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FIRST NATIONAL AGRICULTURE SYSTEM RESEARCH CONGRESS

CROPS RESEARCH DIVISION

WORKSHOP SESSION NO. 3

COCONUT

RESEARCH PAPERS

U.P. AT LOS BAÑOS CAMPUS, LOS BAÑOS, LAGUNA

FEBRUARY 12–17, 1973

CROPS RESEARCH DIVISION

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CROPS RESEARCH DIVISION

WORKSHOP SESSION NO. 3 — COCONUT

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Summary Report

WORKSHOP SESSION NO. 3 — COCONUT CROPS RESEARCH DIVISION

Thirteen members composed the National Research Team for coconut. Dr. Ponciano A. Batugal assumed the leadership in the formulation of the national research program in the absence of Dr. Juan T. Carlos, Jr. Dr. Batugal pursued the topics presented and systematically with the cooperation of each member of the group, laid down the priority areas for research on coconut.

In the first priority, emphasis was directed to an impact-oriented interdisciplinary and interagency production research program. To attain this, 19 specific research projects were proposed. Massive soil, tissue and nut water analysis to determine fertilizer requirements under different soil and climatic conditions; determination of optimum level and combination of cultural practices such as tillage, fertilization, cover-cropping and the economic analysis of these practices; determination of input supply systems and proposals for improvement, are few examples of priority research topics listed. Morever, training and development of research manpower, and extensive dissemination of information on coconut production by way of yearly publication of recommended practices and other extension materials were also considered.

In addition to impact research projects in the first priority, 6 projects were included under handling and processing and 5 projects under marketing.

The type and degree of problem analysis done by the group was indeed commendable. With their guidance, it is felt that the country's research on coconut will receive its long overdue attention.

THE PRESENT STATUS OF RESEARCH ON COCONUT*

I feel it an enormous task to present an excellent paper on the present status of research on coconut. I make this statement on the basis of time and quality constraints that we in the team and PCAR as a whole have to work against in preparing for this workshop. To be able to present an accurate and meaningful picture of the status of coconut research would require not only an exhaustive evaluation of previous and on-going researches but also a clear identification of our national commodity goals. We have to face the reality that to date neither requirements has been satisfied. The former would need more than a couple of weeks' work and the latter, a concerted effort such as what we will put out during this workshop.

Considering the above limitations, I shall not try to be presumptuous in presenting this paper. I shall therefore limit my topic to a general overview of coconut research since each team member will deal more lengthily on the status of research in his own discipline. More specifically, I will limit my topic to a) identification of the agencies engaged in coconut research, b) identification of the scope of work in these agencies and some of their significant contributions, c) general problems in the present research set-up and d) some suggested directions of research.

A. Major Agencies engaged in Coconut Research

1. Philippine Coconut Research Institute (PHILCORIN)
2. Philippine Coconut Administration (PHILCOA)
3. Bureau of Plant Industry (BPI)
4. U. P. College of Agriculture (UPCA)
5. National Institute of Science and Technology (NIST)
6. National Research Council of the Philippines (NRCP)
7. Cadang-Cadang Research Foundation, Inc. (CCRF)
8. Philippine Atomic Research Commission (PARC)
9. National Science and Development Board (NSDB)
10. Bureau of Soils (BS)
11. United Coconut Association of the Philippines (UCAP)

* Ponciano A. Batugal, Ph.D., Acting Team Leader, PCAR Coconut Commodity Research Team, U.P. College of Agriculture.

STATUS OF RESEARCH

1. Philippine Coconut Research Institute

PHILCORIN was created by Republic Act 4059 on June 18, 1964 with the following functions:

a) To conduct research and investigation on the botanical and genetic aspects of coconut improvement, agronomic problems related to coconut culture, etiology and control of cadang-cadang and other diseases of coconut, biology and control of important insect pests of coconut.

b) Compile scientific information and disseminate results of researches.

c) Train people for the development of the coconut industry.

Although PHILCORIN is a new agency, it has shown its readiness to carry out the objectives for which it was established. Its research program for 1971-1972 (Appendix 1) shows a thorough treatment of the problems of production and crop protection and even touches on crop processing, an area of research which is not included in its original functions. An important complement of its agronomic research program is the economic evaluation of cultural management studies. The results of these studies can have practical importance in the extension of improved cultural practices to farmers.

2. Philippine Coconut Administration

PHILCOA was created by Republic Act 1145 on June 17, 1954 with the following specific powers and duties:

a) To study the orderly development of the coconut industry;

b) To stabilize and strengthen its position in the world market;

c) To promote the effective merchandising of copra, coconut oil, coconut products and by-products in the domestic and foreign markets;

d) To encourage the invention of useful machinery that will hasten the development of the coconut industry;

e) To establish a central experiment station and such numbers of regional experiment stations in the coconut-producing areas of the Philippines as may be necessary;

f) To undertake extensive research on coconut culture;

g) To promote and maintain an efficient production of copra, oil, and coconut by-products, by the effective coordination of the component elements of the coconut industry;

h) To help planters and processors organize themselves into associations and cooperatives and to help them obtain more credit facilities; and

i) Generally, to exercise all the powers necessary to attain the purposes for which it was organized.

To its credit, we can say that among government agencies, PHILCOA has the most extensive tie-up with the private sector. However, its research activities on coconut culture is virtually non-existent.

3. Bureau of Plant Industry

Coconut is only one of the many crops being handled by BPI. Coconut research for this agency is conducted primarily in its Coconut Experiment Station at Tiaong and at Guinobatan. Its Guinobatan station is concerned mainly with research on cadang-cadang while its Tiaong station maintains a world collection of coconut cultivars and conducts researches mainly on cultural practices including intercropping and crop improvement. The development of Laguna X Coco Nino F_1 hybrids that can outyield either of their parents is a significant research contribution of BPI to crop improvement. When fully utilized, these hybrids can provide tremendous benefits to the coconut industry. BPI's intercropping experiments especially with perennials provide important data to enable coconut farmers to increase their farm income.

4. U. P. College of Agriculture

The bulk of research activities of UPCA consists of fundamental studies on crop improvement, cultural practices, crop protection, economics, chemistry and utilization. With NRCP support, UPCA is undertaking research on embryo culture for possible production of 100% macapuno nuts. It also maintains a coconut Gene Bank consisting of 60 cultivars and varietal crosses. In cooperation with PHILCORIN, UPCA has shown that gibberellic acid can minimize premature nutfall and increase fruit set by as much as 100%. UPCA which used to lead in cadang-cadang research, is about to publish a compendium on coconut pests and diseases. Its studies on economics of production and marketing can serve as important benchmarks in decision making.

5. National Institute of Science and Technology

NIST leads in research on the nutritional aspects of cadang-cadang, and in the utilization of coconut for food and other uses. Its researches on integrated processing for food and on chemical derivatives from coconut oil on a pilot plant scale are important contributions to the diversified commercial utilization of coconut products.

6. National Research Council of the Philippines

   NRCP serves as a funding agency for fundamental studies on coconut biology, physiology, crop protection, utilization and marketing. In addition, it also sponsors scientific conferences on coconut technology.

7. Cadang-Cadang Research Foundation

   CCRF was organized to implement a cadang-cadang research program. Initially, NSDB and PHILCOA shouldered a major portion of the funds but the private sector also contributed to the program. Upon the creation of PHILCORIN in 1964, NSDB withdrew its support for the program. In 1966 PHILCOA also discontinued its support for the program.

8. Philippine Atomic Research Commission

   Its research centered mainly on the use of P-32 in studying nutrient uptake and the use of gamma irradiation to effect genetic change in coconut pollen. The former can be used as a guide to judicious fertilizer application while the latter can be used to create more genetic variability in breeding materials.

9. National Science Development Board

   The NSDB supported a UPCA research program on the influence of rates and sources of N and K on nut yields. In addition, it sponsors symposia on the various aspects of the coconut.

10. Bureau of Soils

    The Bureau conducted field trials to determine the response of coconut to NPK and Mg and S in eleven important coconut growing areas. The experiment attempted to correlate soil, nut water and leaf analysis to yield. In this experiment, K induced 15% increase in the number of nuts. The project was discontinued upon the termination of the UNDP assistance.

11. United Coconut Association of the Philippines

    The UCAP is a private non-profit organization representing the various sectors of the coconut industry, namely the Philippine Copra Exporters Association (PCEA), the Philippine Coconut Producers Federation (PCPF), the Philippine Oil Producers Association (PCOPA), the Association of Philippine Dessicators (APD), the Federation of Coir Producers and Exporters, the Coconut Shell Charcoal

Producers and Exporters, and the Philippine Coconut Administration (PHILCOA). The UCAP has published a series of studies on coconut production, research and development, statistics and processing. In addition, it publishes the UCAP weekly bulletin which contains information of interest to various sectors of the industry. While the above research and extension efforts of UCAP are laudable, its beneficiaries are mainly the processors' and exporters' group. It would be desirable to see the UCAP throw its active support to researchers on production and extension. When properly utilized, this type of support would contribute a great deal in our efforts to increase yield and stabilize supply. In addition, it would give more benefit to the group of small coconut farmers which constitute a major portion of the production sector.

B. General Problems in the Present Set-up

Perhaps some of you are as surprised as I am to find out that there are about a dozen agencies entrusted with the function of doing research on coconut. It is more amazing to find out that in spite of these agencies, our yield is one of the lowest among coconut-producing countries of the world. The following are some of the problems that have caused the situation:

1. Insufficiency of funds to carry out good research program — This has resulted in the exclusion of some relevant variables in experiments that would otherwise make the resulting data meaningful. This has also caused the termination of experiments before any meaningful data can be obtained. A case in point is the fertilizer experiment of the Bureau of Soils mentioned previously.

2. Lack of coordination among research agencies — This has resulted in unnecessary duplication of researches to the point of depleting the already meager research support. Cases in point are studies on the "Development of the coconut fruit," conducted separately by NIST and PHILCORIN and on "Fruit set in coconut following gibberellic acid application," which were conducted separately by the UPCA and BPI. Perhaps only one agency should have conducted each of these studies to economize on manpower and other resources, or two agencies should have worked cooperatively to avoid duplication.

3. Lack of a well-balanced coconut research program with systems of priorities within and among disciplines — An example of the apparent imbalance in coconut research program was the tremendous magnitude of funds allocated for cadang-cadang research in comparison to that allocated for other disciplines. Examples of the lack of a system of priority are the studies on "The relation-

ship of the functional eye to the size and weight of the embryo" conducted by BPI and on "Effect of petiole color on copra quality" conducted by UPCA. Certainly, there are more pressing problems than these! Lest I be branded a fault-finder, let me spare other agencies from a catalogue of misdeeds.

I would like, however, to clarify that the problems mentioned above are oftentimes interrelated and the researcher may just have been the victim of the interplay of these factors. I hope that the agencies I have cited take these comments in a constructive manner, the spirit that should pervade among us during this congress.

C. Some Suggested Directions of Research

In spite of the above faults, our research efforts have produced outstanding results in some areas. As is expected, we have arrived at dead-ends in some. Allow me, therefore, to comment on some of these results in order to provide a starting point for deliberation.

1. Crop Improvement

Perhaps the most dramatic and relevant product of research on crop improvement in this decade is the development of F_1 hybrids. Zuñiga (1972) of BPI has developed F_1 hybrids from Laguna X Coco Nino crosses that outyield either parent 2-3 times either in terms of nuts per tree or tons of copra per hectare. With the availability of this material, one of our greatest challenges as researchers is the utilization of this product of research in the most efficient and expeditious manner in order to alleviate our low productivity problems.

Other important products of research are the development of techniques for embryo (de Guzman, 1969) and callus tissue cultures (de Guzman and del Rosario, 1972). These have tremendous applications not only for macapuno production but also for clonal propagation of desirable coconut materials. The full utilization of these techniques is also a challenge to us.

2. Production economics

Several studies have characterized the coconut farmer in different production areas and have identified his production problems. Although these studies are not complete for all areas, the major problems seem to be common namely: lack of capital, lack of know-how and lack of incentives. Our research efforts should therefore be directed towards the solution of these problems.

3. Culture and management

Felizardo (1972) has shown that plowing, cover cropping and fertilization alone or in combination with each other increase yield of coconut. Mangabat and Marquez (1970) on the other hand, have shown that intercropping provides the farmer with substantial income. Although these are positive results, the economic studies of each of these cultural practices must be conducted to evolve a cultural practice that gives the highest net return. The economic analysis of fertilizer application conducted by Mendoza and Prudente (1972) seems to be a step in the right direction.

4. Extension-education

One of the most frequently mentioned causes of non-adoption of improved cultural practices in coconut farms is the lack of technical know-how. Thus it seems that the results of research do not reach the end-user. To me, the job of accumulating, synthesizing and communicating the product of research to the coconut farmer is a big task. But the job of inducing the farmer to adopt the product of research to increase his production is even a greater task. In the latter lies one of the most challenging problems of extension-education.

5. Plant Pathology

Cadang-cadang has come and stayed with us but to date we still do not know what it looks like. One fortunate thing about cadang-cadang is that farmers are now less bothered by it than they were much earlier. In fact, some consider it a blessing: it has forced many farmers to rejuvenate their plantations. Before we embark on a big program of research on cadang-cadang, perhaps it is worth giving the idea a second thought. A thorough re-study of its pathogenetic and economic effects appears to be a logical step before we allocate much funds to this area.

6. Entomology

Previous efforts have been devoted to the identification of insect pests of coconut. Perhaps what is needed now is to determine economical methods of control. Biological methods of control seem to be one alternative, but we must guard against the possible negative effects of such a method.

7. Processing and utilization

We export about 80% of our coconut products, chiefly in the form of copra, oil and desiccated coconut. This reliance on a few products creates instability in the industry. The efforts of NIST and UPCA to look for more uses of coconut seem to be a sound approach. To date there are voluminous literature on these researches. Perhaps we need to give more emphasis on the commercial utilization of these results.

8. Marketing

Marketing has been studied more at the international level than at the national and barrio levels. Consequently, the small farmer who has to sell his coconut to a series of middlemen, does not get the maximum benefit from his produce. The situation should be remedied to provide more incentives to the coconut farmer to produce more. Subsequently, this benefit can permeate the whole industry.

In closing, I would like to reiterate that we have a big task to do in this workshop. I trust that we do not fail.

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Appendix 1. PHILCORIN Research Program for 1971-1972

I — Researches

A. Published

1. Influence of NPK fertilizers on the growth of coconuts from transplanting (Agronomy)
2. Fertilization studies on coconuts at the Philippine Coconut Research Institute (Agronomy)
3. Biology of Rhynchophorus schach Oliv. (Crop Protection)

B. Completed

1. Harvesting frequency and coconut production (Agronomy)
2. Studies on the effect of cutting foliage on yield (Agronomy)
3. Ecological study of the prevalent weeds found in the PHILCORIN Research Center (Agronomy)
4. The load of the tree and its effect on the size and quality of nuts (Agronomy)
5. Economic evaluation of fertilization studies on coconut at PHILCORIN Research Center (Statistics & Economics)

C. In Progress

Agronomy

1. Observations on the performance of macapuno hybrids
2. Toddy-tapping — its effects upon the yield of nuts
3. Study on the optimum stage of harvesting nuts for commercial purposes.
4. Performance of seedlings from seednuts harvested and sown at different months of the year
5. Size and shape of seednuts in relation to germination and growth habits
6. Cultural management studies in coconut plantations
7. Rejuvenation of old coconut plantations
8. Studies on the general yellowing of some coconut groves in Mindanao

Soils

1. Manurial utilization of coconut husks in the cultivation of the coconut palm
2. Physiology of coconuts grown under different moisture regimes

3. Fertilization of bearing coconuts at the Davao Research Center of the PHILCORIN
4. Comparative efficacy of the different methods of fertilizer application on bearing coconuts.

Crop Protection

1. Biology of major coconut pests
2. Pests of copra, copra cake and their control
3. Chemical control of major coconut pests
4. Ecological and population studies of different coconut pests
5. The nature and possible remedial measures of premature nutfall
6. Investigation of the "skirting" characteristics of coconut palms in Mindanao
7. Investigation on the "boang" disease of coconuts
8. Study on the general yellowing of some coconut groves in Mindanao
9. Studies on copra deterioration due to microorganisms and their control

Plant Breeding and Genetics

1. Collection and evaluation of coconut cultivars
2. Hybridization of dwarf and tall coconuts
3. Evaluation of various coconut yield groups and their progeny
4. Genetics of barren nut production and other abnormalities

Crop Processing

1. Comparative studies on the various methods of copra-making and development of alternate techniques (formerly, Comparative studies on the tapahan and sun-drying methods of copra-making)
2. Comparative incomes from copra and dehusked nuts

D. Proposed

Agronomy

1. The physiology and morphology of premature nutfall
2. Effect of anti-transpirant on coconuts

Soils

1. A study on the effects of various sources: I. Nitrogen;

and II. Chlorine on the growth of non-bearing coconuts
2. Morphological, physical and chemical characterization of soils of the Davao and Zamboanga Research Centers of PHILCORIN

Crop Protection

1. Pollinating insects of coconut
2. Biological control of four major groups of insect pests of coconut in the Philippines
3. Stem bleeding of coconut
4. Internal spotting of coconuts in Oriental Mindoro
5. Leaf spot and blight of coconut and their control
6. Survey of the different pests and diseases of coconut in the Philippines
7. Shot-hole beetles of coconut
8. Control measure studies on coconut bud rot
9. Shoot rot disease in coconut seedlings
10. Etiology of coconut cadang-cadang
11. Anatomical study of leaves of various palms exhibiting cadang-cadang-like leaf spot

Plant Breeding & Genetics

1. Controlled pollination on macapuno trees and progeny testing
2. Coconut breeding studies

Economics and Statistics

1. A study on the marketing of coconut farm products and by-products in selected provinces of the Philippines
2. An economic analysis of the various methods of preparing copra
3. Economic evaluation of cultural management studies at PHILCORIN Research Center: covercropping, catch-cropping, intercropping, tillage practices and fertilization

PROPOSED ACTIVITIES IN COCONUT BREEDING FOR 1973-80*

I am sure that many are surprised that I, instead of somebody else, was the one chosen to talk on the proposed coconut breeding programme for the next seven years. Some people would question this choice as they would question the competence of a Catholic priest to act as a marriage counselor especially if sexual problems are involved. I myself was taken aback when Dr. Ponciano Batugal, the Coconut Team Leader, sounded me off on my willingness to be the plant-breeder planner of his team. It was only after Dr. Batugal pointed out to me that he would prefer someone who is not presently involved in coconut breeding did I agree to serve in his team. In other words, Dr. Batugal emphasized the importance of having somebody make an unbiased evaluation of what is being done in coconut breeding during the last several years and to propose which of these activities should be continued and which new activities should be embarked on during the next seven years. I feel flattered to think that it is in coconut breeding wherein we need the best minds. One mistake in this crop may mean a loss of 10 to 15 years of hard work.

Breeding Objectives. The following are the breeding objectives that should be pursued during the next seven years:

a) Increased yield of coconut meat:

b) Increased protein content:

c) Resistance to cadang-cadang: and

d) Increased frequency of makapuno endosperm

Considering the present status of researches aimed at the four objectives listed above one has excellent reasons to doubt, except for the last one, if any substantial results could be obtained within the next seven years. We do hope however that the partial results obtained are such that they will inspire us to go into a second 7-year coconut breeding programme. The four specific breeding objectives will be discussed in the order they are listed above and the proposed titles of and participants in the specific project proposals will be given towards the end of this paper.

Increased yield of coconut meat. Yield of coconut meat is usually reckoned in terms of yield of copra (or dried coconut meat). If in-

* Ibarra S. Santos, Ph.D., Philippine Atomic Research Center.

creased yield of oil is the breeding objective, then the oil percentage in the copra must also be determined. In the preliminary selection for oil yield, however, yield of copra may be sufficient. Besides, if there is no special emphasis on increased oil yield as a breeding objective, then yield of copra can be more meaningful.

Because of the length of one generation in the coconut (four years for the dwarfs: seven years for the normals), it is not practicable to apply breeding techniques recommended for either often cross-pollinated annual crops such as sorghum or naturally cross-pollinated annual crops such as corn. However, the breeding behavior of coconut is very similar to that of corn. In fact, as could be predicted, heterotic crosses have also been found in coconut. In the utilization of heterosis in the F_1 hybrid, there is no need to develop high-yielding F_1 hybrids between two true-breeding selfed lines of coconut. This is so because unlike in corn there is no need for any degree of uniformity in a field of coconut trees. Hence, varietal crosses will do. And even if hand-pollination and bagging have to be resorted to, production of hybrid seed nuts is still economically justifiable because a coconut tree can remain useful for at least 50 years.

Results of performance test of crosses between Laguna and Coco niño reported by Zuñiga (1972) indicate the wisdom of resorting to varietal crosses in coconut to obtain high copra yields. This yield heterosis exhibited by the varietal cross between Coco nino (as female parent) and Laguna should be utilized commercially, unless there are major difficulties that cannot be presently surmounted. Because of the preliminary observations on the cross between dwarf and tall varieties of coconuts at the Tiaong Experiment Station, the Bureau of Plant Industry has plans to produce hybrid seed nuts between dwarf coconut and Laguna and/or San Ramon varieties in about 300 hectares of land involving five locations. Over a ten-year period 10 to 15 million hybrid seednuts are expected to be produced. This appears to be a very reasonable gamble even as more yield data from the crosses dwarf X Laguna or dwarf X San Ramon still need to be gathered.

Data from the performance of dwarf X normal, among other crosses, are expected from the 60 varietal crosses planted in the UPCA gene bank. According to Zuñiga, however, reliable yield data are obtainable mainly from trees that are 15 years or older (but not too old). Also, if this has not yet been done, enough hybrid nuts of each experimental varietal cross should be made to make possible the planting of several replicated performance tests throughout the coconut-growing areas in the Philippines. All these are necessary to enable us to make new decisions 10 to 15 years from now.

The dwarf type may have some advantages even in field cultures. One of these is early maturity; another is ease of harvesting immature nuts. When a dwarf coconut is crossed with a normal coconut, the F_1 is most probably intermediate, rather than dwarf in stature. Therefore, there is also a need to make and test crosses among several varieties of dwarf coconut.

During the next seven years, it is suggested that selfing and production and testing of "three-way" or "four-way" varietal crosses be omitted. Instead, efforts should be concentrated on the making and testing of "two-way" varietal crosses.

Parent varieties should be maintained in isolation. Similarly, isolated crossing blocks can be utilized to produce hybrid nuts in millions as proposed by Zuñiga (1972).

Increased prote in content. Because of the many uses of the different parts of the coconut palm, it will continue to be regarded by the Filipinos as the "tree of life" most probably for another 50 years. The dwindling importance of coconut oil in the world market, however, can considerably reduce the national importance of the coconut tree as a foreign-exchange-earner. It becomes necessary, therefore, to gradually modify the principal use of the coconut from a source of oil to a source of food protein. (The example in abaca is very illustrative; change from its importance as a raw product in the manufacture of rope or cordage to that in the manufacture of special types of paper). At present coconut meat contains about 8% protein while coconut flour contains about 20%.

During the next seven years, several coconut varieties, crosses, etc. should be surveyed as possible sources of increased protein content. In this connection, the coconut breeder should be reminded that protein content is a character that is easily affected by the environment. This can partly be solved by evaluating a number of progeny from a single tree in replicated tests. The development of vegetative propagation in the coconut, most appropriate for a single tree in this case can then be truly replicated.

As mentioned earlier, the UPCA already has a coconut gene bank. So does the BPI. The Philcorin most probably is putting up one, too. The wide collections of materials in these gene banks might yield a directly usable high-protein variety or one that can be used as a parent in varietal crosses.

In all these gene banks, coconut trees grown from seed nuts produced with mutagen-treated pollen should be included. Aside from high protein content, other desirable traits such as resistance to the cadang-

cadang "disease" might be found among second generation progenies of such trees.

Resistance to the cadang-cadang disease. It is not certain yet if cadang-cadang is a disease. However, it appears reasonable enough to continue with the selection of survivors in cadang-cadang-infested areas and the planting of their progenies in the same or similar areas.

Increased frequency of makapuno endosperm. Within the next seven years, we will know for sure whether or not the "makapuno" coconut trees grown from the embryos taken out of the makapuno nuts (de Guzman, 1969) will produce 100% makapuno nuts of the desired types. Even now, research toward increasing the percentage success of the embryo culture, especially with respect to the three types of makapuno endosperm described by Zuñiga (1972) should be intensified. Callus formation which is one of the types of tissue culture as classified by de Guzman and del Rosario (1972) should also be studied intensively in the coconut. As mentioned earlier, vegetative or clonal propagation in the coconut is also needed in the breeding of normal coconut, *e.g.* replicated evaluation of a genotype for protein content in the meat.

Also, in conjunction with the all-out effort to increase frequency of makapuno endosperm, the study on the genetic basis of the makapuno character deserves to be continued during the next seven years. Zuñiga (1972) recognizes three types of makapuno nut (or endosperm) which are as follows:

Type 1. Nut cavity is filled completely with soft and consistent endosperm.

Type 2. Nut cavity is filled with a little of the thick viscous liquid in addition to the soft and consistent endosperm.

Type 3. Nut cavity has plenty of the viscous liquid in addition to the soft endosperm which is much thinner than in types 1 and 2.

Isolated plantations of each of the three types of makapuno endosperm will have to be established. In each plantation non-makapuno-bearing trees will have to be removed. Incidentally, this procedure if repeated in commercial scale in coconut-growing areas designated for makapuno will tend to increase the frequency of makapuno nuts in a makapuno-bearing tree if the makapuno endosperm is a genetic trait.

Research proposals. Under crop improvement, the following researches should be undertaken during the period 1973-80:

1. Evaluation for yield and other agronomic characters of varieties and F_1 hybrids at the UPCA coconut gene bank, Philcorin and

BPI Stations.
Participants: UPCA, BPI, PHILCORIN

2. Chemical analysis for protein, lipid, and carbohydrate in the meat of coconut varieties and F_1 hybrids.
Participants: UPCA, BPI
3. Hybridization of selected tall and dwarf varieties of coconut.
Participants: Philcorin, UPCA
4. Selection of cadang-cadang free trees in infested areas and the testing of their progenies.
Participant: BPI
5. Production, maintenance and evaluation of trees from embryos of makapuno nuts.
Participant: UPCA
6. Callus induction and organogenesis in makapuno and normal coconut trees.
Participant: UPCA
7. Studies on the genetic basis of the makapuno character.
Participant: BPI
8. Establishment of more coconut gene banks.
Participants: PHILCORIN, BPI, PAEC
9. Production of second-generation seed nuts from trees grown from nuts produced with mutagen-treated pollen.
Participants: PAEC, UPCA, BPI, PHILCORIN
10. Studies on the genetics of meatless coconut.
Participant: PHILCORIN

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PROBLEM AREAS ON FARM ORGANIZATION, CREDIT AND INPUT SUPPLY SYSTEM IN THE COCONUT INDUSTRY*

This paper seeks to identify the problem areas which may be set into a program of research. The identification of problems proceeds with a review of the present status as observed in existing studies.

The studies reviewed here are primarily those on farm management, the subdivision of the general field of agricultural economics which deals with both the organization and operation of the farm. Farm management is accordingly concerned with how the farm activities are financed and the marketing of input as well as output at least in so far as the farm is directly involved.

Analysis of costs and returns, although considered the heart of farm management analysis, is not included in this paper because another paper entitled "Economics of Coconut" is on schedule. The same fate awaits other areas of farm management like factor efficiency analysis. In a sense, this paper covers the areas which most likely will not be covered in the other papers mentioned above.

THE PRESENT SITUATION[1]

Four major areas are examined in the studies being reviewed: farm organization, farm management practices, financing schemes, and input supply system.

FARM ORGANIZATION

Coconut farms differ widely in size with small farms of less than four hectares representing 32 per cent of all farms (Table 1).

Table 1. Frequency of farms by size.

	NUMBER		PER CENT	
SIZE IN HECTARES	Farms	Hectares	Farms	Hectares
Less than 4	325,000	560,040	65.79	31.
4 — 20	160,000	928,000	32.39	52.
More than 20	9,000	273,000	1.82	15.
TOTAL	494,000	1,761,040	100.	98.

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[1] Statistical tables are reconstructed or drawn from different studies listed in the Appendix.

The capital investment on such farms is largely in terms of land and tree representing anywhere from 72 to 99 per cent of the total (Table 2).

Table 2. Investment Structure.

LOCATION[a]	PER CENT Land	Building	Animals	Others	Total
LAGUNA					
Alaminos	97	b	2	1	100
Alaminos	88	7	4	1	100
Cavinti	97	b	2	b	100
Lilio	88	11	b	1	100
Nagcarlan	99	b	b	b	100
San Pablo	99	b	1	b	100
QUEZON					
Adangan	95	1	4	b	100
Calauag	87	6	6	1	100
Albay	82	11	7	1	100
Romblon	72	17	9	2	100
Leyte	90	b	9	b	100
Surigao del Sur	93	b	6	2	100

The high percentage of investment in land indicates to some extent the kind of farming practices on the farms. Considering further that of the other proportion (which is already insignificantly small) the bigger bulk is generally in dwelling, it is obvious that investment on more directly productive items is nil.

The greater variety of tools and equipment can be found only on farms which grow crops other than coconuts. Such farms are common in the Cavite, Laguna and Batangas areas where inter-or catch-cropping is a common practice.

[a] Each location represents a separate study.

The intercrops include both annual and perennial crops (Table 3) such as rice, corn, lanzones, coffee, bananas, and ginger (Table 4).

Table 3. Intercropping pattern. Alaminos, Laguna

INTERCROPPING PATTERN	NO. OF FARMS	PER CENT
Fully intercropped with perennial crops	1	1
Fully intercropped with annual crops	37	42
Fully intercropped with both perennials and annuals	13	15
Partially intercropped with annual crops	17	19
Partially intercropped with both perennials and annuals	21	23
ALL FARMS	89	100

Table 4. Intercrops. Alaminos, Laguna

INTERCROP	NUMBER OF FARMS	PER CENT[a]
Rice	77	65
Corn	29	25
Lanzones	98	83
Coffee	103	27
Bananas	39	33
Ginger	28	23
TOTAL	374	xx

Cultural Practices

Intercropping

Intercropping as discussed above may be considered one of the management practices of some farmers. Many farmers in the other areas of Luzon, Visayas and Mindanao however do not follow this practice.

Some sizeable plantations in Mindanao have gone into raising cattle under coconut.

Distance and system of planting

The most common distances between trees range from 7-10 meters with the square system predominating. The proportion in irregular spacing is significant.

[a] Based on 100 farmers.

Cleaning the plantation

The most common chore on the plantation other than harvesting and preparation of the product for marketing is cleaning the plantation. The main reason for cleaning has always been to facilitate movement in gathering the nuts during harvest.

Other practices

Fertilizer application and pest/disease control are done on exceptional cases. Chances for the coconuts being fertilized, even indirectly, are increased with intercropping. Fertilizer applied to intercrops most likely will benefit the coconut also.

Harvest and Post-harvest practices

Harvesting the nuts is done either by climbing or by the pole-sickle method. The former is practiced in areas starting from Quezon province south wards to Visayas and Mindanao. The pole-sickle method is primarily a Laguna-Batangas practice brought over on an insignificant scale to Visayas and Mindanao by a few Tagalog-originating migrants.

Husking is done before splitting the nuts. These are usually dried in "tapahans" with the meat separated only after it has generally disengaged itself from the shell.

The meat of the split unhusked nuts is scooped out immediately after splitting or pre-dried until it is easy to remove.

Sun drying is prevalent in Southern Luzon

Credit

Considering that there is not much cultural activity on coconut, financing or credit may not be expected to be high. A study in Nagcarlan, Laguna, however, shows that coconut farmers get into debt. Such credit tends to be for purposes other than financing the coconut farm (Table 5).

Table 5. Farmers reporting by credit use

PURPOSE OF CREDIT	NUMBER OF FARMERS	PER CENT
Purchase of new plantation	10	13
Farm Operation		
Planting new trees	10	13
Cleaning and weeding	6	8
Fence construction improvement	3	4
Non-Farm purposes		
Education/advancement	21	27
Family living	17	22
Capital for business	10	13
House construction/repair	12	16
Others	12	16

The rural banks have played significant roles in supplying the credit needs of the farmers. The experience in Nagcarlan may be comparable to other areas where rural banks are available (Table 6). The Development Bank of the Philippines has a special financing plan for coconut but its accessibility is not comparable to that of the rural banks.

Table 6. Source of Credit

SOURCE OF LOAN	NUMBER OF LOANS	PER CENT
Nagcarlan Rural Bank	50	41
Merchants/Businessmen	21	17
Other Rural Banks	12	10
Other Government Agencies	9	7
Insurance Companies	6	5
Others	23	19
TOTAL	121	100

Input Supply System

The coconut industry does not have a specialized input supply system; it may not be necessary as yet. Input use has been highly exceptional. The most acquired inputs are the seedlings but these are a one-shot deal for over a long period of time. The little that is used of fertilizer is obtained from general market channels which have improved a great deal in the past five years or so.

PROBLEM AREAS FOR RESEARCH

The broad areas of needed research outlined below are best approached with multi-disciplinary cooperation. Economic analysis proceeds better with agronomic data collected with an advanced eye for more than just agronomic anayltical use. Cooperation may therefore start in the planning of specific research projects.

The recommended areas for research follow:

1. Economic analysis of cultural management practices such as fertilization, tillage, intercropping, catchcropping, cover-cropping, irrigation and drainage;

2. Economic analysis of the various methods of harvest and post-harvest operations;

3. Determination of optimal sizes of farms for different systems of management *e.g.*, individual family and cooperative management;

4. Input requirements of and output expectations from "standard models" categorized according to different variables, *e.g.*, farm size, sets of cultural practices, and enterprise combinations;

5. Comparison of present farms and standard models;

6. Determination of credit requirements and institutions or programs to provide such requirements, and

7. Determination of existing input supply system and proposed improvement thereof.

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TOWARDS AN EFFECTIVE EXTENSION-EDUCATION PROGRAM IN COCONUT*

Introduction

In Taiwan, agricultural extension work is defined as a type of out-of-school educational system which helps the farm people adopt improved methods developed by agricultural improvement stations or successful experiences of other farmers through educational processes carried out by extension workers. Some define it as "an educational service organized, directed and financed by the government" which is structured to bring to the farmers and the farm families the knowledge of scientific methods by trained extension men. These methods are those developed by agricultural research stations, colleges and other crop improvement institutions." Others say it is a teaching and learning process; an out-of-school education to produce changes in human behaviour.

The various institutions doing research activities should therefore conduct researches that are geared to the needs of the end-user-the farmer/people. An extension group on coconut would fill the gap among the researchers, the coconut farmers and others working for the improvement of the industry.

The Coconut Industry

Before we dig deeper into the topic of effective extension-education program in coconut, let us take into focus the coconut industry.

The industry marked its beginning as the heretofore unchallenged top export revenue earner as early as 1942, when the Spanish Royal Government, by edict, compelled the Filipino citizenry to plant coconut palms: 200 square feet for the chiefs of villages and 100 square feet for the natives. In 1911, the Philippine coconut industry was already established. At the time there were some 208,000 hectares planted to 42 million trees. Official figures in 1971 of the Bureau of Agricultural Economics (Table 1) revealed that there were 1.884 million hectares planted to 272.4 million trees with a total of 7,745.2 million nuts gathered, giving a production value of 1,327.4 million pesos.

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Table 1 — Area, value and production of coconut products (1971)

Total area planted			1.884 M. has.
Total No. of trees		272.4 M.	
Bearing	215.2 M.		
Non-bearing	57.2 M.		
Total nuts gathered			7,745.2 M.
Copra	7,139.3 M.		
Desiccated	349.6 M.		
Home-made oil	30.1 M.		
Food nuts	226.2 M.		
Value of Production			₱1,327.4 M.
Copra	₱1,196.0 M.		
Desiccated	76.9 M.		
Home-made oil	3.8 M.		
Food nuts	50.7 M.		

Problems of the Industry with Reference to Extension-Education

Apacible (1971) and Lopez (1972) cited several problems affecting the coconut industry in general. Among the problems they cited which are relevant to our discussion this afternoon are the following:

1. Majority of the local producers do not practice scientific cultural methods of production, such as the application or minimum usage fertilizer, proper seed selection, the control of pests and diseases and sustained research;
2. Copra processing methods in the country are still crude and therefore produce copra of relatively poorer quality;
3. Shortage of extension fieldmen to disseminate and implement improved and applied research in the industry;
4. Farm management techniques — cultivation and intercropping to include animals are not yet fully appreciated;
5. Low production — In 1970 the Philippines averaged only 36 nuts per tree per year which is very much lower compared with other countries. Malaysia, for example, produces 60 nuts per tree per year;
6. Financing research — the inadequate sum allocated to coconut research retarded the progress of the Philippine Coconut Research

Institute (PHILCORIN), the sole agency established by R.A. 4059 to do coconut research. Unless the full amount of ₱1.6. million is released to PHILCORIN for a period of 5 years and ₱1 million each year thereafter, the programs envisioned by PHILCORIN shall not be efficiently carried out;

7. Supply of selected planting materials — there is a need to have a continuous selection of parent palms with known bearing capacity;
8. Low salaried coconut technicians, and
9. Lack of transport/mobility to penetrate to the farms of coconut growers.

It is against this background that this paper will attempt to present ideas to minimize/solve these problems towards an effective extension-education program in coconut. The proposal is designed more for those problems which can be done in a shorter range of time.

General Objectives of an Extension-Education Program

1. To bring to the coconut farmer recent developments and knowledge in coconut technology to enable him to manage his coconut farm more efficiently, thereby increasing his income;
2. To improve living conditions of coconut farmer families; and
3. To develop prosperity in rural coconut communities.

The specific objectives shall be dealt with in each extension-education program that shall be proposed later.

Extension-Education Approach

To formulate an effective extension education program there is a necessity to understand the profile of the Filipino farmers. As we have mentioned earlier, extension involves people and unless we have a good grasp of them our extension effort shall be a failure.

Davide (1970) discussed a study on results of a survey of Filipino farmers. Here are some of the findings:

1. Education — in general the farmer is not adequately-schooled, 73 per cent have less than the complete secondary education; 22 per cent have no formal education;
2. Exposure to media — 44 per cent of the farmers read magazines, newspapers or comics;
3. Radio listening — 77 per cent listen to the radio;

4. Different dialects spoken — Farmers speak one or more of the 57 dialects spoken of which four are considered major: Tagalog, Cebuano, Ilocano and Hiligaynon;
5. Operationally-oriented set — Someone must tell, must show specific steps to follow; and
6. Almost all farmers consult their wives; friends and neighbors before deciding on important matters.

Eleazar (1972) in a memorandum to the PHILCORIN Board of Trustees claimed the farmers were apathetic. This apathy, he said, did not only result from the irrelevance of some research and development programs to the farmers' daily problems; it also resulted from monotonous series of government programs which were not substantiated by effectiveness, continuity and genuine change. A farmer will understand only what he encounters in his limited share of life; for where decision makers and planners study problems, the farmer lives by these problems.

Somewhere in the early part of FY 1972-73, the Coconut Coordinating Council created an Ad-Hoc Committee on Production and Extension. The bulk of the program outline submitted was on training. For increased production, it was planned to deploy 300 coconut technicians in 600 municipalities in 26 priority provinces which were selected on the basis of coconut tree population. These provinces have more than 3 million trees. Approximately, one technician will cover 600-800 coconut farmers.

As far as deployment is concerned, Chairman Tanco of the Coconut Coordinating Council asked what should be taught and how. The Agricultural Productivity Commission (now Bureau of Agricultural Extension) opined that the demonstration project would be the best approach. This is the problem. Most people tend to think that technology on rice and coconut are comparable to promote. We should be aware that there will always be a difference in the acceptability of the extension-education method between the rice growers and the coconut planters. With rice, any new method or variety can be performance tested and proved or disproved in a very short period of time. With coconuts it takes years to screen or even pick-up a promising variety. Effects of fertilization for example, will not show results until after the second year of regular application. The coconut planter may not have the patience to wait that long before he realizes profit out of his investment so that his attention shifts to available short season crops which he plants under his coconuts for subsistence. Ultimately, through continuous cropping under the coconut both coconut and cash crops suffer from soil nutrient exhaustion. Hence, the perennially low average yield of coconuts in the country. Other reasons contributing to low yield may be attributed to poor or apathetic management practices.

Secretary Tanco acknowledged the seedling distribution scheme of the BPI as commendable but that it is a long-range project.

What must be done are extension-education programs which would increase production and income a shorter period of time. The following proposals are geared towards this direction.

Proposals

I — Field Fertilizer Trials

A. *Situation*

1. Coconut production is very low — 36 nuts per tree per year;
2. Coconut farmers know very little about the scientific way of growing coconuts; and
3. Learning by seeing is a very effective extension method in the Philippines.

Seventy per cent of our farmers in general do not use fertilizers. Only 3.68 per cent out of 2,293 coconut farms surveyed by the BPI practice fertilization. Some of the reasons advanced are the lack of adequate knowledge regarding fertilizer usage and the problem of supply, lack of credit and price of fertilizers (Davide, 1970 and Alix, 1972). Others contend that farmers have sufficient knowledge as seen by the demand for the commodity in most parts of the country, though the demand is for government supply of fertilizers which are relatively cheaper. The reason may be that they do not have the money to buy or they are not yet fully convinced of the effectiveness of fertilizer to overcome cost of production.

B. *Objectives*

1. To show the extension workers of government agencies and coconut planters that production of coconuts can be increased by improved management practices and fertilization;
2. To develop field laboratories for extension workers of various agencies and farmers, and
3. To use the field fertilizer trial sites as focal points in the conduct of seminars where improved coconut growing will be discussed.

C. *Strategy of Implementation*

1. Site representative of the area where they belong shall be selected. Interested farmers of average knowledge of improved coconut growing shall preferably be picked;
2. A minimum of one hectare shall be used as experimental plot. All expenses may be shouldered by the implementing agency;

3. Soil and leaf samples shall be taken prior to the start of the experiment. Leaf samples shall be collected every six months during the conduct of the trials;
4. The plot shall be cleared of weeds and other unwanted plants at the start of the experiments. Ring weeding of the trees and inter-row clearing shall be done as often as necessary;
5. Fertilizers shall be broadcast and forked-in with a radius of one meter for 1-2 year-old palms and two meters for 2-4 year-old and bearing palms. For sloping terrain the fertilizers shall be placed two to four inches below the soil surface one meter upslope from the trunk. For impact bearing palms are preferable;
6. Pest indexing shall be done from time to time;
7. The experiment shall have a duration of 4 years for bearing palms and 6 years for non-bearing palms, and
8. All expenses shall be recorded.

The PHILCORIN is now starting to launch this project in selected Mindanao provinces.

II — Pilot Farm Project

Below is a brief presentation of a 10-hectare coconut farm management pilot project of the Bureau of Plant Industry.

A. *Introduction*

Generally, most of the coconut plantations in the Islands are neglected and maintenance to keep the trees at high production level at all times is virtually lacking. A number of cultural practices if employed on coconut farm could possibly increase directly or indirectly the yield of coconut trees and also provide additional income for the coconut planters. These practices are: (a) plowing the spaces between the coconut trees, (b) timely application of right quality and quantity of fertilizers and (c) planting of inter-crops and catch-crops between the trees.

B. *Situation*

1. Despite the fact that one-third of all cultivated lands in the Philippines is planted to coconuts there are no significant extension services available to coconut growers.
2. Growers know very little about the scientific way of growing coconuts.
3. Productivity of coconut plantations is very low.
4. Most coconut plantations are not intercropped for additional income.

C. *Objectives*:

1. To demonstrate to growers that coconut production can be increased through application of improved cultural practices.
2. To show the growers that other crops can be grown profitably under coconuts.
3. To increase and enhance land usage.
4. To give additional income to the planters.

D. *Area of Operation*

1. The project will operate in 25 coconut-growing provinces.
2. A 10-hectare coconut farm management and pilot project site will be selected from each province, preferably coconut farm of contiguous area owned by a group of growers.

E. *Target Goals*

The farm management pilot project aims to increase coconut production and raise the income of the coconut planters through improved cultural practices. Tillage and fertilizer application is expected to increase the yield of coconut trees by 15 nuts per tree per year after the first year and by 20 nuts after the second and fifth years. The additional grower's income from catchcrop is expected to be approximately 20 per cent for the first year and 30 to 50 per cent in the second and sixth years. Likewise, the expected revenue from the intercrop ranges from 20 to 30 percent after the second year of operation.

F. *Strategy of Implementation*

1. Approximately 25 pilot farms will be set-up in the priority provinces in the first year, 15 in the second year and 10 in the third year with a total of 50 pilot farms to be maintained for at least 6 years from the date they were established.
2. Each pilot farm will have an area of 10 hectares which will be subdivided into 4 plots of 2.5 hectares each. The farm practices which will be introduced in the plantation are:
   a. cultivation and tillage
   b. application of fertilizer
   c. intercropping with perennials
   d. catchcropping
3. CRDP Supervising Agronomists in the priority provinces will supervise the establishment of the pilot farm. One field agronomist and one assistant farm technician will be assigned for each project site.
4. All trees will be fertilized at the rate of two (2) kilos complete fertilizer plus one (1) kilo muriate of potash per tree per year. The perennial intercrop and catchcrop will be fertilized accordingly.

5. Production inputs will be extended to growers free of charge.
6. Growers in the project sites will be encouraged to form associations or cooperatives.

G. *Program of Work*

1. Field agronomists will be trained intensively in coconut production in Tiaong Experiment Station and nearby plantations.
2. Trained technicians will be deployed in the project sites in the 25 priority provinces.
3. Massive informational campaign will be conducted in the project sites before the implementation of the project to evolve awareness and interest among the growers. This may be done by individual contacts, planters' meetings and dissemination of pamphlets.
4. Seminars on coconut production and proper plantation management shall be conducted.

Similarly, the PHILCORIN is establishing two (2) pilot farms in Mindanao, the features of which are summarized below:

A. Situation

1. Pilot farms are not made available to farmers, overseers and extension workers for viewing and guidance.

2. There are only a few agencies doing applied research work hand in hand with coconut planters.

3. No farms were ever established wherein coconut growers, overseers and extension workers of various agencies worked closely and regularly together.

B. Objectives

1. To conduct applied researches on research findings of PHILCORIN and other agencies.

2. To make the pilot farm the focus of discussions among extension workers for possible transmission to coconut growers and overseers.

3. To conduct short training and workshops for extension workers once it has established findings on specific areas of coconut production, *i.e.* nursery management, seednut selection, transplanting technique and so forth.

C. Strategy of Implemention

1. One (1) pilot farm each shall be established in Zamboanga del Norte and Misamis Oriental. In these pilot farms shall be conducted at least three applied researches on coconuts.

2. Extension workers shall be invited every now and then to these pilot farms. Discussions on the applied research shall be made for their guidance and information.

3. A Memorandum of Agreement shall be executed between the PHILCORIN and the farmer-cooperator who owns the farms to be used in the project.

III — Improvement of Copra Quality

A study to provide guidelines for production of good quality copra and corresponding premium price thereof is included in the proposed 5-year PLANOP of the UNDP-PHILCORIN PROJECT. Suitable copra driers will be built and used for training extension workers so that they may become familiar with quality copra and the techniques by which it is produced. Perhaps the PHILCOA should steer this project while it is not yet in operation.

In the three (3) projects discussed various extension methods and techniques shall be applied, with the extension workers being given the option to use the method or combination of methods he finds most effective.

IV — Training Program

It will be noted in the three (3) projects discussed that training is always a part of the projects. Every now and then, there is a need to update and upgrade the knowledge of the extension personnel on current developments of research and other relevant information in order for him to have confidence and competence in his job.

The PHILCORIN is preparing a training program for extension workers, details of which are shown below:

A. Introduction

Technological and cultural changes are not just like any material market commodity that could be easily sold and immediately used. It is not self-evident; hence the applied research and training program for dissemination. The many differences in tradition, farm cultural orientation and stages of agricultural development make it necessary for the adoption of psychological dissemination through field demonstrations, seminars, in-service trainings and workshops.

While there are several ways and means of imparting information differing slightly in scheme, a common control point is stressed by each: to diffuse among our extension technicians, overseers, producers and farmers useful and practical information on coconut farm management and to encourage its application on the farm. Applied research activities through the establishment of pilot and training farms, field fertilizer trials and in-service training and workshops, ultimately stress the development and upgrading of extension staff and end-users. It is the concern of in-service training and workshop not only to train and teach but also to raise the outlook of farmers in life to a point that they will eventually seek to improve their coconut farming enterprise and home life.

B. The Program

Situation:

1. There are 2,016 agricultural field technicians doing agricultural extension work on coconuts, either directly or indirectly. They are distributed as follows:

APC, Farm Management Technicians	1,708
PBI, (CRDP)	252
PHILCOA (Agricultural Services)	56
	2,016

2. Out of this number, only 274 are assigned in Mindanao, distributed as follows:

APC (FMT)	179
BPI (CRDP)	86
PHILCOA (Agri. Ser.)	9
	274

3. Technical personnel who are capable and knowledgeable of disseminating information on efficient and sustianed coconut production are very few;

4. Personnel of existing extension agencies may be trained to become more effective production technicians and trainers;

5. Professional coconut specialists are needed for the maintenance and development of the coconut industry.

B. *Objectives*

1. To train and upgrade the skills of technical personnel of cooperating extension agencies on coconut production and plantation management;

2. To foster cooperation and coordination among extension workers of coconut and related crops, and

3. To update extension workers on the developments in the cultural management and technology of coconuts.

C. Presentation

1. A month-long training and workshop on improved coconut management and production shall be sponsored as often as possible by the Extension and Training Division. PHILCORIN at PHILCORIN Research Center, Davao City participated in by technical personnel of other extension agencies and coconut farmers of nearby farms. Short training courses on specific lines (fertilization, seed selection, transplanting techniques) shall be done in the pilot farms.
2. Lectures and demonstrations on the different aspects of improved coconut management and production shall be given by the respective division staff of PHILCORIN most competent on the specific field. Resource persons from other agencies (BPI, UPCA, UCAP, Cooperatives, DBP, etc.) shall also be invited to speak on specific topics. Syllabi on short training courses shall be published from time to time.
3. Recruitment of trainees shall be done intensively by the Division Staff. Other personnel of the Institute and allied government extension agencies shall be encouraged to participate in the recruitment and on the training proper. Interested coconut farmers, farm overseers and planters may send their application for attendance or come in person to the nearest research center, pilot farms or fertilizer trial farms as observers.
4. Reasonable expenses incurred by the trainees and invited speakers during the training may be supplied partly by the Institute and partly by the agencies where the trainees come from.
5. Feedback of the trainees' activities after training shall be requested from them periodically.
6. Refresher courses shall be made and designed depending on the needs of the trainees.

Ultimately, a training program that would involve farmers should be developed. Eleazar (1972) made the following recommendations for the very reason that the coconut industry rests ultimately on the coconut farmers. The farmers must have competence and the responsibility to develop their own farms. He proposed the setting up of a national training program for representative coconut farmers. The national trainers shall conduct training in their respective regions; the regional trainors shall conduct training in their respective provinces, and provincial trainors shall conduct training in the municipalities. Pre-requisite to these trainings are careful preparation of the training program (selected aspects, training methods, selection of trainees), efficient evaluation and reporting system and incentives. The farmers who have undergone training will eventually become community leaders, outlets of information, reporters of general information and change agents.

COCONUT

In the training proper, aside from coconut production technology lectures on matters which will influence the success of the project should be included, like availability of fertilizer, credit and prices.

Recommendations

1. There is a need for a coordinated effort among agencies to implement an extension-education program. It would be ideal if any one program though individually proposed be jointly implemented.

2. There is a need to take a hard look on the extension technicians. As an example, in the PHILCOA program, a technical man would be paid ₱305 basic pay per month and ₱75 allowance. This is hardly enough. All told, the CCC believes he should get ₱600 a month: ₱350 basic pay and ₱250 allowance.

3. There is no phasing out of any extension program. The foregoing proposals should be sustained although from time to time adjustments shall be made to fit the current needs of the coconut farmers.

4. In order to have as many research results disseminated to the end-user, all research findings and proceedings of all workshops on agriculture should be compiled in a central documentation Center. This is among the resolutions submitted after 1970 seminar-workshop on soil and fertilizers.

Concluding Remarks

In closing, allow me to read a foreword of an extension bulletin which states:

> "No agricultural development program can ever be successful unless it is supported by adequate farm extension. This is particularly true when such a program entails the expenditures of comparatively large sums of money by individual farmers who have the choice of several options, some of which will give better results than others. The lower the standard of farmer education, the more it becomes inperative for a country to provide a well-trained farm advisory service capable of leading farmers into the acceptance of new techniques."

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CULTURE AND PRODUCTION PROBLEMS IN COCONUT*

One of the most pressing problems of the Philippine coconut industry is low productivity. Coconut farms in this country seldom yield one ton of copra per hectare while in the Ivory Coast yields of 2.5 tons per hectare are common. Carlos (1970) estimated that our present yields correspond to only about 22% of the total yield potential.

Low productivity results in low income per unit area and causes unstable prices for coconut products. The former affects the small farmer while the latter exposes coconut products to substitution with other oils in the international market, a situation which could cause the doom of the coconut industry.

FACTORS AFFECTING PRODUCTIVITY

Yield is the result of the interaction between the genetic potential of the crop, the environment in which it is grown and the management practices employed. The genetic potential sets the limit to yield while the environment and management practices influence the expression of the genetic potential. In this paper I will discuss the factors affecting productivity, attempt to identify problems associated with each factor and propose approaches to these problems.

1. *Genetic limit* — Researchers are constantly developing genetic materials which can be utilized to increase yield. While these efforts have initially yielded positive results, the perennial nature of coconut hinders the maximum utilization of high-yielding materials to substantially increase yields. Unlike in annuals, we cannot change varieties in coconut as frequently as a desirable variety is developed. For all practical purposes, therefore, the genetic limit of our standing coconut palms has been set. Hence, at best, high-yielding materials can find utilization only in the following: 1) planting new areas, 2) replanting old palms and 3) replacing not so old palms with the new varieties. There does not seem to be much problem in the use of high-yielding varieties in new areas. However, replanting old palms may pose some problems because of resistance from owners to replace even marginal trees. The third possibility may meet greater resistance. Research should be directed

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towards evolving a practical scheme for implementing the second and third possibilities.

2. *Poor site* — This may be due to poor accessibility, unfavorable rainfall or prevalence of typhoons. The first two problems can be remedied but not the third, unless we adopt crop zoning, *i. e.,* planting coconut only in favorable areas. Zoning, however, does not seem acceptable unless we can cope up with the resulting economic and social dislocation.

3. *Old age* — Many of our coconut palms have passed their "maximum economic life span." Obviously, early replanting is needed to produce more coconuts per unit area. However, the farmer is often resistant to replace his old palms. Research should evolve a scheme for the acceptance of rejuvenation as a method of increasing production.

4. *Close planting* — Most plantings are spaced 8 x 8 meters or closer, resulting in many unproductive trees. When properly managed, a 10 x 10 meter spacing could give equal if not higher yields and decidedly higher total farm income. The problem is how to induce the farmer to cut down some of his unproductive trees. He is often as resistant to do this as it is for him to cut his 80-year-old trees. Research should evolve a strategy to remedy the problem.

5. *Pests and diseases* — Cadang-cadang is still the major abnormality causing decline in productivity. However, its occurrence is limited only to certain growing areas. Disease and pest outbreaks do not seem to be as serious as those of cadang-cadang. Nevertheless we should continue research in these areas as an insurance to the coconut industry.

6. *Lack of care of plantations* — Low productivity is generally caused by nearly total neglect of coconut plantations. Weeding is the only operation widely practised, but even this is limited to cutting tall weeds to facilitate gathering of fallen nuts. In general, neither tillage nor fertilization is practised (Nyberg, 1968). The coconut has therefore earned the reputation of being a "lazy man's crop." Under present conditions, it gives the highest net return but the lowest total return per unit area among agricultural crops. We cannot afford to perpetuate this if we want to maintain leadership in coconut.

MAJOR CULTURAL PRACTICES AFFECTING PRODUCTIVITY

Because of the limit set by variety and environment, the only other factor which offers flexibility in our efforts to increase yield is cultural management. This includes, among others, operations such as weeding, cultivation, fertilization, irrigation, cover cropping and intercropping.

Felizardo (1972) showed that plowing, fertilization and cover cropping practised alone or in combination with each other increased nut yield in 45-year-old coconut trees in Pagbilao, Quezon (table 1). This experiment demonstrated that these cultural practices can be used to increase yield of "middle-aged" trees in low-yielding areas.

TABLE 1. *Copra yield per tree per year of coconut trees that received different cultural management treatments.*

Treatment	Annual Yield	Copra Yield (kg)
Plowing plus fertilization	68	16.2
Fertilization	64	16.1
Plowing plus cover cropping plus fertilization	54	15.4
Cover cropping plus fertilization	54	14.0
Plowing plus cover cropping	52	13.1
Plowing	47	11.5
Cover cropping	44	11.0
Control	35	9.5

The work of Mendoza and Prudente (1972) in Davao on the other hand, demonstrated that fertilization can increase the yield of young trees in high-yielding areas. In this experiment treatment of 8-year-old palms with 1.5 kg. $(NH_4)_2SO_4$ and 1.66 kg. KCl effected an increase of 147% and a 52-80% annual increase in nut yield from the second to the seventh year. This work further showed that an annual net return of ₱3.50 can be realized per peso invested in the above fertilizer treatment.

In another experiment the same workers showed that fertilization induced early flowering. NK treatment induced flowering 42 months after transplanting. These initial results indicate that fertilization can reduce flowering time by about 3 years.

Results from the above studies suggest that fertilization can be immediately taken advantage of to dramatically increase yield in majority of coconut farms. To realize this possible benefit, a fertilization program initially using projected optimum levels of fertilization has to be immediately implemented. Such a program would necessitate a nation-wide research on soil and tissue analyses of coconut farms. This could provide data for interim fertilizer recommendations.

A complementary research program should be started to evolve a more accurate and profitable system of fertilization. For this purpose, a study to correlate yield with soil, tissue and water analyses should be conducted under different soil and agro-climatic conditions. This study should be integrated with the proposed nation-wide soil and tissue analyses research.

Another farm practice that can be utilized to increase productivity is intercropping. There are indications that this practice does not reduce coconut yield (table 2). On the other hand, Mangabat and Marques (1970) showed that substantial income can be derived from intercrops.

TABLE 2. *A comparative analysis of 64 coconut farms with and without intercrops in Leyte, Misamis Oriental, and Quezon, (Philippines), 1957-1958*

	Leyte		Mis. Oriental		Quezon	
	Inter-crop	No in-tercrop	Inter-crop	No in-tercrop	Inter-crop	No in-tercrop
Number of farms	10	10	16	16	6	6
Average area, (ha/farm)	2.0	3.4	3.8	3.6	7.0	3.2
Per cent interccropped, (average of all)	85.0	—	26.0	—	57.0	--
Bearing palm per hectare	80	79	87	99	112	152.
Nuts per ha.	3064	2202	2729	2924	4359	3375
Nuts per palm	38	28	31	29	39	22
Kg. of copra per 1000 nuts	285	279	248	245	208	256

There are indirect evidences that water deficiency reduces yield. This is suggested by the low yields obtained in areas which experience severe drought. Conversely bumper crops have been attributed to favorable rainfall. Research should be conducted to determine optimum water requirements of coconut.

The data presented above clearly show that improved cultural practices can be used to increase yield. What is urgently needed, therefore, is to determine the levels and combinations of these cultural practices that can give maximum returns under various ecologic conditions. Naturally, this research is long-ranged and should be an integrated program.

While a massive program on cultural management can yield spectacular results, maximum utilization of these results would depend on the solution of the following problems for which corresponding research should be undertaken:

1. *Lack of capital* — Studies on systems to provide the farmer with practical sources of inputs and on methods that would generate, implement and maintain these systems.
2. *Poor transportation* — studies on benefit of transportation systems and methods to generate, implement and maintain these systems.
3. *Marketing* — Studies on efficient and profitable systems of product disposal to increase the income of the farmer.

4. *Lack of efficient extension system* — The researches on cultural management should be conducted in pilot/demonstration farms. Massive extension training programs should be carried out to produce agents of change who are capable of inducing the farmer to accept innovations in the farm.

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COCONUT PATHOLOGY*

INTRODUCTION

The coconut, although a sturdy plant with a long life span, is just like any other crop for it is not spared from the attack of phytopathogenic microorganisms. On the other hand, coconut pathology in the Philippines has not advanced as far as other crops probably because of the stature and slow growth of coconut and, perhaps to a certain extent, due to the indifference of plant pathologists toward this crop.

This paper does not intend to describe the diseases of coconut but instead aims at establishing the due need of coconut pathology and research priorities along this area.

WHAT ORGANISMS ARE KNOWN TO CAUSE DISEASES OF COCONUT?

References on coconut diseases published by coconut-producing countries show that around 60 species of fungi, 7 virus-suspects, 5 nematodes, and 2 species of bacteria, have been reported as inciters of coconut diseases. Among them, fungi are the most common and they can be found on the leaves, stem, bud, and roots of coconut. The majority of the fungi, however, are weak parasites and they can cause epidemics only in extreme cases. Surprisingly enough, the diseases suspected to be due to viruses are the ones causing the greatest damage to coconut.

WHAT ORGANISMS HAVE BEEN REPORTED IN THE PHILIPPINES AS CAUSING DISEASES TO COCONUTS?

In this country only a few species of fungi causing leafspots, and bud root, a bacterium causing leaf stripe, and probably a virus causing death to the whole plant, have thus far been reported. There might be more, only they may have not been fully studied or remained unreported because they have not yet caused much damage to the coconut to warrant a study. This we do not know. In the Philippines from 1937 to the present, or some 36 years, the virus (?) has caused the most damage to our coconut industry.

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WHAT CONTROL MEASURES HAVE BEEN ADVOCATED AGAINST THESE MICROORGANISMS?

The use of pesticides to combat diseases in coconut is not a popular method of control especially when the coconuts are already in the bearing age. Hence, control measures have been restricted to proper cultural management like phytosanitation by cutting infected plant parts or the whole plant and burning them, and the applicaion of fertilizers. Bordeaux mixture has been used for spraying against fungus diseases of coconut seedlings and seemingly healthy palms in the plantation immediately surrounding the infected tree, but not the whole field.

WHAT SHOULD BE DONE IN THIS COUNTRY WHEN IT COMES TO COCONUT PATHOLOGY?

First of all I would like to identify the problems on hand and then give my personal recommendations for each situation.

Problem 1. There is no master list of coconut diseases in the Philippines nor estimates of yield losses due to diseases.

Suggested solution:— A national survey should be made to make an inventory of our coconut diseases. The region from where the disease is observed should be noted because different diseases may occur in different regions, *e. g.*, the *cadang-cadang* and *boang* diseases. The former is only reported in the Bicol region spreading to Bondoc peninsula up to Laguna whereas the latter has been observed to occur only in Mindanao.

For any disease, yield loss record is important because it will give us an idea of the importance of the disease. However, if the determination of yield loss is not feasible then the extent of damage within the region will suffice.

Nursery diseases may vary with plantation diseases hence a comparative study should, likewise, be made.

If this said list is done then the occurrence of whatever new or unreported diseases can easily be made known and timely and proper studies can be readily performed.

Problem 2. The epidemiology of known diseases is not well studied.

Suggested solution:— Since most studies conducted in the Philippines were mainly towards the indentification of the causal organism, epidemiological studies should follow to give us ample data which can possibly be used as a guide for disease forecasting.

Problem 3. *Cadang-cadang* disease is still the number one killer of coconut in the country and up to now no effective control measures have been devised because of insufficient knowledge of its possible cause.

Suggested solution:— The consensus of FAO experts who have worked on this mysterious disease from 1955 to date is that it is caused by a virus and it is insect-borne. There is strong evidence in support of this theory and as such, this should be pursued. A good research team composed of a plant virologist, entomologist (taxonomist), biochemist, and plant anatomist should be set up.

The job of the plant virologist will be to transmit the disease using all the methods known and successfully tried on other plant viruses for the simple reason that transmission is the ultimate proof that a disease is caused by a virus in the absence of fungi, bacteria or nematodes. Claims of mechanical transmission by Celino and del Rosario are still accepted with skepticism simply because of the low percentage of transmission, the difficulty of infecting coconut and the very long incubation period of the disease, which is from 3 to 4 years. The low percentage of transmission obtained has been attributed to the low concentration of the virus and also the presence of an inhibitory substance in the coconut sap. If this is so, a reverse procedure could possibly be tried. What I mean is this. Instead of extracting the sap of infected coconuts to be used for inoculation, other known plant viruses like tobacco mosaic virus, cucumber mosaic virus, bean mosaic virus, and grass viruses should be inoculated to coconut either singly or in combination to see whether the cadang-cadang syndrome can be similarly produced.

The entomologist should identify the the insects frequenting the coconuts, in cadang-cadang and non-cadang-cadang areas, using colored sticky traps, rather than light traps. Light traps are not too reliable because they can attract insects from other crops and from anywhere, whereas sticky traps catch only insects that are closely associated with the coconut and which move about from tree to tree. This collection and identification of insects should be done daily for a minimum period of one year or so to be able to correlate insect population from day to day and season to season to the spread of the disease. Species of insects that can be identified as vectors of known viruses should be tried by the plant virologist as possible vectors. With sticky traps, one can also determine insect population at different elevations from as low as a foot to as high as forty or more feet.

The biochemist should try to establish the chemical composition of purified sap from diseased and healthy coconuts as well as their concentration to compare results with the chemical properties of known plant viruses. This will give us additional evidence, although an indirect one, in support of the virus theory.

The plant anatomist should be able to do ultra-thin sectioning and try to identify the presence of virus-like particles in the cells of infected plants thru the use of the electron microscope. I would like to point out here that the *electron microscopist* is an essential partner of the plant virologist in virus research.

Problem 4. Can other types of microorganisms like mycoplasma and nematode possibly cause *cadang-cadang?*

Suggested solution:— Research along this line should also be done because many plant diseases transmitted by leafhoppers which were considered plant viruses are now definitely established as due to mycoplasma. Nematodes, on the other hand, are not only inciters of diseases of many economic plants but are also vectors of a number of plant viruses. Further studies along this line should be done by a nematologist with first hand experience on nematodes and plant viruses.

SOME IDEAS ON RESEARCHES ON THE PHYSIOLOGY OF COCONUT*

Few commercial varieties of coconut are known. Carlos (1963) described 3 varieties namely: 1) typica, a tall, late-bearing and generally cross-pollinated variety, 2) tambolilid or javanica, relatively short and self-pollinated, and 3) coco-niño or nana variety which is also relatively dwarf, self-pollinated and bears small nuts at an early age. There are several forms under each variety. With this limitation in genetic potential increased production can be achieved through manipulation of conditions of growth and development for the expression of the maximum yield potential of existing varieties. To do so would be to understand the ways of the plant first.

I. Coconut Nutrition

It has been said (Gardner, 1966) that no single factor is more important than the mineral nutrients obtained from the soil. Not only do these nutrients supply a necessary portion of the raw materials from which many organic plant substances are synthesized, but they also exert certain regulatory influences which determine the plant's response to the other features of the environment.

The data in Table 1 gives an idea of the depletion of nutrients from the soil by coconuts. Expectedly, fertilizer trial studies show increased nut production by fertilization. However, although these are significant responses they are not always sufficient to be economical. Further, there are instances where no clear-cut benefits are obtained. Some researches found that different levels of N have no effect on the coconut palm although there was an interaction which could bring about an increase in yield. Likewise it was observed that despite the reduction to a low level of phosphorous no response was brought about by the application of the deficient element. These disconcerting observations indicate that for maximum benefit from fertilization there should be a reliable index of the nutritional status of the plant as a guide for fertilization as well as thoroughly evaluated fertilizer formulations suitable for various localities under different environmental conditions.

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Table 1. :Quantities of plant food ingredients removed from the soil per annum

No.	N	P_2O_5	K_2O	Ca O	Mg O	Basis	Authority
	lbs/A	lbs/A	lbs/A	lbs/A	lbs/A		
1.	18	5	38	—	—	2,000 nuts per acre per year	Pillai, 1919
2.	57	26	85	—	—	From one acre per year	Jacob and Coyle, 1927
3	82	37	122	—	—	2,800 nuts per acre	Copeland, 1931
4.	66	27	123	15.7	28.6	Soil rich in plant nutrients	Georgie and Teik, 1932
5.	81	36	117	—	—	Annual removal from one acre	Eckstein et al., 1937
6.	24	12	60	—	—	Recommendation for annual addition	Patel, 1938
7	81 to 126	27 to 45	108 to 144	—	—	156 mature palms per hectare	Carvalho, 1947
8.	26	8	24	13.0	20.0	60 palms per acre with 25 nuts each per annum	Cooke, 1950
9.	49	24	75	42.1	18.5	70 palms per acre with 40 nuts each per annum	Pillai and Davis, 1963

Under certain conditions the nutrient applied is more available to the tree than under other conditions. This is no doubt due to the physical and chemical variations which exist between various soil types.

In coconut, the fertilizers are commonly supplied through soil applications. For other crops nutrient feeding through the aerial parts is being practised. Nutrients do penetrate the lipoidal layer which is the cuticle. P^{32} and Ca^{45} may be detected within the leaf cells 5 seconds or less after their application to the leaf surface. $MnSO_4$ applied to the foliage of soybean has increased the Mn content 30 to 40 fold in one hour. Nethingse remedied yellowing in coconut by forthnightly spraying of 1% $MgSO_4$. Foliar applications overcome the unavailability of the applied nutrient in the soil due to fixation and other conditions preventing uptake. One of the spectacular effects of foliar application is the greening of chlorotic leaves due to calcium or manganese-induced chlorosis. For coconut, the unusually tall habit may pose the problem of transport and this could be one of the factors responsible for the sluggishness of response. (Why are the dwarf varieties early-bearing compared to the tall ones? Why does it take 2 years before response to fertilization can be assessed?) The distance which separates the point of entry and site of utilization for the nutrient elements will be drastically reduced by foliar application. In this connection studies on uptake and transport of nutrients using radioactive tracers should be undertaken to establish whether height of the plant is indeed a limitation and also to establish patterns of uptake and transport which will be additional basis for fertilization practices.

Studies on the nutrition of coconut under controlled conditions such as in sand cultures should not be neglected. Further work should be done on the characterization of nutrient deficiency and toxicity symptoms for its more reliable use as a diagnostic tool. There is a dearth of information on this aspect. The limited work of Velasco and coworkers are about the only source of information on the deficiency symptoms of coconuts. Controlled studies would likewise give a more definitive picture about the complex problem of nutrient interactions.

II. Water Relations

Drought markedly reduces the size of nuts, the volume of nut water and the potassium content of the foliage. Yield per palm and number of nuts required to produce a ton of copra are related to the total rainfall in the current and previous years. Data from Malaya indicated a positive correlation between monthly copra production and the rainfall for a 3-month period, 7-9 months previous to harvest. In Ceylon a record yield of 150 nuts per tree per year was reported as a result of applying irrigation water to a coconut plantation. Not only is water important for trees in the field but also for growing coconut seedlings in the nursery.

III. Vegetative Propagation

Coconut has no known standard means of vegetative propagation and this is a major obstacle to the rapid propagation of selected varieties. With clonal propagation not only could superior palms be multiplied indefinitely but also would make available uniform plants for experimental purposes. It would reduce operation expenses for field trial tests by minimizing replications. The following observations can be the basis of clonal propagation in coconut: 1) production of suckers by splitting growing points, 2) reversal of spadices to form bulbils, and 3) foliation of flowers, that is, the reversal of the individual flower into a vegetative plant. As a result of splitting the apical bud as many as 8 shoots have been produced. It has been suggested that hormones, heat treatments, etc. be tried to induce the same effect on a large scale operation. There have been reports of palms producing bulbils in place of spadices. As soon as the spadices emerge out of the covering sheath most of them start developing into vegetative shoots. Some bulbils form roots even while attached to the palm. In one case it has been observed that hundreds of flowers have undergone transformation. Both male and female flowers are capable of the change. A tree with bulbils is known to occur in Davao. The importance of the above methods of clonal propagation falls into insignificance when compared to that of the techniaue of tissue culture. Tissue and cell cultures can result in the production of innumerable number of plantlets and these can be faithful reproductions of the parents.

IV. The Physiology of Reproduction

a. The onset of flowering

Bearing age in coconut varies with the variety; dwarfs are generally early bearers compared to the tall ones. Plants undergo a certain period of vegetative growth before they attain a stage of ripeness to flower. The duration of this juvenile phase is a characteristic of the species or variety. However, the duration can be modified or development can be accelerated to such an extent as to attain the necessary physiological development within a shorter period. Reduction in bearing age from 5-7 to only 3 years and 7 months have been reported by Mendoza and Prudente of Philcorin at Davao. From Jamaica comes a report of hastening the onset of flowering from 4 to 5 years, also through fertilization. From the literature there is wealth of information about the control of flower initiation in many species. There should be a deliberate and systematic study along this line for coconut. Firstly, shortening the vegetative period means an earlier recovery of investments and extension of the productive phase of the life coconut. Secondly, this may help explain and solve the so-called biennial bearing tendencies in some coconut groves, which makes yield forecasting difficult.

b. Control of sex expression

The coconut is a monoecious plant with the staminate flowers borne superior to the pistillate ones. These 2 flower types may occur in a certain ratio and since nut yielding potential is essentially determined by the number of female flowers, shifting the ratio toward femaleness might result in increased yield. Control of sex expression can also be directed to the synchronization of male and female development. Reversal from reproductive to vegetative conditions is another aspect. As mentioned earlier such reversal can give rise to bulbils which can be propagated into independent plants. Natural occurrences of the phenomenon indicate the existence of a natural tendency for the behavior, hence, induction by artificial means appears more likely to be successful. The artificial alternation of sex expression has been achieved in several plants through the application of growth regulators. Auxins increase tendency to femaleness, gibberellins to maleness. Cytokinins and inhibitors and retardants likewise can modify sex ratios.

c. Control of premature nut fall

Prevention of bottom shedding is one way of getting more nuts per bunch. Based on preliminary results Gangolly *et. al.* (1957) recommended 30 ppm 2, 4-D solution plus coconut water in equal quantities as a spray. Preliminary observations by Carlos and co-workers also indicate that gibberellic acid could prevent abscission of young nut. Control of the problem could mean a 300% increase in nut yield with the same number of trees (Mendoza *et. al.*).

V. Seedling Growth and Establishment

Photosynthesis starts to contribute assimilate to the plant at 4 months and by the 11th month supplies over 90% of the dry matter gain. Before this the seedling is dependent upon the haustorium. At transplanting, interruptions in water and nutrient uptake may occur; this in turn would adversely affect the photosynthetic capacity. Hence it may be preferable to transplant at an early age (*e. g.* 4-5 months) when the endosperm is still the major contributor to seedling growth.

Transplanting brings about considerable injury to the seedlings. Furthermore, the seedlings have to adjust from nursery conditions to the more severe field conditions. To prepare seedlings for the shock, treatment with transplanting-hardening agents like growth substances should be tried. The desirable side effects of increased seedling vigor and better fruiting and flowering behavior as a result of the treatment with growth regulators should be looked into.

VI. Physiological Diseases

There are a number of coconut diseases whose etiology is unknown. On the other hand the symptoms are suggestive of physiological nature. Example are: skirting, *boang*, yellowing, bronze leaf wilt and tapering.

Skirting disease is the term applied to the presence of overturned fronds hanging from the tree giving the impression of a skirt wrapped around the stem at the crown. It is the result of non-abscission of the mature leaves. A skirt may be constituted of from 22-342 overmatured fronds (Abad). Termites were reported to be found in affected trees. However it was concluded that skirting is caused by some other factors and that the role of the termites is just secondary. The disease being a manifestation of inhibition of abscission, should be studied from the standpoint of the physiology of abscission. Meanwhile removal of the overmatured leaves of the skirt may be done with the use of defoliants.

Boang (partially or completely empty) is another disease whose cause is unknown. In affected trees the production of *boang* nuts is about 2%. The disease occurs in the Tiblawan Plantation in Davao. According to dela Fuente, Tiblawan soil has a high content of nickel. Nickel content of the abnormal endosperm is higher than that in the endosperm of normal nuts from the same plantation. It was hypothesized by dela Fuente that nickel might be a cause of the abnormality.

Bud rot disease is characterized by the wilting and yellowing of the youngest leaf. When the first symptom appears the growing point of the coconut is already rotten. The disease has been shown to be caused by a fungus but recovery may be brought about by boric acid application. Investigation should look into the very incipient stages of the disease to establish whether infection is really the cause of the disease or that it is only secondary as a consequence of tissue degeneration due to boron deficiency.

Another probable physiological disease of importance is the general yellowing observed in some coconut groves in Mindanao. Occurrence is widespread in Davao and other places in Mindanao. According to Abad the results of field observation indicate that the problem is more of a physiological rather than a pathological problem. It has been reported by Felizardo and co-workers that fertilization could alleviate yellowing.

Bronze leaf wilt is also a physiological disease assumed to be caused by unfavorable soil conditions such as limited root penetration in shallow soils, water table too near the soil surface and drought. The symptoms do not usually appear until several weeks after flooding and drought. The lower leaves die, yellowing and brittleness progress from the oldest to the youngest leaves. If the condition persists the roots die and finally the growing point will rot and the palm dies.

Tapering disease is apparently caused by poor soils conditions. The trunk of the palm tapers below the crown giving it a pencil-shaped appearance. The leaves are short and stiff. The crown eventually dies resulting in the death of the entire palm. Tapering is associated with reduced absorption of nutrients which may be caused by a number of factors such as too little or too much water or by plant competition.

VII. The Cadang-cadang Problem

All too familiar is the controversial nature of the disease. Speculations involving virus and microorganisms as the causal agents will not be considered here. Pertinent to this paper is the nutritional theory of the disease as proposed by Velasco and co-workers. Their big problem, however, is their inability to establish the clear-cut identity of the toxic principle or even to induce the sypmtoms of the disease by application of the suspected element. Their case for a physiological nature of the disease is strong and pursuing this aspect further should be intensified.

Possible elucidation of the nature of the malady through anatomical investigations have been attempted. Velasco *et. al.* made some studies on the anatomy of normal and infected leaves and roots but found no significant differences. Rasa anticipating to find phloem necrosis in the shoot as expected of virus infected tissues was surprised to find necrotic areas only at the distal region but below the 2 mm-portion of the shoot apex. With the availability of functional electron microscopes in the country the ultrastructure of affected tissues should be studied. Probing the problem with electron microscopy may reveal the incipient effects of the disease as well as the presence of viral particles if present.

Instead of deploring the fact that the disease is far from understood despite the millions of pesos poured into the cadang-cadang project, scientists working on the disease should receive continuing moral and financial support.

INTERCROPPING SYSTEM IN COCONUT PLANTATIONS*

Introduction:

The topic of the paper I shall present this afternoon is a common and accepted idea among people familiar with coconuts. The practice of intercropping or growing of other crops with coconuts in the Philippines is very old as evidenced by the existing perennial intercropping practices in San Pablo City, Bicol, Cavite and Zamboanga. Nevertheless, it has not developed and expanded into a magnitude that would make an impact to the coconut industry. At most, the practice of intercropping with coconuts are in scattered patches or in localized communities within the coconut regions. Whatever knowledge our farmers have about intercropping with coconuts, have been the products of their experience through these years, with a minimum support from research results.

The only significant studies on intercropping are those of the BPI Tiaong Experiment Station using bananas, lanzones, coffee, and cacao as intercrops (Bartolome, *et. al.*, 1956: Mangabat, 1960). However a system akin to intercropping, which is multiple-cropping, has been well studied and has developed for Taiwan an advanced technology of intensive cropping that insures families a decent living from a hectare of land (Kung, ————). In the Philippines, its development through research got an impetus from Dr. Bradfield of IRRI. At present, UPCA and IRRI have on-going projects towards the maximum development of multiple cropping practice in tropical annual crops.

Whereas multiple cropping may be interchangeable with intercropping using some constraints, we shall use intercropping in our discussion to refer with some exclusivity to coconuts. I suppose the words multiple-cropping will lead us to some needless discussion, but, the word intercropping will mean familiar applicability.

The Problem:

There are about two million hectares planted to coconut in the Philippines today. While this is the largest area among coconut producing countries of the world, the yield is among the lowest. On the

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average, the Philippines produces a little over one-half ton of copra per hectare while the Ivory Coast averages 2.5 tons. This indicates that the average Philippine coconut farm gives a very low return per unit area. Consequently, the coconut farmer derives a very meager income. This disparity in production and income is attributed to, among other things, a general lack of efficient cultural and management practices in coconut farms.

The low income of a coconut farmer is aggravated by a relatively large family size (Pelaez, 1971). With the average yield of 42 nuts per tree and 124 bearing trees per hectare, a coconut farmer may get from his coconut only about ₱1,000 per hectare per year or even less as reported by studies in agricultural economics (San Lorenzo, 1965; Guerrero, 1969; Abarentos, 1972; Manto, 1972). With that income 32% of our coconut farmers are receiving not more than ₱2,000 per year from their coconuts, and 41% are receiving not more than ₱4,000 per year. Only about 20% of our coconut farmers may be receiving a decent income from coconut products. With the cost of living now, and the rising expectations, even the best home management expert would complain in making a decent living for 7-8 people out of ₱3,000 per year.

With the population explosion, a potential social problem could arise under the tranquility of that beautiful and versatile palm, if nothing is done to disturb the present equilibrium.

Proposed Approach in Attacking the Problem:

We propose to give more attenton to the life of a coconut farmer and his technology without sacrificing our attention to the life of the coconut. In all these years, most of our attention has been on the plant and its product. Let us now give a break to the coconut farmer, his technology and his environment. Let us develop a strategy that would harness his natural creativity with the help of science.

The Rationale of our Approach:

We have said that the general lack of efficient cultural and management practices contribute to the low income of coconut farmer. Although Felizardo (1972) has shown that plowing, cover cropping and fertilization either alone or in combination with each other would increase the yield of coconut trees, Nyberg (1971) indicated that most coconut farms use none or very little of these cultural practices. The present intercropping practices in coconut farms in Laguna, Batangas, Davao and other provinces can be used to remedy the situation. Intercropping, with its attendant cultural requirements, can provide the coconut trees with the cultivaion, weeding and fertilization operations needed to boost yield. For the farmer, this will mean a productive use of family labor, a bigger income from the coconut and a substantial income from his intercrop. For the country, this will mean a productive and healthy rural population, a stable and cheap supply of coconut and will generate a very viable intercrop industry.

Intercropping, as a method of increasing production, is relevant and feasible in the Philippines. The rapid increase in population and the decrease in productive agricultural lands due to infrastructure and subdivision developments, are exerting pressures towards the development of intensive agriculture with high income per unit area. The abundance of sunlight in the tropics, when coupled with improved cropping practices like weeding, cultivation, fertilization, irrigation, etc., can result in spectacular yields. These potentials are aided by the fact that more than fifty per cent of our coconut farms are cultivated by full-owners: seventy percent of our coconut farms are less than five hectares and ninety per cent of the coconut land area consists of farms which are less than 10 hectares, a size which is manageable and suitable for intensive cropping.

Intercropping under coconut is a profitable venture. A national survey[1] of coconut farms revealed that the net gain from intercropped coconut farms is more than twice those obtained from farms without intercrops. A study at the Bureau of Plant Industry in Tiaong, Quezon showed that intercropping increased both the yield and total farm income per hectare (Managabat, 1969). In his 7-year study, farms without intercrop gave a mean yield of 40 nuts per tree per year while those intercropped with coffee and cacao gave a mean yield of 55 nuts. Current data[2] reveal that Cavite farmers get an annual income of ₱3,000 per hectare from their coffee intercrop, those in Laguna, ₱5,000 from pineapple, and the Matalin Coconut Plantation in Lanao, ₱4,000 from cassava. Initial studies at the UPCA[3] show a projected income of ₱720 per hectare from a sorghum intercrop.

The above data indicate that a sizeable income can be derived from a coconut farm through intercropping. With the use of a developed intercrop technology, an annual income from intercrop of ₱1,000 per hectare per year can easily be attained. Assuming that 10% of the total

[1] Unpublished report, Dept. of Ag. Economics UPCA.
[2] Personal communications.
[3] ICPP Project, Department of Agronomy, UPCA.

coconut area in the Philippines is intercropped, an income of ₱200 million per year can be generated. However, the attainment of this objective depends largely on a systematic development and dissemination of intercrop technologies to suit the specific agricultural, financial and socio-cultural conditions in coconut farms of the country. Hence, the ten research projects on intercropping with coconuts are proposed for the next seven years.

The Proposed Research Projects:

The objectives of the proposed projects are:

a. To increase the income of small coconut farmers by increasing coconut yield and generating additional income from intercrops.

b. To maximize the efficient utilization of existing coconut lands, farm labor and operational resources.

c. To determine the most adapted intercrops and cultural management practices affecting productivity and profitability.

d. To evaluate the effects of intercrops on coconut yield under various intercropping systems.

e. To establish a mechanism for the eventual extension of intercrop technologies to coconut farmers.

The thrust of the projects is integration of researches. Screening of all possible intercrops with coconut, their appropriate cultural practices and the economics of growing them under coconut should be done, to assure a package of information when intercropping should be practised by farmers. In the process, we hope to develop a strategy for increasing coconut production and farmers' income, and a mechanism for its sustained development and successful translation at the farm level.

PROPOSED RESEARCH PROJECTS:

1. Survey of current coconut intercropping practices and systems and locate centers of intercropping technology. The study should evaluate:

   a) available literature and reports regarding intercropping with coconuts

   b) current intercrops and systems of cropping being used

   c) the cultural practices employed

   d) distribution of intercropping practices and market outlets of intercrop products

e) sociological and economic aspects of acceptance and non-acceptance of intercropping technology.

Results of this study shall provide important benchmark in the development of intercropping technology and strategy.

Agency: UPCA

Budget: ₱40,000

2. Studies on the microclimate of a coconut environment under different locations.

   Agencies: UPCA, PHILCORIN, Universities

   Budget: ₱150,000

3. Screening and selection studies of annual, biennial or short term crops for intercropping suitability with coconuts. The study should evaluate the suitable variety, yield, general performance and cost and return analysis, under medium level of fertility.

   Agencies: UPCA, BPI, PHILCORIN

   Budget: ₱100,000

4. Advanced field testing of suitable variety of intercrops under varying:

   a) soil fertility

   b) soil type

   c) soil moisture or rainfall

   d) plant population

   e) perecentage of shading or light intensity

   f) distancing and age of coconuts.

   The study should evaluate the yield and quality of intercrop products, treatment effects to yield and quality of coconut products and the cost and return analysis of the different crop and environment combinations.

   Agencies: BPI, PHILCORIN, UPCA

   Budget: ₱500,000

5. Studies on cropping patterns (relay, rotation, companion etc.) under the best crop-environmental factor combination found in 4.

   Agencies: BPI, PHILCORIN, UPCA

   Budget: ₱300,000

6. Pest, disease and weed control studies on the different intercropping systems in 4 and 5.

   Agencies: BPI, UPCA, PHILCORIN

   Budget: ₱180,000

7. Economic optimization of coconut farms' intercropping operation.

   Agency: UPCA

   Budget: ₱90,000

8. Pilot and comparative studies on selected perennial intercrops using optimum cultural and management practices for each crop.

   Agencies: PHILCORIN, BPI, UPCA

   Budget: ₱700,000

9. Provincial adaptive testing in pilot farms on actual production and management of economic size farm units using the recommended technologies for short-term intercropping systems.

   Agencies: PHILCORIN, BPI, BAE, UPCA

   Budget: ₱150,000

10. Development of personnel, Graduate training. Farm apprenticeship and live-in training programs for future intercrop farmers, change agents and technologists.

    Agencies: PHILCORIN, UPCA, BPI, BAE

    Budget: ₱198,000

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* Stipend only at ₱6,000 each per annum .

CATTLE-COCONUT FARMING IN MINDANAO*

Beef cattle raising under coconuts is here to stay. It had long been practised although at the start it was purely draft animals that were grazed.

A total of 103 cattle-coconut farms in Agusan, Cotabato, Davao del Sur, Davao del Norte, Davao Oriental, Misamis Occidental, Misamis Oriental, Zamboanga del Norte and Zamboanga del Sur, considered to be the nine leading provinces in cattle-coconut operations in Mindanao, were surveyed. The average length of operation of these cattle-coconut farms was 11.5 years with a range of 2-50 years.

The objective of this paper is to outline the existing management situation in cattle-coconut farms and discuss the potential for expanded production of these farms in Mindanao.

EXISTING MANAGEMENT SITUATION (1968)

Calving Percentage — Mindanao had a calf drop of 69.2 percent ranging from 54.1 in Cotabato to 80.3 percent in Agusan. Percent calf crop (weaned) was 55.4 for Mindanao, ranging from 66.7 percent in Agusan and 38.3 percent in Davao Oriental.

Mortality — The average number of total death was 5.61 heads per farm. Bull and heifer calves had the biggest mortality with an average of 2.6 and 2.1 head per farm or 46.3 and 37.4 percent, respectively. The average value of death loss was ₱961 with bull calves valued at ₱372 or 38.7 percent, heifer calves at ₱311 or 32.4 percent of the total. Average pre-weaning mortality was 17.2 percent ranging from 3.2 percent in Zamboanga del Sur to 6.4 percent in Misamis Occidental. Average post-weaning mortality was 1.3 percent ranging from less than one percent in Davao del Sur to 2.5 percent in Zamboanga del Norte. Pre- and post-weaning mortalities combined average 18.5 percent, ranging from five percent in Zamboanga del Sur to 28.8 percent in Misamis Occidental.

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Capital Investment — The average area per farm was 107 hectares with an average total investment of ₱1,011.00 per hectare. The average number of cattle per farm was 87, with a total average capital investment of ₱1,250 per head. The average number of cows was 36, with a total average capital investment of ₱3,022 per cow. The average number of animal units[1] per farm was 74, ranging from 5 to 559 and the average total capital investment per animal unit was ₱1,470 per farm.

Farm Income — Total income per farm amounted to ₱92,591. The biggest sale which amounted to ₱81,383 or 87.9 percent came from coconuts. The average number of cattle sold was 11.4 head valued at ₱5,283 or 5.7 percent of the total. Stock eaten was 1.4 head valued at ₱420 or 0.5 percent. Increase in inventory was 11.6 head valued at ₱5,410 or 5.8 per cent. Other cash receipts were valued at ₱95 or 0.1 percent.

Expenses — Total expenses per farm amounted to ₱76,367 of which 63.1 percent or ₱48,229 were cash and 36 percent or ₱28,138 were non-cash. The largest cash expense was for harvesting and hauling nuts and copra making which amounted to ₱10,963 or 14.4 percent followed by ₱9,479 or 12.4 percent of the total expenses for salaries and wages. Unpaid labor and management cost was valued at ₱14,576 or 19.1 percent; interest on capital investment at ₱11,151 or 14.6 percent; and interest on operating capital at ₱2,411 or 3.2 percent of the total expenses. Of the total labor utilized, 10 percent or ₱2,217 was unpaid in contrast to 90 percent or ₱9,706 for paid labor.

Labor Utilization — Total labor utilized was valued at ₱11,323 of which 74 percent or ₱8,860 was for the establishment and maintenance of the coconut plantations; 20 percent or ₱2,376 for care and upkeep of livestock; and six percent or ₱687 for pasture development and maintenance.

Classes of Stock Sold — The average number of stock sold per farm was 11.21 head of which 5.2, 2.9, 1.7, 1.4 head or 46.4, 25.9, 15.2, 12.6 percent of the total were steers, yearling bulls, cows, bulls and heifers, respectively.

Cost and Returns — Cash income averaged ₱86,761 while cash expenses averaged ₱48,229 leaving a net cash return of ₱38,532 per farm. Total income averaged ₱92,291 while total expenses was ₱76,367 leaving an average total net return of ₱16,224 per farm. Percentage earned on capital was 27.4. The average area per farm was 107 hectares. Total

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[1] one mature cow or bull = one animal unit; two calves of either sex = one animal unit; three yearlings = two animal units.

income per hectare averaged ₱865.31 while total expenses was ₱713.63 leaving a total net return of ₱151.68 per hectare. The average number of animal units was 74. The total income per animal unit was ₱1,254.21 compared to total expenses of ₱1,031.92 per animal unit, resulting in a total net return of ₱222.29. The average number of calves weaned was 23 per farm. Average total expenses per hectare amounted to ₱3,630.22 against an average total income of ₱4,025.68, the latter exceeding the former by ₱405.46 per calf weaned.

Classes of Pasture Area Under Coconuts — Pasture improvement received insignificant attention as evidenced by the predominance of natural grasslands. About 76.6 percent of 62.99 hectares of the average area utilized were natural grassland. Para grass (*Brachiaria mutica* 'Forsk.' *Stopf.*) on the average occupied 8 percent of 6.6 hectares, ranging from 0 to 300 hectares; guinea grass (*Panicum maximum* Jacq) occupied 4.9 percent or 4.04 hectares ranging from 0 to 197 hectares; legumes occupied 8.1 percent or 6.68 hectares, ranging from 0 to 200 hectares. Ferns were observed to occupy large coconut areas in Agusan. Shrubs and big stones were found in large coconut areas in Camiguin Island and Misamis Oriental, reducing considerably the available grazing area.

Available Land Area and Its Utilization — On the average a total of 107 hectares of land was available for pasture but only 82 hectares or 76.6 percent was actually utilized for cattle raising. From the total land area available, 15 hectares or 14.0 percent was not utilized as pasture because of the presence of young coconuts, other crops planted, and the limited number of cattle raised.

Causes of Death Loss — The first five common causes reported for pre-weaning deaths of 33 calves or 74.9 percent of the total were: eaten by dogs, 29.5%; parasitism 22.7%; calving difficulty, 9.1%; refusal of dam to be suckled, 6.8%; and, drowning or stuck-in-mud, 6.8%. The first five commonly known causes of post-weaning deaths which accounted for 31 animals or 8.4% of the total deaths of known causes were: strangled, 28.9%; parasitism 15.7%; fell into canal or ravines, 13.1%; drowned or stuck-in mud, 13.1%; and caused by neighbors and other people 13.1%.

Problems — From the list of problems mentioned by the respondents: lack of feed; pests and diseases; lack of chutes, corrals and proper fencing; lack of good bulls; lack of capital; and understocking represented 21.5%, 12%, 9.2%, 7.2%, 6.1% and 6.1% of the total respectively.

Solutions — The solutions offered by the respondents to their own problems put forage establishment and pasture improvement as the most frequently proposed. This was followed by extension of liberal credit facilities by the Development Bank of the Philippines, purchase of good bulls, installation of force pump or deep well, and finally soiling and pasture rotation.

Modifying Spencer-Schrader's conclusion, it could be said that "with the best feeding and management, even a herd of mongrel cattle will improve, but only up to the limits of their genetic make-up; while even the genetically superior breed of cattle in the world cannot help but deteriorate with poor feeding and bad management."

Beef cattle problems and improvements may be viewed as a jigsaw puzzle, each of which contributes to the completion of the picture of a more efficient beef production.

IMPLICATIONS

Generally, the capability of cattle-coconut farmers to pay their loans is much better than for a single crop or animal enterprise loan. The same amount of loan is expected to at least maintain coconut yield and increase beef production in the same land area.

The study reveals that the present livestock in coconut farms contributed, on the average, a total income per year of ₱11,119 or 12 percent of the total farm income even without government support.

On the average, a cattle-coconut farmer is not as financially hard-pressed as the farmer who operates either a beef cattle ranch or coconut farm alone. This is simply because he has two sources of income. This would also mean that they are satisfied with their present income from cattle. As such they do not exert a little more effort in trying to get better prices for their products. However, this does not preclude the fact that improved management and marketing could increase returns but these "complacent" cattle-coconut farmers are not aware of their hidden losses of unrealized potential income due to non-optimum use of improved management and marketing practices.

A cattle extension program appeared to be unheard of by most cattle-coconut farmers interviewed. Basic approved cattle husbandry practices were not known to at least 80 percent of the farms surveyed.

If there was any government agency that was responsible for educating cattle farmers it must not have reached the majority of the cattle-coconut farms at the time of the survey. The PHILCOA (Philippine Coconut Administration) appears to have done a lot towards improving coconut farms but this was for coconut interest alone. It would indeed be most appropriate if the PHILCOA could extend technical aid to cattle-coconut farms to enable coconut farmers to increase their net income not only from increased copra yield but also from a better cattle-coconut integration program. This can be done with both the small and big cattle-coconut farmers.

Short courses on cattle management patterned after the cattle production business executive course, should be offered to small cattle-coconut operators to update their technical know-how to develop farmer-to-farmer relationships as well as relationships between farmers and government instrumentalities for efficient production and marketing.

Pest and Disease Control — The Bureau of Animal Industry in cooperation with other government agencies, should extend basic disease control programs. State universities and colleges would also be able to do a good job in launching a progressive cattle extension program by holding extension classes for adult cattle coconut farmers.

CONCLUSIONS:

Cattle and coconut enterprises complemented one another and provided mutual benefits to each enterprise, through the application of proven basic animal and plant production techniques. Using four basic approaches in planning and budgeting returns on investment of cattle-coconut operations could be increased by 50 to 100 percent. These approaches are as follows: (a) improved management to attain a 90 percent calf crop; (3) plant and maintain improved pasture grasses to increase the present stocking rate to two animal units per hectare and also to improve the quality of animal produced; (c) increase the number of breeding stock by acquiring or retaining desirable animals through judicious selection and culling; and (d) improve the present marketing efficiency through cooperative marketing providing the producers with adequate price information and chanelling their products through proper market outlets.

Cattle-coconut enterprises increase the loan carrying capacity of an area thus providing more capital to enable ranchers to adapt better management and husbandy techniques which ultimately maximized the income per unit of land area utilized. Cattle production under coconuts illustrates the tremendous potential that the cattle industry can play in increasing the national food production through coconut agriculture.

Table 1. Farm resources, cost and returns and management efficiency of three-cattle-coconut farms compared, 1968

ITEM	FARM NUMBER Two	Nine	Ninety
Area, ha.	667	35	158
Ave. number of head	553	38	5
Ave. number of cows	415	25	118
Ave. number of animal units	391	36	41
Number of calves weaned	205	10	10
Calf drop, %	93	46	50
Calf crop (weaned), %	87	40	45
Mortality, %			
1. pre-weaning	5	16	16
2. post-weaning	0	0	3
3. total	5	16	19
Actual stocking rate, (hectares, animal unit)	1.7	1	4
Capital outlay, pesos	822,351	52,398	135,655
Ave. stock inventory, head	533(330,975)	38(17,770)	52(15,655)
Number of stock sold	174(118,360)	2(900)	1(400)
Labor utilization, % Establishment and maintenance of coconut plantation	9(3,666)	81(4,340)	74(24,000)
Establishment and maintenance of pasture	67(27,746)	none	7(2,200)
Care and upkeep of cattle	24(10,000)	19(1,000)	19(6,200)
Pasture area under coconuts utilized natural grassland	159	35	158
Para grass	300	none	none
Legumes	100	none	none
Total Income, pesos	891,370	33,440	116,116
Total expenses, pesos	646,510	22,082	88,879
Net cash return, pesos	303,537	13,660	42,340
Total net return, pesos	244,860	11,358	27,237
Percent earned on capital	30	22	18*
Guinea grass	50	none	none

* ₱3,000 unpaid labor and management deducted from net return.
Note: Figures in parentheses are values in terms of pesos.

"COCONUT COMMODITY" PROCESSING AND UTILIZATION*

Problem Areas	*Proposed Research*
I. Coconut has potentiality of a basic food ingredient but is not so utilized commercially.	1. Research and development on coconut as a basic food ingredient.
II. Present copra processing for oil is not suitable for protein recovery	1. Develop methods for manufacture of food grade copra.
	2. Develop methods for reducing fibrous component of coconut flour.
	3. Study the nature, structure and properties of fibrous component.
	4. Improve technology and economics of preparing protein isolates from coconut flour.
	5. Develop a low-cost version of the Mattil wet process for coconut oil-protein recovery.
III. Copra-meal has limitations as ingredient in animal feeds	1. Develop enzymic, microbiological, chemical methods of reducing fiber.
	2. Try "impulse-rendering" and other similar methods.
	3. Study nature of fiber.
IV. The saturated nature of coconut oil is alleged, when used as food, to affect health.	1. Study problem of saturated-unsaturated fats in diet in relation to health.
V. Miscellaneous Problem Areas	1. Utilization of coconut water and coir dust.
	2. Expansion of uses of coconut in cosmetics, soaps, perfumery, insect repellants.

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3. Improvement of uses of coco oil in baking fat, cooking oil, cacao-oil substitute in confectionery.
4. Expansion of uses for paints, varnishes, wood preservatives, plastics, industrial chemicals.
5. Utilization of coir fiber.
6. Uses of coconut shell.

I. Coconut has Potentiality of a Basic Food Ingredient but is not so Utilized Commercially.

A. Problem Area:

The coconut is a well-accepted food. Expanded utilization as food has received little attention. The money value of the coconut as food is much higher than that of copra. The coconut as a basic ingredient in the manufacture of foods is in its infancy. The one and only such food ingredient material currently commercial is desiccated coconut. From the foreign demand experience with desiccated coconut it may be concluded that other forms of coconut may well be equally exportable.

B. Proposed Research Projects:

1. Research and Development of uses of the coconut as a basic ingredient in manufactured foods.

II. Recovery of Food Grade Protein in the Processing of Coconuts for Oil.

A. Probem Areas:

The present copra-process results in protein containing copra meal which is unsuitable either for food or for recovery of food grade protein. Improvement is indicated by 2 approaches. The latest (1972) work on these are by Mattel *et. al.*, Texas A & M.:

(1) Improvement of the preparation of copra so as to produce "food grade" copra. The copra must be processed at "low temperature" resulting in food grade coconut flour. Problems are: (a) how to prepare economically in large scale, "food grade copra." (b) Currently prepared coconut flour is too "fibrous" for general use; however, protein separates or isolates from the flour appears to be satisfactory. The cost of production (Mattil, 1972) per kilo for coco flour is ₱1.10 from fresh

coconuts and only ₱0.33 from food grade copra. To produce protein costs ₱6.60/kg from fresh coconuts and only ₱2.20/kg from food grade copra.

SPECIAL NOTE: If food grade copra can be prepared commercially, the aflatoxin problem will be considerably diminished.

(2) Improvement of the "wet processing" of coconuts whereby the "milk" is pressed out and processed into oil and proteins. Since the process may be conducted at ambient temperatures, food grade protein may be obtained. Mattil *et. al.*, supported by some 1/3 million US dollars have worked out the methods and the economics which seem to be quite attractive. But, estimated capital for a "small" factory is $1,200,000 and for a really paying factory: $3,000,000.00.

B. Proposed Research Projects:

1. Development of commercially and economically feasible drying methods for large scale preparation of "food grade copra"; Any method based entirely on artificial heat is to be looked upon with suspicion, as uneconomic.
2. Development of methods to reduce the fibrous component of coconut flour, on a large scale at reasonable cost.
3. Basic study of the nature, structure and properties of the fibrous component of the coconut kernel.
4. Improve the technology and economics of preparing protein isolates from coconut flour.
5. For the wet-process, develop an improved "small" factory based on the Mattil experience, but requiring a much lower capital outlay.

III. Copra-meal has Limitations as Ingredient in Animal Feeds

A. Problem Area:

Use of copra in feed rations. Copra meal cannot be used in large proportions in animal feeds for non-ruminants. The problem is well known and sporadically studied with no satisfactory solution. Present-day food situation in the Philippines may not yet meet "unconventional" protein sources; it is still within most anybody's means to eat pork, poultry, eggs once in a while during the week. Animal protein is still the most desirable, hence conversion of coconut protein into animal protein (even at rather low conversion rates) is commercially profitable.

B. Proposed Research Projects:

1. Enzymic, microbiological, chemical and/or combination treatments to reduce fibrous component of the coconut kernel and of copra meal.
2. Use of "impulse rendering" and similar contrivances to destroy the fibrous component, presumed to be the cause of poor performance of copra meal as food.
3. Study of the nature, structure and properties of the fibrous component of the coconut.

IV. Coconut Oil in Foods. Quetions are raised as to possible ill-effects to Health because:

A. Problem Areas:

It is alleged by rival oil concerns that the predominantly saturated fatty-acid composition of coconut oil makes it less desirable in foods; it is alleged to be conducive to arterioschlerosis (hardening of the arteries). The polyunsaturated oils (corn, soy, peanut, rice, cottonseed, pili) are to be preferred. However, a theory of aging is very instructive and runs thus: Aging is due to the destructive effects of radiation (over which we have no control, but is all pervading) on the molecular organization of the vital body cells. Polyunsaturated oils are needed in order to meet the body's normal requirements for essential fatty acids. However it is these polyunsaturated that are vulnerable to radiation causing "free radical damage" and "mainspring in the aging process." There must therefore be an optimum amount of polyunsaturates since too little or too much can be harmful.

Food uses of coconut oil will gradually decline if the alleged ill-effects on health are not scientifically counteracted.

B. Proposed Research:

Determination of the optimum saturated: polyunsaturated ratio for good health.

V. A. Other Problem Areas:

B. Research Projects:

1. Utilization of coconut water and coir dust. Not much utilized at present and causes pollution.
2. Expand uses of coconut oil for cosmetics, soaps, industrial perfumery, insect repellants, etc.
3. Improve use of coco oil for cooking oil, baking fat and cacao-oil substitute in confectionery.
4. Expand uses of coconut oil for paints, varnishes, wood and fabric preservatives, plastics, industrial chemicals.

THE ECONOMICS OF COCONUT PRODUCTION AND MARKETING IN THE PHILIPPINES*

This paper discusses (1) the trends in area, number of trees, and production of coconuts in the Philippines, (2) regional changes in coconut production and hectarage, (3) coconut land-man ratios and labor productivity; and (4) marketing and trade. In addition, it provides a list of previous researches on the economics of coconuts including farm management, marketing, prices, demand, and others. The last part suggests some areas of future research in coconuts.

Trends in Area, Number of Trees, and Production of Coconuts in the Philippines

Hectarage — During the prewar period area grew at an annual rate of 1.9 per cent increasing from 531 thousand hectares in 1929 to 643 thousand in 1938. During the postwar period the growth in coconut hectarage was characterized by a moderate growth from 1948 to 1949, a very slow growth (almost level off) from 1950 to 1960 and very rapid increase thereafter, (Table 1). For the decade of the 1950's the area increased by

Table 1. Number of trees, area, and production of coconuts in the Philippines, 1953-1971.

YEAR	AREA	NUMBER OF TREES			Nut Production	PRODUCTIVITY PER	
		Bearing	Non-Bearing	Total		Hectare	Tree
	th. has.		*thousands*		*million*	*number*	
1953	990	115,197	34,099	149,296	4,182	4224	36
1954	990	126,774	37,526	164.300	4,603	4650	36
1955	990	126,813	37,537	164,350	5,321	5375	42
1956	992	126,851	37,549	164,400	5,504	5548	43
1957	992	126,851	37,549	164,400	5,951	5999	47
1958	996	132,000	33,000	165,000	5,974	5998	45
1959	1,006	133,264	33,316	166,580	6,041	6005	45
1960	1,059	133,759	33,350	167,109	6,016	5681	45
1961	1,200	149,031	36,051	185,082	6,195	5163	42
1962	1,284	167,138	30.497	197,635	7,396	5760	44
1963	1,392	183,357	28,311	211,668	7,704	5535	42
1964	1,483	191,392	40,744	232,136	7,222	4870	38
1965	1,605	185,300	59,610	240,864	7,052	4394	38
1966	1,611	185,174	55,564	244,784	7,090	4401	38
1967	1,820	189,157	54,507	243,664	7,925	4354	42
1968	1,801	185,960	66,471	252,431	7,412	4116	40
1969	1,845	195,205	69,258	264,463	7,244	3926	37
1970	1,884	215,151	57,284	272,435	7,745	4111	36
1971	2,048	238,432	58,569	297,001	7,814	3815	33

* Aida R. Librero, Ph.D., Assistant Professor, Department of Agricultural Economics, U.P. College of Agriculture.

only 0.7 or one per cent per year. However, for the period 1960-1970, it grew by 5.4 per cent per annum. The spurt in area planted after 1960 could probably be explained by the gradual devaluation of the Philippine peso and therefor a higher price for coconut exports.

Number of trees. From 1929-1938 the total number of coconut trees in the country increased from 101,527 thousand to 121,685 thousand while the number of bearing trees increased by more than 26 million trees. Foı the period 1929 to 1932 non-bearng trees remained at almost a constant level of about 36 million trees, increased slightly in the next two years but declined in 1935 and stayed at a level of about 31 million until 1938.

The total number of coconut trees increased by more than 24 million from 1948 to 1949 and by more than 42 million from 1950 to 1951. Then a decline of 30 million occurred from 1951 to 1952. The increase in the number of trees should come from new plantings and the decline from the removal either of old trees, diseased, or some other natural causes like typhoons. However, there is some doubt as to whether number of trees should really vary by such huge amounts from one year to another.

The trend in the number of bearing trees for the period 1953 to 197 may be divided into four periods: (1) the period 1953 to 1960 characterized by moderate growth in bearing trees, (2) rapidly increasing tree numbers from 1961 to 1964, (3) slight fluctuation from 1964 to 1968, and (4) a second period of rapid growth from 1969 to 1971. Ideally, there should be a lag in the growth of bearing trees and that of non-bearing trees. However, no relationship between the two seemed noticeable from Figure 1 which undermines the reliability of the statistics. It should be noted that bearing coconut trees constituted 77.1 per cent of the total number in 1954 and 1955, 71 per cent in 1956 and 1957, 80 per cent from 1958 to 1960. The proportions was variable for more recent years.

Production and Productivity. Production of coconuts had almost doubled between 1953 and 1971. It increased steadily from 4,182 million nuts in 1953 to 7,704 million in 1963 and then fluctuated between 7,000 and 7,900 million from 1964 to 1971.

Productivity was measured in terms of the number of nuts per hectare planted and per bearing tree. It was noted that the production of nuts per hectare was on the uptrend from 1953 to 1959 and then started to decline. Productivity per hectare was characterized by some fluctuations but in general the trend was downward. The production of 3,815 per hectare in 1971 was the lowest for the period. In terms of productivity per tree nut production has remained at the 36 to 47 range from 1953 to 1970 and then became 33 in 1971.

Typhoons have probably done considerable damage to coconut plantations but it is still a sad fact that we have not had a breakthrough as far as yield per tree is concerned. Low yields may probably be accounted for by lack of improved cultural practices on many of the coconut plantations. Coconuts are predominantly a small holder's crop and there is no evidence to suggest that farming methods which would influence productivity have been improved to any significant extent.

Coconut Land-man Ratios and Productivity per Worker

The number of farmers and laborers directly involved in coconut production is not known. However, the 1960 Census of Agriculture counted 440,252 coconut farms out of a total number of 2,126 thousand farms.[1] This number is underestimated since many other farms which had been classified other crops would very well be planting coconuts also. Over one million farms grow coconuts.

In order to get an estimate of employment in the agricultural sector of the coconut industry, annual agricultural employment was multiplied by a constant proportion of 20.323 per cent (Table 2).[2] From 1956 to

Table 2. Coconut land-labor ratios and production per worker, 1956-70.

Year	Agriculture[a]	Coconut Farms[b]	Coconut Land-labor Ratio	Productivity[c] Per Worker	
				kgms.	Pesos
	thousands		hectares		
1956	4,523	919	1.08	1,286	278
1957	4,597	934	1.06	1,470	321
1958	4,854	986	1.01	1,369	342
1959	4,874	991	1.02	1,132	258
1960	4,806	977	1.08	1,144	399
1961	5,073	1,031	1.16	1,096	317
1962	5,426	1,103	1.16	1,286	406
1963	5,317	1,081	1.29	1,439	543
1964	5,376	1,091	1.36	1,421	606
1965	5,267	1,070	1.50	1,433	628
1966	5,787	1,176	1.37	1,324	656
1967	5,824	1,184	1.54	1,402	745
1968	5,181	1,053	1.71	1,345	774
1969	5,300	1,077	1.71	1,448	804
1970	5,419	1,101	1.71	1,568	1,156

[a] Crisostomo, C. and R. Barker, "Growth Rates of Philippine Agriculture, 1948-1969," Paper presented for the conference on 'Comparison of Agricultural Growth Rate in Japan, Korea, Taiwan, and the Philippines," East-West Center, Hawaii, Sept., 1972, Appendix Table A13.

[b] 20.323 per cent of agricultural employment.

[c] Sum of copra and desiccated coconut.

[1] The Bureau of Census and Statistics defines coconut farms as those farms in which the area planted to coconuts is equal to 50 per cent or more of the total cultivated area.

[2] Proportion of coconut to total of farms in 1960.

1960 the member of workers in coconut farms increased from 919 to 977 thousand, an annual growth rate of 1.3 per cent. The rate of growth for the period 1961 to 1970 is only 0.6 of one per cent representing only 70 workers added to the 1961 labor force in coconuts.

Table 2 also presents coconut land-labor ratios and productivity per worker both in physical and monetary terms. On the average one worker had more than one hectare of coconut land; in 1970 he had more than one and a half hectares. The land-man ratio increased from 1.01 to 1.71 hectares from 1958 to 1971 indicating that coconut land areas was growing more rapidly than employment.[3]

The quantity of coconut produced in any given year depends among other things on the number and age distribution of bearing trees, the amount of rainfall in the previous year, typhoons and cost of production.[4] Thus, for any given employment in coconuts the productivity per worker would also depend to some extent on these factors many of which are beyond his control. The physical productivity per worker employed in coconut farm varies, with the lowest 1,096 kilograms in 1961 and highest 1,568 kilograms in 1970. The productivity in monetary terms naturally depends on the price which for the period under study was highest in 1970.

Marketing and Trade

Between the farmers and the processors are the various intermediaries through which coconut products pass. The Philippine Coconut Administration estimated approximately 10,000 barrio buyers of coconuts in 1965. During the same year, there were about 3,000 licensed and 1,500 unlicensed municipal buyers. The barrio and town buyers are those operating in the barrio or town and are usually financed by dealers, traders, or exporters in the upper part of the market structure. The barrio buyers usually do not own a warehouse and sell their copra immediately.

In addition to the barrio and town buyers there were 25 copra dealers located in a terminal market. The main function of the copra dealers is to aggregate copra into a larger volume for sale to exporters and processors

With about 440,000 coconut farms it appears that about 100 farmers sell coconuts to every barrio buyer indicating a relatively strong position

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[3] It is possible, however, that the pre-1960 estimates of agricultural employment in the coconut industry were overestimated while those for the post-1960 period were underestimated since there could have been an increase in the proportion of coconut to total farms.

[4] See Librero, A. R. "A short note on Production Relationships for Coconuts" (unpublished) and Nyberg, A. J., *The Philippine Coconut Industry,* Ph.D. dissertation, Cornell University, 1968.

of the buyer. The buyer's posiion is generally strongest in areas which are poorly served by transport, where it is frequently true that the farmer confronts only one seller.[5]

The concentration of the buyers with respect to the farmers indicates the potential existence of monopsony power. Farmers usually sell to regular buyers and if they do they seldom receive top prices for their copra. Oftentimes they are indebted to the buyer through previously extended credit in either cash or commodities. In such situations, price or weight is often shaded and the seller has little alternative because of the selling commitment made at the time credit was extended.

The largest disparity between the number of farmers and the number of traders is reflected in the average income of the two sectors. Hicks[6] estimated that the average income per farm where coconuts were the main enterprise was ₱1,312 in 1965. The gross income of the marketing sector was the value of output of the farm sector plus the value added by the marketing sector which was about ₱982 million. Shared among 14,000 domestic traders, this yields an average gross income per trading enterprise of ₱70,000.[7] Taking only the value added of the marketing sector, the average income per trader is about ₱16,000.

Despite this disparity, however, the coconut industry may still possess competitive elements. Competition exists between buyers of copra, between oil processers and desiccators, between and among oil millers and copra exporters, as well as in world markets with other suppliers and other products.

The efficiency of the marketing sector is difficult to measure. Marketing margins had been large. One factor that may explain this high marketing cost is the method of buying copra from the farms. It is alleged that copra producers do not have incentives in producing high quality copra as the buyers dictate the grade of copra and the price for that particular grade. In a study of 132 farmers in Quezon it was found that the price paid by buyers to most of the copra producers was based on the corriente classification. Therefore farmers whether they sell high or low quality copra, are paid the same price.[8]

Aside from automatically classifying all the copra into corriente, copra buyers deduct two kilograms for every sack of copra purchased.

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[5] J. L. Hicks, "The Philippine Coconut Industry: Growth and Change, 1900-1965." Center for Development Planning, National Planning Association, Field Work Report #17 June, 1967.

[6] *Ibid.*

[7] This assumes that there is no reselling among traders which may not be true but the effect of reselling within the marketing sector is to raise still further the average gross income. *Ibid.*

[8] P. G. Lapid, "A Study of the Marketing of Coconut and Copra in Selected Towns of Quezon Province," Undergraduate thesis UPCA (1968) p. 21

This is supposed to be the equivalent of an empty sack which ordinarily weighs approximately 1.5 kilograms or less.[9]

Recto[10] reported that a reduction in the marketing margin would result in a reduction in the oil and meal prices. If the margin declines by, say, $10 per metric ton, coconut oil price would decline by about $8 per metrc ton and the copra meal price by $10 per metric ton. With no shifts in the oil and meal demand function this could result in increased consumption both in the domestic and foreign markets and a better position for coconut oil and copra meal in the world market. Furthermore, this necessitates larger copra crushings, also benefiting the processing sector. Crushing mills in the Philippines have been operating below capacity. In 1970, 20 of the coconut oil extractors had a rated capacity of 1,380 thousand tons[11] of copra but processed only 760 thousand tons[12] implying that only 55 per cent of total capacity was utilized.

There are so many substitutes for coconut oil that sustained periods of high prices are less likely to occur. Due to the inelastic demand for coconut oil, an increase in the total supply of fats and oils would likely result in a large drop in the price of coconut oil. The industry, therefore, should explore avenues of cost reduction not only in marketing but also in production and processing.

Structural changes in demand for oils in importing countries have been taking place partly because of the interchangeability characteristic of these products. A number of oils can be used interchangeably in the manufacture of many food and non-food products. Cottonseed oil, for instance, has largely replaced coconut oil in the manufacture of margarine, and the increasing supply of soybean oil in the United States has affected a rise in its utilization in shortening.[13] In addition, soybean oil is presently used to a much greater extent than before in margarine and other food products. Soybean and cottonseed production is increasing quite rapidly particularly in the U.S. where most of our exports are sold. Moreover, these products benefit from agricultural support policies a continued extension of which might have severe consequences to the coconut industry of the Philippines.

Sunflower seed oil also substitutes for coconut oil especially in European countries. Trade in this oil increased nearly 15 times from 1957 to

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9 *Ibid*, p. 24.

10 A. E. Recto, "An Analysis of the International Demand for Philippine Coconut Products," Unpublished Ph.D., dissertation, University of Minnesota, 1971.

11 United Coconut Association of the Philippines, *Coconut Statistics*, 1970, pp. 169-170.

12 United Coconut Association of the Philippines, 1971. pp. 102-103.

13 Food and Agriculture Organization of the United Nations, Coconut Situation, Nos. 18 (1969) and 22 (1970).

1967 and is still increasing. The Common Market imports of this oil have jumped from 24 thousand metric tons in 1950 to 1968 thousand metric tons per year in the 1960's bringing sunflower seed oil into much closer competition with other oils.

Technological developments in the preparations of many oil-using products have increased the interchangeability of vegetable oils. However, it would not be correct to conclude that substitutability is infinite especially between coconut oil and other vegetable oils. Coconut oil has unique properties not possessed by other oils and its presence in many final products is required. An example is in the manufacture of high-lathering soap which requires a minimum amount of coconut oil.

No analysis has been made with respect to competition with petroleum derivatives in the manufacture of synthetic derivatives. A study done by Hicks[14] indicated that anticipated loss in the U.S. detergent market is equivalent to a fall in Philippine exports of 7 per cent. There is no indication that a similar process will occur in Europe or even in Canada and the expansion of the European market may more than compensate for contraction in demand for synthetic detergents.[15]

The demand for coconut products is inelastic price which implies that a rise in price would increase the revenue and a lower price would lower the revenue unless demand increases. However, if the higher price persists this will encourage substitution. Due to the elasticity of demand a small change in supply would bring about a large change in price. This price instability has implications on the revenue not only of producers but also of exporters.

Another factor which would significantly effect demand and trade is government protectionist policies exemplified by tariffs and quantitative restrictions. These policies have important consequences to a major export product. Trade barriers maintained by the importing developed countries impede imports from the less developed countries and would affect the pattern of international trade. For coconut products, tariffs discriminate against coconut oil thus making copra the economic choice for importation.

By 1974 all the coconut oil exports of the Philippines to the U.S. will be subject to a one cent per pound tariff or approximately $22 per metric ton. This policy will affect primarily the coconut oil sector, however, because of the interdependence among the markets for coconut products, there will be spillover effects in the other sectors. The imposition of a

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[14] *Op. cit.*
[15] *Ibid.*

fixed tariff on a commodity causes a parallel shift in the export demand function by the amount of the tariff, that is, at any given price, importers will be willing to buy a volume which is less than before. The effect of this policy can be viewed as an increase in the effective purchase of the importing country but a reduction in the effective selling price of the exporting country. The impact of a tariff on coconut oil can be analyzed as follows: a fall in the price received by exporters (but an increase in the price paid by importers) of coconut oil, an increase in the price of copra meal, a reduction in the quantity of copra meal and coconut oil exports, a fall in copra price and an increase in copra exports.

Research areas:

1. Costs of marketing coconuts.
2. Market structure of the coconut industry.
3. Prices of copra, coconut oil and other coconut products.
4. Competition between coconut oil and synthetics.
5. Utilization of coconut products in the Philippines and exporting countries.
6. Location and efficiency of coconut oil mills.
7. Marketing arrangements with other exporting countries and/or with importing countries.
8. Supply projections for coconuts.

MARKETING AND DISTRIBUTION OF COCONUT PRODUCTS*

Many agricultural researchers and even policy planners are prone to argue that this research project or that policy is designed to benefit the farmer. Of course, the term farmer is a very relative term in a society where some form of social mobility has thinned the borderlines of description.

Who are the coconut farmers? This appears a pertinent antecedent to a paper on the marketing of farm produce. Does he live on the farm, manages: his farm, actually harvest or supervise the harvesting of his products, personally market his produce, personally gather information with which to bargain for a better price for his product and hence increase his overall income?

Let us look at the real situation so that relevance in our research efforts are present. This is what the coconut farmers association. Philippine Coconut Producers Federation say:

> Coconut farms are uneconomically small: 65% are under 4 has. 32% are over 4 has. but under 20, with both categories composing 97% of the total coconut hectarage. These farms are mostly owned by middle-class entrepreneurs, government employees and professionals, whose *off-farm* incomes are bigger than their earnings from coconuts. The farms are occupied by coconut farmers or workers (or by owners themselves) under a 30-50% sharing contract for the occupants whose non-coconut incomes from poultry, vegetable raising, casual employment, or minor trades adequately complement their coconut sharing earnings.
>
> The coconut farmes' major effort is concentrated largely on harvesting. There are 6-10 harvesting cycles annually at no more than 6-10 days per cycle per land parcel, leaving more than 200 days of the year free for non-coconut activities. Yet the work connected with harvesting, like picking coconuts (sungkit), husking (tapas), and even hauling is further sub-contracted to barrio "specialists" ("sungkiteros", "tapaseros", etc.).

* Leonardo F. Ignacio, Jr., M.A., United Coconut Association of the Philippines (UCAP).

There is a special and peculiar inter-relationship between and among (a) the coconut land-owners, mostly small entrepreneurs and employees, (b) the coconut land occupants or contractors, and (c) the sub-contractors, or barrio "specialists." The coconut land-owner, who uses his *off-farm* income to meet the immediate needs of his family, views his farm income as insurance and/or pension for his old age. The occupants or contractors, on the other hand, regard his coconut-sharing income as his base earnings, to be augmented with his income from *non-coconut* activities. In the meantime, the sub-contractor or "specialist" is busy all over the barrio contracting the harvesting chores of different land parcels. While all three categories subsist partially or fully on coconut income, not one category can be expected to invest on coconut lands increase productivity. Under such a system, coconut production and productivity are sacrificed for immediate and short-term returns.

The proliferation of coconut lands into uneconomic sizes must be stopped and program of reversing the trend towards consolidation into economic-sizes operations launched.

As you will notice from the paper of George L. Hicks (*The Philippine Coconut Industry: Growth and Change*, 1900-1965. Working Papers, National Planning Association, 1967. U.S.A.) there is no statistical delineation as to whether coconut landowners are resident or non-resident or whether they directly or indirectly manage their farms. Obviously, this shortcoming is due to the lack of primary data from Philippine sources. Two of the few extant sources in this field we know are E.T. Castillo's paper ("*Who is the Filipino Farmer?*" presented at the symposium: In Search of Breakthrough in Agricultural Development, 1971) and the unpublished M.S. thesis of A. Bernal ("A role of landlords in Philippine Agricultural Development. An exploratory study," UPCA, 1967) which contends that "the decisive factor in sharing arrangements is the method of crop disposal by contract sale of nuts with husk or by husked nuts in the case of suppliers to desiccated coconut factories and copra in the general trade channels of copra exporters and coconut oil millers, as these systems determine the contribution of the tenant's labor to production."

CORRELATION BETWEEN LAND TENURE AND MARKETING

The "worker-families" while partially deriving their incomes directly from coconut production, substantially earn more from short-crops planted under the coconut trees. Legally obligated to share their short-crop incomes, the worker-families are not made to do so by the owner-families.

Their subsistence needs are taken from the farm (cooking oil, "gata", bananas. cassavas, "camotes", vegetables, etc.). The owner-family, especially in the Southern Tagalog region, merely gets its share from coconut products and pays the taxes to the government. Additional plantings and expansions fertilization, plowing, pest-control, and other improvements in the farm are paid by the owner-families.

The social relationship between the two groups is truly social. It is more democratic, and in many cases, familial. It is not unusual, especially in the Southern Tagalog provinces, for owners and workers to be "compadres."

The man-hour investment of the worker-families in direct coconut production, while small, assures them of enough cash untill the next harvest season, at the same time allowing them enough time for off-farm employment or other non-coconut production connected with farm ventures like piggery, poultry, vegetable raising, etc.

There is no tenancy in coconut areas in the sense of tenancy as practised in rice and corn regions. The coconut worker-families are mere "guardians" of the trees. By the very nature of coconut farms, "no-cost" housing areas are available to the workers, in contrast to other agricultural sectors where housing areas (ghettos, actually), must be limited to the fringes and non-usable portions of precious lands that must yield rice, sugar, corn, etc. One only needs to make the most superficial occular inspection of coconut lands to see the proliferation of "no-cost" housing areas under the coconut trees.

The major effort of the worker-families is the harvest of the ripe nuts ("sungkit"), the gathering of nuts ("pulot"), the husking ("tapas"), hauling and, either final sales to desiccated factories as dehusked nuts, or conversion to copra (where desiccated factories are not present) by either the sun-drying or the open-kiln drying ("tapahan") system, or a combination of both. The copra is then sold to the buyers and sharing is done depending on the conditions of the area, accessibility, etc., but in most cases from 33-1/3% to 50% of sales goes to worker-families.

In cases where the worker-family is under sharecrop arrangement, it usually sub-contracts the harvesting chores which are paid from the worker-family's share of the harvest.

The owner-worker-families are facing eventual displacement. Presently enjoying the highest agricultural wages (₱1 to ₱2/hr. as against the ₱3.50/day paid to the "sacadas"), these happy people will soon run out of options. The inexorable effects of population explosion will double the farm population in the next generation. As owner-worker-families proliferate, coconut lands will be further fragmented into uneconomical units which will simply deteriorate with the inability of the coconut people to put in the necessary time and money for rehabilitation. The only way to reverse this undesirable trend is to consolidate small parcels of lands into more economical sizes of 50 hectares and above, under a cooperative management system or corporation.

The alternative to this is to tap the small advantages presently enjoyed by the coconut people so that a long range forced-savings plan can be established to generate funds for a mass-based corporation owned and run by all coconut people. The funds will be used to establish processing plants for semi-finished and finished goods, to invest in collateral and support enterprises, etc., which will absorb the excess manpower of the future coconut population. This was the estimate which led to the passage of R.A. 6260 or Coconut Investment Fund to capitalize the ownership of coconut lands almost akin to the method by which land reform was introduced in Taiwan so that the harsh effects of an abrupt land-to-the-tillers program in coconuts would not take place and disrupt the gross national income. from coconut products in the interim.

COST OF PRODUCTS PREPARATION

SUN-DRYING (Mindanao conditions) — The worker-families are paid on the basis of ₱30 to ₱40 per ton. A good copracero can process a minimum of one ton of copra (8% water) per week. His man-hour investment on the basis of one ton copra requiring 4,000 nuts is as follows:

1st day splitting	— 8 hours
2nd day, "tadtad," "laguit"	— 8 hours
3rd day, " "	— 8 hours
4th day, drying	— 1 hour in the morning to spread meat 1 hour in the afternoon to pile and cover meat
5th day, "	— (same)
6th day, "	— (same)
7th day, "	— (same)
TOTAL	— 32 hours — ₱40.00 (₱1.25/hr.)

"TAPAHAN" (kiln-drying) — under a sharecrop system, the worker-families normally process the nuts into copra. The earnings on the basis of 4,000 nuts to produce one ton of copra may be computed as follows:

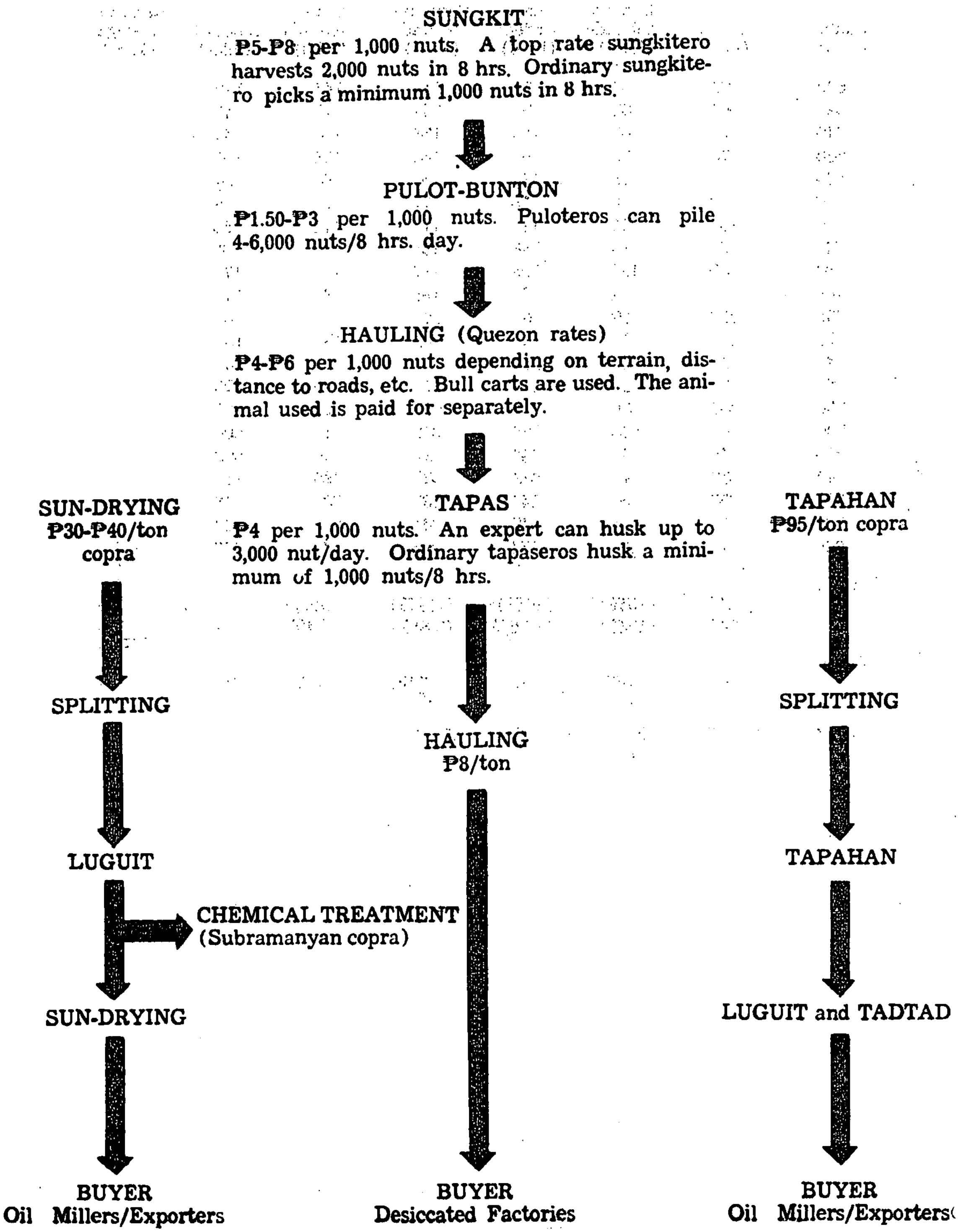
(The worker-family can process a minimum of one ton of copra in one week)

Sale of one ton of copra	—	₱500.00
1/3 of gross sales	—	166.66
Less: cost of harvest, hauling & tapas on the basis of ₱18/1000 nuts x 4	—	72.00
		₱ 94.66 (earned in 48 hr. wk. or ₱1.97/hr.)

N.B. The above computations are based on the minimum farm site price of ₱50/100 kgs. copra.

The worker-family may or may not be involved in the coconut harvest (Southern Tagalog conditions, specifically the San Pablo-Tiaong areas). For staying in the land (usually with 400 cocnut trees), and cleaning the groves once or twice a year, he gets 1/7 of the net after sales. The harvesting is done by contractors, more or less the "specialists" of the barrio informally organized into "work-guilds."

WORK-FLOW, PAY-SCALE and MAN-HOUR COCONUT PRODUCTION



EQUIVALENTS OF COPRA IN COCONUTS

Number of nuts	Corriente (kilos)	Corriente Mejorado (kilos)	Buen Corriente (kilos)	Buen Corriente Mejorado (kilos)	Semi-Resecada (kilos)	Resecada (kilos)	Resecada Bodega (kilos)
600	162	157	152	148	144	136	
620	167	162	157	153	149	141	
640	172	167	162	158	153	145	
660	178	172	167	163	158	150	
680	183	178	172	168	163	154	
700	139	183	178	172	168	159	
720	194	188	183	177	172	163	
740	199	193	188	182	177	168	
760	205	199	193	187	182	172	
780	210	204	198	192	187	177	
800	216	209	203	197	192	182	
820	221	214	208	202	196	186	
840	226	220	213	207	201	191	
860	232	225	218	212	206	195	
880	237	230	223	217	211	200	
900	243	235	228	222	216	204	
920	248	240	233	227	220	209	
940	253	246	238	232	225	213	
960	259	251	244	237	230	218	
980	264	256	249	241	235	222	
1000	270	261	254	246	240	227	222
Discount							
	(20%)*	(15%)*	(10%)*	(7½%)*	(5%)*		+.2%
	(25%)	(19%)	(13.6%)	(9.8%)	(7.4%)		+.5%
Moisture							
	28%	23%	18%	15.5%	13%	8%	6%

SOURCE OF DATA: Philcoa and Industry Members.

MARKETING & CREDITS

When the farmer sells his copra and when the buyer in turn pays this farmer, the last rank of the coconut marketing ladder has been reached, the last deal consummated. For the farmer is at the bottom of a huge pyramid; he is the last participant in a long series of buying and selling So that, when the farmer sells his copra, he also gets the lowest price for he is the last recipient in a long series of profit-taking, and, therefore, of a long series of lowering of price.

The farmer sells to the barrio buyer. The barrio buyer sells to the town buyer. The town buyer sells to the exporter. The exporter, through his local and foreign brokers, sells to the processing industries of fully-developed United States and Europe. The whole trade rests on the ability of the buyer to depress prices. Being the last seller, and having the least say in setting prices, the farmer gets the lowest price.

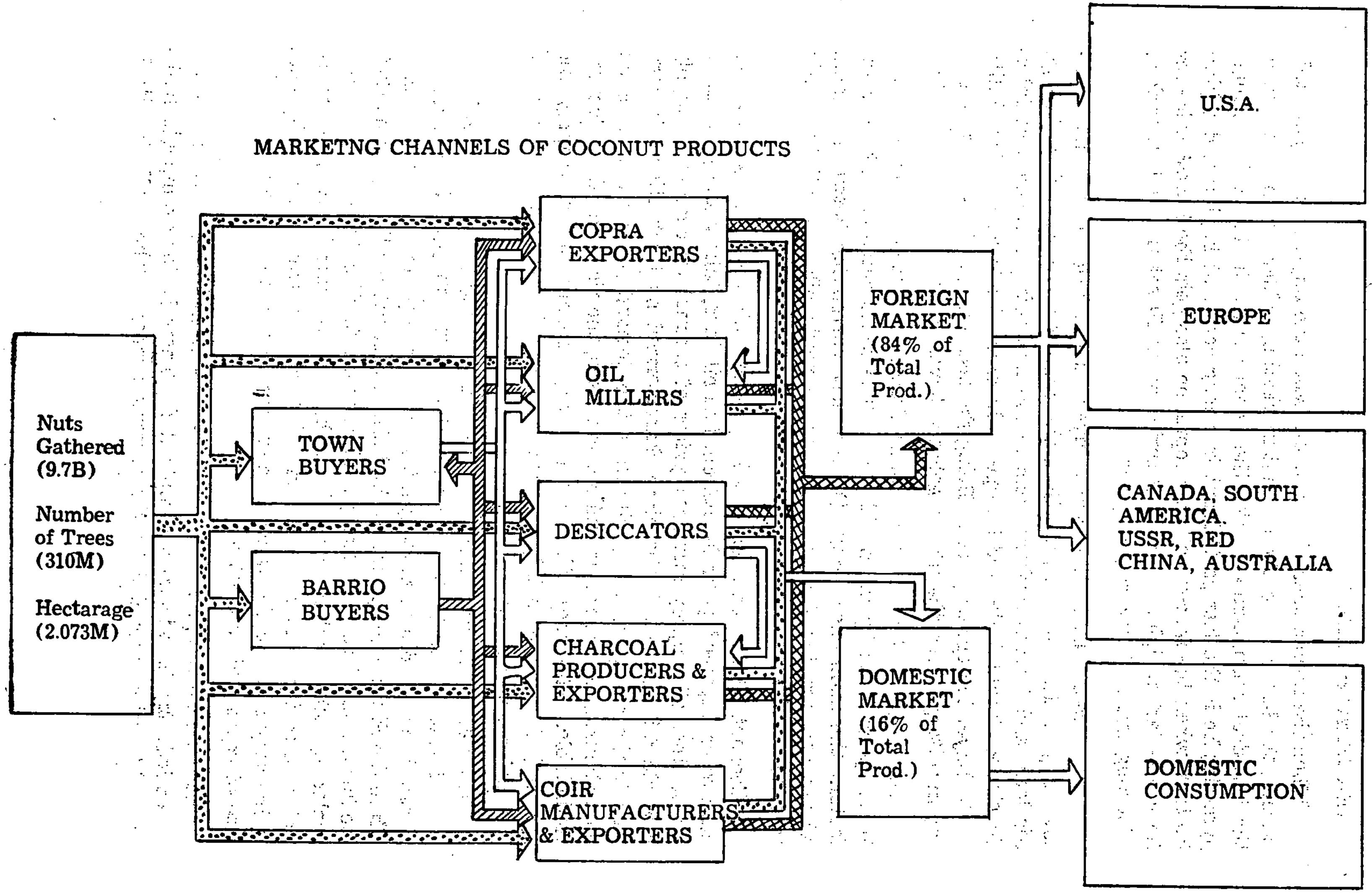
The price leader in the coconut domestic market is Manila. The Manila price is set by the world price. The world price is set by several factors, the main ones being: (1) the close correlation between coconut oil and other major oils, or, the supply of world oils, and (2) the world demand for oils.

Coconut oil can be substituted by other fats and oils like soybean, sun-flower, rapeseed, palm kernel oil, fish oil, lard, tallow and groundnut. When other oils supply increases, prices of coconut oil decrease. Supply of world fats and oils is therefore characterized by fluctuation. In contrast to the changing supply situation, the demand situation is inelastic: the industrial needs for fats and oils are fixed, the rise and fall of demand predictable. The interaction of these two economic factors (supply and demand) determine mainly the fluctuations of world prices which in turn determine domestic prices.

The factors briefly outlined above bring to light a characteristic aspect of trade in underdeveloped countries. The Philippine coconut industry is not a direct participant in all the aspects of world trading. While the Philippines produces the bulk of coconut for the world market, she has a limited participation in actual world trading because she is restricted by other factors over which she has no control. And yet these factors directly influence the domestic price systems. The Philippines is, in every sense of the world, a mere supplier of raw materials, in this case of copra and coconut oil.

It must be recognized that the present marketing pattern of the coconut industry is extremely complicated. There is, for example, a built-in credit system provided for the coconut farmers. The credit facility is

MARKETNG CHANNELS OF COCONUT PRODUCTS



oriented towards meeting the actual needs and situation of the coconut farmer. The buyer, for instance, can give money for the farmer's needs like his children's tuition fees, or a town fiesta for which the farmer must prepare a feast. The buyer can also give credit in kind, like medicine, housing material, etc. The credit is granted without formalities. No papers are signed, for in most cases credit is extended on the mere word of the farmer, his *palabra de honor.*

Coconut marketing defies the normally-accepted concepts of merchandising. Ordinarily, when a person buys his radio, or his sewing machine, he may pay the merchandise in cash, or may pay under an installment plan of 30 to 60 days, or 90 days. In contrast to this normal arrangement, when a farmer sells his copra, it is usually 30 to 60 or 90 days paid for in cash, and in advance! The ultimate buyer abroad pays the domestic exporter for what he has contracted *before* he even receives his copra. The local exporter gives the money to the town buyer, which in effect is advance payment for copra. The town buyer in turn advances the money to his buyer in the barrios, who in turn pays the farmer for the copra he still has to produce. While this pattern is not true for *all* domestic traders, the "safe" trader (the "segurista") operates along this line: contact, cash advance, buy and deliver.

This complicated method of passing money from hand to hand results in another peculiar aspect of the coconut market. The domestic market is slow in reacting to price increases abroad, whereas a price fall abroad is immediately reflected in a lowering of local prices. World market prices seep down to the domestic producer through middlemen and he gets his share of the profits only after the middlemen have taken theirs.

There are advantages that can be cited in the present system of marketing copra. These are, however, cancelled out by the other inadequacies and inefficiencies of present marketing facilities, the additional costs of which are left to the coconut farmer to exclusively shoulder or absorb, by the principle of "passing the buck."

The present man-handling rate of loading export vessels is only 10 tons of copra per hour. No less than $1,000 are used for daily operations of copra vessels which must travel from port to port in a period of 30-45 loading days. In contrast, unloading rate in Wesern markets is 600 tons per hour.

Coconuts are mostly grown in coastal and mountainous areas usually inaccessible except through third-class roads or trails, or through dialapidated boats and barges. Except in certain well-developed areas, like for instance in Southern Luzon, the cost of domestic transport is high (it is cheaper to ship cattle from Australia to Manila than from Mindanao to

Manila). To further compound the problems, our domestic copra marketing flow indicates an unnecessary movement of coconut products from the provinces where they are produced, to ports and areas where sometimes *no* coconuts are even grown like Manila and Cebu, but where domestic prices paid are highest. In times of abnormal price situations, coconut products even move from Cotabato to San Pablo City for processing. Here again, the coconut farmers "foot the bill" for this movement, thereby getting less for his product. The price disparities between regions in the country has been caused by inadequate port facilities (or complete absence of ports), lack of processing plants in the area, lack of adequate road systems, etc. Based on an average price disparity between price leaders like Cebu, Manila, Davao and the other depressed price areas like Jolo, Cotabato, East Davao, Mindoro, the Bondoc Peninsula, etc., and assuming a minimum disparity of ₱3/100 kgs. of copra (or its equivalent), and further assuming a normal production of 1.8 million tons a year, the coconut farmer, because of present marketing deficiencies, is further penalized by failing to earn no less than ₱54 million every year!

This price disparity is computed on the basis of only the most obvious disparity *between* regions. The bigger price disparities can be discerned *within* the region itself. From barrio to town in certain regions where distances are merely 5 to 10 kilometers apart, a minimum price disparity of 1-3 centavos per kilogram of copra already starts. From small towns to bigger towns which may be considered centers of copra trading, another 2-5 centavo difference may be observed. A depth study of this situation (price disparities *between* and *within* regions) will certainly yield some shocking results.

But the industry itself, and the people in it, have a fantastic inherent flexible strength.

Consider this: Everytime a farmer sells his copra, there is always a nagging instinctive feeling in him that he could have probably sold his copra at just one centavo higher than what he was paid say ₱.50/kilo. But since the difference per unit is insignificant he shrugs his shoulders and walks away. The next time the farmer comes around to sell, he is told that prices have dropped to ₱.45. He begs his buyer to give him the old price and the buyer agrees (because the farmer is an old "suki") to raise the price to ₱.49. The farmer walks away, again shrugging off his insignificant 1-centavos loss. Come the next month, the buyer comes around and offers a price of ₱.65 because, according to the buyer, prices have gone up. The farmer is elated and decides to close in advance at that good price. He delivers his copra. But lo! and behold! the farmer discovers upon delivery that prices have gone up to ₱.70. To make the farmer happy, his buyer pays him 2 centavos more above his contracted price, but still 3 centavos less than the current prices. Then one day, the price shoots up to phenomenal levels of ₱.90 to ₱.95 a kilogram. The farmer will agree to sell at ₱.93 because the price is "out of this world." Then the crash comes. Prices plummet down to ₱.50 a kilogram — a price differential of 45 centavos. The same farmer comes around and, despite his disappointment, still sells his copra. The farmer goes home hoping that the next time around will bring better copra prices.

Take again the case of the copra moisture deductions. Consider the case where a farmer is deducted 10% for moisture. (In normal barrio trading, deductions are almost always made haphazardly, guessingly). So, the farmer complains and the buyer finally agrees to an 8% deduction. Converted into centavos, that 2% differential is merely a 1 centavo gain in a price offering of ₱.50/kg.

Or again, take the case of price disparities between barrios and towns. A price differenial of 5-10 centavos per kilogram between barrios and small towns to trading centers is almost normal. The farmer could make 2 centavos more if he personally took the trouble of bringing his copra from the barrio to the town. But he shugs it of again as insignificant.

This one centavos is ₱1.00 per hundred kilograms. This one centavo is ₱10.0 per ton. This one centavo is ₱1.5 million per month on a monthly national production average of 150,000 tons. This one centavo is ₱18 million a year based on a 1.8 million tons of copra annually produced.

MARKETING PROBLEMS

One of the main problems in marketing and/or distributing coconuts is the general lack of adequate transportation facilities and a high cost on available equipment or services. The progressive increases in petroleum prices and imported equipment and parts for land transportation and inter-island vessels and barges pyramid this cost. Even coconut exports suffer periodic increases in ocean-going freighters.

This inter-industry input/output correlation shows its effects on the coconut. An increase in transportation cost means an increase in production cost and therefore reduces the price the farmer obtains from his product. Husked or unhusked nuts have to be hauled over a distant barrio road to a buyer collection point and this involves an income deduction of about ₱1/kilometer for every 1,000 nuts. This situation also abets the multiple handling of copra before they reach export loading points or the coconut oil mills. The common practice is for barrio buyers to collect the copra and for the town buyers to send their truck or jeep/

trailer to pick up the copra. The commodity is further moved to the bigger regional or export loading point, buyers' or exporters' buying stations or barged along coastal waters. During times of low supply, barged copra or copra loaded on inter-island vessels finds its way to key bulk terminals or major export loading points or oil mill/plant sites. From that point, however, modern facilities of loading and handling take over. It is only at this point that some measure of economy of scale is introduced designed to lower consequent freight and handling cost (see color slide presentation).

Corollary to this problem is the utter lack of storage facilities at farm sites except for the large plantations whose scale makes the construction of bodegas economically viable.

These situations weaken the bargaining position of the small coconut farmer. This results in the extension of costly credit and advance agreements on prices to the detriment of the farmer. The complex socio-economic matrix of this problem can be seen as an inverse buyer-seller relationship which is generally characterized by the advancing of goods or other consumables rather than money in the transaction. This makes it difficult to analyze the operation of market forces in this sector of the economy. It also underlines the dualistic nature of our economy.

All export statistics, however, either of the Central Bank, the Bureau of Census and Statistics, or the UCAP will show the close correlation between the export or international prices and the domestic prices. The numbers show that the farmer usually enjoys 77% of the average export price while the balance of 23% is credited to marketing costs. The latter figure, it appears, could be reduced if the problems earlier cited were not present.

PRODUCT DIVERSIFICATION

There is some amount of advocacy for the substantial shift to food protein extraction although extraction of the protein content of coconuts is a major portion of the income structure of the trade in these products today but this is directed towards animal consumption in the form of feedstuff material — copra meal/cake/pellets exported and consumed mainly in Europe. Copra meal produced by U.S. Pacific Coast oil mills also find their way into American livestock and dairy farms as feedstuff compounding material or compounded feedstuffs.

The UCAP has encouraged the search for an economically viable source of food protein. Many of its member companies are doing consistent research into this field and have done actual marketing of coconut-based lysine (protein) enrichment material for wheat flour baked into loaf bread.

One of the three processes of food protein extraction developed by Texas A & M University has received full support from UCAP although there remains the problem of the techno-economic feasibility of this process and the plant equipment costs. There is also the Chayen Impulse Rending machine of the Tropical Products Research Institute of London and a similar process presented by the Chemical Corporation of India. There is also a process developed by a Filipino technician along this line.

The other gray line in product diversification and research is in the field of coconut shell charcoal extraction from nut shells and coir mattress fiber or rubberized coir products. It appears from the data on the subsequent pages of this paper that many farm income, value adding, processing gains and foreign exchange inflows are being lost from the non-utilization of husks and shells.

It is clear that we are losing millions of pesos from the almost 9 million whole husks and shells/nuts not converted into coir bristle fibers or charcoal. Imagine the shells producing 450,000 metric tons of charcoal worth $24,606,000 (₱167,320,800) abroad and 720,000 tons of mattress coir fiber worth $117,936,000 abroad (₱801,964,800) for a total potential dollar income of $142,542,000.

The problem that nut shell and coir utilization as separated non-integrated products poses is again the cost of transporting the raw material from the farm to the processing plants.

There are other by-products of the coconut like coco jam and jelly which have found international markets and *nata de coco* which is being eyed by Japanese confectioners and food processors. The problems of packaging and freight remain to be tackled in this field to make export production a lucrative field.

INTERNATIONAL PROBLEMS

As Agriculture Secretary Arturo Tanco, Jr. and Finance Secretary Cesar Virata pointedly emphasized during the opening ceremonies of the PCAR-sponsored First National Agriculture System Research Congress yesterday, there is also a need for the agricultural researcher to have a "world outlook" or to look at the end-product of their efforts — a highly marketable export product of the agricultural and mineral sector — from a geopolitical standpoint.

You may wonder why the U.S.S.R. is buying copra from the Philippines and shipping this to Vladivostock or why the People's Republic of China is buying coconut oil and unloading it in Shanghai. The fact is that these are countries with large populations whose fat or oil requirements are upgraded. From an economic standpoint, we could say that the consumption of edible coconut oil is a function of income: $C = f\ Y$, or maybe $\Delta = Y = \Delta C$.

The Soviet Far East is fast developing into an industrial area which needs fats and oils as well as feedstuffs for livestock. Shanghai is a highly-industrialized sector of China which requires end-products with longer shelf life.

The world, as one may perceive from the talks of our policymakers is fast moving into economic blocs like the European Economic Community for Western Europe and the Comecon for Eastern Europe so that on our part we have had to organize the Association of Southeast Asian Nations (ASEAN) and in the specific case of the coconut industries of the region, the Asian Coconut Community (ACC). As these blocs are formed they tend to protect their own industries and consumers and to lift obtacles to our export trade and foreign exchange incomes we have to deal with these blocs at the negotiating table. It is for this reason that the ASEAN and ACC are negotiating for trade and tariff advantages. And as outlined by Secretary Virata in the open forum at the UPLB canteen, negotiations are becoming more multilateral and our trade agreements with the United States may pass into the multilateral stage maybe at the Multilateral Trade Negotiations under the auspices of the General Agreement on Trade and Tariffs (GATT) set to be held in Geneva this October and may last for several years.

Copra is allowed to enter all countries of the world duty-free but coconut oil levied one cent per pound in the U.S. and 10% *ad valorem* in the EEC. The UCAP is aiding the Department of Foreign Affairs in a technical capacity towards reducing this tariff barrier with the consequent benefit of higher prices and net returns to the producers of the basic material.

In the international field, there have been deleterious information circulated against the coconut which we are trying to counteract. These take the form of alleged aflatoxin contamination of copra meal produced in the U.S. West Coast from copra imported from the Philippines as well as the so-called findings of foreign technicians about the high saturation or fat content of products using coconut oil.

AREAS OF RESEARCH

Those outlined in the preceding paragraphs can form some of the priorities for agricultural research:

1. Study into better copra processing techniques to reduce incidence of molds and to make this a general practice by extension.

2. Study the intake of coconut products to determine effect of cholesterol formation on human physiology.
3. Study ways of making transportation cost cheaper to farmers.
4. Study ways of making storage facilities available to farmers at low costs.
5. Study better processing techniques that preserve valuable elements in the coconut like protein or oil.

COMPARATIVE VOLUME AND VALUE OF SUPPLY AND UTILIZATION OF RP COCONUT SHELL CHARCOAL
(Volume in Long Tons — Value in FOB U. S. dollars)

Region	3-year Average Coconut Production (in 000 nuts)	Charcoal Supply [1] (in L.T.)	Estimated Value [2] (FOB US$)	1972 Actual Volume Exported (in L.T.)	1972 Actual Value of Exports (FOB US$)
Ilocos	4,634	228	$ 13,167		
Cagayan Valley	NIL	NIL	—		
Central Luzon	1,841	91	5,267		
Southern Tagalog	534,398	26,298	1,522,138		
Bicol	316,447	15,572	901,307		
Eastern Visayas	2,089,554	102,827	5,951,627		
Western Visayas	722,361	35,548	2,057,518		
NE Mindanao	1,139,772	56,088	3,246,373		
SW Mindanao	2,964,750	145,896	8,444,460		
Total Philippines	7,733,759	382,548	$22,141,878	$16,888	$977,396

[1] Computed at 20,000 nuts per metric ton of charcoal
[2] Computed at $57.88/long ton based on 1972 export price

Source of Basic Data: BAE and PHLCOA

1970-1972 TOTAL NUTS GATHERED BY REGION
(in 000 Nuts)

	1970	1971	1972	3-year Average
PHILIPPINES (TOTAL)	7,139,279	7,083,270	9,098,730E	7,773,759
Ilocos	4,091	4,296	5,517	4,634
Cagayan Valley	NIL	NIL	NIL	NIL
Central Luzon	1,842	1,611	2,071	1,841
Southern Tagalog	644,856	419,489	538,850	534,398
Bicol	389,192	245,191	314,958	316,447
Eastern Visayas	2,065,746	1,839,723	2,363,195	2,089,554
Western Visayas	581,492	694,053	891,538	722,361
NE Mindanao	942,683	1,084,085	1,392,549	1,139,772
SW Mindanao	2,509,378	2,794,820	3,590,052	2,964,750

E Estimate
Source of Data: 1970-1971, BAECON; 1972 Estimate Computed by UCAP Research Department

1971 COMPARATIVE SUPPLY OF COCONUT SHELL & ACTUAL EXPORT

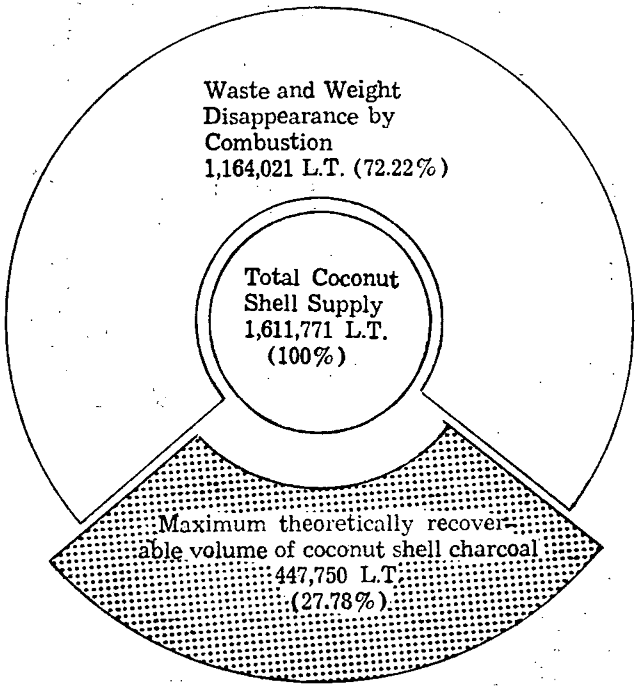


FIG. 1

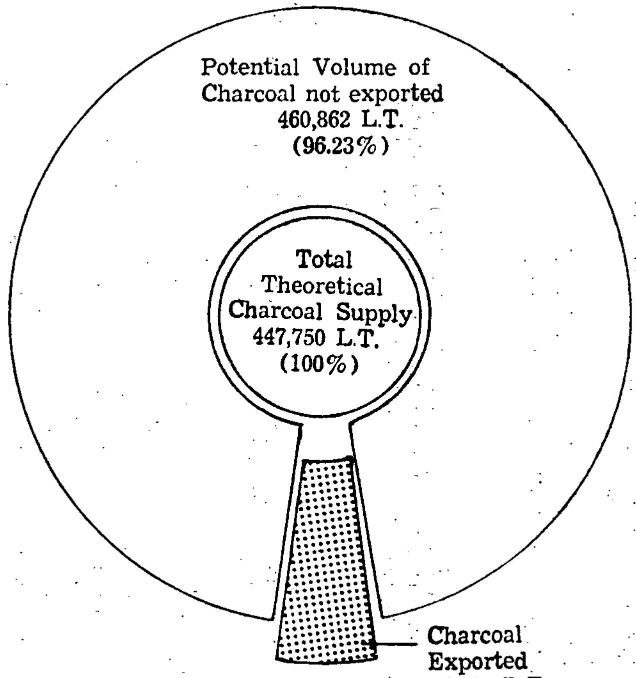


FIG. 2

Coconut production in 1972 reached a high record crossing a 9 billion mark in terms of nuts gathered. Based on this figure supply of coconut shells reached a peak of more than 1.6 million long tons which can produce an approximate volume of 447,750 long tons of charcoals representing a 28% recovery from shells (see fig. 1). However, despite the tremendous supply of shells, disappearance of charcoal in 1972 registered a total of only 16,888 long tons valued at $997,396. This means that only only 3.77% was produced from a total expected production of 447,756 long tons (see fig. 2).

TABLE I
MATTRESS COIR FIBER AND COIR BRISTLE THEORETICAL PRODUCTION BASED ON 1972 COCONUT PRODUCTION
(in metric tons)

	1972 Coconut Production in Thousand Nuts [1]	Mattress Coir Fiber in m.t. [2]	Coir Bristle in m.t. [3]
Ilocos	5,517	441.36	220.68
Cagayan Valley	Nil	—	—
Central Luzon	2,071	165.68	82.84
Southern Tagalog	538,850	43,108.00	21,554.00
Bicol	314,958	25,196.64	12,598.32
Eastern Visayas	2,363,195	189,055.60	94,527.80
Western Visayas	891,538	71,323.04	35,661.52
NE — Mindanao	1,392,549	111,403.92	55,701.96
SW — Mindanao	3,590,052	287,204.16	143,602.08
Total Philippines	9,098,730	727,898.40	363,949.20

[1] Estimated 1972 production
[2] Computed at 12,500 nuts per metric ton of mattress coir fiber
[3] Computed at 25,000 nuts per metric ton of coir bristle

NOTE: Computation is based on 10% coir bristle and 20% mattress coir fiber from a 400 grams weight of husk per nut
Source of Conversion Data: Industry sources
Source of Production Figures: Estimated from Baecon Statistics by UCAP Research

TABLE II
1970-1972 PRODUCTION AND EXPORT VOLUME AND VALUE OF MATTRESS COIR FIBER AND COIR BRISTLE*
(Volume in Metric Tons — Value in FOB US$)

	Production	Export Volume	Export Value
1970	445.20	436.80	$49,712.58
1971	815.25	801.30	94,676.95
1972	262.80	254.10	31,723.70

* Statistics gathered show a combined total for the two products in volume and value

Source of Data: Export Division, Bureau of Fiber Inspection

TABLE III
1972 COMPARATIVE POTENTIAL SUPPLY OF COIR PRODUCTS AND ACTUAL EXPORT
(In Metric Tons)

	Potential Volume of Production[1]	Combined Actual Production[2]	Combined Actual Export[3]	% of Actual Production to Potential Production
Mattress Coir Fiber	727,898			
Coir Bristle	363,949			
Total	1,091,847	262.80	254.10	.024%

[1] See Table I
[2] See Table II
[3] See Table II

Source of Data: Export Division, Bureau of Fiber Inspection and BAECON Statistics

TABLE IV
1972 COMPARATIVE EXPORT VALUE BASED ON POTENTIAL SUPPLY OF COIR PRODUCTS AND ACTUAL EXPORT VALUE

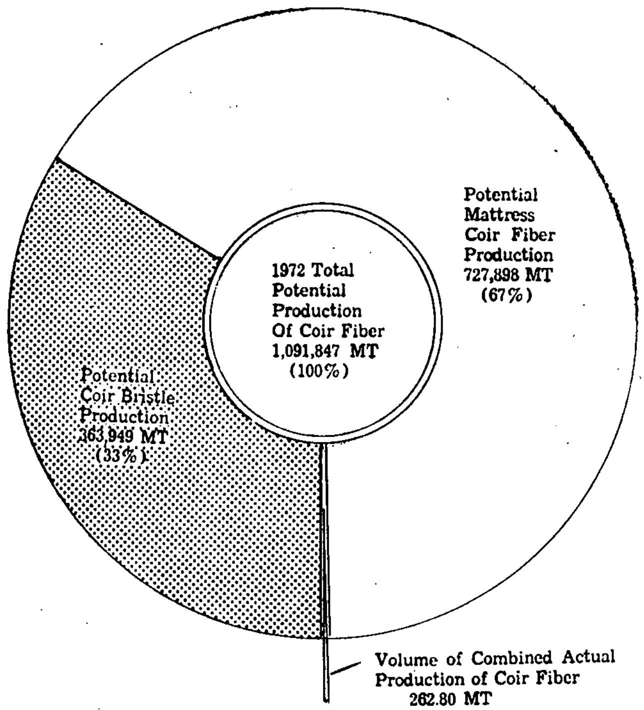
	Potential Volume of Production[1]	Value of Potential Volume of Production[2]	Combined Total of Actual Export[3] Value (FOB US$)	% of Actual Export Value to Value of Potential Volume of Production
Mattress Coir Fiber	727,898	$ 72,607,826		
Coir Bristle	363,949	63,818,457		
Total	1,091,847	136,426,283	31,723.70	.023%

[1] See Table I
[2] Computed based on February 1973 prices. $99.75/m.t. of mattress coir fiber and $175.35/m.t. of coir bristle FOB Manila
[3] See Table II

Source of Basic Data: Export Division, Bureau of Fiber Inspection and BAECON Statistics

Computed by: UCAP Research

1972 PRODUCTION SHARE OF
POTENTIAL COIR SUPPLY & EXPORT



Based on the 9 million production in terms of nuts gathered in 1972, potential production of Mattress Coir Fiber could have realized 727,204 metric tons and 363,949 metric tons of Coir Bristle or a combined total of 1,091,847 meric tons of Coir Fiber. If these products could have the same demand and produced incentives as that of copra where 90 percent of the nuts gathered has been produced for export and local consumption, then the coir sector might surpass even the copra sector in terms of growth rate.

Statistics show that coir production in 1972 reached a combined total of only 262.8 metric tons where 254.1 was exported and the rest locally used. These mean that out of a potential volume of production of 1,091,847 metric tons (see table III), only .024 percent was actually utilized and more than 99 percent was wasted representing a waste of more than 136 million U.S. dollars (see table IV).

To date there are only three companies registered with the Bureau of Fiber Services engaged in the manufacture of these products: 1) Laguna Coco By-products in San Pablo, Laguna; 2) Luzon Coir Industries in Tiaong, Quezon; and 3) Ricardo Eugenio in Candelaria, Quezon. These three plants are all located in Luzon.