving the price mechanism, and improving the economic infrastructure, such as industrial planning for utilizing increased production. To reduce the valence of disincentives for adoption, programs should give high priority to improving the water management system, providing better knowledge of, and guidance in, water use and to intensifying researches to find effective technical and organizational alternatives for farmers in the use of production resources.

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White, Robert Anthony Rural Sociology

STRUCTURAL FACTORS IN RURAL DEVELOPMENT: THE CHURCH AND THE PEASANT IN HONDURAS

The present study outlines a model of rural development in hierarchical societies which relates macro-structural changes to changes in community structure and then to individual behavioral responses. The operational indicators and policy implications of this model are analyzed in the setting of Honduras, focusing mainly on the urban-rural alliance of the Christian Social Movement in the Catholic Church. Rural development is defined as the emergence among campesinos of independent national organization, a culture of lower-status power and solidarity, and access to national resources.

The model predicts rural development in terms of a sequence of (1) antecedent conditions which cause rural protest, weaken elite capacity for repression of campesinos, and generate potential urban allies; (2) internal dynamics, the process by which urban opposition to traditional elites incorporates rural protest groups; and (3) the consequences of increased campesino power in terms of changes in community structure and campesino behavior.

In the Honduran case the initial precipitating factor of mass organization of campesinos from 1968 to 1975 has been the introduction of international economic and technical linkages. These simultaneously brought about the commercialization of agriculture among rural elites and generated a wide spectrum of new, upwardly mobile, modernizing urban groups in opposition to the inefficient patronage political system. As the socio-economic situation of small cultivators

deteriorated, either through landlord encroachment or lack of access to new agricultural inputs, campesino protest groups began among evicted smallholders. With the support of urban labor and the military and with the increasing structural fluidity which neutralized opposition by interlocking agreements, this rural protest grew into three large campesino federations.

The decline of the Catholic Church's national centrality in the face of modernization influenced within the Church a solidarity movement which stimulated religious revitalization, the redefinition of Church priorities in terms of rural lower-status development, and the support of campesinos in their opposition to rural elites. The intesification of internal commitment around goals of integral development and religious values and the strengthened rural-urban communication-resource linkages within the movement are explained as characteristics of solidarity movements, not as the result of ideological diffusion or charismatic leadership. Power relations within this agrarian movement have been symmetrical to the degree that structural conditions generate greater social independence among campesinos.

The increase of campesino power in urban-rural alliances is reflected in the development of linkage, interest articulation, and solidarity structures in rural communities, but there are divergent competing linkages relating to distinct rural status groups.

Stronger linkage-solidarity structure in rural communities (but not urbanization) influences the level of individual awareness of alternatives, communal activism, independence from rural elites, and perception of injustices suffered by lower-status groups.

Increased institutional capacity for rural organization is related indirectly to macro-structural change and directly to interest articulation, solidarity, and resource linkage structures in rural communities. Individual organizational capacity is related to the presence of collective decision-making structures in rural communities.

Education, social status, and cosmopoliteness influence the knowledge dimension of campesino competence for national political participation, but not dissatisfaction with inefficient government or interest in campesino pressure-group organizations. Conflict with rural elites combined with incorporation into more radical national campesino federations influences greater political knowledge as well as dissatisfaction and orientation toward political pressure tactics.

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