CGPRT NO.1

RESEARCH IMPLICATIONS OF EXPANDED PRODUCTION OF SELECTED UPLAND CROPS IN TROPICAL ASIA

Proceedings of a workshop
Bangkok, 27 - 30 November 1984

Organized by:
UN / ESCAP Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber (CGPRT) Crops. In the Humid Tropics of Asia and the Pacific (CGPRT Centre)

EXPERT GROUP MEETING

ON

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FOREWORD

The Expert Group Meeting on Research Implications of Expanded Production of Selected Upland Crops in Tropical Asia was held in Bangkok, Thailand, on 27-30 November 1984. The meeting was organized by the Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber (CGPRT) Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre), which is a subsidiary body of the United Nations Economics and Social Commission for Asia and the Pacific (UN / ESCAP).

Twenty-six papers were presented for discussion. More than 50 experts from 12 Asian countries and 8 international and regional institutions and agencies attended the Meeting. The papers cover demand, marketing and production aspects of major CGPRT crops in developing countries of Asia. They focus on identifying constraints to increased production and productivity, specifying areas of research needs, and considering methodologies appropriate for socio-economic analysis of these crops.

This volume will have many uses. It contains a large amount of basic data on CGPRT crops in tropical Asia, and will therefore be useful as a sourcebook on agriculture in the region. It also contains a variety of analyses and methodological considerations which will be useful to economists, agronomists and researchers in other disciplines, and to policy-makers in the region. We hope that this book will contribute to establishing and promoting a co-operative research network for the development of CGPRT crops in Asia and the Pacific.

This book and the Proceedings of the Workshop on the Future Potential of Cassava in Asia and the Research Development Needs (jointly issued by the CGPRT Centre and CIAT) reflect the scope of programme activities of the ESCAP CGPRT Centre and the progress made at this early stage of its existence.

The Expert Group Meeting was funded by the Government of Australia through the Australian Development Assistance Bureau. We would like to express our gratitude to the Government of Australia for its valuable support to the Centre.

This book was edited by Ir. J. W. T. Bottema and Ms. Nancy Crompton.

October 1985
Bogor, Indonesia

Shiro Okabe
Director
ESCAP CGPRT CENTRE

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OPENING STATEMENTS

STATEMENT BY MR. KOJI NAKAGAWA, DEPUTY EXECUTIVE SECRETARY, UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Distinguished participants, ladies and gentlemen,

It gives me great pleasure to welcome all of you to this Expert Group Meeting on the Research Implications of Expanded Production of selected Upland Crops in Tropical Asia, organized by ESCAP's CGPRT Centre. We are grateful to all of the distinguished experts who have joined in this effort to sharpen the focus of research so as to better realize the potential of various important upland crops.

Everyone here is well aware that the world's food and agricultural problems are far from solved. Indeed, famine-stricken Ethiopia and many other African countries are suffering such agonies that a major relief operation has been mounted. While we of course support such emergency efforts, we also realize that the real solution to food problems lies not in the short-term measures, but in strengthening the production potential and capabilities of developing countries themselves. It is in this context that ESCAP and our member Governments have formulated priorities for assistance and co-operation in the field of food and agriculture.

Technical assistance in the development of coarse grains, pulses, roots and tuber crops is one of the secretariat's newer activities. As you know, the Asia-Pacific region produces about one fifth of the world's supply of coarse grains, half of the pulses and one third of the root and tuber crops. With a few exceptions, these crops serve mainly as supplements or substitutes for rice and wheat for many of the poor people in this region. From a nutritional standpoint, pulse crops make a particularly important contribution to their protein needs. Nonetheless, CGPRT crops are considered as so-called secondary crops to rice in tropical Asia. They are usually grown in marginal upland areas, using relatively low levels of technology, and, consequently, the result is usually low productivity. In fact, the region's average yields of these crops are below the global average.

Breakthroughs in rice research led to the Green Revolution of the sixties and seventies, with spectacular gains in rice yields. But for hundreds of millions of impoverished farmers, there has been no Green Revolution in CGPRT crops and little or no improvement in their standard of living. Thus, the region faces a pressing need to increase the production, utilization and trade in CGPRT crops, which can augment not only the national food supplies, but can also provide livestock feed and raw materials for industries. It was for these reasons that the CGPRT Centre was established in 1981.

As you know, the main purposes of this Expert Group Meeting are to assess the problems being encountered in the production, utilization, marketing and demand for selected CGPRT crops and to find the best ways to analyse and evaluate the potential impact on rural economies given expanded production of these crops. Your task is a difficult one, the path being much less clear than it was in the case of the Green Revolution's rice improvement programmes. The socio-economic problems hindering the development of CGPRT crops are much more complicated than those concerning rice. The demand and marketing aspects are also extremely complex to analyse and evaluate, and these and other problems vary from country to country and from locality to locality. Thus, we expect your exchange of views and experiences to be very useful in helping the CGPRT Centre to soundly identify priorities and to formulate action programmes for maximum benefits. Ultimately, these will contribute to the strength of national programmes for research and development on CGPRT crops, which have received relatively little attention in the past.

I am pleased to note the progress that the CGPRT Centre has made in establishing links with national and international research facilities and other co-operating agencies. Distinguished participants, we are confident of your sound technical capabilities, and I have no doubt that your findings will prove to be extremely valuable in the mounting of an effective programme of socio-economic research on these important crops. We warmly welcome your participation and assistance, and wish you every success in your deliberations.

Thank you.

STATEMENT BY DR. RUSLI HAKIM, CHAIRMAN ESCAP CGPRT CENTRE

The ESCAP Deputy Executive Secretary, distinguished delegates, ladies and gentlemen,

It is Indeed a great honor for me to have the opportunity to join all of you on this Expert Group Meeting to exchange views on the socio-economic problems of CGPRT crops which will lead to co-operative action in research.

Recognizing the potential of the CGPRT crops to feed the growing population in the ESCAP region, and the lack of emphasis given to socio-economic aspects as some of the major constraints to the development of the CGPRT crops, are some of the factors which led to the establishment of the CGPRT Centre.

It is our hope that this Centre will strengthen the national research system of the member countries through co-operation with national as well as international research institutions, and that exchange of information will pave the way for identifying common problems.

Since the establishment of this Centre in 1981 contacts have been established with appropriate national focal points in several member countries and with some international and regional research institutions. Through these contacts some programmes were initiated in

1983, such as:

a. A study on the soyabean commodity systems in co-operation with the Government of Indonesia.

b. Workshop on Asian Cassava in collaboration with CIAT.

c. Training researchers in co-operation with ICRISAT.

d. A project to be implemented under a sub-contract arrangement with FAQ.

This Centre has already had a good start. It has the growing support of the donors as well as the member countries for its operations. We do hope that support will continue and expand. But the CGPRT Centre must prove its credibility as a clearing house to solve common problems on the socio-economic aspect of the CGPRT crops.

Distinguished delegates and my dear fellow researchers, the CGPRT Centre will greatly appreciate your contribution during the discussions and your deliberations in terms of concepts and thoughts leading to well-defined subjects of research for regional co-operation.

Thank you very much.

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EXPERT GROUP MEETING: CONCLUSIONS AND RECOMMENDATIONS

1. After presentations and discussions of country and resource papers, the rapporteurs prepared a draft assessment of the conclusions and recommendations of the Meeting, which were presented on the final day. Based on the ensuing discussion, the final conclusions and recommendations were adopted as follows. It should be noted, however, that these were mainly based on the problems/issues of the pre-specified CGPRT commodities only.

A. Assessment on Problem Identification and Formulation of Research Priorities

2. The primary issue in the production of CGPRT crops is low profitability which is caused by two sets of factors, namely: (i) low yields and (ii) prices. The constraints/issues and research priorities were, therefore, grouped into these categories. Tables 1 and 2 present summaries of the constraints/issues and research priorities, respectively, which were presented in the country papers and discussed during the Meeting's deliberations.

3. Low yields could be explained by a number of factors, among them farm size and quality of land, lack of quality seeds and high yielding varieties, shortage or high prices of purchased inputs such as fertilizers and chemicals, as well as accessibility of input suppliers, inadequate knowledge, particularly on the technology of production, capital viability, and others. Output prices have been low and unstable and price policies have either been nonexistent or ineffective. Imports seemed to have influenced domestic prices to a large extent. High market margins and inadequate infrastructural facilities have contributed to the problems faced by the CGPRT industries.

4. Against this background, most countries identified both micro/on-farm research and macro studies. Constraints to increased yield and economic consequences of increased production appear to rank high among the suggested research areas. The study on implications of increased production should examine the effects on a number of variables, including the aggregate supply and demand for the product, the demand for inputs, prices and markets, farm level production and income, resource use efficiency, equity considerations, e.g., the distribution of benefits among groups of farmers and among various sectors, and the social and economic conditions of the farmers and the impacts on rural welfare. Research on prices and markets needs to examine the effect of devaluation/ inflation and the role of middlemen. Policy research both on prices and imports has to be undertaken.

5. A wide range of research areas are shown in Table 2 and is suggested that the CGPRT Centre should examine them more carefully and rank the priority areas so that necessary emphasis is focussed on the more important problems. It is also sugested that the CGPRT Centre should look at the potentials of the different CGPRT crops in the different countries as well as the interactions of the various crops both within the regions and outside the regions. In studying the above issues and research priorities, three questions should be addressed: (1) Should CGPRT crop production is expanded? (2) If so, where and what kind of farms and resources should be used? (3) How effectively can economic research contribute to policy and to the minimization of constraints to production?

B. Common Methodologies of Analysis and Assessment

6. Methodologies to be used in the analysis and assessment will depend on the type of studies to be undertaken. From the reports presented, the analytical techniques include: (i) descriptive statistical methods, (ii) econometric analysis, (iii) programming techniques, and (iv) other techniques including break-even analysis and ratio analysis (e.g., the area shift analysis). The data required for the analysis may come from both primary and secondary sources. For econometric studies, time series data are usually required. This has posed problems in some Asian countries as time series data are usually not available. In this case, cross-section data may be collected and used.

7. In selecting the areas for the study on socio-economic constraints (including marketing demand, price and credit) and the impact assessment, at least two different types of areas should be chosen: a relatively progressive area vs. a less progressive one. Multi-stage stratified random sampling techniques can be used. The interviews should be conducted by a well-trained group of interviewers and supervised by experienced and relatively senior researchers. This is to ensure that the data obtained will be adequately reliable.

8. The econometric model (s) to be used in the analysis should be carefully constructed and the variables clearly defined. In some cases, simultaneous equations may be used so that interrelationships among variables may be studied. As for the programming technique, though a relatively simple model can be used, it may be desirable to use a more sophisticated model (e.g. multi-period or dynamic programming, quadratic risk programming) so that useful results can be obtained. However, this may require both detailed data and modern computer facilities which may not be available in some Asian countries. The level sophistication and/or complication of the model used will therefore depend on these factors.

9. Considering the fact that Asian countries vary in the utilizations of farming/cropping system, farm technology, research capability, and other related factors, it will not be practical to define a common methodology for the socio-economic study on CGPRT crops. However, for the purpose of comparability, some common methodologies should be adopted. This will include the use of the same technique of analysis: e.g., criteria for the selection of the location of study, the questionnaire design, the field survey technique and the interview. In fact, a manual for research study for the participating countries may be developed. Again, the technique of analysis for particular study may be different in terms of the level of sophistication as this will depend on the research capability of a particular country. In addition, as research is a continuing process, and as research capability in particular country or institution may be increased, improvement in the analytical technique for a particular study should be made over time. Finally, the following are some of the major research activities which may be undertaken and the corresponding methodologies that can be used.

10. **Farm level production decision**. The objectives will be to study the present production environment; to identify constraints to the production of CGPRT crops; to evaluate the available alternative options; to alleviate constraints; and to assess the impacts or study the economic consequences of the increased production of CGPRT crops. Methodological aspects include farm surveys, simple tabular analysis, econometric analysis and, wherever possible, the whole-farm constraint analysis using linear or quadratic risk programming models. Both the production and consumption decisions at the individual farm level should be considered simultaneously. This is particularly important in developing countries where most of the production is subsistence-oriented and most of the resources are individually owned. The

whole-farm constraints analysis will also be helpful in the assessment of imports or in understanding the economic consequences of a changed situation.

11. **Studies on cost structure and international trade**. These studies would help in understanding the absolute and relative costs various CGPRT crops in different countries in the ESCAP's region. For this, micro-level cost studies could be carried out for synthetic farms representing various resource endowment categories. Both domestic and world prices for inputs and outputs could be considered.

12. **Infrastructural studies**. These include studies such as on marketing, market channels, marketing efficiency, marketing margins, credit, other input-supplies, output processing, grading, standardization, behavioral studies, socio-cultural studies, consumer preferences, nutritional studies, etc. For most of these studies, functional econometric analysis would be quite appropriate. Tabular analysis and an intuitive approach would be sufficient.

13. **Demand studies**. Standard methodologies are available to estimate demand parameters such as price elasticity, substitutics, etc. The well known method is a linear expenditure system. Various income groups and regions may be considered separately. Data may be a serious problem for most of the countries. Data on CGPRT crops may not be available in disaggregated forms. However, estimates are available for a few countries which could be used or extended to other relevant countries.

14. **Supply studies**. Standard methodologies are available to study areas and output responses. Literature reviews could be undertaken to update knowledge on methodologies and estimates.

15. **Impact assessment or economic consequences.** The economic consequences of the changed productions of CGPRT crops could be understood at various levels and through different aspects; i.e. the impact on consumers; producers, income distribution, employment risk, economic surplus to consumers and producers, total economic surplus, shift in the production, and regional distributions of income. Whole farm constraints analysis at micro-level and spatial equilibrium models at macro-level could be used in an integrated manner to understand the above implications.

16. **On-farm research.** An interdisciplinary approach in collaboration with biological scientists could be adopted to do on-farm research in the interests of diagnostic and problem solving types of research. This is a particularly suitable approach for diagnosing problems with respect to the farmers' understanding, acceptance and adoption of new production technologies.

C. Regional Network Co-operation for Socio-Economic Studies on CGPRT Crops

Background

17. The meeting generally recognized that a great deal of effort has been and should be continuously spent to promote the production of CGPRT crops. Major reasons behind this agreement are the nutritional importance of CGPRT crops and the increases in demand while production has been lagging behind. In several member counties, these commodities have been relatively neglected in terms of policy orientation, research priority and resource allocation, in

comparison with major food crops such as wheat and rice. Considering this situation and the fact that millions of farmers are involved in the production of CGPRT food crops, it should be recommended that CGPRT crops be given higher priority by various governments

18. Major common issues faced by the member countries in their attempts to promote the production of CGPRT crops include: (i) Production, distribution, certification and pricing of seeds; (ii) Low productivity related to poor soil, low quality seeds, poor cultivation practices resulting in high cost of production, and high risk factors making them less attractive to farmers; (iii) Insufficient credit to support production and processing; (iv) Inadequate storage, marketing, transport and processing facilities. Addressing these issued, each country has taken various measures, ad-hoc actions and studies. But, due to limited budgets and experience, these national level measures will not be sufficient to solve the problems. For this reasons, the meeting recommended the establishment of a network in order to ensure more efficient use of existing research resources.

Objectives and Scope of Co-operation

19. The main objective of the proposed network is to promote co-operative research, and exchange of experience and information on CGPRT crops, with the emphasis on the socio-economic aspects of the issues. Areas of activity that can be the subjects of network co-operation include:

(i) Research planning and co-ordination;
- inventory survey of works already done,
- review of priorities,
- inter-country work sharing;

(ii) Enhancement of research capabilities through:
- Exposure to various aspects of similar crops in different situations, and in different approaches followed by other teams,
- learning from successes and failures of projects elsewhere,
- shared experience in problem identification and research planning,
- development of common methodologies,
- training;

(iii) Widening research coverage, through:
- development of studies related to marketing and demand, especially for recent utilizations,

(iv) Support to research projects or studies through:
- provision of technical assistance from the Centre, or IARCs, FAQ or other institutions, or from consultants,
- provision of assistance to secure additional funding when necessary;

(v) Collection, processing and dissemination of information; and

(vi) Establishment of appropriate linkages with international centers and programmes.

Structure and Participation

20. Each member country should recommended a lead institution which will be the focal/contact point of the country sub-system. This institution would be responsible to channel information from the network to interested institutions in the country, and from the country to the network. A lead institution will co-ordinate in-country activities.

21. The CGPRT Centre should function as the secretariat of the network. One full-time co-ordinating scientist will be based at the CGPRT Centre whose salary shall be charged to the

co-ordinating cost. Communications among participating countries could be done through the secretariat, or directly with notification to the secretariat.

22. Co-operation with international organizations or institutions such as FAQ, IITA, INTSQY, CIAT, IDRC, ACIAR, CIMMYT and the like, will be strengthened. When specific projects require the assistance of international agencies, an ad-hoc triangle type of co-operative arrangement could be set-up between the interested institution, the international agency and the Centre. The centre should assist in preparing, implementing and providing financial support as well technical assistance to carry out co-operative projects.

Research Agenda and Other Activities

23. The deliberation of research agendas and other activities of the network should be developed in regular or ad-hoc meetings. The meeting may not necessarily be a special meeting but can be a part of the agenda of an occasion in which member countries are well represented, such as an Expert Group Meeting. Initially, research priorities that have been approved and presented in Section B could recommended for the research agenda of the Network.

Financial Support

24. Financial support to carry out the activities of the co-operative network should be cost-shared by member countries, donor agencies and the CGPRT Centre. Part of the co-ordination cost shall be included in the annual budget of the CGPRT Centre.

Preparatory Action

25. Since this meeting does not have the authority to officially establish such as a network, the proposal should be submitted to the Governing Board of the CGPRT Centre for approval. In the meantime, to facilitate the exchange of research findings, information and research co-operation, the CGPRT Centre should continue to perform as a "clearing house" for any information pertaining to articles or research findings on CGPRT crops.

D. Recommendations of the Meeting

Research

26. The following research studies are recommended to be conducted (i) Identification of constraints to increased production, post-harvest handling and utilization of CGPRT crops; (ii) Economic and social consequences of the expanded production of CGPRT crops; (iii) Efficiency and equity considerations in promoting CGPRT crop productions; (iv) Improving efficiency of the marketing of CGPRT crops; (v) Policy research on CGPRT crops; and (vi) Effects of monetary policies on CGPRT production, utilization and trade.

Research Methodologies

27. These include consistent effort on the following aspects: (i) Development of standard methodological approaches for studying CGPRT crops with adequate flexibility to suit local conditions; (ii) Development of a whole farm analysis approach to understand the production environment at the farm level; (iii) Preparation of a manual on standard methodological approaches to the study of socio economic aspects of CGPRT crops.

Collaborative Research Network

28. The following are activities which should be promoted: (i) The CGPRT Centre should actively monitor socio-economic research and development activities related to CGPRT crops in

the region; (ii) The CGPRT Centre should formulate a mechanism for collaborative research on the socio-economic aspects of CGPRT crops in line with the priority research areas identified during the Meeting; (iii) Member countries are requested to co-operate with the Centre for the effective implementation of a collaborative network ; (iv) The CGPRT Centre should strengthen its linkages with relevant national, regional and international institutions and programmes.

E. Other Items

29. The Meeting appeals to all member countries and donor agencies and relevant international agencies to provide sustained technical and financial support for collaborative activities related to the socio-economic research and development of CGPRT crops. The Meeting notes with appreciation the financial support provided by the Governments of Australia and Japan and the technical backing of the ESCAP Secretariat.

Table 1. Summary of Constraints/Issues in CGPRT Production, Utilization, Marketing and Demand

Constraints/Issues	Philippines (Maize)	Thailand (Soyabean)	Indonesia (Soyabean)	Malaysia (Maize)	Korea (Maize, Soyabean)	Lao PDR (Maize, Soyabean)	Vietnam Maize, Soyabean)	Bangladesh (Pulses)	Pakistan (Maize)	Sri Lanka (CGPRT crops)
Production										
Low Yields	v			v	v	v	v	v	v	
Land										
Small farm size			v	v	v	v			v	v
Marginal land	v			v	v			v		
Decline in area				v	v					
Input										
Seeds	v	v	v		v	v	v		v	
Shortage/high							v		v	v
Price of inputs	v	v				v				
Farm equipment			v							
		v		v		v				
Manpower/labour										
Inadequate knowledge	v						v			
Risk	v							v		
Cash/ credit availability	v					v		v	v	
Lack of institutional support						v	v			
High harvesting losses		v				v				
Weather	v			v				v		
No irrigation	v						v			(continued)

Table 1. Summary of Constraints (continued)

Constraints/Issues	Philippines (Maize)	Thailand (Soyabean)	Indonesia (Soyabean)	Malaysia (Maize)	Korea (Maize, Soyabean)	Lao PDR (Maize, Soyabean)	Vietnam Maize, Soyabean)	Bangladesh (Pulses)	Pakistan (Maize)	Sri Lanka (CGPRT crops)
Consumption/ utilization										
Unprofitability		v		v				v		v
Price	v	v				v	v	v	v	
Ineffective/ no price control	v		v						v	v
Import competition	v	v	v	v	v	v				v
Role of middlemen		v		v				v		v
High market margins	v							v		
Inadequate storage facilities		v		v		v		v		
Low capacity utilization	v									
Locational concentration	v									
Lack of market information	v									v
Consumer preferences	v						v		v	
Transportation	v					v	v			

Table 2. Summary of Research Areas Suggested for CGPRT crops.

Research Areas	Philippines (Maize)	Thailand (Soyabean)	Indonesia (Soyabean)	Malaysia (Maize)	Korea (Maize, Soyabean)	Lao PDR (Maize, Soyabean)	Vietnam Maize, Soyabean)	Bangladesh (Pulses)	Pakistan (Maize)	Sri Lanka (CGPRT crops)
PRODUCTION/YIELD										
Economic consequences of increased Production	v							v		
Input distribution		v					v			
Constraints to increased yield	v	v		v	v	v	v	v	v	
Machinery				v	v					
Efficiency and Equity	v							v		
Seeds		v					v			
Capital markets/ investment								v		
New areas				v	v		v			
Production programmes									v	

(continued)

Table 2. Summary of Research Areas (continued)

Research Areas	Philippines (Maize)	Thailand (Soyabean)	Indonesia (Soyabean)	Malaysia (Maize)	Korea (Maize, Soyabean)	Lao PDR (Maize, Soyabean)	Vietnam Maize, Soyabean)	Bangladesh (Pulses)	Pakistan (Maize)	Sri Lanka (CGPRT crops)
PRICES										
Effect of devaluation/ inflation	v	v	v							
Better stock	v									
Role of middlemen	v	v							v	
Policy research- prices		v							v	
Policy research- imports		v								
Price incentives							v			
Demand studies								v		

RESOURCE PAPER

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON MAIZE IN THE PHILIPPINES*

Occupying more than three million hectares of agricultural land, maize accounts for almost half of the area planted to cereals in the Philippines. In terms of total production, however, maize represents only about one-third of all the cereals produced in the country. The national average yield is less than one metric ton per ha (0, 99).

Numerous breakthroughs have been achieved in developing high-yielding varieties of maize. Despite this, farmers' yields have not changed significantly. Research stations have obtained 5-6 tons/ha/crop, while field tests are able to get 3 tons; however, at the farm level, the yield is a moderate 0.5 ton in marginal areas and 1.4 tons in optimum areas.[1]

Although the yield of maize under experimental conditions may not be attainable by farmer's fields, it is hypothesized that there is a potential farm yield which is higher than the actual farm yield which has been achieved. Figure 1 conceptualizes the different yields obtained in experimental stations, field trials and actual farm conditions. The differences between experimental stations and field trials (yield Gap I) can be attributed to environmental differences and to certain components of technology that cannot be transferred (e.g., high quality water control and better management).[2]

Hopefully, yield Gap I is small: A large gap indicates that the technology is not relevant to most farmers' conditions. The difference between trial fields and farms (Yield Gap II) is explained by biological and socio-economic factors. Biological constraints such as variety, weeds, diseases, etc., are outside the farmers' control. In addition, social and economic constraints include inefficiency of capital, non-availability of inputs, profitability of the technology, and others. These constraints are major bottle-necks in crop production. The potential yield of maize can only be attained if biological and socio-economic constraints are minimized, if not totally eliminated.

This paper is divided into four sections. The first section concentrates on the socio-economic constraints on maize production, utilization, and marketing. Priority research on the socio-economics of the maize industry are presented in the second section, followed by a proposal for research on the socio-economic implications of expanded production of maize and other upland crops. The third section presents methodological experiences derived from similar studies, and the fourth section proposes the methodology for the proposed research project.

Socio-Economic Constraints

Production Constraints. – Table 1 presents the trend in area, production, and yield of maize in the Philippines. Maize hectarage increased from 909 thousand hectares in 1950 to more than three million hectares in 1975.

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* Prepared by Aida R. Librero, Director, Socio-Economic Research Department, Philippine Council for Agriculture and Resources Research and Development, Los Banos, Laguna.

(1) A.R. Librero, Socio-Economic Constraints in Technology in Rainfed Crop Production. Paper presented at the National Workshop on Development and Management of Rainfed Crop Production held at Los Banos, Laguna, July 31-August, 1978.

(2) R. Herdt, S. de Datta, and D. Neely, Farm Yield Constraints in Nueva Ecija and Laguna. Philippines, 1974, IRRI.

Production exhibited an upward trend which could be largely attributed to expansion in hectarage rather than to higher productivity. The national average yield has grown slowly reaching a level of 0.99 metric ton per hectare in 1983. During this year, an average yield of over one ton (1.38) was achieved only in Central.

Mindanao (Region 11) and Southern Mindanao (Region 12). Total production could have increased much faster, had the expansion of area been accompanied by an improvement in productivity.

The low yield of maize can be explained mainly by the use of traditional varieties, inadequate inputs, and the use of marginal lands for maize production. Low yield is also caused by climatic aberrations such as typhoons, floods, drought, and by pests and diseases.

Nonavailability of seeds has been a major constraint in adoption of high-yielding varieties of maize. To a certain extent, the Masaganang Maisan programme has been able to alleviate this problem. In recent years, the private sector has provided a large portion of the seed required by the maize industry.

As an upland crop, maize is primarily dependent on rainfall. The majority of maize farms in the country are upland areas where irrigation facilities are not available. Although maize does not require much moisture, water is critical in the early stages of growth and during kernel formation.

Farmers usually plant two crops of maize, the date of planting depending on the rainfall pattern. Lack of rain, or too much rain, may cause a delay in planting. It is possible that, even if the recommended level of fertilizer were used, the lack of irrigation could lead to low yields.

Figure 1. Conceptual model explaining the yield gaps between experiment station yields and actual farm yields.

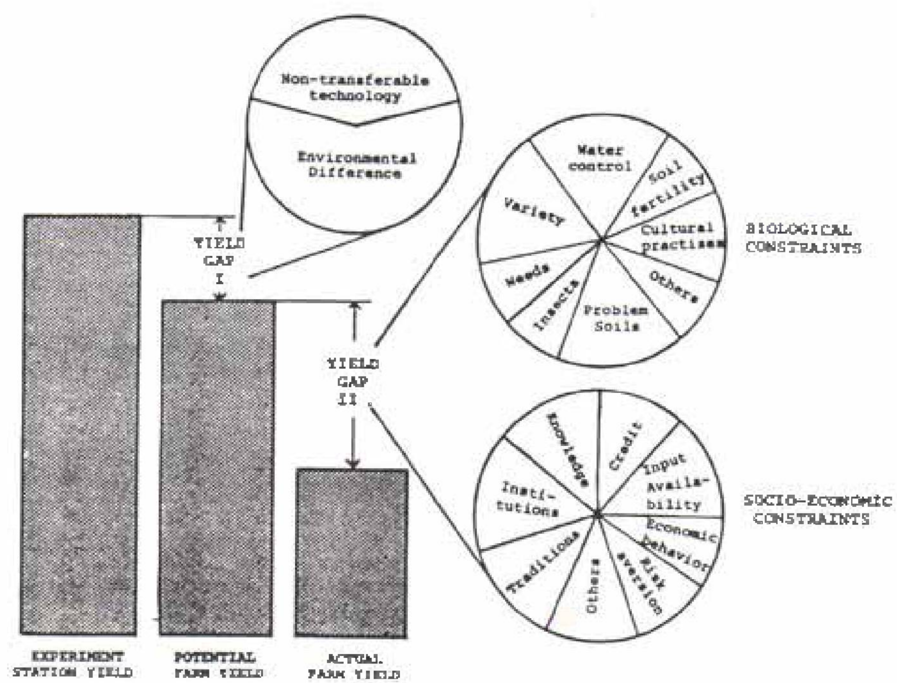

Table 1. Area, Production and Yield of Maize in the Philippines, Selected Years

YEAR	AREA (000 ha)	Production (000 MT)	Yield/ha MT
1950	909.0	573.30	0.63
1955	1388.4	770.13	0.55
1960	1845.5	1165.27	0.63
1965	1922.8	1312.70	0.68
1970	2419.6	2008.20	0.83
1975	3062.4	2568.38	0.84
1980	3318.7	3122.79	0.94
1981	3238.7	3109.68	0.96
1982	3360.7	3290.18	0.98
1983	3157.5	3179.20	0.99

Table 2. Treatment Used in the POT Trials

Package of Technology (POT)	The package was composed of five recommended practices: 1) variety ; 2) fertilizer rates, and method of application ; 3) recommended used control management ; and 4) recommended plant spacing and method of planting.
POT – F	All recommended practices were used except for fertilizer where the farmers' practice was Followed.
POT – WC	Farmers' used control was used.
POT – IC	Farmers' insect control practice was used.
POT – D	Farmers' plant density and method of planting were used.
Farmers' Practices	Farmers' practices included the following: 1) farmers' variety ; 2) minimum fertilization; 3) hilling-up or off-barring for used control ; 4) no insect control measure; and 5) farmers' planting density and method were followed.

Source : "On-farm Package of Technology Trial (POT) in Corn". Upland Crops Extension Program, UPLB, 1976.

A major economic barrier to the adoption of agricultural technology stems from the fact that new technology almost always requires the expanded use of purchased inputs. To show the relative advantage of technology adoption in maize, two studies were undertaken: (1) a survey of 291 maize farmers in Cagayan and Isabela [3] where on-farm trials were conducted by the U.P. at Los Banos and the Bureau of Plant Industry ; and (2) a survey of 189 maize farmers in Negros Oriental,[4] where a package of technology (POT) was tested.

The field trial in Negros Oriental consisted of seven treatments (Table 2). The results of the field experiments showed that POT yields were markedly higher than those obtained by the farms not using the recommended practices. Non-use of the recommended fertilizer reduced potential yield by 59 per cent. Likewise, non-adoption of factors such as recommended varieties, weed control, density and insect control reduced the potential yield by as much as 22, 15, 11 and 9 per cent, respectively.

The experimental results suggest that higher yields could have been attained if the farmers had used the package of technology. If a disparity in yields exists due to the quantities of inputs, profitability would also be expected to vary according to the type of inputs applied.

On the whole, the profitability of POT adoption over farmers' practices was substantial.

Among the POT components, the use of recommended fertilizers produced the highest increase in profit. Although the cost of adoption was relatively high for fertilizer, the rate of compensation was still above the levels obtained from recommended weed and insect control. However, the use of recommended varieties demonstrated the greatest added net return per pero invested.

In selecting the study villages in Cagayan Valley, it was hypothesized that the presence of demonstration trials would encourage the adoption of new technology and consequently increase farm productivity. Sample farmers were therefore selected from the villages where field trials were conducted and from adjacent and farther barrios.

Farmers obtained the following yield levels (metric tons/ha):

	First crop	Second crop
Trials villages	.98	.68
Adjacent villages	.89	.75
Far villages	1.21	.94

One of the major factors limiting maize yield in the Philippines is the non-yielding varieties. In a survey of maize farmers in Cagayan Valley, 70 per cent used traditional varieties. A number of farmers reported varietal characteristics as the reason for non-adoption, including maturity period, taste, and susceptibility to pests and diseases, while about one-fourth said the recommended varieties were not available, 6 per cent reported that they could not afford to buy seeds. Moreover, while 6 per cent were averse to modern varieties, 14 per cent had no information about these varieties.

Some factors that could possibly affect adoption of modern maize varieties were analyzed.

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(3) A.R. Librero, J. Yorobe, Jr. and A. Ceuno, Identifying Constraints to Higher Corn Yields in Cagayan Valley, Institute of Agricultural Development and Administration, UP at Los Banos, 1978.

(4) J. M. Yorobe, Production Constraints of Corn in Negros Orienal, Unpublished M. S. thesis, UPLB 1979.

First, it was hypothesized that non-adoption resulted from the distance of the farms from the field trials or experimental stations. About one-fourth of the farmers in the trial and farm barrios and 18 per cent of those from adjacent farms used modern varieties (MVs). From the chi-square test, the farmers' decisions to adopt MVs were not adversely affected by the distance from field trials. The second factor tested was the tenure of the farmer ; again, there was no apparent adverse effect caused by distance. Almost an equal proportion of 21, 22 and 23 per cent of the part owners, share tenants, and owners adopted MVs. Third, it was postulated that farm size could affect adoption of modern technology. Among the farmers studied, there was a significant relationship between the use of MVs and farm size.

Although farms which applied fertilizer obtained higher yields than the non-users (1.26 tons/ha. for the users and .86 ton for non-users in the wet season and 1.05 versus .51 ton for the dry season), only a small proportion (14 per cent) of the maize farmers used fertilizers (Table 3).

Economic factors seemed to be a major deterrent to the application of fertilizer, as expressed by farmers who claimed that "fertilizer is expensive", that they "do not have money", or that they "do not want to be in debt". It is surprising to find that 17 per cent lacked knowledge about fertilizers; either they "for not know about it" or they "do not know how to apply it". This is actually different from the nonavailability of fertilizer reported by 12 per cent of the farmers in Cagayan. Some 7 per cent were averse to the use of fertilizers, while 9 per cent were averse due to risk of crop failure from floods and pests. Physical factors were also important. In particular, farmers believed that the soil was fertile although no soil test had been done.

Farmers used chemicals mainly as a control rather than as a preventive measure. However, despite the knowledge that pests and diseases would reduce yields, a majority of the farmers were not able to use effective methods. A large number of farmers simply lacked the information on the effective control of pests and diseases (Table 4). Some did not know where to but insecticide, what kind of insecticide to use or how to apply it. Economic reasons combined with traditional beliefs hindered the use of chemicals.

Most of the farmers weeded by hand. Only 33 per cent had problems with weeds, primarily for economic reasons such as the amount of labour involved and the lack of money to pay labourers or buy weedicides (Table 5).

Other studies point out that the prices of inputs [5], financing [6], and profitability [7] are the factors that constrain adoption of technology.

An increase in the price of fertilizer reduced its use on maize farms from 1.9 bags/ha to 0.85.bag.[8]

Likewise, the rate of pesticide application decreased in 1983 compared to 1979 levels. Concerning the levels of chemical use by variety, a greater quantity is used for the hybrid than for the traditional varieties.

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(5) M.L. Laopao, P.S. Caddarao, and C.C. Olalo, Patterns and Level of Fertilizer and Pesticide Use in Philippines Rice and Corn Farms, Economic Research Report No. 4, Bureau of Agricultural Economics, August 1984.

(6) D.T. Isada, "The Impact of the Corn Production Kits in Selected Corn Priority Provinces", (Unpublished M.S. Thesis, 1973, UPCA).

(7) A.R. Librero, "The Role of Farm Management Research in Relation to an Efficient Extension Service". Extension Bulletin No. 119, ASPAC Food and Fertilizer Technology Center, Bangkok, Thailand, 1979.

(8) M.V. Rondon, Levels of Input Usage and their Prices for Rice and Corn Production in the Philippines, Bureau of Agricultural Economics, Quezon City, 1980.

Table 3. Reasons for Nonadoption of Recommended Amounts of Fertilizer, Cagayan Valley and Negros Oriental

Reasons	Cagayan Valley No. of Farms	%	Negros Oriental No. of Farms	%
Economic				
Too expensive	43	18	24	15
No cash	59	22	23	15
Don't want to borrow	2	1	10	6
Can't afford more	1 (105)	- (41%)	6 (63)	4 (38%)
Lack of Knowledge				
No information	36	13	14	9
No information on use	9 (45)	4 (17%)	21 (35)	14 (21%)
Nonavailibility				
Not locally available	20	8	4	3
Don't know where to buy	6	2	3	2
Lack of dealers' supply	4 (30)	2 (12%)	1 (9)	1 (6%)
Physical Conditions				
Soil is fertile	20	8	4	3
Soil is not analyzed	2	1	3	2
Farm is distant or sandy	2	1	6	2
Soil is story or sandy	2	1	5	4
Farm is flooded	4	3	5	3
Lack of water	1 (31)	- (13%)	4 (27)	3 (17%)
Risk Aversion				
Risk of crop failure	2	1	2	1
Fertilizers attract pests	1	-	-	-
Risky due to floods	16	7	9	6
Might not increase yield	2 (21)	1 (9%)	3 (14)	2 (9%)
Aversion to Fertilizers				
Don't like fertilizers	13	6	2	1
Unfamiliar with use	2	1	8	5
Not practical for area	1 (16)	- (7%)	- (10)	- (6%)
Prefer Traditional Practises	3 (3)	1 (1%)	5 (5)	3 (3%)

Recto [9] found that, besides the price of maize, alternative crop prices, agricultural wage rates and technologies were important factors in influencing the maize hectarage in the Philippines. Her findings are further supported by Corpuz [10] , indicating that in recent years, maize farmers were more price responsive than in earlier periods.

To summarize, the use of inputs has three facets: (1) cost ; (2) supply adequacy: and (3) accessibility of supply centers. Farmers ignore recommended levels of inputs, not because they are not convinced of the profitability, but because they cannot afford to purchase them. Adverse weather conditions, damage due to pests and diseases, and risk aversion further inhibit farmers from investing in certified seeds, fertilizer, and chemicals. The financing scheme of the Maisagana Program (maize production programme) has led to use of recommended production practices (at least among the participants) ; however, with the low repayment rate, it may take a time for the farmers to regard this loan as a production incentive rather than as a remedial source of funds. The high cost of fertilizer and chemicals could be compensated if the resulting yield levels enabled the farmers to earn some profit. However, gaps in the production technologies and the inadequacy of information on maximizing the effectivity of inputs prevent the farmers from regarding maize production as an investment.

The problem of input availability is also attributed to the geographical distance between the farms and the trade centers. Distance is also a factor in loan repayment.

Another constraint to efficient input use is inadequate information on the proper use of these inputs. For example, in the use of pesticides, the morphological characteristics of the organism, the nature of damage it inflicts on the plants, and its reproductive cycle, determine the most effective type, method and time of application to ensure effective results. Without specific information, the farmer may think that simply applying a bottle of recommended pesticide is sufficient to eliminate a pest. [11]

Constraints on Utilization. Maize is used for human consumption and as feed for livestock and poultry. About 50 per cent of the total supply is used as food, 44 per cent for feed, 4 per cent for manufacturing and 2 per cent for seeds (Table 6). Maize consumption for food was steadily increasing until 1975, largely due to the rice shortage in 1973 ; thereafter, there has been a decline. Since the total supply actually increased, the demand for feed must have increased substantially. Although manufacturing comprises only 4 per cent of total domestic use, utilization for industrial purposes shows a steady upward trend. During the 1973 rice shortage the government enforced the use of rice-corn mixes. Maize was found acceptable by a majority of the Filipinos, demonstrating that in the absence of rice, maize is a suitable substitute. However this could possibly be true only in the short run. Under rice shortage conditions, whether in the maize consuming regions like the Visayas and Mindanao, or in Luzon, people did not demonstrate a long term preference for corn grits and rice-corn mixes. A study showed that Luzon consumers pointed out "digestive problems" while the Visayas and Mindano consumers cited "extra labour preparation" and "poor quality". [12]

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(9) A.E. Recto, "Price and Market Relationships for Corn in the Philippines", M.S. thesis, 1965, University of the Philippines, Diliman, Quezon City.

(10) M. Corpuz, "Supply Response of Corn to Price in the Philippines", Unpublished M.S. Thesis, 1977, UP at Los Banos.

(11) This attitude is somehow perpetuated by researchers who test chemicals under field conditions without adequate knowledge of the morphology of the pathogen or organism and the physio-logical characteristics of the plant variety to be protected. (See Collado, G., et al. Agribusiness Corn Systems, Philippines and Thailand

(12) R.D. Torres and L.B. Darrah, Low Income Families' Reaction to Corn Grits MA-SSD Vol.4 No. 9, , Quezon City, 1974.

Table 4. Reasons for Nonadoption of Recommended Amounts of Insecticide, Cagayan Valley and Negros Oriental

Reasons	Cagayan Valley No. of Farms	%	Negros Oriental No. of Farms	%
Economic				
Too expensive	25	11	48	34
No cash	45	18	16	11
Don't want to borrow	2 (72)	1(30%)	1 (65)	* (38%)
Lack of Knowledge				
No information	57	23	24	17
Don't know which kind to use				
Don't know where to buy	8	4	8	5
Never heard of it	6	3	4	3
	1(72)	* (17%)	3 (30)	2 (27%)
Nonavailibility				
Not locally available	15	7	-	-
Sprayer not available	10	4	-	-
Don't know where to buy	3 (28)	1 (12%)	-	-
Physical Conditions				
Late planting/spraying	7	3	8	5
Severe infestation	3	1	4	3
No infestation	12	5	-	-
Rain cancel spraying	1	*	4	3
Small farm	- (23)	- (9%)	4 (20)	3 (14%)
Risk Aversion				
Risky due to floods	5 (5)	2 (2)	-	-
Aversion to Fertilizers				
Don't like insecticides	6 (6)	2 (2%)	-	-
Prefer Traditional Practises				
Have not tried insecticide	26	11	-	-
Believe they are ineffective	8	4	7	5
Agree with non-users	2	2	6	4
Not practical in area	1	*	6	4
Insecticides attract pests	1 (38)	* (15%)	- (19)	- (13)

* Less then 1 per cent

Given a choice between the rice-corn mixes and pure rice (or pure corn), a great majority preferred the latter. The apparent reason was that they could mix or use the pure rice and corn grits as they desired. Those who preferred rice suggested a 2:1 ratio of rice to corn grits.

Demand estimates for maize in the Philippines showed a preference for rice and wheat products over maize. The income elasticity of demand for rice to rice products has been estimated at approximately .07, implying that a doubled income would result in a 7 per cent increase in expenditures for rice and rice production. On the other hand, the income elasticity of demand for maize and maize products was -0.53, indicating a tendency to reduce maize purchases as income increases. A series of consumption surveys made by the MA Special Studies Division showed declining quantities of maize and maize products for human consumption.

Malnutrition has been a serious problem in the Philippines. The nutritional role of maize hinges on the development and cultivation of high lysine varieties in quantities sufficient to meet the dietary requirements.

As a feed grain, maize comprises 50 per cent of the quality poultry and hog mixes. A considerable amount is also fed as ground or whole maize grits to hogs and cattle.

Since maize has traditionally been an item for human consumption, farmers prefer to plant the white flint varieties rather than the yellow varieties, even if the demand by feed processors is higher for the yellow maize. Yellow maize has higher protein and carbohydrates and contains carotene, which promotes pigmentation in the eggyolk and meat of chicken. Most feed mills mix about 60 per cent white maize and 40 per cent yellow maize-proportions based on availability rather than preference.

There are 66 feed mills in the country; The largest feed processors, located mainly in metro Manila, have a capacity of 1,110 thousand metric tons of feeds, but produce only 774.9 thousand metric tons, indicating a capacity utilization of 68.8 per cent per year. [13]

The manufacturers of animal feeds are highly dependent on the availability of raw materials, particularly maize. However, direct purchase from small farmers is uneconomical, due to the large number of suppliers to deal with to obtain the desired quantity. Because of supply uncertainties and frequent shortages of raw materials, many smell livestock owners mix their own feeds, thereby insuring stability in their feed supply.

During times of severe maize shortage, feed processors use substitutes such as sorghum, rice bran, cassava, wheat by-products and others. However, these feedstuffs cannot equal the nutritive values of maize. To reduce deficits in maize supply, importations are necessary to meet the domestic maize requirements of the feed industry. Most millers and maize processors in the feed milling industry also own market outlets and livestock farms, which makes their operations a priority for increased maize importations in times of inadequate supply. The government has formulated policies to ensure that the feed and processing sectors do not compete with the food supply. In times of shortage, therefore, the maize processors bear the costs of importation.

Another problem facing the feed milling industry is that about 93 per cent of the volume of sales is accounted for by almost one-third of the total number of firms operating in one center of the market. [14] The concentration of location, together with the spread of demand for feed as well as the supply of raw materials, spells high distribution and procurement costs which contribute to the high price of feeds.

Almost 70 per cent of processed maize grains are made into corn starch. Other processed from Include corn oil, corn germ and gluten, from which hundreds of product limes are manufactured for food processing, textiles, and other industrial enterprises.

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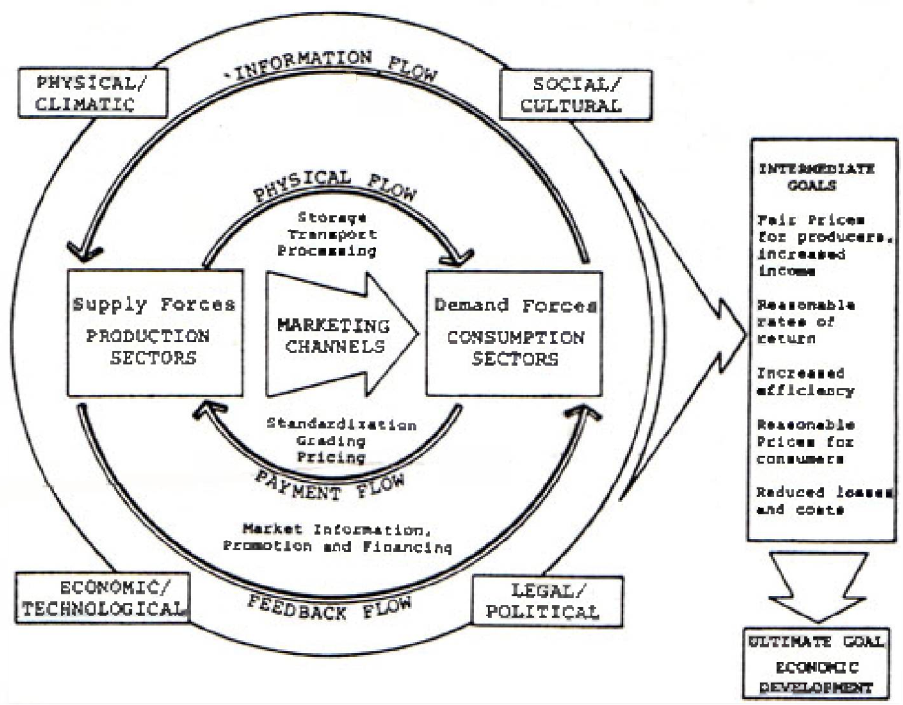
(13) Collado, G. et al.

(14) N.G. Alviar and T.T. Mina, Market Structure of the Corn Feed Milling Industry, Staff Paper Series No. 111, Institute of Agricultural Development and Administration, UP at Los Banos Collage Laguna.

Table 5. Reasons for Nonadoption of Recommended Amounts of Weedicide, Negros Oriental (187 Farms)

Reasons	No. of Farms	Percentage
Economic		
Too expensive	31	
No cash	16	
Can't afford more	2	30
Don't want to borrow	3 (52)	
Lack of Knowledge		
No information	39	
No information in use	13	
Don't know where to buy	11	
Don't believe in use	3	
Never heard of it	3 (69)	41
Nonavailibility		
Not yet available	8 (8)	
Physical Conditions		
Farm is distant	3	
No sprayer	2	
Farm is small	1	
Too much rain	2 (8)	3
Risk Aversion		
Risky due to bad weather	11	
Risky due to crop failure	8 (19)	7
Aversion to Fertilizers		
Don't like weedicides	3	
Unfamiliar with use	3 (6)	3
Prefer Traditional Practises		
Prefer hand weeding	21	13
Have not tried weedicides		

Figure 2. Marketing Systems Framework for Development



While maize-processing plants have a total capacity of 232,000 metric tons of maize grains, these are only 30 to 35 per cent operational. These plants process about 3 per cent of the total maize production. The increased cost of production is a major drawback to the development of maize processing.

Marketing Constraints. The efficiency of the marketing system to a large extent affects the stability of supply and demand. A disorderly and unsystematic marketing network creates an irrational and inflexible seasonal flow of commodities. Inefficiencies jack up the costs and the ultimate price to the consumers, thus widening the price spread between the producers and the end-users. An unstable market discourages farmers from expanding and improving production, thus leading to instability. In the long run, the growth of the economy is hampered.[15]

Figure 2 conceptualizes the components of the marketing system and the Interactions of the subsystems. Like any other system, marketing has its objectives or goals which are normative criteria set by society. The system has inputs consisting of transportation, storage, processing, grading/standarization, and all the necessary activities to move products from the production sectors to the consumption sectors. For maximum achievement of goals, the system roads institutional support, planning and management.

About 50 per cent of the maize grain production is handled by assembler-wholesalers. Other maize handlers include grain wholesalers, miller-wholesalers, agents and retailers. The balance is channeled to the National Grains Authority, co-operatives and direct consumers.

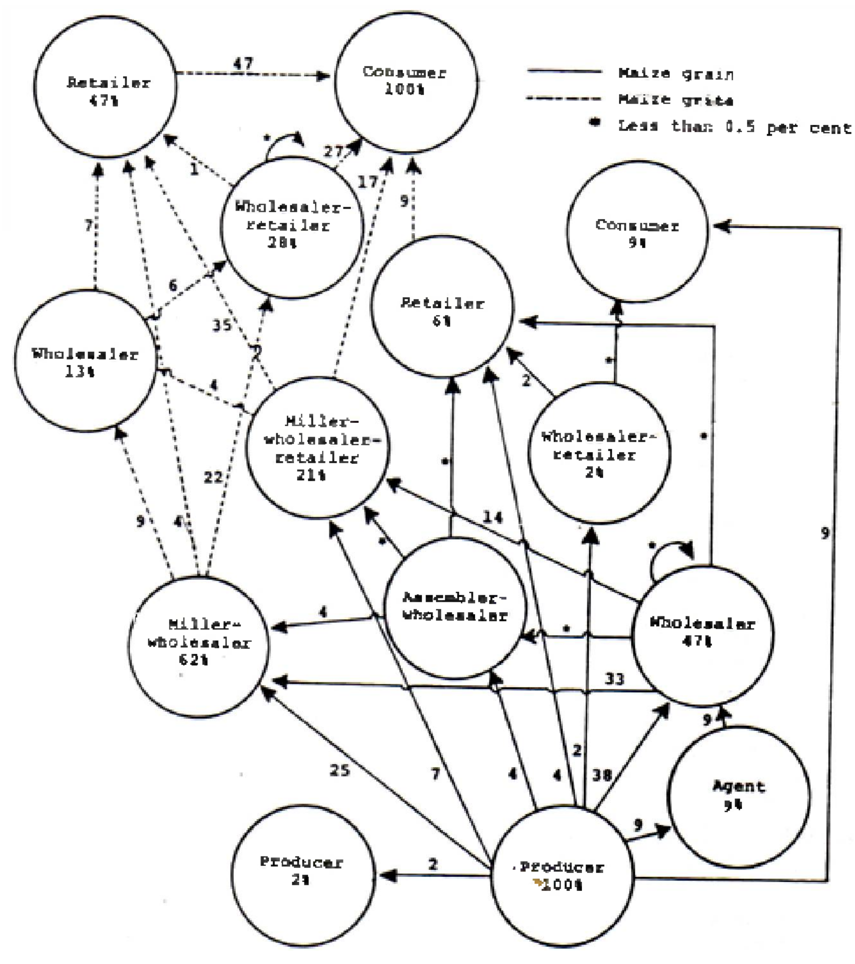
15) A. Gallinguez, L. Castor and V. Evangelists. "A Strategy: Role of Agricultural Marketing National Development and the Involvement of the Food Terminal in this Approach', in Marketday (Taguig, Metro Manila. Food Terminal Inc.. January. 1978).

Figure 3 shows the channels through which maize passes before finally reaching the ultimate consumers. Maize in many areas of the Philippines is marketed through these intermediaries.[16] The existence of several intermediaries in the marketing of maize contributes to increase marketing costs. Some of these intermediaries perform similar functions As a result farmers receive on average only 62 per cent of the consumers' price for maize.

Other common constraints were price variation, lack of or poor roads, inadequacy absence of marketing facilities (mechanical shellers, driers, storage facilities, and miller and the lack of a standarized unit of sale. Wide variations prices may be due to the lack of good.

16) For further studies on maize marketing, see studies by S. S. Olgado, et al., I. P. Carlos J. M. Manto and V. E. Sernadilia, and E. B- Tambak, et al

Figure 3. Market Channels for Maize Grain and Grits, Central Visayas, 1974.



market Information. Bukidnon farmers complained of unstable prices of maize, lack of storage facilities, tie-up of credit to buyers, inadequate transportation facilities, and high transportation costs.[17]

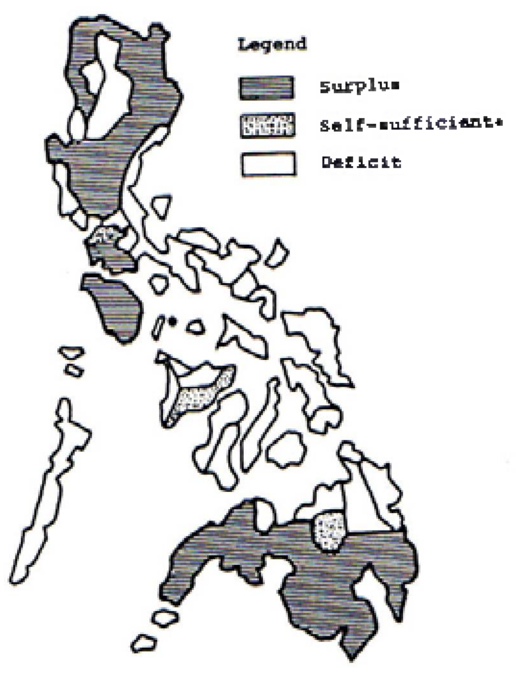
Expectedly, maize moves from major production areas to different markets. However, instances were observed where maize not only moved from one area to another, but then moved back to the origin, or moved indirectly to its ultimate destination, resulting in product flow inefficiency. Moreover, sometimes maize moves from a deficit producting region to main terminal market points, adding up the marketing costs if the same grain moves back again to the deficit regions (figure 4).[18]

The maize marketing system is controlled by a group of wholesaler-millers whose trading and procuring operations converge in Cebu, which is considered the national maize center. Equipped with transportation and warehousing facilities, Cebu operators assume a dominant role in the trade and pricing structure of maize in the country.[19]

The difference between farm and retail prices could indicate comparatively the services offered and the efficiency of the marketing structures and processes. Price margins among regions of the Philippines show wide fluctuations. Farmers often receive smaller spreads than

(17) Canete, cit p. 50
(18) Colledo, et al., op. cit, pp. 157-158
(19) Collado, et al. op. cit

Figure 4. Surplus and Deficit Areas of Maize Supply by Province, The Philippines, 1981



Source: G. M. Collado, J. D. Drilon, G. F. Saguituit, Agribusiness Corn Systems: The Philippines and Thailand, Southeast Asian Regional Centre for Graduate Study and Research in Agriculture, College, Laguna, Philippines, 1981.

* With surplus production of not more than 10% of the consumption requirement.

wholesalers and retailers. The magnitude of the margin is directly proportional to the inefficiencies of the marketing services and the profits of the middlemen. One would expect that the farmers' share of the consumer peso would vrry directly with the farm prices and inversely with the marketing margins. However, larger margins can be obtained with increasing wholesale and farm prices. [20]

The price support programme for maize sets floor and ceiling prices to balance the conflicting interests of producers and consumers. as well as to promote stability. The government price support prqemme is implemented by the Netional Grains Authority which controls only 10 per cent of the total grain support.

Seasonal supply. along with inadequate storage facilities may also be considered an impediment to marketing efficiency. After the harvest seasons (August-October and February-April), the country experiences a lean supply of maize. Farmers normally market their meize immediately after harvest because of the need for cash and the lack of storage facilities. Moreover. the volume of production is not likely to be substantial enough to justify the establishment of storage units. The high cost of construction also limits the establishment of warehouses by mil1er-wholesalers.

(20) Librero. A.R., et .1. Prices and Price Margins for Rice. Com, and Selected Export Crops. Project ADAM, NSDB-BAEcon.

Table 6. Maize Supply and Utilization in the Philippines, Selected Years (thousand metric tons)

Supply and Utilization	1967 -70	1973 -75	1974 -75	1979 -80	1980 -81	1981 -82	1982 -83	Average % of Utili-zation
Production	2013	2258	2514	3123	3110	3290	3126	-
Imports	9	94	159	93	351	275	406	-
Total Supply	2068	2448	2930	3480	3609	3740	3704	-
Domestic Utilization								
Food	1205	1317	1709	1559	1536	1544	1479	50%
Feed and Waste	651	738	832	1573	1687	1802	1893	44%
Industry	53	90	97	136	146	155	165	4%
seeds	39	43	49	64	65	67	63	2%

Research Priorities

The review of studies on production constraints allows careful examination of the factors which influence yields. Orientation should be set in a multi-disciplinary context encompassing relationships between physical and socio-economic aspects. Emphasis should lie on the interaction of the different physical and economic factors. Further investigation should also focus on the influences of culture, infrastructures, and institutions. Studies should consider various farmers' environments to come up with a comprehensive strategy to reduce impediments to a higher maize yield. Such research areas are further enhanced by the present policy of the Philippine government to increase maize production and reduce the importation of feedgrains. Looking forward, what are the implications of expanding the production of maize? What would be expected to happen to the supply, prices, marketing and utilization of maize? What are the alternatives to releasing the constraints on maize production? Worth noting is the level of technology adoption by farmers. How is the rate and level of technology adoption explained?

The government has been claiming that self-sufficiency in maize will soon be attained. In fact, it is said that there are possibilities of a surplus, in which case the Philippines would be exporting maize. How realistic are these pronouncements?

Some of the priority areas for research in the socio-economic aspects of the maize commodity system are 1isted below:

1. Socio-Economic Implications of the Peso Devaluation on the Maize Commodity System.
   a. Effect on the quantity of maize produced, area allocated to maize, distribution of production, prices of maize, demand and supply relationships for maize
   b. Ways of minimizing constraints to increase yield
   c. Demand for inputs such as seeds, fertilizer, chemicals, etc.
   d. Technology transfer and adoption
   e. Effect on the socio-economic conditions of the maize farmers
   f. Resource productivity
   g. Income distribution
   h. Employment
   i. Marketing and trade - domestic and international
   j. Processing

2. Buffer Stock Scheme for Maize
   a. Quantity requirements, distribution, storage facilities
   b. Cost of maintaining a buffer stock
   c. Benefits
   d. Price determinations
   e. Procurement activities

3. Effect of Intervention Policies
   a. Quality requirements, distribution, storage facilities
   b. Cost of maintaining a buffer stock
   c. Benefits
   d. Price determinations
   e. Procurement activities

4. Are Maize Farmers Exploited by the Middlemen?
   a. Role/Functions of traders
   b. Prices received/ paid
   c. Storage facilities
   d. Margins
   e. Cost of marketing
   f. Market structure

For the purposes of this paper, the first research area is being proposed, that is: Socio-Economic Implications of the Peso Devaluation on the Maize Commodity System. This is relevant at the moment, considering the recent devaluation of the Philippine peso and the consequent price increases. Likewise, the government policy is for the expended production of maize and it would be important to examine the consequences of such expansion on different groups: (1) farmers; (2) wholesalers; (3) consumers; and (4) the economy as a whole.

For this project, both primary and secondary (time series) date will be used. Primary data will require surveys as well as experiments on farmers' fields for the constraints study.

Methodological Experiences in Similar Studies

For methodology, I would like to summarize the methodology used by IRRI [21], which has a wide range of experience in conducting studies to identify constraints to increasing rice yield, not only in the Philippines but also in other countries. The objective of the IRRI research project was to understand the factors which create the gap between the yields which farmers actually get and the potential yields under their conditions.

Experiments and socio-economic surveys were combined in a representative area. Farmers' practices on a "comparable paddy" were simulated on farmers' level plots in the experiment. Recommended levels using a factorial design were used in the other plots. Using data from a benchmark survey and from an analysis of physical conditions of study sites, four inputs were identified as the probable major yield constraints, namely, fertilizer, weed control, insect control, and land preparation. The yield gap was identified as the yield difference between the plots with all the inputs at a high level, and the plots with all the inputs at the farmers' level. The yield contribution of each individual input was determined by comparing the average yield of' all the treatments with the factor at the high level. Statistical analysis of the factorial component was made to determine the presence of interactions.

To identify socio-economic constraints, a partial budgeting analysis of the costs and returns associated with the package of inputs tested in the management package component of the experiment was carried out. Then, to determine the relative importance of factors explaining the level of input use, multiple regression was employed using either the expenditures on inputs or the number of practices as a dependent variable; and the following as independent variables: (1) technical knowledge; (2) credit used; (3) input availability; (4) traditional beliefs; (5) alternative earnings; (6) irrigation as a dummy; (7) technician's value; and (8) share tenure as a dummy.

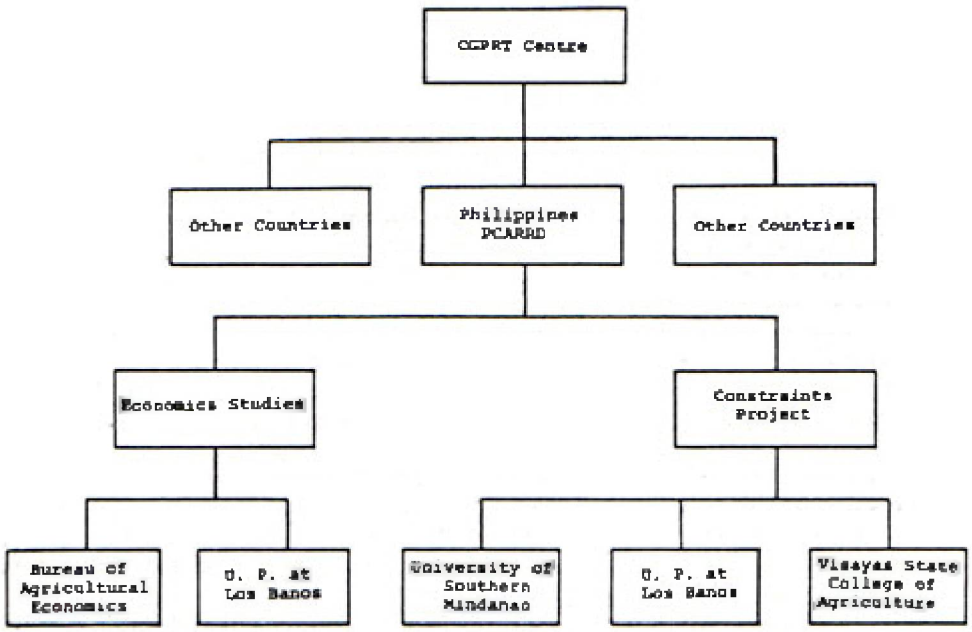
Proposed Research Network

For the proposed project, it is suggested that if there are other projects in the region, the CGPRT Centre should co-ordinate these projects. Within the Philippines, the Philippine Council for Agriculture and Resources Research and Development (PCARRD), the national co-ordinating agency for agricultural research, could be the co-ordinator. There are two major types of work to be done in the project, namely: (1) experiments to determine ways to minimize constraints to increased yield; and (2) studies involving survey and time series date analysis. The first can be conducted in three major maize producing regions: Region IV by UP at Los Banos; Region VIII by the VISCA; and Region XI I by the University of Southern Mindanao.
These institutions are all part of the national research network and are assigned maize as a commodity for research (Figure 5).

The other economic studies can be done by the U.P. at Los Banos and the Bureau of Agricultural Economics. Other institutions can be identified and included in the network as the proposal is presented in a more detailed form.

(21) IRRI. Constraints to High Yields on Asian Farms: An Interim Report, 1977.

Figure 5. Proposed Network for Philippine Project



SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON CASSAVA DEVELOPMENT IN ASIA*

I. Introduction

Cassava is well-known for its capability to meet a wide range of end-uses and many kinds of development policy goals. It can be grown almost anywhere in the tropics, including home gardens, although it is especially well - adapted to marginal upland soil conditions in the region. It may save as the main source of staple food for the poor section of the population, and also contribute significantly to the incomes of farmers in the depressed upland areas. However, future development of the crop requires a definition of how cassava fits into an essentially rice economy. Moreover, development also depends on how its end-uses as substitutes will compete with other commodities, both in the domestic and world markets.

Cassava has remained a secondary crop to rice in the region, both 1n terms of public resource allocation for research and in extension (except perhaps in Thailand), and in social status as a staple food Irrigated rice cultivation has been known since the beginning of modern history, and increasing areas of Irrigated land have been cultivated throughout the eges. It is only natural that, until recently, the efforts of most national development policies on food crops have been focussed on expanding the irrigated areas and intensifying the paddy cultivation.

It was then quite appropriate that, as John Lynam (CIAT) put it, the Green Revolution that swept through tropical Asia during the 1970s centred on high-yielding rice varieties. The improvements in both the consumers' welfare and the farmers' income that followed were substantial and, in turn, stimulated other sectors of the local rural economies. However, the growth potential generated by the new technology has been largely exhausted in most countries and, consequently, research efforts have shifted to the maintenance of yield gains. Moreover, the producer benefits of this technology were largely limited to the productive irrigated areas, and to farmers with higher levels of income. The challenge for the 1980s thus shifts to identifying future sources of agricultural growth, especially for the upland areas of tropical Asia, and it is exactly in this light that cassava deserves consideration.

This paper intends to highlight the results of the Workshop on the Future Potential of Cassava in Asia and the Research Development Needs, which was held in early June 1984. One of the important objectives of the workshop was to assess problems constraining the potential increase in production, utilization and marketing of cassava in Asia. Much of the content of this paper draws upon the draft recommendation prepared by the workshop. In addition, it also quotes substantially from John K. Lynam's "Cassava in Asia", CIAT International Document, March 1983.

II. Problem Identification

1. Review on Demand-side Problems

Among the Asian cassava-producing countries, Thailand, Indonesia, India, Philippines and Malaysia have been the most important ones, respectively. Almost 80 per cent of the total cassava output in tropical Asia comes out of these countries. The estimated production and utilization of cassava of each country are shown in Table 1.

A quick look at the date in Table 1 reveals a substantial variation in the end-uses of cassava

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*) Prepared by Irlan Soejono Agricultural Economist,
ESCAP/CGPRT Centre. Bogor, Indonesia.

Table 1. Production, Export and Domestic Utilization of Cassava Production in Principal Producing Countries in Asia, 1976-1982, in 1000 T fresh tuber equivalents

Country	Production (100%)	Export	Human Consumption	Starch	Animal feed	Waste
Thailand						
1977	13,554	9,451 (73%)	-	788 (6%)	16 (0.1%)	2,800 (21%)
1982	17,788	14,025 (79%)	-	1,039 (6%)	35 (0.059)	2,689 (15%)
Indonesia						
1976	12,191	801 (7%)	5,865 (48%)	3,308 (27%)	-	2,217 (18%)
1981	13,301	1,036 (8%)	9,686 (73%)	740 (6%)	245 (2%)	1,594 (12%)
India (Kerala States)						
1977	3,189	-	2,595 (81%)	246 (8%)	-	348 (11%)
1981	4,097	-	3,113 (76%)	492 (12%)	-	492 (12%)
Philippines						
1976	761	-	407 (539)	107 (14%)	161 (21%)	86 (11%)
1980	948	-	434 (46%)	112 (12%)	312 (33%)	90 (9%)
Malaysia						
1976	575	160 (28%)	-	226 (39%)	43 (7%)	146 (25%)
1980	392	35 (9%)	-	230 (64%)	24 (6%)	83 (21%)

Source: Lynam (1983), Titapiwatanakun (1984), CBS Indonesia (1984) , Subramanian (1984), Sarma and Paulino (1984), Ten and Welsch (1984).

It can also be observed that little relative change in uses occurred from 1976 to 1982. In traditional agricultural export economies, such as Thailand Malaysia, cassava has developed as essentially an export crop. On the other hand, cassava production in India (Kerala State) is utilized almost exclusively for domestic consumption. Between the two extremes, Indonesia and the Philippines show the true potential of cassava and its multi-uses.

Recently, however, there has been a growing tendency for a stagnation in the cassava world market. The increasingly effective trade barriers in most of the cassava- importing countries and the technological breakthroughs in starch modification and maize wet milling have been cited as the main reasons for the limited demand. In the foreseeable future, it appears that the cassava export market will remain limited. Hence, the options left for the cassava-exporting countries are to increase domestic consumption, or to reduce production, or to make cassava more competitive in the broader world grain market. Clearly these alternatives for market growth require lower price levels. Assuming nonavailability of government subsidies, sufficient production incentives can only be met by the adoption of cost-reducing technologies. Without considering the potential growth of the domestic cassava novel product markets, the same conclusion should also apply for the other producing countries, if they should want to increase the cassava growers' income.

One of the important uses of cassava is for direct human consumption after simple processing (boiling, stewing, steaming, frying, etc.). However, a socially determined value has long served as an effective barrier to the increased domestic use of cassava. With regard to traditional consumer preference, cassava is generally considered to be an "inferior" food. Thus, if domestic consumption of cassava and cassava products is to be increased beyond that by the poor, it will be necessary to upgrade the prestige value of cassava and to change its image of being a "poor man's food".

More respectable cassava food can be made available by sophisticated processing. Cassava starch is a well-known intermediate product for many of the highly processed cassava foods and for various industrial goods. Furthermore, when the average income of the population has risen, the expansion of the demand for chicken and livestock products would potentially give rise to an increase in the domestic demand for cassava for feed However, all these possible developments depend upon the competitiveness of the various cassava products with respect to the potential substitutes.

2. Review on Supply-side Problems

It would not be fair to say that no efforts have been made to improve the productivity of cassava Actually, some progress has been achieved, at least on the experimental fields, mainly resulting from breeding and selection programmes. However, the annual growth rates of cassava yields in many producing countries appear to be much smaller then those of the harvested areas (Table 2).

As cassava production data in Table 2 indicate, more than two-thirds of the total output growth rate is contributed by the growth rate of harvested area, while less than one-third comes from the yield growth. With rice, which is the preferred staple food, exactly the opposite case occurred during 1961-1980. Two conclusions deserve attention here:

1) relatively greater efforts and resources have been expended over time to increase rice production than to increase cassava production, and
2) the expansion of cassava areas has occurred in the marginal uplands, as cassava could not compete with rice for the more fertile and irrigated lands.

Usually, most marginal upland areas in Asian countries are occupied by relatively poor people. Thus. the goal of increasing cassava production depends upon the availability of national resources for cassava research and development, which then should be directed at raising the cassava yields of the poor farmers in the marginal upland areas. This is not an easy task, as most marginal areas are remotely located, with poor access and few support agencies.

Agronomic research and cassava breeding have resulted in the discoveries of high-yielding varieties and improved techniques of production. Yet, often it is a long time before these findings are adopted by farmers, and even then, the adoption is rarely complete. Commonly, many researchers stop short, pointing to the problem of extension. But the reel problem appears to be a lack of understanding of the many environmental variables which influence the farmers' decisions. The farmer often has no control over the constraints to adoption, due to his limited capital. Economic calculations are needed to assess the feasibility of removing the (potential) constraints, to allow adoption to take place profitably.

Experimental stations tend to be located 1n optimal locations and to utilize high input levels, appropriate for research on rice. A bias toward ideal conditions may seriously hamper the discoveries of appropriate technologies for cassava, which requires studies of stress tolerances. These potential biases should be recognized when selecting cassava research locations in the region.

The pronounced heterogeneity in production conditions and production systems for cassava increases the complexity of the research process and argues strongly for farmers to be brought more effectively into the research effort. A closer link between the farmer and the experimental design and evaluation is clearly beneficial for studies on soil fertility management, erosion control, intercropping systems, and in the final stages of varietal selection.

More than other crops, cassava requires attention in post-harvest research. Cassava roots need to be transformed into stable products for wide market distribution to meet the demand for various end-uses. Studies are needed to determine how to reduce losses between the farm and the final end-use, and to increase the derived demand for cassava through processing into novel forms.

Table 2. Comparison of Annual Growth Rates of Harvested Area and Output of Cassava and Rice in Tropical Asia.

Country	Cassava (1971/ 80) Area (percent)	Output (percent)	Rice (1961/ 80) Area (percent)	Output (Percent)
Bangladesh	-	-	0.8	1.7
Burma	7.4	6.0	0.3	2.2
India	0.5	1.4	0.7	2.3
Indochina a)	18.9	20.8	-0.6	0.1
Indonesia	-0.4	2.2	1.4	5.0
Malaysia	6.7	4.9	2.0	3.8
Pacific Islands b)	1.6	1.6	0.9	1.2
Philippines	11.7	23.4	0.7	3.8
Sri Lanka	-4.0	3.6	2.9	4.0
Thailand	18.8	18.9	1.4	2.3
Total	5.6	8.2	0.7	2.4

Source: Sarma mid Paulino (1984), based on FAO data.
a) Comprises Kampuchea, Lao and Vietnam
b) Comprises Fiji and Papua New Guine..

III. Research Priorities

The following is a description of some of the priority research areas in socio-economics, recommended by the Workshop on the Future Potential of Cassava in Asia and the Research Development Needs, S-8 June 1984, in Bangkok. The priorities include research on cropping systems, systems of research and extension, novel end-uses, cassava farm production, utilization and demand, price analysis, trade, and integrated food policy. Economic research in cassava should focus on technological that is, biological, agronomic and utilization research, the planning of cassava development programmes, and overall food and agricultural policy.

The general principles of erosion control, such as minimum tillage, multiple cropping, live barriers and strip cropping, need to be widely adopted and established. These basic principles will need adaptation to fit in with the local cropping systems, conditions of input availability, and the local demand for the products of intercropping. Since erosion control involves either investment or reduction in short run profits, the importance of land tenure and its effect on the attitudes of farmers toward long term soil conservation should be studied as well. There is a clear need for on-farm research activities to develop erosion control methods.

The development of more on-farm research activities would aid in countering the biases toward rice conditions in both research and extension programmes. Such research would often be location specific, but the development of a typology of cropping systems in the region could lead to a more effective transfer of information obtained in one system to similar systems in the region as a whole.

Various novel products derived from cassava which have received attention in Asian countries include composite flour, modified starch, alcohol, single cell protein, and high fructose sweetener. The attention currently devoted to these products differs by country. There is a need to define the technical and economic parameters that most influence the market feasibility of the products and, in turn, economic assessments are required in the specific countries.

There is a potentially large demand in the region for cassava for animal feed rations. The basic technology is well-known and probably requires little further study. Fine-tuning of the existing processing and drying systems for particular countries and different sizes of operation may be necessary. Moreover, as cassava moves into the domestic animal feed concentrate industries, there may be a demand for animal feed trials, and information on cassava characteristics and management of the products within the mills and rations.

In the initial phases of research, the factors responsible for the variation in cassava yields, both between regions and within a region, should be identified. There is the broader need to identify the constraints on cassava within both the cropping system and the whole farming system. An evaluation of the competition between cassava and other crops for land, labour, capital, and particularly for fertilizer, would be needed. Other principal areas of study would include the timing of cultural practices, the cropping and rotation systems, and on-farm uses versus cash sales.

Adoption studies of new technologies serve to identify the constraints on the farmers' adoption. Particularly important are studies on input availability, resources within the farm, credit, and the farmers' understanding of the new technologies.

Demand research can be divided by end market. For the markets and countries where cassava is consumed directly as a human food, the principal research topic is the estimation of the demand parameters for cassava, mainly in order to gauge the growth prospects in this market.

An estimation of the crass-price elasticity with rice is important in determining whether cassava might play a role in rice price policies. Finally, consumer preference studies are a necessary component to the development and launching of novel cassava products.

In the starch market, principal research topics would include an economic evaluation of the various scales of processing and the role that government policies play in determining the profitability of different scales of processing. Secondly, an understanding of the consistent under- utilization of capacity in starch processing is necessary, in order to achieve further cost reductions. Thirdly, an evaluation of the demand growth parameters is completely lacking both in terms of the end-uses for cassava starch and its competition with corn starch. Finally, given that many countries in the region import sugar, an economic evaluation of the high fructose sweeteners derived from cassava and their ability to compete with sugar prices is cruicial to define the possible future investments in this market.

Animal feed probably offers the most immediate growth prospects for cassava, and should be the first priority in demand research on cassava. A comparison between international grain prices and domestic price policies would help to determine the impacts of policies on the potentials for cassava, and the price at which it would be competitive with grain substitutes.

Research in price analysis should integrate the production and demand researches, to gauge the price cassava will have to compete at in alternative markets and, after taking account of the processing costs, the implications this has for farm-level prices, costs of production, and yield targets. This research is of the highest priority in the future planning of the crop, and in generating increased government support for cassava research.

A major research area in international trade is an evaluation of the potential for cassava exports in the Asian region, particularly to Japan, Korea, China and Taiwan, and an assessment of the barriers to trade.

Research in policy areas should focus on inputs into government policies and, in turn, should provide the basis for further government support of cassava. The latter makes this research of relatively high priority. Each country needs to establish how cassava may contribute to government policy objectives. A definition of policy goals for cassava will have implications for both biological and utilization research priorities. An evaluation should include a social costing of the impact of the cassava cultivation and processing on the environment, and in particular, the impact of starch processing on water resources. A part of the evaluation would be a social benefit and cost accounting of the potential impact of cassava on the national economy, and the potential distribution of the social benefits. particularly to the low-income producers and consumers.

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ASSESSING FARMERS' ECONOMIC CIRCUMSTANCES: APPLICATIONS IN CROP PRODUCTION RESEARCH AND MICRO-LEVEL POLICY RESEARCH*

1.0. Taking the Farmers' Viewpoint

It is widely accepted that farmers, in general, are reasonably good decision-makers. They have been shown to be reasonably effective in selecting crops and production technologies that maximize income (broadly defined) at reasonable levels of risk, given limited resources and in the context of complicated sets of natural and economic circumstances. Farmers' production decisions often result in complex farming systems, with various crop and livestock enterprises, various production practices for a given enterprise, and considerable interaction between production and consumption activities.

When researchers and policy-makers aim to increase crop production, they must take into account the farmers' viewpoint. Whether the intent is to increase crop production by means of new technology or by policy changes, farmers will only respond favorably when it is in their interest to do so. Farmers will change the crops they grow, or the production practices for a given crop, only when these changes:

- lead to increased income,
- require reasonable levels of risk,
- are reasonably compatible with current farming system practices.

Consequently, researchers and policy-makers need a good understanding of farmers' circumstances.

2.0. Farmers' Circumstances

Farmers' circumstances are those factors that affect farmers' decisions with respect to the use of production technology, and are often divided into "natural" and "economic" circumstances. Natural circumstances include soils and topography; rainfall, temperature and other climatic factors; and pests, diseases, weeds and other biological factors. These natural circumstances limit the farmers' production possibilities through a series of technical constraints. For example, rainfall may be erratic and unreliable; while one area suffers from flooding, another may be affected by drought. Problems with moisture availability may be compounded by problems with weed competition, both of which can reduce the crop's responsiveness to fertilizer. Pests and diseases and harvest and storage losses can take a further toll.

The success that farmers have in confronting these technical constraints is heavily conditioned by their "economic circumstances". Economic circumstances include farmers' goals and resources, input and product markets, institutions, and national policies. The linkages between agroclimatic, biological and economic circumstances, and their effect on production decisions, are presented in Figure 1 (Byerlee, Collinson, et al. 198U).

Farmers' resource constraints can affect their production decisions in many ways. For example, a farmer might not be able to adopt a more labour- intensive method for weeding maize if he is already fully employed at that time harvesting rice. Similarly, he might not be able to plant his mazie earlier (and thereby escape the effects of late-season drought) because his cotton still occupies the land. Competition and complementarity between activities are common in

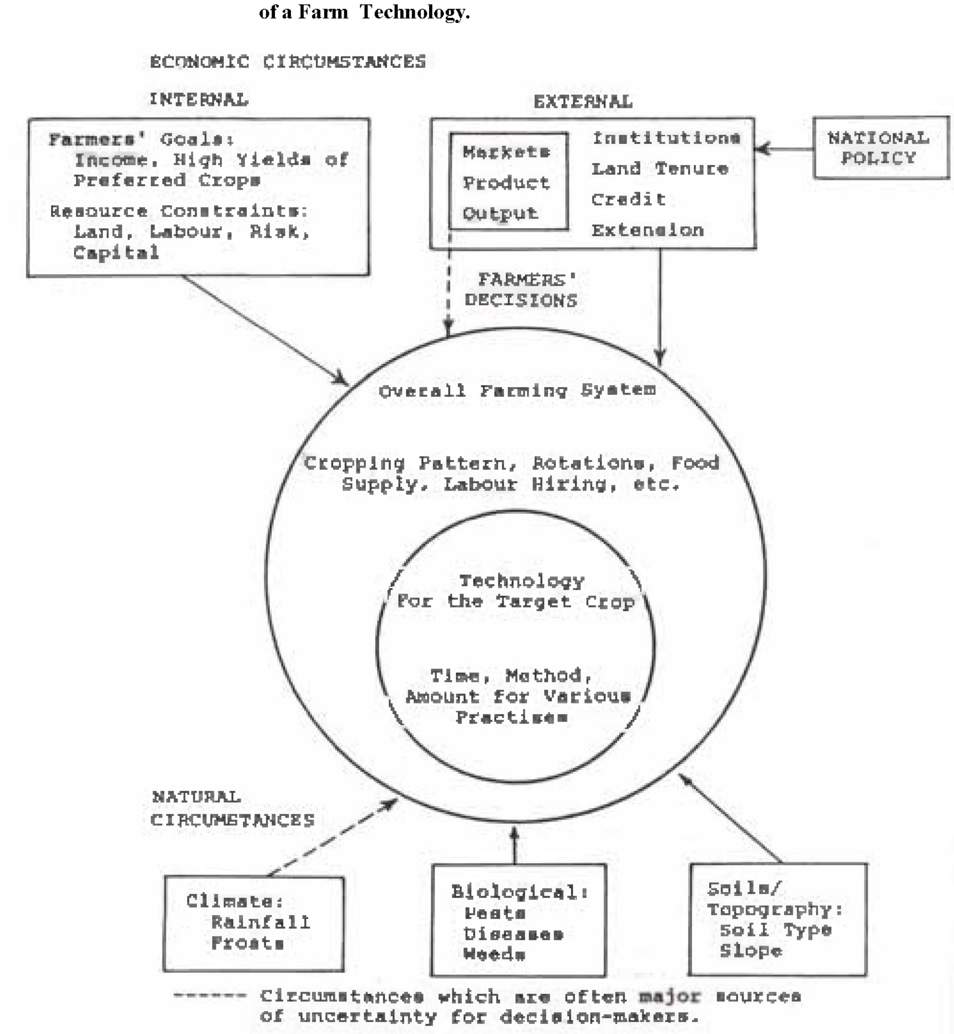
*) Prepared by Larry W. Harrington, CMMYT Economics Program, Bangkok. The opinions expressed are not necessarily those of CIMMYT.

most farming systems.

Input and product markets usually have a strong influence on farmers' production decisions and can be constraints to production. High marketing margins (due to high reel costs of transport, storage or processing, or barriers to entry to marketing activity) can lead to low farm level output prices, high input prices, problems with input availability and little incentive to increase production.

Agricultural and macro policy often discriminate against agriculture in general and upland crops in particular, Policy-related constraints can include export barriers or taxes on output; import barriers or taxes on inputs used by farmers; subsidies to enterprises that compete with upland crops for farmers' resources (e.g., free water for lowland rice, export subsidies for perennial crops); overvalued currencies that make imports artificially cheap and cause exports to be less competitive in world markets (reducing incentives to produce crops for export or for

Figure 1. Various Circumstances Affecting Farmers' Choices of a Farm Technology.



Finally, institutions can also inhibit production. Numerous institutions co-operate with farmers in the process of agricultural development, e.g., research institutes, extension department, credit offices, etc., and a failure by any one of them to perform effectively can hinder development and adoption of more productive technology.

3.0 Two Strategies

Researchers who aim to help farmers increase crop production can follow two distinct strategies. The first strategy is to develop new technologies farmers are willing to adopt, given their current economic circumstances. The second strategy is to encourage policy-makers to modify farmers' economic circumstances, so that they can adopt otherwise suitable new technology.

Both strategies are most successful when researchers and policy-makers are able to see things from the farmers' viewpoint, that is, understand the effect of farmers' circumstances on production decisions. It should be noted that success in the second strategy (influencing policy-makers) may require a prior commitment to the first strategy (production research). In either case, participation of a trained economist or social scientist is needed to help understand farmers' economic circumstances, and Incorporate this understanding in subsequent research decisions.

4.0 Strategy One: On-Farm Research

It is one thing to generally describe farmers' economic circumstances. It is something quite different - and much more difficult - to ascertain in detail which economic circumstances constrain production for which kinds of farmers, how each constraint makes itself felt, and how to use this information in planning and interpreting research. This section describes CIMMYT's experience in handling these kinds of issue.

During the last decade, CIMMYT, in co-operation with biological and social scientists from numerous national programs, has developed a set of procedures for "on-farm research with a farming systems perspective" (OFR/FSP). These procedures are designed to help national programme researchers develop, for defined groups of farmers, new technologies that will be adopted in the near term. Research guided by these procedures is characterized by:

- a careful focus
- representativenes
- a farming systems perspective

Research is carefully focused when priority is given to the more reasonable and feasible treatments, that address the more important research themes, -for the more important crops or enterprises, for an explicitly defined target group of farmers or "recommendation domain". Well-focused research is more valuable when conducted under representative conditions.
Co-operating farmers and their fields should be reasonably typical of the domain they are selected to represent. Finally, the chances of achieving a proper focus to research are enhanced when farming systems interactions are explicitly considered during the design and interpretation of research.

The procedures introduced above are documented in a variety of publications, (e.g., Byerlae, Collinson et al.., 1980) and are being used in several national research programmes (e.g., Moscardi et al., 1983 ; Martinez and Arauz, 1983).

An understanding of farmers' circumstances, including economic circumstances, is needed in order to effectively plan an OFR programme.

4.1 Identifying Recommendation Domains

Recommendation domains are groups of farmers with similar practices and circumstances, who are eligible for roughly the same recommendation (Harrington and Tripp, 1984). Domains are formed through the stratification of farmers into reasonably homogeneous groups. As usual in stratification, the resulting strata are most useful when they are large yet internally homogeneous.

Domains are immensely powerful tools in OFR/FSP. They define the context for identifying representative farmers and locations; they allow extrapolation of experimental data beyond individual experimental locations-, and they indicate to extension workers precisely for whom a given recommendation is intended.

Clearly, a good comprehension of farmers' circumstances is needed to identify recommendation domains. Indeed, different domains are associated with large changes in farmers' circumstances. Often, domains are distinguished through differences in natural circumstances. For example, in one study area in E. Java, Indonesia, researchers found it convenient to distinguish three domains, based on soil type and access to irrigation:

RD1) Farmers growing upland crops (e.g., maize) on young volcanic soils under rainfed conditions.

RD2) Farmers growing upland crops on bunded, partially irrigated young volcanic soils Is

RD3) Farmers growing maize intercropped with cassava on less fertile, limestone-based soils.

Each domain of farmers was j judged to face somewhat different circumstances, to use somewhat different production practices, and to require somewhat different recommendations. At times, domains need to be distinguished through differences in economic circumstances; not natural circumstances. For example, in one study area in E. Africa, researchers found it most useful to divide farmers into two domains, distinguished by distance to markets or transport cost. Farmers close to markets (low transport cost) grew maize for green ears to sell for cash, and they used relatively high levels of inputs. Farmers farther from markets grew a different kind of maize for home consumption and used few purchased inputs.

In order to select useful domains, then, researchers need a sound understanding of farmers' natural and economic circumstances.

4.2 Identifying Representative Experimental Locations, Farmer Co-operators, and NEV's

A key characteristic of OFR/FSP is "representativeness". Researchers aim to estimate the impacts that farmers themselves will observe when they introduce elements of new technology into their own farming systems. Consequently, field conditions, farmers' resources and levels of fixed factors (i.e., nonexperimental variables or "NEV's") need to be reasonably representative of the domain for whom the research is being conducted. For example, it does" little good to conduct trials on flat, fertile fields if target farmers plant their crops on infertile, hillside fields.

Similarly, if farmers interplant maize and beans while researchers do not, then weed control recommendations arising from their research may not be appropriate for farmers, and in the absence of effective weed control, recommended fertilizer levels may not be profitable.

Clearly, a good understanding of farmers' natural and economic circumstances is needed to define what is meant by a "representative" location, a "representative" farmer, or "representative" levels of fixed factors, for a given recommendation domain.

4.3 Technology Design and Pre-Screening

OFR/FSP is characterized by "careful focus" and the use of "a farming systems perspective" during the process of planning research. A sound understanding of farmers' circumstances, including economic circumstances, is essential to the design of a well-focused research programme.

Technology design, or the planning of the content of a programme of on-farm experiments for a specified recomendation domain, includes several steps

a) *Selection of target crap or crops*: Within the limitations imposed by research mandates, important crops are given priority over less important crops. "Importance" may be measured in terms of crop areas, production and/or importance to the farmer (as a food staple or source of cash income).

In one domain in E. Java, for example, maize was the predominant crop and served farmers as staple food and as a major source of cash. Consequently, maize was selected as the target crop for on-farm research.

b) *Identification of research opportunities*: Researchers aim to identify technical constraints that, if resolved, can have a strong influence on yields, production costs, or system intensity.

Continuing with the maize example from one domain in E. Java, researchers were able to clearly identify several research opportunities, including:

- Planting method (farmers tend to overplant, using up to 8 plants per hill. Fewer plants per hill should increase yield.
- Variety (Farmers continue to plant traditional varieties. Improved varieties and hybrids should yield better.)
- Fertilizer dose (Farmers use high levels of N only. Lower levels of N and a bit of P and possibly micronutrients should serve to raise yields and reduce costs.)
- Timing of fertilizer application (Farmers do not use basal applications. Basal application of P should increase yields).
- Shootfly control (Farmers do not apply insecticides to control shootfly although stands and plant vigor are affected.)

c) *Understanding the* reasons *behind the farmers' practice*: In order to carefully focus research, it is necessary to ascertain why farmers follow their current practices, and why they have not already taken advantage of the opportunities noted in the previous step. This is done by developing and testing alternative hypotheses that relate farmers' circumstances to production decisions. It is particularly in this step of "understanding farmers' reasons" that a comprehension of farmers circumstances is critical. The kinds of research that merit priority are often discovered during this step.

For example, one of the research opportunities identified in the E. Java domain was "planting method": Researchers felt that farmers tend to plant "too many" seeds per hill. Based on an initial round of exploratory farm surveys, researchers developed three hypotheses to explain the farmers' practice:

- Farmers overplant to compensate for shootfly damage.
- Farmers overplant to compensate for low germination and poor seedling vigor.
- Farmers overplant and then thin to obtain fodder for their livestock.

Similar hypotheses were developed with respect to the other research opportunities as well.

Farm survey work is continuing in order to test these hypotheses. Those hypotheses which cannot be rejected should form the basis fo r continued experimental field work.

The effect of hypothesis testing on research programmes should be clear. If, for example farmers overplant to compensate for shootfly damage, adoption by farmers of shootfly control measures (e.g., Furaden application) will have to precede adjustments in the number of seeds per hill. Similarly, 1f farmers over plant to compensate for poor quality seed, improved farm-level seed storage technology may be needed before an improved planting method can be adopted - but then research on shootfly control may not be needed after all. The hypothesis on fodder use of maize thinnings introduces further complications. The selection of a specific research focus (shootfly control vs. seed storage techniques vs. alternative sources of fodder, to allow the adoption of improved planting methods) depends on a sound understanding of farmers' circumstances and farming system interactions. In any event, a naive recommendation (simply reduce seeds per hill) is not likely to be adopted by farmers.

In the specific example used above, natural circumstances played a dominant role. However, economic circumstances frequently come to bear as well. For example, farmers may have to rely on poor quality seed that they store themselves because of poorly developed input markets for seed, perhaps caused in part by government policy that discourages efficient multiplication and sale of improved seed. Finding these "cause and effect" links is the heart of understanding farmers' circumstances.

d) *Treatment selection and pre-screening*: Once researchers understand why farmers do not take advantage of apparent opportunities to-increase the production (or reduce costs) for a target crop, they can select specific experimental treatments, and then "pre-screen" them. Pre-screening means assessing alternative experimental treatments for likely profitability, likely risk and likely compatibility with the current farming system.

For example, if researchers have determined that farmers overplant to compensate for shootfly damage, they will went to measure the gains from introducing improved planting methods under conditions of good shootfly control, and also assess alternative methods of control (e.g., Furadan or other insecticide applications at different levels, change in planting date, etc.).

The likely profitability of each treatment can be assessed through breakeven budgets. For example, a yield increase of 600 kg/ha of maize may be needed to repay all costs associated with a certain dose of Furadan. If agronomists judge that this yield increase is unlikely to be attained, the treatment may be considered as not likely to be profitable.

Checking the compatibility of a proposed treatment with the current farming system is a bit more complicated, and requires a good understanding of farmers' circumstances, including economic circumstances. Stated briefly, researchers list the likely effects (and side-effects) on the farming system if farmers were to use a given treatment, then they compare these effects with farmers' circumstances.

For example, one side-effect of an earlier application of fertilizer (basal application as opposed to application twenty days after planting) would be an increase in labour input during the planting period. However, farmers might not be willing to use their labour at this time for tasks other than planting if the allowable turnaround time between crops is very brief. Thus, an incompatibility appears between farmers' circumstances (limited labour supply during a peak period) and a characteristic of the proposed treatment (increased labour input during that period).

5.0 Strategy Two: Modifying Farmers' Circumstances

A comprehension of farmers' circumstances can be valuable to policy-makers as they consider policy changes that modify farmers' circumstances. At times policy-makers have insufficient access to information on how alternative policies, by modifying farmers' circumstances, may affect the farmers' choice of crops and/or production practices. As a result, policy changes can result in unexpected and undesirable decreases in crop production. Efficient and timely access to information on "the farmers' viewpoint" can help policy-makers more thoroughly assess the relative advantages of policy alternatives

Policy changes are more likely to modify farmers' economic circumstances than their natural circumstances (apart from such exceptions as irrigation development or transmigration). Policy can affect farmers' resource constraints through land re-distribution or subsidized credit schemes. Similarly, policy can affect the performance of input and product markets through marketing boards, restrictions on the importation of inputs, fuel taxes, "local content" rules on truck assembly, grain quality regulations, and many other ways. Certainly, policy can affect the performance of agricultural service institutions: research policy with respect to the use of on-farm research procedures is a good example.

Frequently policy changes are made for good reasons, but without sufficient consideration of how these changes may modify farmers' circumstances and, as a consequence, farmers' production decisions. For example, a policy may be introduced to set a maximum farm-level price for improved seed, the aim being to make improved seed more affordable to farmers. However, the real effect of the policy may be to discourage seed producers from multiplying and distributing seed. Farmers' circumstances are changed: improved seed becomes unavailable, farmers revert to the use of traditional varieties, the use of complementary inputs declines, and yields and production fall along with farmers' incomes.

At times, policies themselves may favor farmers but inefficient implementation may, unknown to policy-makers, result in undesirable changes in farmers' circumstances. For example, a government fertilizer distribution agency may be formed to insure timely delivery or appropriate fertilizers to farmers. Inefficient implementation of the policy may lead to delays in fertilizer distribution. Unreliable fertilizer supplies may induce farmers to use lower levels of other, complementary inputs, or even switch crops.

In order to be useful, information on the effects of policy changes on farmers' circumstances and farmers' production decisions needs to be specific to defined group of farmers or recommendation domains. Policy-makers need information that summarizes the chain of cause and effect that links policy decisions to farmers' production decisions for specific domains.

For example, what would be the effect on the E. Java maize domain described in the previous section if Furadan imports were prohibited? It is possible that farmers could not control shootfly damage; that intra-hill plant competition would continue to depress maize yields; that excessive seed rates would still be required; and that because of high seed rates, hybrid seed use would not be profitable.*

A well-focused programme of on-farm research could examine each link in this chain of cause and effect, and summarize the corresponding results in a package suitable for use by policy-makers. This kind of information is not likely to be available to policy-makers from any other source, yet would undoubtedly prove to be exceedingly valuable, as it allows full consideration to be given to the farmers' viewpoint.

6.0 Summary

Farmers have been shown to be reasonably effective in selecting crops and production technologies for these crops, given complicated sets of natural and economic circumstances.

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*) Such a cause and effect chain has not yet been established - the example is only made to illustrate the concept being presented,

Economic circumstances include resource constraints, input and product markets, institutions, and policies that affect farmers' decisions with respect to crop production technology.

Researchers and policy-makers that aim to increase crop production need to cultivate the ability to see things from the farmers' viewpoint, that is, comprehend exactly how farmers' circumstances influence production decisions for defined groups of farmers. Specifically, they need to know how to ascertain in detail which circumstances constrain production for which kinds of farmers, how each constraint makes itself felt, and how to use this information in planning and interpreting research and in accessing policy alternatives.

In crop production research, an understanding of farmers' circumstances, including economic circumstances, is needed to effectively take several kinds of research decisions, including:

- Identifying recommendation domains,
- Identifying representative experimental locations, farmer co-operators and levels of NEV's,
- Designing and pre-screening new technology (including selection of target crops; identification of research opportunities; understanding the reasons behind the farmers' practice; and treatment selection and pre-screening).

In micro-level policy analysis, an understanding of farmers' circumstances and farming system interactions is needed to fully assess the likely effects of policy alternatives on farmers' production decisions. With this information in hand, policy-makers can more easily avoid unforeseen and undesirable declines in crop production and farmers' incomes. An understanding of farmers' circumstances, and the cause and effect chains between policy alternatives and farmers' production decisions, is most efficiently obtained from a particular kind of research- “on-farm research with a farming systems perspective". "

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CASE STUDIES ON PROBLEM IDENTIFICATION FOR DEVELOPMENT OF FARM ECONOMICS DEPENDENT ON UPLAND CROPS IN SUMATRA*

Introduction

The development of rice production in Indonesia has had a good effect on the economy. However, it is recognized that many rice growing areas will need further and costlier improvement, such as on tidal, swamp, deep water, rainfed and upland areas. The forthcoming development of rice will parallel the feasible progress in the generation of new technology and the extension of the areas.

On the other hand, the development of upland crops has been lagging behind. Indonesia is importing large quantities of upland crop products to satisfy the domestic needs. The fact is clear that the potentials for the development of upland crops are large and encouraging.

As an illustration, the cropping index of paddy land in Sumatra is 1.23. The figure of 0.23 comes from 11,000 ha double rice and 71,000 ha rice and upland crop patterns. The area of lowland rice and upland crops in Sumatra are shown in Table 1 and Table 2, respectively. The upland crops are mainly intercropped with upland rice or planted after rice, except on the estate farms which use monocrop planting. Only same 71,000 he of upland crops are planted on paddy land in rotation with paddy rice.

A substantial portion of the potential agriculture land in Sumatra will be utilized for transmigration and estate crop programmes (Table 3). The majority of transmigration areas will be devided to food crops, in which upland crops will be the main component, at least during the first year.

Table 4 shows the performance of maize and soyabean crops grown under two conditions in Sumatra: North Coast - Aceh and Sitiung - West Sumatra. These two sites will be used as the case areas discussed in this paper. The technologies generated in these sites are progressively being adopted in the surrounding areas and are being introduced to other areas in Sumatra, as well.

The data in Table 4 are encouraging. However, the development of upland crops in Sumatra depends upon many other factors. This paper presents the potential problems and suggests alternative approaches to determining the solutions.

Case Study Areas and Farming Descriptions

There are several types of farm conditions and environments in Sumatra where upland crops can be grown. For the purposes of the case study, we selected two major ones, i.e., North Coast - Aceh and Sitiung - West Sumatra. The north coast of Aceh represents an area where upland crops are grown on paddy land with good soils and fairly good roads. Sitiung - West Sumatra represents an area where upland crops are grown under upland conditions, with marginal soils and fairly good roads. As mentioned in the introduction, the other potential areas for upland crops are the irrigated paddy land with a current cropping index of 1.23. The technologies developed in North Coast-Aceh are most likely appropriate to this type of irrigated paddy land.

* Prepared by A. Syarifuddin K. and Irlan Soejono. SARIF Director, 5ukarami, and Senior Economist, ESCAP CGPRT Centre, Bogor, respectively.

Table 1. Rice Areas in Sumatra (Scholz, et al., 1983)

Physical Conditions	areas (ha)
Technical irrigation	274,000
(Public Works)	
Village irrigation	419,000
Rainfed	319,000
Deep water	168,000
Swamps	61,000
Tidals	205,000
Uplands	486,000
Total	1,932,000

Table 2. Upland Crop

Crop	areas(ha)
Maize	150,000
Cassava	172,000
Sweet Potatoes	39,000
Peanuts	53,000
Soyabeans	70,000
Other pulses	13,000
Total	497,000

Table 3. Agricultural Land (Soepraptohardjo, et al., 1979)

Slope and other	areas (ha)
0 - 3 X	8,491,000
3-8%	4,102,000
8 - 15 x	1,844,000
Total 0 - 15 %	14,437,000
more than 15 %	5,578,800
swamps	13,21 1 ,000
unclassified	14,133,200
S u m a t r a	47,360,000

North Coast - Aceh

This region consists of three kabupatens (Aceh Besar, Piddie and North Aceh) and two municipalities (Banda Aceh and Sabang). In the following discussion, the last two administrative units are excluded since these have no agriculture production, although it is noted that Banda Aceh is a potential market for agricultural products.

Climate: Semi humid, where yearly rainfall is low (about 1500 mm/year), with about 90 raindays, 2-3 wet months and 4-6 dry months per year. It belongs to the D-2, E-2 and E-3 climate types, according to Oldeman, et al. The area has a distinct dry season in June, July and in August. Sometimes May and September are also dry. Temperatures range about 22-33 degrees C. with an average of 27-28 degrees C.

Land and soil: The region covers 1 ,121 ,000 ha and consists of two major physiographical features. Slopes and undulating areas characterize the west and southwest parts, while gently sloping to almost flat lands are found in the north and northeast parts. The majority of the areas have slopes of 0-8%. Soils are alluvial and fairly fertile with medium to slightly heavy textures. Soil pH ranges from 6-6.7, with sufficient P, K and other major essential plant nutrient elements. However, early symptoms of salinity, related to poor drainage and a distinct dry season, are found on sporadic patches

Table 4. Maize and soyabean performance in two sites in Sumatra (Syarifuddin, et al., 1983 and Syarifuddin, 1984)

Site, crops and management	Yield (ton/ha)
North Coast - Aceh	
Maize after rainfed paddy	2.1
tractor plowing + harrowing	2.1
zero tillage	3.3
Soyabean after rainfed paddy	
tractor plowing and harrowing	1.3
zero tillage	2.2
Sitiung – West Sumatra	
Maize intercropped with upland rice and cassava	
(25,000 maize plants/he)	
no lime, no phosphorus	0.2-0.4
no lime, with 200 kg TSP/ha	0.7-1.1
2 ton/ha lime and 200 kg TSP/ha	1.5-2.8
Soyabean after upland rice	
no lime, no phosphorus, no rhizobium	0.2-0.5
no lime, with 200 kg TSP/ha, no rhizobium	0.6-0.9
2 ton/ha lime + 200 kg TSP/ha, no rhizobium	0.9-1.4
2 ton/ha lime + 200 kg TSP/he + rhizobium	1.3-1.9

Population: Almost half of the population of Aceh is concentrated in this region, with a population density of 74- 122 people per square kilometer (Table 5).

Table 5. Area and population of North Coast - Aceh (Bappeda, Aceh dalam angka, 1979)

Kabupaten	Aceh (km2)	Population	Population (km2)
Aceh Besar	3,029	224,912	74
Piddle	3,415	336,073	98
North Aceh	4,775	579,113	122
North Coast	11,219	1,140,098	102

Infra structure: The region is connected to the neighbouring areas with good roads to Banda Aceh and North Sumatra (Medan). The super-highway cuts across the middle of the region from the northwest to the southeast. However, the access roads connecting the farms and villages to the super-highway are of poor quality, particularly in the rainy season.

The storage for farm supplies (except for seeds) is sufficient: however, the storage for farm products is not adequate. Marketing channels and the storage of farm products presents a problem.

Agriculture: In terms of land use, the primary agricultural activity in the area is paddy rice growing, followed by rural small-holder estate crops and upland annual crops (Table 6). Landholdings are relatively small (Table 7).

Table 6. The composition of agriculture land use (ha), North Coast - Aceh (Bappeda; Aceh dalam angka, 1979)

Kabupaten	Paddy rice	Small-holder estate crops	Upland annuals	Others
Aceh Besar	23,653	12,387	1,164	-
piddie	35,937	13,313	6,747	-
North Aceh	44,617	43,852	10,799	1,770
North Coast - Aceh	104,197	69,552	18,710	1,770

Table 7. Average Kabupaten land holding (ha) in North Coast - Aceh(Bappeda; Aceh dalam angka, 1979)

Kabupaten	Paddy	Uplands	Perennials	Total
Aceh Besar	0.58	0.03	0.31	0.92
piddie	0.56	0.10	0.21	0.87
North Aceh	0.45	0.11	0.45	1.01

As mentioned in the introduction, the potential area of upland crops includes some irrigated paddy lands. Unless there are other problems, such as drainage, flood, or salinity, all of these lands can be planted to upland crops after *paddy* rice. The existing cropping index of the paddy land is 1.16- 1.19 (Scholz et al., 1983). Therefore, the readily available lend for upland rice expansion in the region is about 100,000 ha. Along with the improvement of irrigation

Table 8. Farm profile in North Coast - Aceh, 1984

Commodity	Area (ha)	Yield (kg/ha)	Price (US$/kg)	Estimated gross revenue (US$/year)
Farm size	1.11			
Harvested area	1.26			
Paddy lend	0.57			
Harvested area	0.72			
Wet rice	0.66	4,000	0.17	448.8
Peanut	0.02	1,200	0.80	19.2
Soyabean	0.03	1,200	0.35	12.6
Onion	0.01	4,000	0.60	24.0
Upland annuals	0.2			
Harvested area	0.2			
Upland rice	0.03	1,500	0.17	7.7
Maize	0.03	1,600	0.13	6.2
Cassava	0.03	10,000	0.03	9.0
Soyabean	0.09	1,000	0.35	32.0
Chilli	0.02	2,800	0.80	45.0
Perennial crops	0.34			
Rubber	0.03	700	0.30	63.0
Coconut	0.25	4,200 nuts	0.15/ nut	157.5
Cloves	0.03	200	7.5	45.0
Areca	0.03	-	-	-
Livestock	Number			
Buffalo	0.86	-	110	94.6
Cattle	1.11	-	90	99.9
Goat, sheep & chicken	0.25/5	-	15	15.0
Agriculture				1,022.8
Non-Agriculture	10 x 12 x $ 1.5			180.0
Total income				1,202.8

The estimated cost is about US $350 (excluding family labour cost), resulting in a net income of about US $853. This income belongs to the high income group among farm models in Sumatra.

facilities, some of the paddy land maybe planted to double rice cropping. However, there is a local programme to increase upland crop (soyabean) production using the irrigated paddies instead of promoting double rice cropping.

Another obstacle to development of upland crops are the practises of cattle raising. Farmers release their cattle in paddy land during the dry season after rice harvesting. The number of cattle in the area is relatively high. Therefore, if upland crop production is to be increased, either the cattle must be put into grazing areas or fodder crops must be included in the cropping systems.

Farm profile: Table 8 shows the farm profile in North Coast - Aceh. This format is taken from Scholz, et al. (1983, p. 116, Table 17), with adjustments in the commodity prices.

Sitiung - West Sumatra

This site is located in Kabupaten Sawahlunto/Sijunjung, West Sumatra Province. It represents the major upland farming areas with humid climate conditions. The area has been made available for transmigrants since 1976, although local inhabitants have resided there for a long time. The indigenous people practice shifting cultivation and traditional small-holding rubber plantations.

Climate: The area has moderate to high rainfall, which amounts to 2,600-3,200 mm per year. The rainfall is evenly distributed over most of the year with 0- I dry month per year (July). It belongs to the B- 1 zone according to Oldeman, et al.

Land and soils: The morphology of the area is characterized by flat alluvial terraces along the river courses and a hilly, sometimes rather dissected, terrain in the hinter lands of the l arge rivers. The average elevation is between 50-150 m above sea level. Alluvial soils are found in areas along the river banks, while latosols and red-yellow podsolic soils are found in the hills.

Infra-structure: The area is located on both sides of the Sumatra highway, Along with the development of transmigration villages, feeder roads were also established. However, since the feeder roads were not asphalted, transportation during rainy season is not always reliable. The marketing of upland crops still remains a problem. However, if the production increases, the market could be developed. As an example, European Economic Community has a soyabean programme in a nearby site (Muarobungo). A tapioca factory was established in Sitiung two years ago. The transmigration project covers about 10,000 ha land. Together with local farms, the whole area may become a feasible economic unit for agro-industrial development.

Population: The present population is still low, with only 40 people per square kilometer (1980). However, presumably it will rapidly increase because of the good accessibility of the Sumatra highway and the on-going transmigration/resettlement programmes.

Agriculture: Transmigration Projects distributed lands to migrants after deforestation in 1976. The land clearing was performed using big tractors, which in some cases destroyed the fertile top layer, which is only a few centimeters thick. Top soil was further depleted by heavy rainfall and the erosion of steep slopes of uncovered soil. It is hard to say if any transmigrant can become fully dependent on farm income for a living. Most transmigrants are growing food crops with low yields. Some farmers grow perennial tree crops, such as cloves, coconuts, coffee and fruits. The trees perform well enough and are becoming productive. The native farmers grow more tree crops than the transmigrants, for whom rubber trees are more common. Tables 9 and 10 show profiles of transmigrant and indigenous farms, respectively.

Farming systems shown in the respective Tables 8, 9 and 10 are clearly subsistence oriented, as farm enterprises are varied and tend to be relatively small in size. More than half of the total farm income comes from the value of staple food crop products.

Supporting Services

Technology

Unlike paddy rice technologies, farmers have not adopted many of the upland crop technologies. For example, in many parts of Sumatra, native farmers simply do not recognize or never grow soyabean. Many upland crop technologies have not been tested in certain areas which have good potential for the commodities. On average, it can be said that the upland crop technologies are not well understood by the farmers, or in other words, there is a technology gap. The transfer of upland crop technologies apparently is not as effective as that for paddy rice, besides being relatively new.

However, at the two study sites (North Coast - Aceh and Sitiung - West Sumatra), the upland crops have been recognized. The earlier transmigrants in North Coast of Aceh (1940) have been growing upland crops for a long time. Their technologies were gradually adopted by native farmers. Until 1981 , less than 10,000 ha of soyabean were grown in Aceh Province. At that time, 1t appeared that the technologies of soyabean production for the area were not well know, even by the extension people. With recent findings on zero-tillage of soyabean grown after paddy rice, the area of soyabean has increased to more then 40,000 he in 1984. Upland crop technology, particularly for soyabean, is relatively new to Sitiung native farmers. Transmigrants who came in 1976 brought the technologies from Java. However, due to soil problems (acid soils - oxisols), the development of upland crops was slow. With the introduction of liming and other technologies, the development recently gained momentum (1983/84).

Input supply

The major constraint to upland crops development is the insufficiency of good seed. The seed supply for upland crops is not as advanced as that for rice.

The soil in Sitiung requires liming. At present, however, the lime supply is limited by amount and by cost and 1s still a major constraint to upland crops development in the area. Other inputs such as fertilizers and pesticides are sufficiently available, and are supplied through village unit co-operatives.

Marketing

As mentioned earlier, marketing of upland crop products still remains a problem. Since many of the crops were relatively new to the area, the marketing systems of the commodities simply did not exist. However, with high demand from outside the area and with recently established roads, the market for the upland crops of North Coast - Aceh has developed significantly. The improvement of marketing facilities could be one of the factors responsible for accelerating the development of soyabean in the area within the last two years.

In Sitiung - West Sumatra, upland crops are still small and are readily absorbed by local needs. The introduction of liming has increased the production significantly. However, the existing marketing system is not yet able to absorb the excess production. There is no formal, market price information, which is partly responsible for unstable farm gate prices, and results in unstable production.

Table 9. Farm profile of transmigrants (adjusted from Scholz, et al., 1983)

Commodity	Area (ha)	Yield (kg/ha)	Price (US$/kg)	Estimated gross revenue (US$/year)
Average farm size	1.15			
Harvested area	1.50			
Paddy land	0.31			
Harvested area	0.49			
Wet rice	0.47	3,000	0.17	239.7
Maize	0.01	1,500	0.13	2.0
Soyabean	0.01	1,500	0.35	5.3
Upland annual	0.63			
Harvested area	0.80			
Upland rice	0.22	1,200	0.17	44.9
Maize	0.18	1,200	0.13	28.0
Cassava	0.32	8,000	0.03	76.8
Sweet potatoes	0.01	7,000	0.06	4.2
Peanut	0.01	800	0.08	6.4
Soyabean	0.04	900	0.35	12.6
Vegetables	0.02	2,000	0.40	16.0
Perennial crops	0.21			
Coconut	0.15	4,800	0.20	144.0
Cloves	0.01	200	7.50	15.0
Fruit	0.01	100 trees	20.00/tree	20.0
Bananas	0.04	500 bunches	1.00/bunch	20.0
Livestock	Number			
Buffalo	0.01	-	110	11.0
Cattle	0.39	-	90	35.2
Goat, sheep & chicken	0.25/5	-	15	15.0
Agriculture				696.0
Non-agriculture	10 days x 12 month x $ 1.5			180.0
Total income				876.0

Estimated cost is about US $340 (excluding family labour cost), resulting in a net income of about US $ 536.

Table 10. Farm profile of native Sitiung Farmers (ousted from Scholz, et al., 1983)

Commodity	Area (ha)	Yield (kg/ha)	Price (US$/kg)	Estimated gross revenue (US$/Year)
Average farm size	2.13			
Harvested area	2.29			
Paddy land	0.36			
Harvested area	0.39			
Paddy rice	0.39	2.200	0.17	145.9
Upland annual	0.30			
Harvested area	0.43			
Upland rice	0.28	1,200		57.1
Maize	0.03	1,200	0.13	4.7
Cassava	0.04	8,000	0.03	9.6
Peanut	0.03	900	0.80	21.6
Soyabean	0.02	900	0.35	6.3
Mungbean	0.02	600	0.50	6.0
Chilli	0.01	2,800	0.80	22.4
Perennials	1.47			
Rubber	0.09	700	0.30	228.9
Coffee	0.17	500	0.60	51.0
Coconut	0.05	4,800 nuts	0.15/nut	36.0
Cloves	0.02	200	7.5	30.0
Pew	0.09	600	0.5	27.0
Fruit	0.02	100 trees	20.0	40.0
Bananas	0.03	500 bunches	1.0	15.0
Livestock	Number			
Buffalo	0.47	-	110	51.7
Cattle	0.46	-	90	41.4
Goat, sheep & chicken	0.25/5	-	15	15.0
Agriculture				809.6
Non-agriculture	5 x 12 x US $ 1.5			90.0
Total income				899.6

Estimated production cost is about US $ 300 ; excluding family labour cost), therefore, the net income is about US $ 599.60.

Discussion

Farm size

Land availability in Sumatra permits farmers to cultivate additional land. Due to submarginal soil conditions (Sitiung) they should cultivate more land in other to achieve higher production. Nevertheless, the facts show that the food crop cultivated wee per farmer in Sumatra is similar to various places in Java with higher production. What are the possible reasons for this phenomenon?

Labour cost in Sumatra is higher than in Java. Farm mechanization is not yet common, except for certain areas such as the north coast of Aceh. Land preparation in North Coast - Aceh is performed by tractor. The farm size in this area is slightly larger than in other parts of Sumatra. As mentioned above, good seeds of upland crops are not always available. Most of the upland crops are grown under rainfed conditions, which limit the growing periods.

Similarly, the marketing system of upland crop products is not yet encouraging Therefore, it is a greet risk for a farmer to cultivate a larger lend area and grow more upland crops.

With all these risks and limitations, upland farm sizes tend to be smaller than they should, with lower input prices and higher output prices. This situation would prevail, even the farm income is very low, as long as there is no alternative labour employment with higher returns.

Marketing

Many of upland crops products are perishable, although less perishable than most horticultural crops. Upland crops in Sumatra are commonly grown in small scattered areas under low management. Therefore, the amount of products in a given time and area is relative small, discontinuous, and of low quality.

This situation has weakened the interest in the merchandizing of upland crop product Clearly, the cost for collecting is high and the prices received by the producers are low, due poor quality. Therefore, they cannot compete with the sane products from other areas, which already have better marketing facilities. On the other hand,, farmers are reluctant to invest more capital, due to uncertainty in marketing. There is a gap in the link between farmers a merchants in the collecting point. The question is, who should be responsible to bridge the gap?

The quality of products can be improved with available technologies and extension. It will not take a long time to extend the technologies to farmers. However, it seems that there are no specified functional agencies to improve the marketing system. T here is also no clear picture on how much cost is involved to improve the marketing system.

Seed availability

Many papers report that seed availability is not sufficient. Unlike rice, most upland crop seeds cannot be kept at room temperature and in open air for more than 4 months. The tropic climate is conducive to fast seed deterioration. The climate for growing upland crops is not optimal in the tropics, particularly for seed production. As the yield for good seed is low, and the storage system is relatively expensive, the result is a high cost of seed production. Small farmers, who have limited capital, are not in a position to purchase expensive seed.

Based on the results of an experiment, the quality and production of seed in high attitudes is better than in lower altitudes. There are many farms in Sumatra which are located in the mountains, where seed production could be developed profitably. As temperatures in this area are relatively low, the extra cost of maintaining seed quality would be for the lowering storage humidity to the standard requirement.

Cost of production

Since the potential production per he of upland crops in the tropics is less than that in the subtropics or temperate areas, the cost per unit of production in the tropics is relatively high. If the cost of production can be reduced, farmers will be encouraged to produce more. As mentioned before, soyabean planting area in Aceh increased from less than 10,000 ha in 1981 to more then 40,000 ha in 1984, partly due to the introduction of zero-tillage technology. The zero-tillage method reduces the cost of tillage for soyabean grown after paddy rice at about US$ 70 per hectare. It was surprising to find that the yields of zero-tillage soyabean and maize were similar to, or even higher than, those with conventional tillage (Table 4).

Simple economic analysis

The problem to be solved is: Does the introduction of upland crops increase the farmers' income and benefit? The answer is "yes" if:

1) Farmers use appropriate cropping pattern and technologies;
2) good seed is available; and
3) marketing is efficient.

Tables 1 1 and 12 show the farm profiles, without change of the original farm size, but with improved cropping systems, crop management, efficient marketing and good seed. The total agricultural income increases from US$ 1,022,8 to $ 1,688 for farms in the north coast of Aceh (see Table 8) and from $ 696 to $ 1,633 for Sitiung farmers (see Table 9). The input cost also increases 1.5 to 2 times.

Of course, this income is not high enough to maintain a satisfactory level of living. More land per family is needed to further increase the farmers' income

Conclusion

Bassed on the above facts and discussions, we realize that:

1. Upland crops production potential in Sumatra is high.
2. Introduction and improvement of upland crops technologies will improve farmers' income, if the marketing system is efficient.
3. Further studies are needed for an effective technological improvement, including studies on:
   a. Marketing system and economic analysis of upland crop production
   b. Seed production, storage and distribution
   c. Production system such as: crop management, production, land tenure, etc.
4. Improved extension programmes for upland crops production technologies are necessary
5. Acces road improvement is indispensable
6. Co-operative farm activities should be developed, both on input purchases and on product marketing.

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Table 11. Prospective farm profile in North Coast – Aceh after introduction of upland crops technologies (compare to table 8)

Commodity	Area (ha)	Yield (kg/ha)	Price (US$/kg)	Estimated gross revenue (US$/year)
Farm size	1.11			
Harvested area	3.43			
Paddy land	0.57			
Harvested	1.99			
Wet rice	0.57	4,000	0.17	387.6
Soyabean	0.57	2,000	0.35	399.0
Maize	0.28	2,500	0.13	127.4
Cowpee	0.57	600	0.20	68.4
Upland annuals	1.20			
Harvested	1.10			
Wet rice	0.20	1,500	0.17	51.0
Soyabean	0.20	3,500	0.13	91.0
Maize	0.20	1,300	0.35	91.0
Cowpee	0.20	600	0.20	24.0
Cassava	0.10	10,000	0.03	30.0
Perrennial crops	0.34			
Rubber	0.03	700	0.30	6.3
Coconut	0.25	4,200 nuts	0.15/nut	157.5
Cloves	0.03	200	7.5	45.0
Areca	0.03	-	-	-
Livestock	Number			
Buffalo	0.86	-	110	94.6
Cattle	1.11	-	90	99.9
Goat, sheep & Chicken	0.25/5	-	15	15.0
Agriculture				1,687.7
Non-agriculture	5 x 12 x US$ 1.5			90.0
Total				1,777.7

Estimated production cost is about US$ 600, (excluding family labour).
Therefore, the net income is about US$ 1,170.

Table 12. Prospective farm profile of Sitiung transmigrant farmers after improvement of upland crops (compare to Table 8).

Commodity	Area (ha)	Yield (kg/ha)	Price (US$/kg)	Estimated gross revenue (US$/year)
Average farm size	1.15			
Harvested area	4.68			
Paddy land	0.31			
Harvested area	1.24			
Wet rice	0.31	3,000	0.17	158.1
Soyabean	0.31	2,200	0.13	88.7
Maize	0.31	1,600	0.35	173.6
Cowpee	0.31	600	0.20	32.7
Upland annuals	0.63			
Harvested area	2.51			
Upland rice	0.63	1,200	0.17	128.5
Maize	0.31	2,000	0.13	80.6
Soyabean	0.63	1,300	0.35	286.7
Cowpee	0.63	600	0.20	75.6
Cassava	0.31	10,000	0.03	93.0
Perrennial crops	0.21			
Coconut	0.15	4,800	0.20	144.0
Cloves	0.01	200	7.50	15.0
Fruit	0.01	100 trees	20.000/ tree	20.0
Bananas	0.04	500 bunches	1.00/ bunches	20.0
Livestock	Number			
Buffalo	0.10	-	110	11.0
Cattle	0.39	-	90	35.1
Goat, sheep & Chicken	0.25/5	-	15	15.0
Agriculture				1,382.1
Non-agriculture	5x12xUS$ 1.5			90.0
Total				1,472.1

Estimated production cost is about US$ 600. (excluding family labour), hence the net income is about US$ 872.

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CO-OPERATION WITH THE FAO REGIONAL PROGRAMME*

Background information

1. A TCDC programme for research and development of food legumes and grains (CGP) in the Tropics and sub- Tropics of Asia was launched this year. The executing Agency is FAO which has subcontracted the socio-economic component of the programme to the ESCAP/CGPRT Centre.
2. Project activities were discussed during the first Regional Co-ordination Committee Meeting (RCCM 1) in May 1984 in Bogor. These included for the first year (1984) an initial survey on supply and demand of major coarse grains and food legumes in 7 selected countries of Asia: Indonesia, Philippines, Thailand, Sri Lanka, Bangladesh, Nepal and Pakistan.
3. The survey was carried out during August-September this year and a draft report will be submitted to the second meeting of the Co-ordination Committee (RCCM2) to be held from 5 to 7 December in Bangkok. It includes an evaluation of the project demand in 1990 for food, feed, and industrial uses of major CGP crops in the selected countries.

Preliminary findings

4. Coarse grains and food legumes still play an important role in the people's diet in many countries of the region, especially Indonesia, Philippines, Nepal and Pakistan. However, the demand for such food is generally stable or even decreasing in some countries.
5. Food deficits exist in several countries, including Bangladesh but also Sri Lanka and parts of Nepal. The two former countries should import a significant part of their food requirements in the next several years.
6. Industrial uses of CGP crops will still be minor in the coming years, but feed uses are expected to take an increasing part of the demand. Apparently, major deficits of maize are bound to appear or worsen in countries like the Philippines or Indonesia.
7. Soyabean is coming to the forefront of imports in most of the surveyed countries, either for various food preparation (SE Asia), for cooking oil (Pakistan, Nepal), or for animal feed (soyabean cake).

Work directions

8. Although the present knowledge of the demand for CGP crops in the region is still inadequate and needs further investigation and analysis, it is already sufficient to proceed to the following steps where clear deficits have been identified.
9. There are essentially two types of situations.
   (i) A growing demand which cannot be met by local production under current trends, and which calls for constraints studies; and
   (ii) An increasing demand for food, but apparently not for coarse grains or pulses, but only for the main cereal (s).
10. The first situation applies to maize in Indonesia and possibly in the Philippines, and to soyabean in many countries in the region. Supply constraints have be analyzed at various levels: production, marketing and processing.

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*) Prepared by Dr Francois E. Dauphin, Senior Agronomist, ESCAP CGPRT Centre, Bogor.

11. In the second situation, a number or questions can be raised, which all call for different studies:

(i) Assuming that a demand exist, is it possible to grow more CGP crops (what are the production constraints)?
(ii) What is the actual food demand for CGP crops?; and
(iii) Is it possible to create a new demand for some of the CGP crops?

Proposed programme of work

12. While the main focus at this stage will be placed on constraints analysis, and on a few detailed case studies of demand, different situations in countries and crops should call for a different emphasis on the various possible subjects as mentioned above.

13. However, the general framework of activities will be the same for all participating countries, and will include:

(i) preparation of guidelines for reviewing the supply situation of selected major commodities and for identifying production constraints ;
(ii) provision of technical guidance for formulating and conducting the above review and identification activities with assistance of external and local consultants;
(iii) implementation of the planned programme of work, including survey, collection, analysis and evaluation of data and information on supply and production constraints; and,
(iv) inventory surveys on present research programmes of the selected countries and identification of the research field to be strengthened. Under the Project, Bangladesh and Indonesia will receive rather intensified support during Phase 1 to serve as benchmarks, while Philippines and Thailand will receive limited support. To share the experiences in these countries with other participating countries, the Project activities will also include a workshop and study tours, within the available resources for 1985.

14. Operational arrangements: The Centre will hire an external expert for short-term (2.0 m/m) consultancy service to obtain assistance in preparing and implementing the planned work. Local consultants will also be hired in three countries for co-operation with the Centre's staff and external consultant. The centre will be responsible for overall matters, including preparation, implementation, monitoring and report preparation, and co-ordination as a whole. After the RCCM2, a sub-contract arrangement will be worked out between FAO and ESCAP to finalize the Centre's programme with considerations on financial matters necessary for the 1985 activities. Operational contacts will be maintained with the Project Network Co-ordination of the Project during the project implementation. Contacts will also be made with the FAO/HQ in Rome as well as the FAO/RAPA Office in Bangkok as and when needed.

15. Budgetary implications: Total costs for the proposed 1985 activities are estimated at $US 99,500: $US 47,000 for in-country activities, $US 50,000 for a regional workshop, including short study tours, and $US 2,500 for project operating costs. Under the sub-contact arrangement for 1984, $US 50,000 was allocated to the Centre's activities, of which it was estimated that $US 35,500 would be spent in 1984; the balance of $US 14,500 would be carried over to 1985. Total costs for the two-years activities in Phase I will be $US 135,000.

THE SOUTHEAST ASIAN FEED INDUSTRY
A STATISTICAL PROFILE*

"….settlers arrived in the Ban Chiang region
around 4000 B.C. and grew rice, raised cattle,
pigs and chicken…"

- Joyce White, archaeologist
TIME, Nov. 19, 1994

The following comprises a statistical profile on the feed industry in Southeast Asia.

INDONESIA

For the past 10 years, the feed industry has been rapidly expanding in Indonesia. The most rapid expansion has occurred in the egg industry, due to the introduction of strains of layer breeds with greater heat resistance. The majority of the layer producers use concentrates supplied by the feed manufacturers. These concentrates are mixed with locally available maize and rice bran.

The second greatest expansion has taken place in the broiler industry. Most broiler producers use complete pelleted feed supplied by the feed manufacturers.

Indonesia produces a sufficient quantity of the raw energy materials for feed production: however, most of the raw protein materials must be imported.

MALAYSIA

Several large, modern feedmills have been constructed in Malaysia in the past five years, and the feed industry has become highly competitive. However, Malaysia must import most of the raw materials required by the feed producers. Maize and fish meal are imported mainly from Thailand; soyabean meal comes mainly from South America.

THE PHILIPPINES

Poultry and swine feed are the two major kinds of feed produced in the Philippines. Several of the large feed manufacturers also have operations for the production of eggs, broilers and pigs.

The Philippines imports most of the raw materials required for feed production.

SINGAPORE

Singapore ranks first among the Asean countries in terms of per capita consumption of pork. Most of the pig procedures mix their own feed, although they often purchase pig prestarter feed from the manufacturers. The recent policy of the Singapore government is to phase out pig production in this island country, so that the land can be utilized by more productive enterprises.

Most of the broiler producers buy complete pelleted feed from the feed companies.

THAILAND

*) Prepared by Chingchai Lohawatanakul, Group Vice President, Charoen Pokphand Group of Companies, Bangkok

Thailand has a surplus of raw feed materials, except for soyabean meal. The cost of animal production in Thailand is the lowest among the Asean countries, due to the low costs of the raw materials.

Thailand is one of Japan's most important sources for broilers, second only to the United States. Thailand may also become the major supplier of pork to Singapore, when that country's pig Production has been phased out.

Huge quantities of tapioca produced in Thai land are not used locally for feed production. Most of the tapioca chips or pellets are exported to the EEC countries, due to the favourable import levy structure. However, the current tapioca import limitations set up by the EEC are causing problems for the Thai tapioca producers.

ASIAN LIVESTOCK STATISTICAL PROFILE. 1983

	INDONESIA	MALAYSIA	PHILIPPINES	THAILAND
PRODUCTION				
MILK, 1,000 MT/YR	135	35	28	12
EGG, 1,000 MT/YR	315	106	234	131
POPULATION				
CATTLE, 1,000 HEAD	6,600	600	1,938	4,600
BUFFALO, 1,000 HEAD	2,500	300	2,946	6,150
P1GS, 1,000 HEAD	3,600	2,100	7,980	3,800
CHICKENS, 1,000 BIRDS	170	78	62	65

Source: RAPA FAO (Rapa Monograph No. 13, 1984)

INDONESIA

LIVESTOCK POPULATION/PRODUCTION
OF INDONESIA, 1982

CATTLE, 1,000 Head	6,435
BUFFALO, 1 ,000 Head	2,506
PIGS, 1,000 Head	3,296
CHICKENS, 1,000 Birds	114,000
DUCKS, 1 ,000 Birds	18,749
EGGS, Mt/Yr	116,000
MILK, 1,000 Mt/Yr	82

Source: 1982 FAO Production Yearbook

RAW MATERIALS SUPPLY SITUATION IN INDONESIA

NAME	SOURCES	
	LOCAL	IMPORT
MAIZE	100%	-
RICE BRAN	100%	-
COCONUT MEAL	100%	-
IPIL IPIL	100%	-
SOYABEAN MEAL	< 10%	> 90%
FISH MEAL	< 10%	> 90%
MBM	< 10%	> 90%
FEATHER MEAL	< 10%	> 90%

Source: Private Estimation

MAJOR FEEDMILLS IN INDONESIA, 1983

NAME	PRODUCTION (MT/MONTH)
CHAROEN	35,000
COMFEED	9,000
SUBUR GOLD COIN	6,000
CARGILL	2,000

Source: Private estimation.

LIVESTOCK/FEED PRODUCTION OF INDONESIA, 1983

ANIMAL	PRODUCTION	FEED CONSUMPTION
BROILER	2.5 MLN/WK	312,000 TON/YR
LAYER	500,000 BD/WK	1,560,000 TON/YR
PIG	3.0 MLN/YR	840,000 TON/YR

Source: Private estimation.

MALAYSIA

LIVESTOCK
POPULAT ION/P RODUCT ION
OF MALAYSIA, 1982

CATTLE, 1,000 Head	555
BUFFALO, 1,000 Head	295
PIGS, 1,000 Head	1,785
CHICKENS, 1 ,000 Birds	53,620
DUCKS, 1 ,000 Birds	21
EGGS, Mt/Yr	129,624
MILK, 1,000 Mt/Yr	23

Source: 1982 FAO Production Yearbook.

MAJOR FEDDMILLS IN MALAYSIA
AND ESTIMATED PRODUCTION CAPACITY

FEEDMILL	ESTIMATED PROD. CAPACITY(TON/HR)
GOLD COIN	60
SIN HENG CHAN	40
SOON SOON	20
CHEEKHENG	15
SABAH FLOUR	20
DINDINGS SOYA	25-50
FEDERAL FLOUR	10

Source: 1982 Malaysia Animal Production
Society Sixth Annual Conference

RAW MATERIAL SUPPLY SITUATION
OF MALAYSIA, 1982

PRODUCTS	SOURCES	
	IMPORT	LOCAL
MAIZE	773,496	-
RICE BRAN	58,289	-
SOYAB EAN OIL MEAL	70,470	-
PEANUT OIL MEAL	19,455	-
OTHER OIL MEAL	12,566	-
FISH MEAL	38,371	32,891
OTHERS*	54,007	-
COCONUT CAKE	-	36,844
RICE BRAN & POLISH	-	67,146
TAPIOCA REFUSE	-	68,146
MILLED BRAN & POLLARD	-	121,009
PALM KERNEL CAKE	-	270,000
TOTAL	1,026,654	596,036

Source: United Asian Bank Berhad, K.L.
* Note: Molasses, limestone, and oyster shells
are also being produced, but in small quantities.

THE PHILIPPINES

LIVESTOCK POPULATION/PRODUCTION OF THE PHILIPPINES, 1982

CATTLE, 1,000 HEAD	1,950
BUFFALO, 1 ,000 HEAD	2,800
PIGS, 1,000 HEAD	7,800
CHICKENS, 1,000 BIRDS	58,000
DUCKS, 1,OOO BIRDS	4,400
EGGS, MT/YR	216,000
MILK, 1,000 MT/YR	10

Source : 1982 FAO Production Yearbook

ANIMAL PRODUCTION

BROILERS, BIRD/WK	4,000,000
HOGS, HEAD/YR	7,000,000
EGGS, PC/MONTH	35,000,000

Source: Private estimation

MAJOR FEEDMILLS IN THE PHILIPPINES

SAN MIOUEL	35,000*
GENERAL MILLING	12,000*
UNIVERSAL ROBINA	10,000*
VITARICH	8,000*
RFM	7,000*
FAR EAST AGRI. SUPPLY	5,000
PHILIPPINES FEED MILLING	5,000
CHAMPION FEED MILL	5,000
LIBERTY FLOUR MILL	4,000
VERGINA	4,000
MABUHAY	4,000
FORMOST	4,000

Source : Private estimation
*) Integrated with animal production operations

RAW MATERIALS SUPPLY SITUATION IN THE PHILIPPINES

NAME	SOURCE	
	LOCAL	IMPORT
MAIZE	40%	60%
RICE BRAN	100%	-
COCONUT MEAL	100%	-
IPIL IPIL	100%	-
SOYABEAN MEAL	< 10%	>90%
FISH MEAL	< 10%	>90%
MBM	< 10%	>90%

Source: Private estimation

MIXED FEED PRODUCTION
IN THE PHILIPPINES, 1983

POULTRY	752,572
SWINE	388,605
CATTLE	4,441
HORSE	2,971
OTHERS*	6,120
TOTAL	1,154,709

Source : Land Bank of The Philippines
*) Includes feed for rabbit, duck, pigeon, fish, dog, monkey, and dairy goat.

SINGAPORE

LIVESTOCK POPULATION/PRODUCTION
OF SINGAPORE, 1982

CATTLE, 1,000 HEAD	4
BUFFALO, 1,000 HEAD	2
PIGS 1,000 HEAD	1,302
CHICKENS, 1,000 BIRDS	13,883
DICKS, 1,000 BIRDS	498
EGGS, MT/YR	27,345
MILK, 1,000 Mt/Yr	1

Source: 1982 FAO Production Yearbook.

R AW MATERIALS SUPPLY SITUATION
IN SINGAPORE

NAME	SOURCES	
	LOCAL	IMPORT
MAIZE	-	100%
RICE BRAN	-	100%
IPIL IPIL	-	100%
WHEAT BRAN	>50%	<50%
FISH MEAL	<10%	>90%
SOYABEAN MEAL	<10%	>90%

Source : Private estimation

MIXED FEED PRODUCTION OFSINGAPORE, 1983

FEED	PRODUCTION MT/YR
BROILER	156,600
PIG	64,200
DUCK	18,600
TOTAl	239,400

Source : Private estimation.

MAJOR FEEDMILLS IN SINGAPORE

NAME	PRODUCTION MT/MONTH
GOLD COIN	7,000
SHIN HING CHAN	5,000
CHIA TAI	4,000
MALYSIA	2,000
SINGAPORE FOODER	2,000

Source : Private estimation.

THAILAND

LIVESTOCK POPULATION/PRODUCTION OF THAILAND, 1982

CATTLE, 1,000 HEAD	4,500
BUFFALO, 1 ,000 HEAD	6,150
PIGS, 1,000 HEAD	3,700
CHICKENS, 1,000 BIRDS	63,264
DUCKS, 1,000 BIRDS	13,381
EGGS, MT/Y	110,500
MILK, 1,000 MT/YR	5

Source: 1982 FAO Production Yearbook

ANIMAL PRODUCTION IN THAILAND

PIG,HEAD/YR	5,475,000
BROILER, BIRD/YR	234,000,000
LAYER - CHICKEN, BIRD/YR	17,550,000
- DUCK, BIRD/YR	10,530,000
FISH, TON/YR	1,580,000

Source: Private Estimation

PROTEIN FOOD CONSUMPTION IN THAILAND

PORK, KG/CAPITA/YR	8.97
BROILER, KG/CAPITA/YR	7.17
EGG - CHICKEN, PC, CAPITA/YR	55
- DUCK, PC/CAPITA/YR	33
FISH, KG/CAPITA/YR	20

Source : Private estimation.

FEED REQUIREMENT

PIG FEED, TON/YR	2,190,000
BROILER FEED, TON/YR	936,000
LAYER - CHICKEN, TON/YR	585,000
- DUCK, TON/YR	561,600
OTHERS, TON/YR	500,000
TOTAL, TON/YR	4,772,000

Source : Private estimation.

CONSUMPTION CALCULATION

PORK	5,475,000 Head × 110 KG/Head × 70% : 47,000,000 = 8.97 Kg/Cap.
BROILER:	234,000,000 Bird x 1.8 Kg/Bird x 80% : 47,000,000 = 7.17 Kg/Cap.
EGG:	
CHICKEN	250,000 x 90% x 220 x 52 : 47,000,000 = 55 Pc/Cap.
DUCK	150,000 x 90% x 220 x 52 : 47,000,000 = 33 Pc/Cap.
FISH:	1,580,000 Ton x 60% : 47,000,000 = 20 Kg/Cap.

FEED REQUIREMENT CALCULATION

	MT/YR
PIG FEED	
5,475,000 x 0.4 TON/HEAD	2,190,000
BROILER FEED	
234,000,000 x 4 KG/BIRD	936,000
LAYER FEED	
CHICKEN	
250,000 x 90% x 52 x 50	585,000
DUCK	
150,000 x 90% x 52 x 80	561,600
OTHERS (CATTLE, COW, FISH, SHRIMP, HORSE, DOG, Etc.)	500,000
TOTAL	4,772,000

Source: Private estimation.

PRODUCTION CAPACITY OF THAILAND FEEDMILLS

BANGKOK FEEDMILL	302,400
KRUNG THAI FEEDMILL	192,000
LAEMTHONG CORP.	144,000
CENTAGO	120,000
SRI THAI FEEDMILL	110,400
BETAGRO	108,000
BANGKOK LIVESTOCK PROCESSING	96,000
THAI FEEDMILL	86,400
C.P. FEEDMILL	76,800
CHAROEN POKPHAND(HAADYAI) FEEDMILL	60,000
LEE FEEDMILL	60,000
STAR FEEDMILL	57,600
CHAROEN POKPHAND FEEDMILL	43,200
P. CHAROEN PHAN FEEDMILL	43,200
ASIA DOMESTIC ANIMAL	8,400
CHANA PHANT INDUSTRY	7,200
TOTAL	1,515,600

Source: Thailand Feedmill Association.

AGRICULTURAL PRODUCTION(MILLION TON)

PRODUCTS	1980/81	% CHANGE	1981/82	% CHANGE
RICE	17.37	+ 10.6	18.5	+ 6.5
MAIZE	3.15	- 4.5	3.7	+ 17.5
TAPIOCA	16.50	+ 32.0	14.5	- 12.1
SUGARCANE	18.70	+ 48.4	26.06	+ 39.4
FISHERY PRODUCTS	1.76	- 10.0	1.58	- 10.0
RUBBER	0.5	- 5.6	0.53	+ 4.8

MAIN FEED INGREDIENT (1,000 T0N)

INGREDIENT	PRODUCTION	EXPORT	IMPORT	FOR FEED USE
MAIZE	3,700	2,500	-	1,200
BROKEN RICE	1,665	-	-	1,100
RICE BRAN	1,620	-	-	1,620
FISH MEAL	220	83	-	137
SOYABEAN MEAL	60	-	208	268
TAPIOCA CHIPS	5,500	5,500	-	-
TOTAL	12,765	8,083	208	4,325

Source : Private estimation.

THAILANDS EXPORT OF FISH MEAL (METRIC TON)

YEAR	1976	1977	1978	1979	1980	1981	1982
SINGAPORE	32,961	38,042	44,252	49,390	43,042	37,515	32,526
INDONESIA	1,349	3,540	11,081	18,084	23,393	28,073	20,478
MALAYSIA	9,318	18,539	26,012	22,334	21,569	19,402	21,786
HONG KONG	2,532	5,848	6,018	7,456	6,836	16,913	2,992
TAIWAN	495	4,029	6,711	16,027	10,391	6,351	2,809
OTHER	2,428	5,619	8,897	15,178	9,112	7,168	2,483
TOTAL	49,083	75,617	102,971	128,459	114,343	115,432	83,074

Source: Department of Customs.

THAILAND'S IMPORT OF SOYABEAN CAKE (METRIC TON)

YEAR	1976	1977	1978	1979	1980	1981	1982
BRAZIL	6,500	47,467	58,015	22,942	90,547	83,505	122,312
U. S. A	805	-	8,407	22,173	16,891	9,267	3,837
INDIA	2,347	5,038	6,824	12,787	44,478	30,423	18,156
OTHER	5	1,056	9,113	660	2,866	19,803	58,595
TOTAL	9,657	53,561	82,359	58,562	154,782	142,998	208,250

Source: Department of Customs.

RELATIVE PRICE OF SOYABEAN MEAL (SOM) AND MAIZE (US$/ MT) E.E.C.- C.I.F. ROTTERDAM

	FEB. 9 1980	DEC. 23 1980	FEB. 9 1981	DEC. 23 1982
U.S. SOM-44%	268.25	287.00	237.00	229.50
U.S. MAIZE	164.25	177.00	126.50	118.75
+ LIVIES	234.80	252.55	225.80	228.15
SOM/MAIZE RATIO	1.14	1.14	1.04	1.01
THAILAND-SPOT PRICE, BANGKOK				
SOM - 44%	286.96	334.78	343.48	328.70
MAIZE	123.04	151.30	154.78	115.22
S0M/MAIZE RATIO	2.33	2.21	2.22	2.85

16 PER CENT PROTEIN DIETS, THAILAND

INGREDIENT	PRICE KG	MAIZE DIET FORMULA KG	COST $/MT	CASSAVA DIET FORMULA KG	COST $/MT
MAIZE	3.20	800	256.00	-	-
CASSAVA	2.01*	-	-	636	128.08
SOYABEAN MEAL	7.80	200	156.00	364	283.92
TOTAL		1,000	412.00	1,000	412.00

* 2.01/3.20 × 100 % = 63%

16 PER CENT PROTEIN DIETS, EEC

INGREDIENT	PRICE KG	MAIZE DIET FORMULA KG	COST $/MT	CASSAVA DIET FORMULA KG	COST $/MT
MAIZE	22.82	800	182.56	-	-
CASSAVA	15.90	-	-	636	101.12
SOYABEAN MEAL	22.95	200	45.90	364	83.54
TOTAL		1,000	228.46*	1,000	184.66**

* Price of cassava is 70% of the price of Maize

** $\frac{184.66}{228.46}$ x 100% = 81% —— a net saving of 19% feed cost.

ANNUAL EXPORTED CHICKEN MEAT OF THAILAND

YEAR	METRIC TON
1974	443
1975	387
1976	1,234
1977	3,860
1978	9,907
1979	13,972
1980	17,314
1981	27,540
1982	33,916
1983	23,821

Source- Private estimation.

UTILIZATION AND NUTRITIONAL ROLE OF CGPRT CROPS IN DEVELOPING COUNTRIES*

A regional survey on the nutritional and utilization aspects of CGPRT crops has just been initiated by ESCAP. An outline of the objectives and some random thoughts are presented in the following summary. The purposes of the survey are to:

1) Assess the importance of CGPRT crops in the nutrition of the population of the areas of significant cultivation of the crops: Interphase of agriculture, socio-economics, and food policy.
2) Reflect upon the nutritional status of the population in the main, areas of CGPRT production; i.e., dietary adequacies and inadequacies nutritional disorders, if any, and factors leading to health problems: Clinical aspects.
3) Study the potentials of raising and stabilizing the nutritional quality of the target crops through genetic, agronomic, and/or input improvement: Plant breeding and agronomy.
4) Document the present market value, shelf life and nutritional value of CGPRT products, and the current methods of processing:
Food technology
5) Refer to interventions that would influence the quantity, quality and composition of food production; i.e., income and employment generation and consequent consumption patterns and nutritional well-being of the populations dependent upon CGPRT crops: Forming systems.
6) Recommend methods of regional co-operation to exchange information and know-how on the nutritional and processing aspects-of the crops: Strengthen the role of the CGPRT Centre.

Nutritional research can be grouped into three categories: 1) Research on the crops, 2) Research on the consumers and their health, and 3) Research on the storage, utilization and processing of CGPRT crops.

1. Research on the Crops:
   (a) Studies on the quantitative and qualitative compositions, i.e., proteins, carbohydrates vitamins, etc.
   (b) Antinutritional aspects, both inherent and induced.
   (c) Complementation studies, at both production and consumption levels.
   (d) Yield thresholds in relation to nutritional quality.
2. Research on the Consumers:
   (a) Dietary surveys.
   (b) Nutritional deficiency disorders.
   (c) Nutritional implications of the socio-economic aspect of production and consumption.
   (d) Seasonal and regional variation in the intake of CGPRT crops.

* Prepared by Dr A. K. Kaul, Advisor, Crops and Forestry, Bangladesh Agricultural Research Council, Dhaka.

(e) Cultural aspects, i.e., traditions and taboos associated with consumption.
(f) Crop production technology, i.e., amount of labour and mode of wage payment in relation to food intake and nutrition.
(g) Income and price elasticities of demand for calories and proteins.
(h) Farm size and production practises of CGPRT farmers.

3. Research on the Utilization:
(a) Storage methods and storage losses.
(b) Degree of processing, including constraints to processing.
(c) Consumer preferencesand nutritional rationale.
(d) Advances in processing for rural and urban consumers, and the consequences of processing on prices and nutritional quality
(e) Marketing surveys to assess the potential expansion of CGPRT products within and outside the countries of production
(f) Comparison of the cost/benefit ratios of CGPRT crops utilization for food, feed and industry.

The survey will cover the areas listed above and will also incorporate other important aspects.

For many years it has been widely believed that there is a "protein gap" in the developing countries due to a dietary shortage of requisite protein. This assumption has led to many programmes world-over, at national and international research centres. Considerable investments have been made on the protein improvement of CGPRT crops. However, in recent years, "protein gap" philosopy has come under considerable criticism. Emphasis is now shifting to the improvement of carbohydrate and vitamin quality, and to processing and cooking attributes. Simultaneously, it has been observed that nutrition policies and plans should recognize the quantity aspect of diet, which is largely determined by the levels of income. The basic nutritional objective is to enable the poor to earn a minimum, income in order to afford the cereal and pulse diet that is adequate to meet human energy needs. Emphasis has therefore shifted to quantity, with attention to higher yields, higher cropping intensity, and crop diversity. It is recognized that the increased and stabilized production of CGPRT crops is likely to have a greater influence on the nutritional status of the population then the improvement of protein quantity or quality. This new emphasis, together with accelerated farming systems research, could result in a nutritionally balanced diet by generating more purchasing power and, in turn, enhancing the demand and consumption of CGPRT crops. Furthermore, it has been observed that the expenditure elasticities for CGPRT food items are sufficiently large to approach unity for the poorest households. Both the budget shares and expenditure elasticities decline with Income for food Items, Implying that any Increase In grain supplies would be largely absorbed by the poorer segments of a population. In India, where more than 60 per cent of the rural population have incomes below the poverty level, more than half the income in rural households is spent on cereals alone; up to 30 per cent is spent on coarse grains and pulses.

METHODOLOGICAL CONSIDERATIONS ON THE ANALYSES OF THE DEMAND FOR MAIZE IN INDONESIA*

I. Introduction

1.01 The Indonesian government is interested in the use of consumption analyses to help formulate its food supply programme. Growth in the demand for rice has outstripped production for the past twenty years. Increasing rice imports from an uncertain world market have placed a financial burden on the government. Indonesian rice imports are large, both in dollar terms ($600 million in 1979) and in the country's share of the total world trade in rice.[1] This has led to the increased interest in the role of non-rice staples and their place in the food system. AS will be seen later, maize and cassava are important staple foods for many rural people.

1.02 This paper presents the methodological considerations on the analyses of demand for maize in Indonesia. A general methodology of demand is presented, followed by a quick overview of the staple food consumption patterns in Indonesia. The final part of the paper presents the empirical results of the demand estimates.

II. General Methodology of the Demand Analyses for Maize

2.01 Demand is defined here as the sum of the demand for food (for human consumption) and the demand for non-food uses. Population and income are the most significant determinants for the food demand. Consequently, one needs to measure the income elasticity in order to measure the degree of impact on the change of consumption due the change in the income of the consumer, as well as to measure the future demand.

2.02 The various types of non-food uses (seed, waste, feed and industrial uses) can be estimated independently. Seed requirements depend to a large extent on the area sown. Waste is estimated as a proportion of the domestic supply. For livestock feed, the requirements we estimated based on the projected growth of animal production. With regard to Industrial uses, the growth of the industries has to be estimated.

Demand for Food

2.03 The projection of the demand for food is determined by the estimated per capita food consumption for a given year (the base year), the estimated income or household expenditure elasticity of demand for food, and the projected Gross National (Domestic) Product and population. Thus, the essence of the method is to use observations on the recent behaviour of consumers in order to work out elasticities of demand, with regard to determinants such as income and prices, and to apply these elasticities of demand, with regard to determinants such as income and population.

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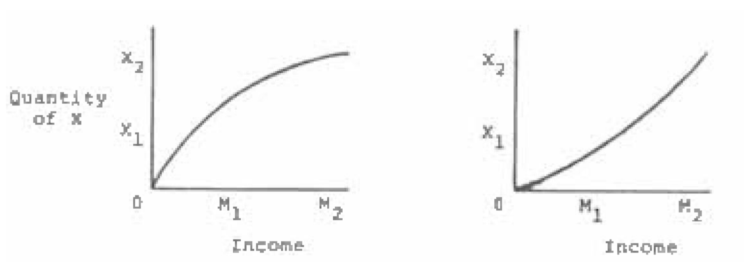
* Prepared by Dibyo Prabowo, Assistant Professor, Faculty of Economics, Gadja Mada University, Yogyakarta

1 The government claims that In 1984 the rice production reached a record 25 million tons; enough to satisfy the domestic consumption. The government has also signed an agreement to supply rice to other countries.

2.04 The analysis of demand may be approached in two ways, i.e., a purely static or a dynamic picture. The static analysis shows at a given period of time the relationship between the total income or expenditure and the consumption of a given commodity. The dynamic analysis compares annual averages of income and consumption over a period of successive years. The main advantage of the static method is that, due to the abundance of the basic data, the use of precise statistical techniques permits the isolation of influences on total income or expenditure from other factors, such as household size, region, social class, etc.

2.05 The calculation of elasticity coefficients is based on either National Soclo-Economic Surveys or Time Series of Consumption per capita. The data derived from HCS's are cross-sectional in nature. HCS's generally provide the data necessary to analyze the relationship between consumption levels of a given product (expressed in terms of quantities or expenditure) and household income (or total expenditure). The curve which shows this relationship is known as the Engel curve (Figure 1).

Figure 1. The Engel Curve.



In mathematical terms the general expression of the demand function is:

$$q_i = fi\,(Yi\,)$$

where q_i = expenditures on different goods.

Y_i = income or total expenditures.

On this basis, the income elasticity coefficient [2] can be calculated for the period of the survey.

2.06 It has been found that few National Socio-Economic Surveys are available in a form suitable for the present study. Such surveys, if the exist, are incomplete. Even in cases where the results of these surveys are given in quantities of product consumed, and not just in terms of expenditure, the definition of the product often makes it difficult to apply the elasticity coefficient obtained to a product as it appears at the production stage. A more basic difficulty exists in the "static" aspect of household surveys; this makes it difficult to use the results for a

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2 The coefficient of income elasticity measures the response of demand to changes in income and is expressed as:

$$e = dqi\,/\,qi$$
$$e = dqi\,/\,qi \;:\; dy/\,y$$
$$= dqi\,/\,q \times y/\,dy$$
$$= dqi\,/\,dy \times y/\,qi$$
$$= dqi\,/\,dy \;:\; qi/\,y$$

where,

$dqi\,/\,dy$ is the marginal propensity to consume, and

$qi\,/\,y$ is the average propensity to consume.

The coefficient of ei is interpreted as the percentage change in expenditure (q_i) on 1th product in response to one per cent change in income (y) projection which is by definition "dynamic". The solution to this impasse is either to have a cross section panel of consumers whose consumption expenditures are recorded over time, or to draw a large enough sample over enough geographical and temporal diversity to capture significant variance in the relevant variables. Both approaches are quite expensive.

2.07 In the analyses of time series, food consumption (net availability) can be compared with per capita income during the same period to give elasticity coefficients reflecting change, in the behaviour of consumers in response to Income. The series of consumption per heed for each product is taken from the Food Balance Sheet. Disposable income per capita is the most appropriate income variable to use in the demand function, but Gross National Product (GNP) or Gross Domestic Product (GDP) is used as proxy because it is available and can be projected with greater accuracy. The GNP or GDP has to be deflated with the appropriate consumer price index (PI).

2.08 A fundamental question arises: Should the projection take account only of income effects, or should it allow for the effect of prices and other factors? This question is clearly related to assumptions about prices. It is likely that prices do change. Thus, we may assume that prices will continue to behave in the same way as in recent years. It can then be summarized that consumer income (represented by GNP), the prices of food in question, and the prices of related commodities are factors that are associated with the demand for food. Taste might also be one of the factors Influencing demand, however, it 1s assumed to be constant.[3]

2.09 The method of OLS (Ordinary Least Squares) is used to derive the coefficient of the independent variables which explained the variations in the quantity demanded of the products. The estimated demand function as derived by the regression method was subjected to the following-criteria: consistency to the a priori relationship, level of significance (t-test, R levels), and standard error. Four types of function are used to estimate the coefficients. These are the double-logarithmic function, the semi-logarithmic function, and the- log-inverse function.[4]

2.10 Following FAO Agricultural Commodity Projections, two sets of projections (basic and supplementary) are made to reflect the two possible courses of development in the period up to a

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3 The relationship between demand and factors or determinants mentioned above can be expressed as the following:

$$Qd = F(In, P_o, P_s, POP, T)$$

or in per capita basis:

$$Q_d/capita = l_n/capita, P_o, P_s T)$$

where

Q_d = quantity demanded in = consumer income

P_o = own price

P_s = price of the substitutes
POP= number of consuming units

$Qd = F(In, P_o, P_s, POP, T)$
T = consumer's taste.

4 The analytical expressions of the function are:

Double-logarithmic function:

$$\log q_{ij} = a + b \log Y_j + u_{ij}$$

Log -inverse function:

$$\text{Log } q_{ij} = a_i - b_i / Y_j + u_{ij}$$

Semi -logarithmic function:

$$q_{ij} = a + b \log Y_j + u_{ij}$$

log-log-inverse function:

$$\text{Log } q_{ij} = a_i - b_i/Y_j - a \log Y_j + u_{ij}$$

given year. The basic assumption is that current trends in consumption will continue. The supplementary projection assumes a more rapid economic growth. Prices are assumed to be constant on the premise that demand for food is inelastic to its own price changes.[5] Population is projected on the basis of past trends in birth and death rates, and also takes into consideration the government's family planning programme. Income is projected based on the past trends and projected contributions of GNP (GDP) of the various industrial sectors of the economy.

Demand for Animal Feeds

2.11 Separate estimates of demand are based on the types of usage of the basic food and feed products, Naturally, this is a derived demand. Calculating the elasticities of demand for non-food utilization does not require the data from National Socio-Economic Surveys, but rather the data from outside the HCS. Time series data are needed to describe the relationship between the growth in the activity outside the household, such as industry, and the community consumption of the activities. The demand of maize is linked to the projection of livestock production. For example, in the case of maize, the livestock productions include the production of chicken eggs or bred chickens and the number of dairy cows.

Demand for Industrial Utilization

2.12 Commodities such as coconut (copra) can be used as human food as well as for industry. Coconut may be eaten fresh or processed into cooking oil. Coconut as cooking oil can be further utilized as a basic material for soap or margarine. This is to say that in order to be able to estimate the demand for a particular commodity for industrial purposes, we should estimate the growth of the industry. The projection of demand of commodities for industrial utilization is related to macro-economic growth.

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5 The population and Income growth and their contribution to the projection for demand can be expressed as:

$$Q_d = f(N, Y, P)$$

Where Q_d = quantity demanded
$N,$ = population
$Y,$ = Income
P = Price (constant)

Taking total derivative of above equation:

$$dQ_D = fy\ dY + fn\ dN$$

$$dQ_D / dt = fy \frac{dY}{dQ_d} \left[\frac{dY/dt}{Y}\right] + fn \frac{N}{Qd} \left[\frac{dN/dt}{N}\right]$$

where

$q = dQ_D/dt$. growth rate in quantity demanded

$Y = \frac{dY/dt}{Y}$, growth rate in income

$N = \frac{dN/dt}{N}$, growth rata in population

$E = fn\ {}^{N}/Q_{D-1}$, elasticity of quantity with respect to population

$e_Y = fg\ {}^{dY}/dQ_D$, income elasticity of quantity

The quantity growth rate, therefore is

$q = (Ey)\ (y) + n$

III. Food Consumption Pattern in Indonesia

3.01 Based on Food Balance Sheet data, the availability of calories and protein in Indonesia at the national level appears adequate to meet the basic nutritional needs. Available data indicated that the total calories were between 2.150 kcals (in 1975) and 2,417 kcals (in 1978), while the minimum requirement was set at 2,000 kcals; and the average protein consumption was between 43.7 (in 1976) and 47.5 (in 1978), while the minimum requirement was 39 grams. The larger part of the total calories and protein comes from vegetable sources. Cereals, root W tubers account for 80 per cent of all calories and 70 per cent of all protein. Among the staples, rice, maize and cassava rank respectively as the most important.

3.02 Data from the National Socio-Economic Survey (SUSENAS) were even more interesting. Consumption varied by region (Java and off-Java), by residence (urban and rural), by season, and by income group. SUSENAS was carried out since 1963/64 in three rounds. Each round had a sample size of 18,000 household. In the surveys, information was obtained on the purchase of both food and non-food items, services, and other expenditures.

3.03 Disaggregation of data gives interesting facts. Table 1 shows that per capita rice consumption in off-Java is 25 per cent higher than on Java, while the reverse is true for maize consumption. When rural-urban differences are examined, the much greater role of maize and cassava in the rural areas becomes evident. Furthermore, if the date are broken down by per capita income, and if the poorer half of the population is considered separately, the data shows that in rural areas, rice consumption decreases by a quarter, and maize and cassava consumption increases in importance; in urban areas, there is some decrease in rice consumption but little change in maize or cassava consumption (Table 1). These differences are indeed important where food security is concerned, since 75 million people are included in this group.[6]

6 For detailed discussion on the findings of SUSENAS see John Dixon. Use of Expenditure Survey Data in Staple Food Consumption Analyses: Examples from Indonesia: Alderman, H and Timmer. C.P.. Food Policy and Food Demand in Indonesia. Bulletin of Indonesian Econ. Studies, ANU Canberra, 3 (1980).

IV. EMPIRICAL RESULTS OF THE DEMAND ANALYSIS FOR MAIZE.

Demand for Food

4.01 In a country like Indonesia, maize is second only to rice as a staple food. In Indonesia, maize is consumed by people in areas such as East Java, Madura and the Eastern part of Indonesia. The average annual per capita maize consumption in 1976 (SUSENAS 1976 as date base) was 13.5 kg.

4.02 The income elasticity of demand for maize showed -0.31. The negative sign indicates that maize is considered an inferior food in Indonesia. The estimate was computed from SUSENAS for all of Indonesia. The disadvantage of this method is that the estimate is too aggregate and relies on the false assumption that all Indonesian people eat maize.

Weekly Per Capita Consumption by the Poorer 50 per cent of the Population

Region and Residence	Rice	Maize	Cassava	wheat Flour
Java				
Rural	1.52	0.35	1.18	-
Urban	1.89	0.02	0.16	0.01
Off-Java				
Rural	1.93	0.21	0.95	0.01
Urban	2.11	0.04	0.26	0.02

Source: Government of Indonesia, Central Bureau of Statistics, Susenas V, VU579-29, Jakarta, 1979 --- in John Dixon, Use of Expenditure-Survey Data 1n Staple-food-Consumption Analyses: Examples from Indonesia appears in Anthony H. Chisholm and Rodney Tyers, 'Food Security: Theory, Policy, and Perspectives From Asia and the Pacific Rim", Lexington Books, 1982.

4.03 Two alternative projections were made. The first alternative is what we consider the basic alternative and is formulated by taking the normal population growth rates and the most likely income growth rates. The basic alternative projections are considered as forecasts of the most likely demand situation in the future. The second alternative projections is based on s more optimistic expectation of population and income growth rates. Alternative II sets the population growth rate slightly lower and the economic growth slightly higher than the levels which are considered as the most probable in Alternative I. The assumptions on the annual population and per capita income growth rates are as the following:

	Population growth, percentage		Income growth, percentage	
	1975-85	1985-90	1975-85	1985-90
Alternative I	2.34	2.2	4.5	4.5
Alternative II	2.20	2.1	5.0	5.0

4.04 Demand for maize food under Alternative I would be 1.94 million tons in 1985 and about 1.99 million tons in 1990. The annual rate of growth of maize consumption for the period 1975-85 and 1985-90 could be 0.96 percent and 0.51 percent respectively. Projections under Alternative II areas the following:

Demand for Maize (million tons)

	1975	1985	1990
Alternative I	1.77	1.94	1.99
Alternative II	1.77	1.88	1.92

Demand for Animal Feeds

4.05 Of the total demand for maize, animal feed accounts for 4 per cent in Indonesia. The estimates of the future maize consumption for animal feeds are based on the projected number of commercial dairy cows, hogs and chicken. It is assumed that the share of maize in the animal feed consumption will remain constant.

4.06 The first task is to estimate the future production of chicken eggs and meat. Main is usually one of the major components of chicken feed. In this regard, it is assumed that the amount of feed to produce 1 kilogram of eggs or meat will remain constant during the projection period. The feed required to support the estimated future production of hogs and cows is calculated in the same manner. The conversion rate assumed in the projections is that 1 kilogram of chicken eggs requires 3 kilograms of feed, of which SO per cent is maize. In 1985, the demand for maize for animal feed will be 304 tons, and in 1990, 522 tons.

Demand for Industrial Uses

4.07 Maize is also used as a raw material for industry. In Indonesia, maize is the source of an increasing number of industrial products such as corn starch, corn oil and corn flake. The data pertaining to maize for industrial uses are scanty. However, the production of industrial products of maize has to be estimated for the future. We assume that the pest production trends will continue in the future. The following table estimates the demand for maize for industrial uses.

Demand for Maize (thousand tons)

	1981	1985	1990
Industrial Uses	144	152	161

Total Demand for Maize

4.08 The following table estimates the total demand for maize (food and non-food).

Estimated Demand for Maize

	1985 (million tons)	1990 (million tons)	Annual Growth 1985 – 1990 (%)
Alternative I	2.40	2.61	1.77
Alternatif II	2.34	2.53	1.61

METHODOLOGICAL EXPERIENCES IN ANALYZING AND ASSESSING THE DEMAND FOR MAIZE IN THE PHILIPPINES*

Introduction

Maize, which is second only to rice as a staple crop, is produced all over the Philippines, accounting for nearly half of the area planted to grains in the past five years. Generally white maize is preferred to yellow maize as human food, but it is also used as feedstuffs for livestock and poultry, mainly because yellow maize accounts for only 10-15 per cent of the total maize production and falls short of the feed demand requirements. Maize is also processed into non-food products such as corn starch and glue, among others, but the volume of the cereal used for such purposes is significantly small compared to its food and feed uses.

Market Demand for Maize

The market for maize in the Philippines consists mainly of the demand for food, feed and industrial uses. From 1969-70 to the present, approximately 50 per cent of the total maize supply has been utilized for food; 38 per cent for feed uses; and 4 per cent for industrial uses. About 2 per cent of the total maize supply are used for seed, and 6 per cent are carried over as stock for the following year.

Maize ranks second to rice as the staple food for 17 million Filipinos, or about 30 per cent of the population. Due to its substitutability for rice, maize acts as a buffer staple during critical periods or rice shortage. In times of a shortfall in rice production, corn grits are substituted for or mixed with rice. Although the total food demand has increased at an annual rate of 1.31 per cent from 1969-70 to the present, the national maize demand has decreased at 2.45 per cent per annum. The decrease is due to the attainment of a rice surplus and to the increasing feed demand for maize by the commercial livestock and poultry industries, which expanded rapidly during the late 1970s. Moreover, the annual increases in total maize for food use of 1.3 per cent are offset by a greater 2.7 per cent population growth, effecting a 0.70 per cent annual decline in per capita consumption.

The domestic use of maize as feed is becoming the dynamic element in the total demand for maize (IAPMP, 1981). Maize and its by-products consitute approximately 43 per cent of the manufactured commercial feeds, making it the major feed ingredient. Maize by-products for feed purposes come in the form of corn bran, corn grits, glutten feed, oil meal and germ. From 1969-70 to the present, the feed demand for maize has grown at a remarkable rate of 8.29 per cent per annum. This increase has necessitated large importations of maize and has caused large outflows of the country's scarce foreign exchange.

Maize is also utilized in a wide range of industrial products, mainly in the form of corn starch. Maize and its by-products are used as raw materials, ingredients or additives in the following processes: drug manufacturing and pharmaceutical pelleting, bakery and candy manufacturing, meat and salad oil processing, beer brewing, food preservation, soft drinks processing, paper manufacturing, textile additives and leatherr tanning (Corpuz, 1977). However, the estimated use of processed maize it, industrial products is only 4 per cent of the total maize stupply, which suggests that this sector is still untapped and deserves further exploitation and development.

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* Prepared by Celestino C. Olalo, Head, Policy Analysis Staff and concurrently Office-in-Charge, Economic Research Division, Bureau of Agricultural Economics, Quezon City.

Total maize production has not satisfied the domestic demand and importations have been increased in order to fill the deficiency. Hence, there is a need for a continuous appraisal of the demand and supply situation of maize and its contribution to the Philippine economy.

Objectives of the Paper

This paper will present the methodological experiences in analyzing and assessing the demand for maize in the Philippines, and is intended to facilitate meaningful comparisons and fruitful co-operation among member countries. Specifically, it presents a synthesized logical framework of the methodological procedures as well as empirical findings from several studies. The responsiveness of the quantity demanded for maize of different demand models to changes in economic factors within the economic system is presented. Moreover, the sources of data and the quality, availability, and accuracy of estimates of the demand for maize are discussed. This paper also analyzes the sampling design used by these studies and, other relevant statistical problems of measurements.

THEORETICAL FRAMEWORK

Economic theory sets the logical framework for defining a problem and formulating realistic assumptions. Thus, the analytical framework for analyzing and assessing the maize demand in the Philippines relies basically on the theory of demand.

Factors Affecting Demand

The theory of demand states that the quantity demanded is a function of the number of consumers, their income, the prices of the commodity and complementary or substitute commodities, and consumer tastes and preferences.

An increase in the number of consumers will naturally increase the quantity demanded.

There is a tendency to spend a larger part of an increase in income on food up to a certain point, beyond which the effect on the consumption of certain food stuffs, percentage-wise, tends to fall I.

An inverse relationship exists between the price and the quantity demanded as consumers tend to shift to lower-priced substitutes. The price effect depends mainly on the possibilities of substitution.

Finally, the consumers' tastes and preferences are influenced by other factors, such as habit, religious beliefs, environment, etc. Tastes and preference, cannot be measured quantitatively, but the assumption that demand depends ultimately on the consumer's final decision implies that these are already taken into account.

Elasticities of Demand

The elasticity of demand can measure the change in the quantity demanded as it corresponds to a change in a specific independent variable, while holding other factors constant. Elasticity relationships show how a rational consumer would adjust his purchases given specific changes in the economic system. Thus, elasticities have important policy implications.

The elasticity of demand (E) of a commodity with respect to its own price is defined as:

$$Ep = \frac{aQ}{aP} \left[\frac{\bar{P}}{\bar{Q}}\right]$$

where, aQ/aP is the change in the quantity demanded for the commodity, given an infinitesimal change in its price, and P and Q are the average price, and quantity, respectively.

The basic determinants of the price elasticity of demand of commodity are the availability of substitutes, the nature of the need that the commodity satisfies, the number of uses a commodity has, the proportion of income spent on the particular commodity, and the time period. The demand for a commodity is more responsive to price change it: there are close substitutes for it; it is considered a luxury; it has more possible uses; and it absorbs a greater proportion of income. In addition, demand is more elastic in the long run.

The income elasticity is defined as the proportionate change in the quantity demanded resulting from a proportionate change in income. A positive income elasticity is expected for normal goods; and negative, for inferior goods. A commodity is classified as a luxury if its income elasticity is greeter than unity, and a necessity if its income elasticity is less than one.

The cross price elasticity of demand is defined as the proportionate change in the quantity demanded for a commodity resulting from a proportionate change in the price of another commodity. The sign of the cross price elasticity is negative for complementary goods, positive for substitute goods. The higher the value of the cross elasticity, the stronger the degree of substitutability or complementariness between the two goods.

The population elasticity of demand is expected to be positive since an increase in population would also Increase the demand for the commodity.

The foregoing discussions indicate two stages in model building: first, determining the dependent and explanatory variables within the economic system; and second, hypothesizing the expected signs and magnitudes of the coefficients of the regressors.

Functional Forms

The choice of the more appropriate functional form to use is important to avoid misspecification of the statistical model in the estimation procedure. Various alternative forms of demand functions for maize may be employed, namely:

(1) Linear $Q = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n + u$

(2) Inverse (Hyperbolic) $Q = a + \frac{b1}{x_1} + \frac{b2}{x_2} + \ldots + \frac{bn}{x_n} + u$

(3) Semilogarithmic $e^Q = a\, x_1^{b1} x_2^{b_2} \ldots x_n^{b_n} e^u$

(4) Double Logarithmic $Q = ax_1^{b_1} x_2^{b_2} \ldots x_n^{b_n} e^u$

(5) Log-inverse $Q = ae\left[\frac{b_1}{x_1} + \frac{b_2}{x_2} + \ldots + \frac{b_n}{x_n} + u\right.$

(6) Log-log inverse $Q = ae\left(\frac{b1}{x_1}\right), x_1^{c_1}\, e\left(\frac{b2}{x_2}\right) x_2^{c_2} \ldots e\left(\frac{b_n}{x_n}\right) x_n^{c_n} e^u$

The ordinary least square (OLS) procedure is generally used to derive the coefficients of the explanatory variables of the above models with the usual set of OLS assumptions (Kmenta, 1971) as follows:

a) the error term (u) is normally distributed and independently distributed independently distributed with mean equal to zero and constant variance;
b) each of the explanatory variables (x_1, x_2,..., x_n) is nonstochastic with fixed values in repeated samples;

c) the number of observations exceed the number of coefficients (a_1, b_1, …. , b_n) to be estimated; and
d) no exact linear relationship exists between any of the explanatory variables.

The specification of the functional form of the model depends largely on the hypothesized of relationship of the variables to be tested. The following discussions show the advantages as well as disadvantages of the different functional forms.

Characteristic of Functional Forms

The linear function is the simplest form to use. The elasticity for a linear function (Q = a + bx) is defined as b x/Q so that as Q increases indefinitely, the estimated elasticity will tend to unity. Since maize and most agricultural products are characterized by inelastic demand, the elasticity derived from the linear function would be larger in magnitude when quantity demanded increases.

The semilogarithmic function is appropriate when analyzing commodities that are considered as necessities. This form implies that the income elasticity is inversely proportional to the level of income and does not allow for saturation point as income increases infinitely.

The elasticity derived from a double-log function remains constant with varying values of the independent variables. If the product is a basic food item, it can be assumed that its elasticity will not vary significantly given some changes in the explanatory variables. Hence, this functional form is appropriate in estimating the elasticities of agricultural commodities or the consumption of food items which remain far below the saturation point. When the majority of the population belong to low-income levels, it can be safely assumed that the consumption is below saturation point.

The hyperbolic (inverse) function allows investigation of a saturation level in its simplest form. This form implies that the elasticity coefficient tends towards zero as total income increases.

The log-inverse function implies that the income elasticity is inversely proportionate to level of income. This form typically applies to food consumption which increases rapidly when starting from a low income level, but tends toward a maximum determined by some physiological criteria. If the nature of the data used is cross-sectional, this presupposes diverse income and consumption patterns among the sample observations; thus, the use of the log-inverse is also logical.

Finally, the log-log inverse function serves as a countercheck to the double-log an log-inverse and can have higher or lower income elasticity then the other two depending on the commodity for which it is fitted. The log-log inverse function takes the general form of log Q = a + b/x + c log x, so that if b = 0, the function results in a double-log, and if c = 0, it is log-inverse. Thus, log-log inverse includes the double-log and log-inverse functions.

The final selection of demand models is based on the type of data available for analysis and economic and statistical considerations such as: simplicity of computation; estimated levels of t-value, F-value, R or a good statistical fit with a small standard error; and a logical interpretation of the demand coefficients in the context of economic theory.

CORN DEMAND MODELS AND EMPIRICAL FINDINGS

Different demand models may be used to analyze the maize demand for food, feed and industrial uses. Maize demand for food consumption is taken as a primary demand since corn grits are purchased by the consumers. On the other hand, maize demand for feed is considered a derived demand since it results from the underlying demand for livestock and poultry products such as pork, meat and eggs. Likewise, maize demand for industrial purposes is a derived demand in as much as maize is used as an input to produce another intermediate or final product.

A part of the country's total supply of maize is used for seed which is a function of maize hectarage. Moreover, maize imports are considered as a government decision variable. Thus, the government determines the quantity of maize to he imported depending upon the needs of the country based on a minimum level of maize carry-over stock for the following year, the level local production, domestic use, and the prices of maize.

Maize demand models for food, feed, and industrial uses as well as for seeds, imports and carry-over stock are discussed below in order to gain a better perspective on the supply and demand situation of the industry.

Food Demand

The quantity demanded for maize (Qwm) for food is a function of income (Y), the number of consumers (N), the price of white maize (Pwm), and the prices (P_1 P_2 , ... P_n) of related commodities. This functional relationship is expressed as:

$Q_{wm} = f\ (Y, N, P_{w,}, P_1, P_2, ... P_n, u)$

The food demand for maize 1s expected to be Inversely related to Its own price, but is positively related to the price of substitute goods. On the premise that maize is an inferior good, an inverse relationship between maize demand and income exists. An increase in the consumers' purchasing power will shift their preference to higher quality and higher priced substitute goods, such as rice and wheat.

A positive relationship between the number of consumers and the maize food demand is expected. An increase in the number of consumers would bring an upward pressure on the food demand of maize.

A number of alternative functional relationships may be developed for the maize food demand. However, empirical testing and in-depth analysis are greatly influenced by the availability of appropriate data. Different food demand models for maize estimated by past studies are discussed below.

Mababaya (19080) fitted several food demand models for maize and the results of the linear function shown below appear to be the best:

$TCMt = 1706.53 - 46.76\ AWPM_t + 102.44\ AWPW_t - 1.27\ TRI_t$

t-value	-1.14	2.02	-1.64
elasticity	-0.22	0.39	-0.32

$R^2 = 0.84$ R= 0.76 F-value= 10.41 DW-1.71

where,

TCM_t = total food consumption of maize in the Philippines at time t, in thousand metric tons,
$AWPM_t$ = deflated wholesale price for maize at time t, in pesos per metric ton,
$AWPW_t$ = deflated wholesale price for wheat at time t, in pesos per metric ton,
TRI_t = total real income of consumers in the Philippines at time t, in million pesos,
DW = Durbin-Watson statistics,
R^2 = coefficient of determination, and
R = corrected R.

This model gives the expected signs of the coefficients and 84 per cent of the variance in maize food demand is explained by the regressors. However, the t-value of $AWPM_t$ is not significant at the 95 per cent level, suggesting that consumers would be more likely to respond to the retail than the wholesale prices, The own-price elasticity reveals an inelastic demand for maize which suggests that consumers are responsive to the market price at a relatively low degree. This conforms to the fact that maize is a staple food or a basic necessity. Moreover, wheat is a major competitor of maize with an elasticity of 0.39 and a significant t-value of 2.02 at a 95 per cent confidence level. Furthermore, the income elasticity of -0.32 suggests that maize is an inferior good since an increase in the consumers' income would shift consumption from maize to higher- priced substitutes.

Nasol (1982) fitted linear and logarithmic maize food demand functions to the following aggregate and per capita variables:

CQm = annual average per capita consumption of maize in kilograms,
CY = annual per capita disposable income in pesos,
CRY = annual real per capita disposable income in pesos (1972=100),
Qm = annual aggregate maize demand for human consumption in million kilograms,
Y = annual total disposable income in million pesos,
RY = annual total real disposable income in million pesos (1972=100),
RP_{wm} = annual average retail price of white maize in pesos per kilogram,
DRP_{wm} = annual average deflated retail price of white maize in pesos per kilogram (1972=100),
RP_r = annual average retail price of rice (macan, ordinary) in pesos per kilogram,
DRP_r = annual average deflated retail price of rice (macan, ordinary) in pesos per kilogram (1972=100), and
N = yearly population in thousand persons.

The per capita maize demand models give low coefficients of determination although the F-values are significant at a 10 per cent confidence level (Appendix Table 4). The coefficients of maize price, rice price and disposable income exhibited the expected theoretical signs and are statistically significant. The positive coefficients of the retail price of rice, whether deflated or not, indicate that rice is a substitute for maize. Contrary to other findings, estimated coefficients of both the current and the real disposable income are positive. Moreover, elasticity of per capita maize consumption with respect to the independent variables are all inelastic.

On aggregate functions, results show that the negative response of maize food demand to nominal or deflated retail price of white maize, is inelastic. The price of rice is statistically significant and the positive sign confirms that rice is a good substitute for maize. Positive income elasticities were also estimated. The coefficients of total population are positive as hypothesized.

The elasticity of maize demand from aggregate variables with respect to the specified variables have larger values than those from the per capita variables.

Indicated below is s simulated per capita food use demand function for maize for the period 1970-1980 (IAPMP, 1981):

$$\log DF/POP = 5.597 - 0.4 \log PM + 0.3 \log PR - 0.2 \log I$$

where:

DF/POP = per capita food use of maize,
PM = price of maize deflated for inflation,
PR = price of rice, deflated for inflation, and
I = per capita income after taxes, deflated for inflation.

The signs and magnitudes of the coefficients appear reasonable. This model has been useful for current demand situation analyses and long run appraisals.

The IAPMP also fitted the following linear regression model far the total maize food demand:

$$DF = -141\,1.9 - 327.7PM_t + 701.OPR_t + .058POP$$

t-value	0.32	0.69	3.63
elasticity	-0.16	0.49	1.62

R^2= 0.69   DW = 1.34

where:

DF = total food demand for maize,
PM_t = price of maize at time t,
PR t = price of rice at time t, and
POP = population.

All the coefficients have the expected signs. In this model, the population turns out to be the main demand shifter for maize food use.

Ferrer (1978) estimated the demand for maize and maize products, both in terms of total and per capita consumption, as a function of house hold size, household income, and its own price The combined quarterly data for three consecutive years (1971- 1973) are fitted to the linear, double-log, log-inverse and log-log inverse functions.

The logarithmic equations indicate elastic maize demand while the linear function reveals an inelastic demand (Appendix Table 6). The quantity- incomer relationship is negative in all logarithmic forms, indicating that maize is an inferior good. The coefficient of the household size has the expected positive sign in the logarithmic equations.

An analysts was also carried out on the disaggregatad or annual data using the double-log function because of the-better results from the preliminary analysis. The findings show maize and maize products to be price-elastic. Estimated income elasticities also show an inverse relationship between income and demand for maize and maize products. The family size variable has a positive coefficient which implies that an increase in the family size will increase the demand for maize.

Bondad (1982) obtained the following linear regression model for maize food demand fitted to 1969/70 to 1979/80 data:

$$MFOOD = 1145.55 - 3829.91\ M2WGWD + 1668.84RPWHD$$

t-value	-1.52	-1.92	1.62
elasticity		-1.52	1.24

$$- 9.27DI + 30.29POP - 244.07D4$$

- 0.47	1.07	0.95
- 0.32	0.85	

R = 0.94   DW = 2.53

where:

MFOOD = maize food demand in thousand metric tons,
M2WGWD = maize wholesale price, white, deflated, P kg
RPWHD = rice wholesale price, deflated, P/ kg
DI = personal disposable income, billion pesos. deflated
POP = population, and
D4 = dummy variable; 1 for 1973 and 0, otherwise.

All coefficients exhibit the expected theoretical signs, but only maize wholesale price and rice retail price are slightly significant. The explanatory variables explain a good 94 per cent of total variation in maize food demand.

Feed Demand

The feed demand for maize (Qym) is a function of the prices of livestock and poultry (P_{h+c}), the animal units f the commercial production of hogs and chicken (N_{h+c}),the price of yellow maize (P_{ym}), and the prices of protein feeds (P_S).The functional relationship of the feed demand for yellow low maize may be expressed as:

$$Q_{ym} = f(P_{ym}, P_s, P_{h+c}\ \ Nh_{+c}, u)$$

An increase in the prices of hogs and chickens is expected to raise the demand for yellow maize. As hog and chicken productions offer profitable market prices, producers will be encouraged to expand production, which would in turn increase the feed requirements of the industry. Corollary to this price-incentive effect, an increase in hog and chicken populations would have an upward pressure on the quantity demanded for yellow maize.

The demand for yellow maize in the commercial livestock and poultry industries is hypothesized to be negatively related with maize prices, but positively related with the prices of high protein feeds. As the price of high protein feed increases, the quantity demanded for yellow maize increases, due to the price effect of substitution.

Mababaya (1980) estimated the feed demand for maize by statistically fitting the derived demand model to the historical data from 1969-70 to 1978-79. The fitted linear demand function for maize for feed use is:

$$OFFMM = 31.02 - 56.10\ AWPM + 30.07\ AWPS = 5.33\ CAUNIT$$

t – value	- 1.43	1.92	10.86
elasticity	- 0.32	0.48	0.87

$R^2 = 0.96$ F-value = 50.72 DW = 2.53

where,

OFFMM = overall quantity of maize in the Philippines used for feeds at time t, in pesos per metric ton,

$AWPM_t$ = wholesale price of soyabean at time t, in pesos per metric ton,

$AWPS_t$ = wholesale price of soyabean at time t, in pesos per metric ton adjusted to the general price level, and

$CAUNIT_t$ = animal unit of the commercial production of hogs, broilers and laying chickens.

All regression coefficients from the derived demand model appear to be reasonable, having the right signs and significant t-values. About 96 per cent of the variance in the aggregate feed demand for maize is explained by the specified variables. There appears to be no problem on multicollinearity in the model based on the Durbin-Watson statistic.

Among the explanatory variables, $CAUNIT_t$ turns out to have the highest t-value of 10.86 which is statistically significant at a 99.5 per cent confidence level. Elasticity-wise, a 10 per cent increase in $CAUNIT_{tt}$ is expected to increase the aggregate feed demand for maize by 8.7 per cent. Likewise, the deflated aver wholesale price of soyabean (AWPSt), a proxy for the market price of high-protein feed meal, is statistically significant at a 95 per cent confidence level and with a cross price elasticity of 0.48. This reconfirms that high-protein meal is a major substitute for maize. The overall feed consumption of maize is affected by the deflated average wholesale price of yellow maize ($AWPM_t$), with an estimated elasticity of 0.32 which is statistically significant at a 90 per cent confidence level.

Nasol (1982) fitted a linear demand function for maize used as feed to data from 1957 to 1978 and obtained the following results:

$$Q_{mt} = -1\,11.\,13 - 310.82RP_{ym} + 75.73RP_{ho} + 13.79RP_{ch} + 0.11N_{ho} + {}_{Ch}$$

t-value	-1.09	1.88	0.86	1.40
elasticity	0.67	0.16	0.03	0.54

$R^2 = 0.91$ F-value = 40.85

where;

Q_{mt} = annual quantity of maize demanded for feed in thousand metric tons,
RP_{ym} = annual average retail ˉprice of yellow maize 1n pesos per kilogram,
RP_{ho} = annual average retail price of pork (pure meat) inpesos per kilogram,
RP_{ch} = annual average retail price of chicken ("dumalaga") in pesos per head of 1.2 kilograms, and
N_{ho+ch} = annual population of hogs and chickens in thousand animal units.

Ninety-one per cent of the variation in the quantity of maize demanded for livestock consumption is accounted for by variations in the retail prices of yellow maize, pork (pure meat) and chicken, and the population of hogs and chickens in the country. Elasticity-wise, only the retail price of pork is statistically significant, although allˉ the coefficients carry the expected signs.

Bondad (1982) fitted a linear regression model to 1969/70 to 1979/80 data and obtained the following results:

MFEED = 233.57 - 643.12MPWHYD + 3.50GLPU + 91.55PLWD

standard error	230.13	0.33	58.35
elasticity	-0.50	0.82	0.42

$R^2 = 0.98$ DW = 2.25

where,
MFEED = feed demand of maize
MPWHYD = maize price, wholesale, yellow, deflated,
CLPU = livestock population units, and
PLWD = price of livestock, wholesale, deflated.

The equation has a good fit and reasonable elasticities. The elasticities suggest that if the price of maize is increased by 10 per cent, demand for feed will decrease by S per cent. Similarly, if livestock production units (CLPU) or the price of livestock (PLWD) are increased by 10 per cent, the feed demand will increase by 8.2 per cent and 4.2 per cent, respectively.

The IAPMP study on the demand for maize as feed (DL) depends mainly on the animal units to be fed (AUC), the price of maize (PM) and the price of livestock (PL), mainly hogs and poultry, showing that the number of the grain-consuming livestock is the major demand shifter. Moreover, the prices of maize and livestock also influence the rate of feeding as shown by the results below:

DL = 131.14 + 0.0035AUC + 117.33PL - 653.6PM

t-value	5.43	1.15	2.55
elasticity [1]	.80	.54	-.50
	$R^2 = 0.98$	DW = 2.17	

DL = 4.98 + 4.44AUC - 329.3PC + 208.34PSM

t-value	18.3	1.41	2.64
elasticity [1]	1.03	-.21	1.68
	$R^2 = 0.99$	DW = 2.80	

The estimated elasticities suggest that a 10 per cent increase in the number of commercial animal units wil1 Increase the maize demand for feed by 8 to 10 per cent. Likewise, an increase of 10 per cent in the price of livestock will increase the feeding rate of maize by 5.4 per cent. Meanwhile, the price of maize has elasticities of -0.21 to -0.50, which suggests that as the price of maize increases, the feeding rate will decline.

The coefficient of the price of soyabean meal (PSM) in the second equation has the right sign, but the elasticity appears quite large. This indicates that soyabean meal is a good substitute for maize in the Philippine feed industry.

Industrial Demand

Industrial demand for maize is considered as a derived demand. Since maize is manufactured mainly as corn starch, the maize demand for industrial uses is basically influenced by the developments in the starch manufacturing sector. Thus, the industrial demand for maize is a function of the price of corn starch, the prices of other major starch sources, and income.

Price series of corn starch are not available ; thus the price of maize is taken as its proxy. The price of cassava represents the prices of other major starch sources. Using the above relationship, Bondad (1982) obtained the following results:

MMANF = -66.21 - 2.83MPFMWD + 85.84CASWR + 2.73DI - 18.27D71

t-value	54.19	20.90	117.90	0.44	0.20
elasticity		- 0.20	0.26	1.54	
	R2 = 0.97		DW = 2.90		

where:

MMANF	=	manufacture demand for maize in thousand metric tons,
MPFMWD	=	maize farm price, white, deflated, calendar year, pesos per kilogram,
CASWR	=	cassava wholesale price, deflated, pesos per kilogram,
DI	=	personal disposable income, deflated, billion pesos, and
D71	=	dummy variable; 1 for 197 1 , and 0, otherwise.

The variables explain 97 per cent of the total variation in maize demand for starch manufacturing. The price elasticity of demand of -0.20 implies that the maize price did not have much effect on the demand for corn starch. The cross price elasticity of 0.26 with cassava means that a 10 per cent increase in the price of cassava will increase the use of maize in starch manufacturing by 2.6 per cent. Increases in real disposable income have a strong positive influence on the demand for corn starch manufacturing.

Seed Use Demand

Seed use is considered as another element of the total maize demand. For the purposes of estimates and projections, IAPMP (1981) expresses seed use as a function of maize hectarage. Surveys on maize utilization show that, on the average, farmers use a seeding rate of 16.24 kilograms of maize seeds per hectare. Thus, total seed use of maize (MS) is expressed as a simple function of maize hectarage (HM):

$$MS = 16.24 \text{ kgs. } (HM_t)$$

With the advent of disease-resistant and high-yielding varieties of maize in 1979, the seeding rate was increased to 20.0 kilograms per hectare.

Import Demand

The government largely determines the amount of maize imports based on the underlying developments in the feed-livestock sector and on world price-supply conditions. Hence, the utility and reliability of ¯estimating the equations far imports are greatly influenced by institutional and administrative controls.

However, IAMP (1981) findings show that the quantity of maize imports is reasonably related to the domestic price of maize, and the ration of Philippine maize production to the use of maize for livestock feed. An increase of 10 per cent in the domestic price of maize (adjusted for inflation) would tend to increase the imports (which are usually relatively small) by as much as 50 per cent. Similarly, as the ration of maize production relative to feed use increases by around 10 per cent, imports may be reduced by as much as 35 to 40 per cent. Obviously, the world availability and the prices of maize also influence decisions on how much to import.

Stock Demand

The maize stock demand relationship relates and-of-year stock (S t +1) to the production level (QM_t), the domestic use (DU_t), and the price of maize (PM_t). Empirical results using linear relationship are:

$$S_{t+1} = -296.2 + 0.381QM_t - 0.315DU_t + 579.79PM_t$$

t-value	3.13	2.67	2.77
elasticity	4.89	-4.22	1.81

$R^2 = 0.76$ DW = 2.7

The above relationship is oversimplified, but the results are logical. The explanation of the positive QM_t and negative DU_t is straightforward; an increase in maize production would increase the and-of-year stock, and an increase in the domestic use of maize would deplete the stock. The positive PM_t suggests that an increase in the price of maize (deflated for inflation) would encourage farmers to expand production, and thus increase the stock.

For the appraisal of the current maize demand, the maize stock is readily determined through regular monthly surveys conducted by the Bureau of Agricultural Economics (BAEcon) and the National Food Authority (NFA). The surveys divide the stock into household, commercial and government categories.

Summary of Demand Elasticities

Table 1 summarizes the total and per capita maize food demand elesticities estimated by different studies. Except for Ferrer's linear equation and Nasol's estimated positive income elasticity, the income elasticity estimates of the other studies range from -0.20 to -0.34, indicating that maize is an inferior good.

The own price elasticity estimates of IAPMP and Mababeya range from -0.16 to 0.40, showing that maize has an inelastic demand.

Except for Bondad's estimate, cross price elasticity estimates with the rice price range from 0.21 to 0.69, and with the wheat price, 0.39. The results confirm that rice and wheat good are food substitutes for maize.

Table 1. Comparison of Estimated Elasticities on Food Demand for Maize, Philippines

Author	Income Elasticity	Own Price Elasticity	Cross Price Elasticity*
Total Demand			
Bonded (1982)	-0.32	-1.52	1.24
Ferrer (1977)	0.04 to -0.34	-0.10 to -1.47	
IAPMP (1981)		-0.16	0.59
Mababaya (1980)	-0.32	-0.22	0.39
Nasol (1982)	0.30 to 0.91	-0.27 to -0.58	
Per Capita Demand			
Ferrer (1977)	-0.3to-1.12	-1.15to-1.35	
IAPMP (1981)	-0.20	-0.40	0.30
Nasol (1982)	0.01 to 0.86	-0.08 to -0.45	0.31 to 0.46

* With rice as a substitute good, except for Mababaya who used wheat.

Table 2 summarizes the estimated elasticities on the feed demand for maize. Livestock population is the main shifter for the total feed demand, with elasticities ranging from 0.54 to 1.03. The maize demand for feed is inelastic with elasticities ranging from -0.21 to -0.67.

The cross price elasticities of the maize feed demand with the prices of livestock and soyabean are 0.42 to 0.54 and 0.48, respectively. The cross price elasticity estimates of Nasol for the chicken price (0.03) and hog price (0.16) appear too low, while the IAPMP cross price elasticity estimate of 1.68 for soyabean-real price appears too high.

Table 2. Comparison of Estimated Elasticities on Feed Demand for Maize, Philippines

Author	Livestock Population Elasticity	Own Price Elasticity	Cross Price Elasticity*
Bondad (1982)	0.82	-0.50	0.42 (w/1)
IAPMP (1981)	0.80 to 1.03	-0.21 to -0.50	0.54 (w/1); 1.68 (w/sm)
Mababaya (1980)	0.87	-0.32	0.48 (w/s)
Nasol (1982)	0.54	-0.67	0.03 (w/c); 0.16 (w/h)

* w/1 = with livestock; w/c = with chicken; w/h = with hog; w/s = with soyabean; and w/sm = with soyabean meal.

DATA REQUIREMENTS

Studies on maize demand rely both on time-series and cross-section data. Time series data are usually secondary In nature, and are gathered from the compilations of different government agencies and private firms. On the other hand, cross-section data on household consumption are gathered from the primary surveys conducted by the Special Studies Division of the Ministry of Agriculture and Food, and the National Food Authority.

Sources of Data

Statistics on maize production, area and yield, poultry and livestock inventories, and prices were taken from the Bureau of Agricultural Economics (BAEcon). The data on population, consumer price index and national income were obtained from the National Census and Statistics Office (NCSO), and the National Economic Development Authority (NEDA). Data on maize imports were taken from the National Food Authority (NFA). The maize supply-utilization data of the Policy Analysis Staff (PAS) of BAEcon also provided useful information needed for the analysis of maize demand.

The transformations of some variables were done to derive other variables specified in the different demand relationships. For example, deflated prices and real income were obtained by dividing the current prices and income by the consumer price index, using 1972 as the base year. For per capita consumption and per capita disposable income, the aggregate data were divided by the total population. The commercial animal units, used as an independent variable in the feed demand models, were computed by adding up the year-end inventory and the slaughtered head of poultry and livestock, and the totals were then converted into their respective live-weight equivalents.

Sampling Procedures

For food consumption surveys, the sampling procedure is performed in two stews. The first stage begins with the distribution of the predetermined number of samples among the 12 regions. The samples are proportionately allocated to the regions based on the population density according to the 1970 Census of Population. In each region, a map is used to ensure a wide distribution of the samples. This procedure and the selection of the provinces, municipalities and cities is done at the Central Office.

The second stage involves the selection of sample households in the predetermined areas. This process is done by the interviewer with the help of a local official in the sample area. The sample barrio/barangay includes one group of households each to the north, east, south and west directions of a chosen landmark, and one group of households from the center of the municipality or city. Thus, a total of five barrios/baragays, or a "poblacion", in every municipality or city are surveyed. In addition, a distance of 5 to 10 kilometers is required for a barrio/baranqay outside the poblacion to qualify as a sample area. In each barrio/barangay, the predetermined number of sample households are selected at random from a list of bonafide residents.

Collection of Data

The main source of cross-sectional data on food consumption is the regular quarterly surveys conducted by the Special Studies Division (SSD) and the National Food Authority (NFA) during the months of March, June, September and December of each year (Santos, 1983). All surveys are nationwide in scope with all the 12 regions of the country represented each time. Each survey covers approximately 1000 household samples which are randomly selected, stratified by region, sub-region and jurisdictional units (cities and municipalities). The surveys are carried out using the personal interview-recall method. The basic information collected includes quantity, source and total value of all food eaten by the household during the 7 days immediately prior to the interview date. Socio-economic information about the household, such as income, size and composition, age of wife, occupation and highest educational attainment of the principal wage-corner, are also gathered.

From 1973 to 1976, the surveys were conducted solely by the SSD-MA and concentrated on the densely populated areas. Random sample households were selected in the chosen survey areas. Results were reported on national, regional and income group bases.

Since 1977, the food consumption surveys have been jointly conducted by the SSD-MAF and the Grains Economic Division of the National Food Authority (GED-NFA). The project has maintained the same survey months, but in three of the four annual surveys, the sample is 1,000 households, while one survey has 10,000 households. The large sample survey is rotated among the four quarters for each year to track the seasonal variations.

The joint survey has utilized a list of predetermined samples concentrated in the rural areas of the country. Survey results have been reported on by six strata, or major economic groups, such as palay and maize farmers, fishermen, manufacturers, other agricultural groups, and other activity groups. Moreover, provincial groups were extended from 10 to 12 regions.

Limitations of Data

Similar to most sample surveys utilizing the recall-method, the SSD-MAF survey suffers from biases due to memory failure. The derived price data from the survey may have some degree of inaccuracy since it is computed by dividing food expenditures by the quantity consumed for the week prior to the interview. Some problems in recalling the total food expenditures for the entire previous week, the income, and the amount of food consumed, may have been encountered.

One problem encountered in the data analysis was in handling sample observations with zero-level consumption. If the zero consumption was reported by households who did not purchase a commodity because of 3 low income, it might be necessary to include, the observation in the analysis. However, when the zero consumption was caused by a qualitative factor other than income, such as religious or racial group affiliation, the data maybe grouped on the basis of the qualitative factor and the non-consumption groups may be excluded from the analysis. In some cases, zero consumption may be caused by the nonavailability of the commodity during the survey period.

In most cases, a smell arbitrary value is used in place of the zero observations. Despite the advantage of simplicity, this procedure introduces a certain amount of bias in the results which were found to be highly sensitive to the exact values substituted for the zero responses. Some suggest the total exclusion of all zero observations from the analysis, while others propose the use of average values from households reporting non-zero consumption and prices (Santos, 1983).

An additional limiting factor to the usefulness of the data is the small size of the sample collected for some of the quarterly surveys. The large survey of 10,000 households is expected to correct this problem, although it is more likely to create other statistical problems. Despite these limitations, the SSD-MAF survey is considered important because it provides the most recent and comprehensive study of household food consumption in the country, in addition to being the only quarterly food consumption survey.

Another problem encountered in time-series data is the nonavilability of data in certain years. This is salved by estimating the necessary data after computing for the growth rates. Thus, concerned agencies are encouraged to improve their data systems to provide researchers with concrete and complete data to minimize or avoid waste of time and effort (Nasol, 1982).

Finally, data series on the inter-/intra-regional flow of maize are not available. Moreover, there is no data on livestock and poultry supply-utilization which can be used to determine the number of animal units.

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Appendix Table 1. Maize : Supply-use, Area, Yield and Related Data, Philippines, Crop Years, 1970/ 71 – 1982/ 83

	1970/ 71	1971/ 72	1972/ 73	1973/ 74	1974/ 75	1975/ 76	1976/ 77	1977/ 78	1978/ 79	1979/ 80	1980/ 81	1981/ 82	1982/ 83
Supply-Use, 000 mt.													
Beginning Stocks	120	148	241	96	257	243	153	154	153	21.4	148	175	172
Production	2012	2024	1843	2258	2514	2717	2775	2796	3090	3123	3110	3290	3126
Imports	31	193	90	91	159	54	160	134	56	93	351	275	406
Total Supply	2163	2365	2174	2445	2930	3014	3088	3084	3299	3480	3609	3740	3704
Food Use, Total	1253	1257	1267	1317	1709	1822	1646	1559	1560	1536	1536	1544	1479
Per capita, kg	33.5	32.7	32.1	32.4	41.0	42.5	37.4	34.5	33.6	32.8	31.5	30.9	28.9
Feed and Waste	671	754	684	738	832	884	1123	1202	1288	1573	1687	1802	1893
Seed	39	40	38	43	49	52	53	51	65	64	65	67	63
Manufacture	52	73	89	90	97	103	112	119	122	136	146	155	165
Total Domestic Use	1920	2124	2078	2188	2687	2861	2934	2931	3035	3332	3434	3568	3600
Carryover Stock	148	241	96	257	243	153	154	153	264	148	175	172	104
Population, million													
Person	37.4	38.4	39.5	40.6	41.7	42.8	44.0	45.2	46.4	47.7	48.9	50.1	51.3
Area, 000 has.	2428	2454	2351	2726	3010	3193	3243	3158	3252	3201	3239	3361	3157
Yield, mt./ha.	.83	.82	.78	.83	.84	.85	.86	.89	.95	.98	.96	.98	.99
World Prices, $/mt.	64	52	72	116	133	119	110	100	106	119	144	116	115

Source : Policy Analysis Staff (PAS) of the Bureau of Agricultural Economic (BAEcon).

Appendix Table 2. White & Yellow Maize: Farm, Wholesale and Retail Prices, the Philippines, 1969 – 1983/ 84

	WHITE	MAIZE,	GRAIN	YELLOW	MAIZE,	GRAIN	WHITE MAIZE MILLED		YELLOW MAIZE MILLED	
	Farm	Whole-sale	Retail	Farm	Whole-sale	Retail	Wholesale	Retail	Wholesale	Retail
				- P/ kg.-						
1969/ 70	0.26	0.32	0.42	0.28	0.35	0.44	0.42	0.50	0.41	0.48
1970/ 71	0.38	0.49	0.66	0.39	0.52	0.64	0.68	0.76	0.62	0.68
1971/ 72	0.53	0.62	0.84	0.57	0.69	0.82	0.88	0.99	0.77	0.90
1972/ 73	0.45	0.52	0.78	0.46	0.62	0.79	0.74	0.88	0.71	0.86
1973/ 74	0.76	0.76	1.11	0.78	0.91	1.14	1.15	1.23	1.04	1.22
1974/ 75	0.97	0.96	1.36	0.96	1.16	1.44	1.28	1.48	1.31	1.48
1975/ 76	0.93	0.90	1.30	0.91	1.09	1.39	1.29	1.45	1.27	1.48
1976/ 77	1.00	1.02	1.40	0.98	1.21	1.48	1.46	1.58	1.39	1.59
1977/ 78	1.01	1.02	1.44	1.00	1.23	1.49	1.43	1.59	1.45	1.59
1978/ 79	0.95	0.98	1.40	0.97	1.18	1.52	1.37	1.59	1.40	1.62
1979/ 80	1.00	1.09	1.53	1.08	1.27	1.70	1.51	1.70	1.50	1.74
1980/ 81	1.13	1.33	1.82	1.24	1.54	1.96	1.80	2.00	1.79	1.07
1981/ 82	1.22	1.38	2.09	1.33	1.61	2.19	1.96	2.20	2.03	2.29
1982/ 83	1.28	1.45	2.12	1.34	1.72	2.25	2.03	2.24	2.06	2.47
1983/ 84	1.66	2.00	2.63	1.73	2.21	2.74	2.56	2.67	2.58	2.97

Source : Policy Analysis Staff (PAS) of the Bureau of Agricultural Economics (BAEcon).

Appendix Table 3. General Features of Different Maize Demand Studies, the Philippines

STUDY	YEAR COVERED	TYPE AND SOURCE OF DATA USED
Bondad, 1982	1969/70-1979/80	Supply-use table (IAPMP), prices (BAEcon), support and ceiling prices (NFA), and income, population, consumer price index (NCSO)
IAPMP, 1981	1969/70-1979/90	Basically the same as above
Mababaya, 1980	1969/70-1978/79	Basically the same as above
Ferrer, 1977	1971-1973 May-June 1971	Consumption surveys (SSD/MA-NFAC) Surveys were conducted quarterly with a total sample of 4,000 families, which was reduced to 3,775 observations in the process of editing; sample size of 1,000 families in each surveys were proportionately distributed throughout the country by region; observations range from 219 in a region with a small population to 835 in a heavily populated area; country was divided into to regions as follows: 4 from Luzon - Northern, Central, Southern, Bicol 3 from Visayas - Eastern, Central, Western 3 from Mindanao - North and East, South and East and South and West
Nasol, 1982	1957-1978	Prices of corn and rice (BAEcon); retail price of pork, chicken and beef (Dept. of Econ. Research, CB); income, population, and population of hogs and chicken (NEDA)

Appendix Table 4a. Estimated Elasticities of Demand per Capita for Maize Used as Food, Philippines, 1957- 1978

Variable	Equation	Intercept	RP_{WC}	RPr	DRP_{WC}	DRP_1	CRY	CY	R^2	F-value
Linear										
CQ	(1)	12,62					0.01*		0.41	13.76*
							(3.71)√a			
elasticity							0.45*			
								0.01*	0.45	5.00*
	(2)	20.12	-17.13*	6.10*				(2.02)		
			(-1.95)	(2.03)				0.01*		
elasticity			-0.45*	0.31						
	(3)	18.33			-14.58	8.01*		0.004*	0.94	4.65*
					(-1.69)	(1.88)		(3.05)		
elasticity					-0.39	0.46*		0.17*		
			LN RP	LN RP			LN CRY	LN CY		
Double-log √b										
LNCQ	(4)	-0.35					0.51		0.44	15.61*
							(3.95)			
	(5)	-2.89	-0.08				0.86		0.47	8.40*
			(1.05)				(2.38)			
	(6)	0.96	-0.37*	0.25				0.29*	0.47	5.31*
			(-0.81)	(1.29)				(1.91)		

Source : Nasol, 1982.

* Significant at 10% level.

√a Figures in parentheses are t-value.

√b For the logarithmic equations, the regression coefficients are elasticities themselves.

Appendix Table 4b. Estimated Elasticities of Aggregate Demand for Maize used as Food, Philippines, 1957 - 1978

Variable	Equation	Inter-cept	PR_{WC}	RP_r	DRP_{WC}	DRP_r	CY	Y	RY	N	R^2	F-value
Linear												
CQ	(1)	513.73	-716.82*	400.90*				0.01*			0.84	32.28*
			(-1.99) √b	(2.84)				(2.69)				
elasticity			-0.58*	0.59*				0.48*				
	(2)	-299.09								0.03*	0.88	153.04*
elasticity										(12.37)		
	(3)	-197.06	-560.72	168.38						1.23*		
			(1.67)	(1.30)			0.24			0.03*	0.90	39.08*
			.0.42	0.25			(1.71)			(3.17)		
elasticity							0.30			1.23*		
Logarithmic √b												
CQ	(4)	-1.60							0.79*		0.91	206.62*
									(14.37)			
	(5)	0.98	-0.53*	0.34				0.52*			0.90	52.27*
			(-2.61)	(1.60)				(4.09)				
	(6)	3.59						0.30*			0.86	120.92*
								(10.99)				
	(7)	2.39			-0.46*	0.44*		0.39*			0.89	48.06*
					(-1.96)	(2.12)		(7.53)				
	(8)	-7.75								1.38*	0.90	190.29*
										(3.20)		
	(9)	-3.02			-0.27	0.21			0.91*		0.92	72.33*
					(1.57)	(1.33)			(9.50)			

Source : Nasol, 1982. √a Figures in parentheses are t-values

* Significant at 10% level. √b For the logarithmic equations, the regression coefficients are elasticities themselves.

Appendix Table 5a. Estimated Elasticities of Demand for Maize and Maize Products used as Food, Philippines, 1971 to 1973 √a

variable	Equation	Intercept	HE	HY		CCPPP	R^2	SEE
CCP	Linear	5.52	-0.76	-0.00006		- 0.78	0.11	8.85
			(0.09) √b	(0.00002)		(0.11)		
elasticity			0.56	0.04		- 0.10		
			LN HS	LN HY	Y	LN CCPP		
LN CCP	Double-log	7.26	0.67	- 0.24		- 1.36	0.42	1.19
			(0.08)	(0.04)		(0.05)		
LN CCP	Log-Inverse	1.09	0.58		207.95	- 1.39	0.41	1.21
			(0.08)		(44.25)	(0.05)		
LN CCP	Log-log Inverse	9.02	0.67	-0.26	-41.24	- 1.36	0.42	1.19
			(0.08)	(0.05)	(66.53)	(0.05)		

Source: Ferrer, 1977.

√a Using quarterly aggregate data for three consecutive years.

√b Figures in parentheses are t-values.

Appendix Table 5b. Estimated Elasticities of Demand for Maize and Maize Products Used as Food, Philippines

Variable	Equation √b	Inter-cept	LN FS	LN TY	LN Y/P	LN CCP	SEE	R^2
Per Capita Demand, LN CCP	(1)	- 0.24						
					-1.12	-1.28	1.34	.30
LN CCP	(2)	1.10	0.50	-0.14	(0.08) √c	(0.12)		
						-1.29	1.32	.32
			(0.19)	(0.08)		(0.12)		
	(3)	-1.02			-0.24	-1.16		
					(0.67)	(0.89)	1.16	.41
	(4)	2.40	0.63	-0.27		-1.15		
			(0.15)	(0.07)		(0.09)	1.14	.42
	(5)	0.93			-0.20	-1.35		
					(0.06)	(0.11)	1.06	.38
	(6)	1.26	1.10	-0.21		-1.35		
			(0.16)	(0.06)		(0.11)	1.06	.43
Aggregate Demand	(7)	0.96			-0.02	1.13	1.37	.26
					(0.11)	(0.16)		
LN CCP	(8)	0.32	0.35	-0.02		-1.1 1	1.37	.27
			(0.28)	(0.11)		(0.16)		
	(9)	3.57			-0.34	-1.03	1.09	.42
					(0.10)	(0.11)		
	(10)	3.08	0.48	-0.31		-1.04	1.09	.42
			(0.21)	(0.11)		(0.11)		
	(11)	2.32			(0.12	-1.53	1.08	.42
					(0.08)	(0.16)		
	(12)	0.63	0.95	-0.10		-1.47	1.02	.48
			(0.21)	(0.08)		(0.15)		

Source: Ferrer, 1977. √a Using yearly disaggregated data. √b All are logarithmic equations: thus,the regression coefficients are elasticities themselves.
√c Figures in parentheses are t-values

METHODOLOGICAL EXPERIENCES IN ANALYZING AND ASSESSING THE DEMAND FOR SOYABEAN IN THAILAND*

Introduction

Although soyabeans constitute a small part of the national agricultural output (less than one per cent of the total value of production) the crop has come under considerable scrutiny by the Thai Government. In recent years, the consumer demand has increased to the point where substantial amounts of foreign exchange are used to import the commodity. This will continue unless some means are devised to encourage domestic production.

Production and Utilization of Soyabeans

Total soyabean production has increased in Thailand over the past two decades. However, the increase is mainly the result of an increase in land area rather than an increase in yield per hectare (Table 1). The crop is still confined mainly to the north, with 50 per cent of the production concentrated in Chiang Mai and sukhothai provinces.

The supply expansion was accompanied by an icrease in the domestic and export demands for Thai soyabeans. The increased demand was due primarily to (1) the growth in population, (2) an increase in per capita income, and (3) an increase in the uses of soyabeans in mixed and packaged foods.

Soyabeans are consumed in a wide variety of foods, feed ans industrial products (Figure 1). Domestically produced soyabeans, however, are processed almost entirely for oil and food. The crude oil component is extracted and the remaining material is processed inyo soyabean oil meal and used as animal feed. Soyabean oil is utilized in cooking, margarine, soap, canned milk compounds, and other miscellaneous products. The major food items made from soyabeand are soyabean sauce, soyabean curd (or tofu), fermented soyabeans (to-chiew, or soyabean paste), soyabean milk, noodles, baby food, and other high protein products. In the northern region, soyabeans are also used in products such as coffee, rice cakes, and chili paste.

Supply, Demand, and Marketing Considerations

Marketing Channels

Figure 2 shows the marketing channels for soyabeans in Thailand. The major movements are from farmers to local assemblers and interior dealers, and then to processors and exporters. The three types of markets are classified as local, central, and terminal. In the local markets, farmers sell their soyabeans to local assemblers. Local assemblers in turn sell the soyabeans to wholesalers in central markets. The central markets are located in the large towns and the capitals of the provinces. The central markets perform the marketing functions of assemblage and storage for short time periods.

Bangkok is the major terminal market for soyabeans in Thailand. Wholesalers, located in the central markets, sell most of their soyabean purchases to other wholesalers and brokers in the terminal market. The soyabeans are then moved from wholesalers and brokers to processors, and finally through various retail channels and exporters to Thai consumers or foreign buyers.

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* Prepared by Dr. Chumnarn Sirirugsa, Senior Economist, Division of Agricultural Economic Research, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives. Bangkok.

Table 1. Soyabean Production, Planted Area, and Yield (per rai)

Crop year	Production (1.000 tons)	Planted area (1.000 rai)	Yield/rai (kgs/rai)	Farm price (8/kg)
1973/74	104.2	756	136	3.41
1974/75	110.4	823	134	3.99
1975/76	113.9	738	154	4.16
1976/77	113.6	635	179	4.70
1977/78	96.3	958	101	5.61
1978/79	158.9	1,010	157	5.39
1979/80	102.1	679	150	5.26
1980/81	100.0	788	127	5.78
1981/82	131.5	797	165	6.81
1982/83	113.4	778	146	6.02
1983/84*	172.0	990	174	5.93

Source: Centre for Agricultural Statistics, Office of Agricultural Economics, Ministry of Agriculture and Co-operative, Bangkok, Thailand

*) Projection by the Centre for Agricultural Statistics, OAE

Table 2. Actual and Target Production Levels in the Thailand National Economic and Social Development Plans, 1969-1981.

Year	Production Targets Amount (Tons)	Actual Production Amount (Tons)	Percent of Targets
1973/74	159,500	104,200	65.33
1974175	199,000	110,400	55.55
1975/76	248,000	113,900	45.93
1976/77	300,000	113,600	37.88
1977/78	310,000	96,300	31.06
1978/79	327,100	158,900	48.58
1979/80	351,000	102,100	29.08
1980/81	387,700	100,000	25.79
1981/82	431,200	131,500	30.50
1982/83	200,000	113,400	56.67
1983/84	240,000	172,000	71.67
1984/85	300,000	-	
1985/86	350,000	-	
1986/87	390,000	-	

Sources: 1) Production target data was obtained from the Office of Prime Minister, Bangkok, Thailand. 2) Actual production data was obtained from the Office of Agricultural Economics, Ministry of Agriculture and Co-operatives, Bangkok, Thailand.

Note: - equals no data.

Supply Considerations

The Thai government has included a soyabean acceleration programme in the National Economic and Social Development Plan. In 1977, the first year of the Fourth National Economic and Social Development Plan, the government created a national committee to develop soyabean production and sales. A production target of 431,200 metric tons of soyabeans in 1981 was established (Table 2).

The quantity of soyabeans harvested since 1974 has not reached the national targets. For example, a goal of 310,000 metric tons of soyabeans was set for 1977. Thai farmers produced only 96,300 metric tons of soyabeans in 1977. The production levels have been below the national targets because: 1) low yields have resulted from the lack of technological breakthroughs; 2) soyabean production is partially dependent upon precipitation instead of irrigation; and 3) the low farm prices for soyabeans may have dampened the supply response.

Thai policy makers and planners have typically attributed the expansion of soyabean production in Thailand to: 1) new land brought into production; 2) intensification of land use by shifts to multiple cropping as a result of public investment in drainage and irrigation; and 3) the introduction of new soyabean varieties. The above list of contributing factors is only partial. It contains only technical considerations without recognizing economic forces. Thai soyabean farmers' decisions to expand soyabean production are partly due to more traditional economic factors, i.e., the prices of soyabeans, the prices of substitute crops, the prices of fertilizer, and weather patterns (rainfall). An improved knowledge of the soyabean supply response in Thailand as it relates to both economic and non-economic forces is necessary for the formulation and implementation of effective production and marketing policies by the Thai government. Such information would aid extension specialists, processing firms, and marketing firms who want to predict the timing and magnitude of soyabean supplies and prices.

Demand Considerations

The demand for soyabeans can be satisfied by domestic demand, exports, and imports. The domestic demand for soyabeans includes the demand for soyabean oil, soyabean cake, and soyabean foods and products. The relationship between the farm prices for soyabeans and the prices for soyabean oil are an important consideration for the agricultural policies of Thailand. There are the competing objectives of increasing farm income versus protecting Thai consumers from the high prices of meat, egg, beef, pork and poultry.

Most of the domestic utilization of soyabeans is in the form of soya sauce, soyabean curd, and soyabean milk. The demand for these food items has been increasing. The promotion of their consumption by food scientists in Thailand appears to be having an impact. Soyabeans are high in protein and are a good substitute for meat. Consequently, it is worth investigating the demand and supply structures for soyabeans, the prices of soyabeans which affect the demand and supply, and the impacts that arise from changes in major demand shifters, such as population, income, and the prices of substitutes.

Exports

The amount and value of Thai soyabean exports fluctuates from year to year (Table 3). Exports are usually less than 10 per cent of the total production. The level of exports can be attributed to two main factors: (1) the level of production and prices, and (2) government regulations of exports.

Thai soyabeans have been exported on a regular basis to Malaysia, Singapore, Hong Kong, and Saba. Malaysia has been the largest importer of Thai soyabeans during the last two decades. The percentage or relative share of Thai soyabean exports to these regular market outlets has fluctuated from four to sixty-five per cent of the total exports. Other occasional foreign markets include Japan, Taiwan, the Philippines, France, and Laos.

Figure 1. Soyabean Utilization in Thailand.

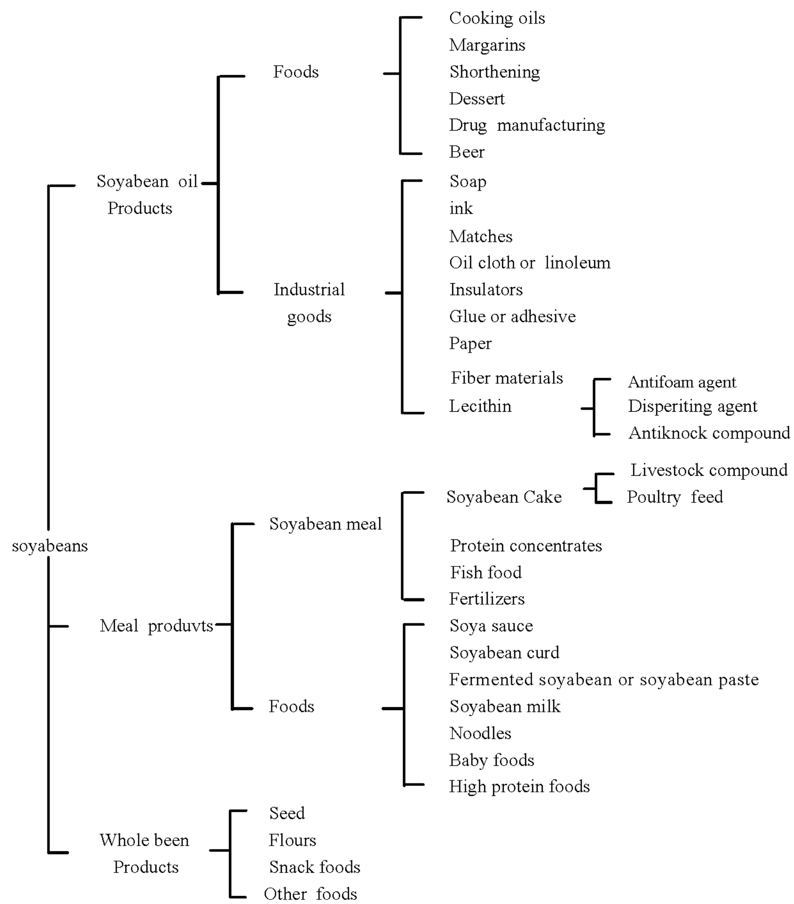
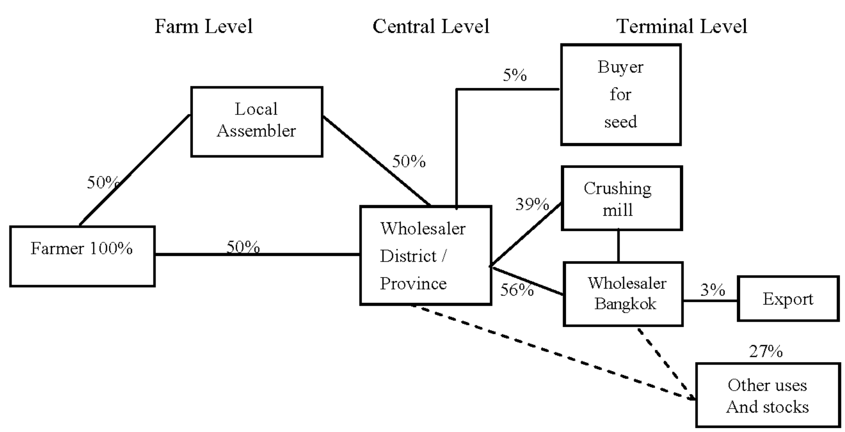


Figure 2. Marketing Channels for Soyabeans in Thailand, 1978-1983



Imports

The imports of oil and soyabean cake have been increasing. Only 2,680 tons of soyabean cake were imported in 1974, while 53,559 tons were imported in 1977 (Table 4). The volume of soyabean oil imports has also increased significantly. In 1973, only 257 tons of soyabean oil were imported, while in 1983, 18,819 tons were imported. Unless domestic supplies increase fester than demand, it can be expected that imports will be necessary to fill the deficit between Thai consumption and production.

Most of the soyabean cake imported by Thailand was from Burma, Brazil, the United States, India, Japan, and Taiwan. More than half of the soyabean oil imports into Thailand came from the Netherlands. Singapore has been an important source of soyabean oil since 1972, while the amount of oil imported from Denmark, the United States, and Japan has fluctuated from year to year.

Review of Studies Which Analyze and Assess the Demand for Soyabeans in Thailand

I. The first study to be reviewed is entitled "Demand Analysis of Soyabean in Thailand". This study was undertaken in 1981 by Associate Professor Supan Tosuntorn, Associate Professor Dr. Kampal Adulwit and Assistant Professor Pitoon Rojwinit of the Department of Agricultural Economics, Faculty of Economics and Business Administration, Kesetsart University. The main objective of this study was to analyse the trend of demand for soyabeans and to identify some of the factors effecting the demand.

A. frame work of relationships

The authors classified the demand for soyabeans as the domestic demand and the export demand. The domestic demand was further divided into the demand for soyabean by the consumers and the primary processing factories, and the demand for soyabean by the oil crushing mills.

(a) Demand for soyabeans by the consumer and the primary processing factories

The demand for soyabean by the consumers and the primary processing factories means the quantity of soyabeans consumed as food and/or used by food processing factories. The quantity of soyabeans used as food by consumers and used by food processing factories was estimated by subtracting the amount of exports and the amount used by the oil crushing mills from the total domestic production plus imports. The demand function was specified as follows:

$$Q_t^d = f(Y_t, P_t)$$

where,

Q_t^d = demand for consumption of soyabeans in year t.

Y_t = per capita income in year t.

P_t = Bangkok wholesale price of soyabean in year t.

(b) Demand for soyabeans by the oil crushing mills

The demand function for soyabeans by oil crushing mills was specified as follows:

$$Q_t^m = f(Prod_t, Pop_t, Y_t, P_t, Rt)$$

Table 3. Amount and Value of Thai Soyabean, Soyabean Cake, and Soyabean Oil Exports, 1973-1983.

Year	Soyabean Exports		Soyabean Cake Exports		Soyabean Oil Exports	
	Tons	1,000 Baht	Tons	1,000 Baht	Liters	1 ,000 Baht
1973	13,715	75,909.61	5,230.33	25,802.42	11,700	147.52
1974	8,612	46,999.55	0.25	2.13	10,500	198.36
1975	24,055	133,760.29	-	-	-	-
1976	8,132	47,633.77	164.97	446.45	-	-
1977	11,506	82,586.09	-	-	-	-
1978	8,098	51,295.00	-	-	-	-
1979	9,715	68,260.00	48.00	329.00	-	-
1980	3,394	27,936.00	100.00	724.00	-	-
1981	2,531	22,570.00	300.00	2,879.00	-	-
1982	1,295	11,400.00	250.00	2,295.00	-	-
1983	1,035	9,272.00	-	-	-	-
1984*	519	4,860.00	-	-	-	-

Source: Department of Customs, Ministry of Finance

* January -July

Table 4. Amount and Value of Soyabeans, Soyabean Cake and Soyabean Oil imports 1973-1984

Year	Soyabeans		Cake		Oil	
	Tons	million Baht	Tons	million Baht	Tons	million Baht
1973	-	-	-	-	257	2.88
1974	-	-	2,681	7.06	242	4.17
1975	2	.01	8,600	31.51	348	5.65
1976	51	.63	9,897	52.90	743	10.31
1977	4,003	25.52	53,559	252.76	1,625	23.23
1978	10,808	59.39	82,357	387.99	1,422	19.42
1979	5	.04	58,563	334.73	3,680	55.40
1980	15,297	100.60	154,782	983.63	13,093	187.17
1981	15	.10	142,997	1,027.58	13,502	183.27
1982	3,227	17.83	203,420	1,027.58	9,609	119.56
1983	39	.03	187,091	1,095.28	18,819	257.67
1984	74	.37	113,496	739.83	23,000	385.55

Source: Department of Customs, Thailand " January-July where,

Q_t^m = soyabeans used by oft crushing mill in year t.
$Prod_t$ = soyabean production in year t.
Pop_t = population in year t.
Y_t = per capita income in year t.
P_t = Bangkok wholesale price of soyabean cake in year t.
R_t = price ratio of soyabean and rice brand.

The demand for soyabean oil by oil crushing mills was specified as follows:

$$Q_t^o = f(Prod_t, P_t^{oi}, P_t^{bl})$$

where,

Q_t^o = demand for oil by oil crushing mill in year t.
P_t = imported price of soyabean oil in year t.
P_t = Bangkok wholesale price of second grade soyabean in year t.

(c) Export demand for soyabean

The export demand for soyabean was specified as follows:

$$Q^E = f(Prod_t, P_t^R)$$

where,
Q^E = soyabean exported in year t.
P^R = ratio of f.o.b. price and wholesale price of soyabean in year t

The data used in this study were time series data (1967-1980).

Results:

For this study, the authors employed the multiple regression techniques to estimate the parameters of the model. The results are shown as the following:

(a) Demand for soyabeans by consumer and primary food processing factories:

Q_t^d = 0.1780 + .0017 Y_t *
R^2 = .84, F = 32

(b) Demand for soyabeans by o11 crushing mills:

Q_t^m = -0.0623 + .00022 Y_t * - 0.146 P_t
R^2 = .61, F = 6

Demand for soyabean oil by oil cushing mills

Q_t^o = 5.6571 - 2.00 P_t + 0.281 $Prod_t$
R^2 = .45, F = 3

(c) Demand for export:

Q^E = 3.4663 + .689 $Prod_t$
R^2 = .24, F = 35

*significant at 95% level

II. The second study to be reviewed is "Modelling the Thai Soyabean Cake Market". This study was done in 1983 by the staff of the office of Agricultural Economics, Ministry of Agriculture and Co-operatives. The main objective of the study was to obtain the import demands for soyabean cake.

The model consists of two sub-models which are the animal feed and the animal industry models. There are 6 endogenous variables in the animal feed model. The six structural equations consist of 5 estimated equations and market-clearing conditions.

The set of structural equations can be summarized as follows:

2.1 import demand for soyabean cake equation
$IFSM_t$ = f ($APMF/ IPSM_t$, PFM_t)

2.2 animal feed production equation
$QSMF_t$ = f ($QFSM_t$, $QFFM_t$)

2.3 feed mill demand of fish meal equation
$QFFM_t$ = f (PEM_t , $IPSM_t$)

2.4 soyabean cake production equation
$DQSM_t$ = f (DQSBt, , $IQSB_t$)

2.5 farm price of soyabean relationship
PSB_t = f ($IPSM_t$, PSBt-1)

2.6 soyabean cake market-clearing equation
$QFSM_t$ = I FSM_t + $FQSM_t$

where,

$IFSM_t$ = imports of soyabean cake in year t.
$APMF_t$ = Bangkok wholesale price of mixed animal feed in year t.
$IPSM_t$ = imported price of soyabean cake in year t.
PFM_t = Bangkok wholesale price of fish meal in year t.
$QSMF_t$ = quantity of mixed feed produced in year t.
$QFSM_t$ = quantity of soyabean cake used by feed mill in year t.

$DOSM_t$ = quantity of soyabe6ns proouced in t.
$IQSB_t$ = imports of soyabeens in t.
PSB_t = farm price of soyabeen in t.
PSB_t = farm price of soyabeen in t -1.

The animal industry model consists of 12 structural equations with 9 estimated equations and 3 market clearing equations. The set of structural equations can be summarized as follows:

2.7 pig production equation
$QSPK_t = f(FDPK_t , INPK_t)$

2.8 chicken production equation
$QSCK_t = f(FDCK_t , INCK_t)$

2.9 demand for pig feed equation
$FDQK_t = f(APMF_t , DFPK_t , INPKt)$

2.10 demand for chicken feed equation
$FDCKt = f(APMF_t , PRCK_t, INCK_t)$

2.11 the beginning stock of pig equation
$FDCK_t = f(APMF_t , PFPK_{t-1})$

2.12 the beginning stock of chicken equation
$FDCK_t = f(APMF_t , PRCK_t, INCK_{t-1})$

2.13 pork consumption equation
$DPK_t = f(PRPK_t , PRCK_t , Y_t)$

2.14 chicken consumption equation
$DCK_t = f(PRCK_t , PRPK_t , Y_t)$

2.15 exports of chicken equation
$EXCK_t = (PECK_t /PRCK_t , T)$

2.16 market clearing of animal feed equation
$QSMF_t = FDPK_t + FDCK_t$

2.17 market clearing pig equation
$QSPK_t = DPK_t$

2.18 market cleraing chicken equation
$QSCK_t = DCK_t + EXCK_t$

where,

$QSPK_t$ = quantity of pigs produced in year t.
$FDPK_t$ = quantity demand for pig feed in year t.
$INPK_t$ = beginning stock of pigs in year t.
$QSCK_t$ = quantity of chicken produced in year t.

$FDCK_t$ = quantity demand fer chicken feed in year t.
$INCK_t$ = beginning stock of chicken In year t.
$APMF_t$ = Bangkok wholesale price of animal feed in year t.
$DFPK_{t-1}$ = pig farm price in year t-1.
$PRCK_t$ = Bangkok retail price of chicken in year t.
$INCK_{t-1}$ = beginning stock of chicken in year t-1:
DPK_t = domestic consumption of pork in year t.
$PRPK_t$ = Bangkok retail price of pork in yeer t.
Y_t = national income in year t.
DCK_t = domestic consumption of chicken in year t.
$EXCK_t$ = exports of chicken in year t.
PEK_t = fob prices of chicken in year t.
T_t = time trend
$QSMF_t$ = quantity of mixed feed produced in year t.

The results of this study can be summarized as follows:

1. imports of soy8be8n cake equation

$$IFSM_t = -218.4600 + \underset{(.643)}{54.2449}\ APMF_t / IPSM_t + \underset{(5.9863)}{27.9996}\ PFM_t$$

$R^2 = .9090$
F -Statistic = 19.9826

2. animal feed production equation

$$QSMF_t = -645.4253 + \underset{(2.7038)}{3.2143}\ QfSM_t + \underset{(2.9370)}{10.1976}\ QFFM_t$$

$R^2 = .9185$
F -Statistic = 11.2690

3. feed mill demand of fish meal equation

$$QFFMt = 64.0320 - \underset{(-1.9999)}{13.6911}\ PFM_t + \underset{(2.6121)}{35.4155}\ IPSM_t$$

$R^2 = .7920$
F-Statistic = 3.8073

4. soyabean cake production equation

$$DQSMt = 55.6589 + \underset{(1010)}{.0110}\ DQSB_t + \underset{(2.3210)}{.9789}\ IQSB_t$$

$R^2 =. 6482$
F -Statistic = 2.7644

5. farm price of soyabean relationship

$$PSB_t = .6309 + \underset{(2.1648)}{.3731}\ IPSM_t + \underset{(2.6767)}{.5514}\ PSB_{t-1}$$

$R_2 = .8576$
F -Statistic = 15.0575

6. pig production equation

$$QSPK_t = 4574.4082 + 1.6068\ FDPK_t + .0253\ INPK_t$$
(10.9222) (1.0817)

$R^2 = .9898$

F -Statistic = 96.9497

7. chicken production equation

$$QSCK_t = 216540.5942 + 275.9803\ PFCK_t + 5.7166\ INCKt$$
(.3991) (1.0545)

$R^2 = .8140$

F-Statistic = 6.5633

8. quantity demand for pig feed

$$FOPK_t = 1168.4551 - 367.7678\ APMF_t + 55.6045\ FDPK_{t-1} + .0080\ INPK_t$$
(- 2.0618) 7570 (.0930)

$R^2 = .8884$

F-Statistic =2.6532

9. demand for pig feed equation

$$FDCK_t = -158.1738 - 27.883\ APMF_t + 13.7894 + PRCK_t + .0053\ INCK_{t-1}$$
(-.7002) (2.0189) (3.4365)

$R_2 = .9526$

F-Statistic = 13.3968

10. the beginning stock of pig equation

$$INPK_t = 406.2484 - 191.7168\ APMF_t + 274.4244\ PFPK_{t-1}$$
(-.1309) (1.5718)

$R_2 = .6169$

F -Statistic = 1.6106

11. the beginning stock of chicken equation

$$INCK_t = 52375.5800 - 13399.7422\ APMF_t - 2750.5942\ PRCK_t + 2.1852\ INCK_{t-1}$$
(-1.6014) (-1.4247) (3.2967)

$R_2 = .9045$

F -Statistic = 6.3154

12. pork. consumption equation

$$DPK_t = 4087.2256 - 93.7152\ PRPK_t + 103.2432\ PRCK_t + 2.5207\ Y\ t$$
(-1.6014) (1.4289) (4.2258)

$R^2 = .9555$

F-Statistic - 21.4678

13. chick.en consumption equation

$$DCK_t = 56030.0626 - 6052.2861\ PRCK_t + 2806.2812\ PRP\sim + 443.7424\ Y\ t$$
. (-3409) (.2067) (2.9447)

$R^2 = .8706$

F –Statistic =13.4548

14. export of chicken equation

$$EXCK_t = 71502.0470 + \underset{(2.9005)}{21966.0352}\ PECKt/PRCK_t + \underset{(9.8677)}{8179.5801}\ T$$

$R^2 = .9458$

F -Statistic = 61.0718

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THE POTENTIAL IMPACTS OF EXPANDED PRODUCTION OF CGPRT CROPS ON RURAL ECONOMY AND WELFARE *

AUTHOR'S NOTE: In introduction to the subject of the potential problems resulting from expanded production, I would like to first quality the situation. I regret to inform the readers than while researching this paper, I could not find any meaningful studies on the subject in Bangladesh. I therefore request the readers to refer as much as possible to the knowledge on this topic which is available in their own countries. Finally, t hope that this paper will encourage further studies on the impacts of expanded production on rural economy and welfare.

The following report on the potential impact of expended production of the CGPRT crops is prepared with the understanding that "production" implies production of CGPRT crops and not. necessarily any other upland crops, and that the impact of any particular crop may vary from country to country depending upon the socio-cultural environment This report also assumes that the expansion of CGPRT crops is technically and economically feasible.

The impact of production expansion of selected crops may be examined from the following angles:

(i) With respect to the producers/ farmers: possible influence on income, and, if income increases, the impact of the additional income with respect to its utilization, i.e. , investment in agriculture, luxury items, improved housing, children's education, better health care, etc.

(ii) With respect to the consumers: increased availability of nutritive food at lower prices, greater consumption of other crops in order to balance the diet, etc.

(iii) With respect to different sectors and subsectors of the economy- feed industry, food processing industry, other relevant industries, international trade, export/ import conditions, etc.

(iv) With respect to overall government policy and planning: price policies, policies on industry, export/import policy, influence on marketing systems, etc.

The following is a summary of the likely impacts of production expansion on the producers and the consumers. Assuming that the production of CGPRT crops is profitable to the farmers at the initial stage of production expansion, farmers will benefit from the additional income generated by the higher productivity, as long as there is an effective demand for the particular crop. At a certain level of production, there will be an impact on the prices for the crop. As the demand decreases, the price will fall, with increased production leading to lower incomes for the farmers, and the consumers will benefit from the lower prices.

In the case of pulse crops, if pulses become available at lower prices due to expanded production, their consumption con be raised and the nutritive value of the diet will be improved, as concluded by Chopra and Gurushri Swamy in their analysis of the demand and supply of pulses in India.

*) Prepared by Ekramul Ahsan. Member-Director. Banglsdesh Agricultural Research Council. Dhaka.

However, the results of expanded production can be quite different, as was experienced in recent times in Bangladesh. The expanded production of potatoes caused a serious glut in the market, particularly due to market imperfections, the lack of proper storage facilities, and the limited utilization of potatoes by the processing industries.

In the case of crops which are usually imported, due to a large demand, the domestic expansion of production can have a direct positive impact on the economy. On the other hand, for export-oriented crops, expanded production might result in a negative impact on the economy, particularly if there is uncertainty in the export market.

For food and feed processing industries which use CGPRT crops as raw materials, expanded production may lead to a reduction in the production costs and stability in the production systems. There should be an effort to minimize the post-harvest losses due to storage and processing, particularly for pulses. In India, the losses due to storage and processing range between 30 and 60 per cent, as reported by Mr. A.P. Shinde in his official study, "New Pulse Technology to Raise Output" (1973).

The expanded production of CGPRT crops will have varied influences on government policies, depending upon the relative status of the particular crop in the economic and socio-cultural environment, and existing government policies.

In countries with growing populations and low per capita expenditures, one of the goals of planners and policticians is to provide wholesome food for the people. In reality, we see in most of the developing countries the inability to provide minimum calories to the people. Hence, efforts have been made to bring about en increase in the production of food crops, particularly cereals. It is equally important that a nutritional balance be maintained in the national diet. Since most of the protein in the diet of the poor comes from vegetables, and since an increase in the production of pulse crops may result in increased consumption at lower prices, it is assumed that expansion of the CGPRT crops can satisfy the nutritive requirements to some extent. On the other hand, a lower price is likely to have a negative impact on the incomes of the farmers and producers, requiring intervention through price policies to protect the farmers' interests.

Ideally, the expanded production will be accompanied by various measures to increase the effective demand The logical measures include improvement in marketing and increased utilization by the feed and food processing industries, as well as increased domestic consumption through manipulation of the food habits. Unless the effective demand is sustained, the production expansion might cause a negative impact on the economy and welfare, and production systems will suffer from instability and insecurity.

PROPOSED RESEARCH PROJECTS ON SELECTED PULSE CROPS IN BANGLADESH*

Research efforts for the improvement of the pulse crops in Bangladesh have been rather negligible until recently compared to the efforts expended on rice and wheat production. Recently, some selected pulse crops have drawn the attention of research leaders and policy makers

The cultivation of pulse crops in Bangladesh is characterized by the diversity of crops and their locational distribution, depending upon the adaptation to specific agro-climatic features. Generally, the pulse crops in Bangladesh suffer from low productivity, due to the low input base associated with farm level socio-economic constraints and the agro-climatic problems of rainfed agriculture.

The farm level constraints may be listed as: 1) lack of market facilities; 2) instability in price levels, and 3) lack of institutional support. The prices of major pulse crops show an increasing trend, but there has not been any corresponding positive trend in productivity. The prices of other crops are also increasing. A comparative economic analysis of production of pulse crops via-a-vis other competitive crops is therefore recommended within the overall framework of a constraints study.

As the rural population of Bangladesh is predominantly poor, the pulse crops receive high priority as the cheapest source of protein. The demand aspect of pulse crops is therefore also recommended for investigation within the general framework of a constraints study, in order to identify the factors influencing the demand for pulse crops.

The pulse crops recommended for the initial phase of the study include lathyrus, lentil, blackgram, mungbean and chickpea. The selection of these crops has been made in consideration of their relative importance with respect to cultivation, the immediate prospect of improvement in production, and their economic and social impacts on farmers' incomes and welfare. Important characteristics of these major pulse crops are described in the Appendix.

The Purpose of the Study

1) To examine the present situation of selected CGPRT crops in selected countries of Asia with special regard to the socio-economic factors at macro and micro levels (including national and international research and development activities related to these crops in the region), and to identify the constraints on the socio-economic environment of CGPRT crops in the relevant countries;

2) To analyse and evaluate the economic potentials of the expansion of CGPRT crops production and its impact on rural economy and social welfare, including demand for these products, prices, marketing, trading and rural employment, and to identify the problems to be solved through co-operative network approach; and

3) To propose appropriate methodologies of socio-economic studies on CGPRT crops so that the outputs of the studies could provide guidelines for further in-depth and large-scale studies to be implemented by national research institutions.

Research Sub-Project-I

Study on Socio-Economic Constraints to Development of CGPRT Crops (Selected Pulse Crops).

1. The status of the CGPRT crops in Bangladesh, as discussed earlier, involves a number of issues and constraints to the development of selected CGPRT crops. There has been no significant

*) Prepared by Ekramul Ahsan, Member-Director, Bangladesh Agricultural Research Council.

empirical investigation to systematically identify the social and economic constraints, nor an adequate in-depth analysis to provide better insight into the major problems. In view of the above, a comprehensive study on socio-economic constraints has been proposed to be undertaken in Bangladesh.

2. The constraints study should center around the following specific issues:
   (i) Proper assessment of the farm level technology of cultivation of selected crops.
   (ii) Assessment of input requirements and input supply and availability at the farm level. This should include identification of social, economic end institutional constraints to higher productivity.
   (iii) Assessment of farmers' capital needs for successful adoption of intensive cultivation practices. Emphasis should be on an analysis of availability of credit at the farm level and the scope for economic expansion of farm level resources use.
   (iv) Assessment of the impact of cultivation of selected pulse crops on farm income.

3. Identification and specification of the technology of pulse crops cultivation should be made for an assessment of farm level technology. This should also include an assessment of the productivity of the specified improved technology (yield level) as compared to the specified technology in practice at farm level. A yield gap (between potential yield and actual farmers' yield) analysis would identify the constraints to higher yield.

Research Methodology

The research methodology for the proposed study on Socio-Economic Constraints on Production Prospect of Selected Pulse Crops in Bangladesh includes methodology for implementing the study, organization of the micro-level survey of sample farms, and the analytical methodology described below.

Survey Design

The study will be based on a survey of sample farms to obtain micro-level information. The survey methodology includes selection of locations (regions), selection of study areas (villages), and sample farms. The sampling framework for the research project is shown in Figure 1. The sampling framework will follow a multi-stage, stratified, proportionate, random sampling design.

Selection of Location (Regions)

The locations should be selected to adequately represent various regional characteristics of the country in terms of soil and water characteristics, cropping patterns and crop dominance. It is also logical to stratify the regions according to the levels of progress and characteristics of rural infra-structure.

The study will be based on sample locations in all four regions of the country, namely: North-West (Rajshahi Division), South-West (Khulna Division), North-Central (Dhaka Division), and Eastern Region (Chittagong Division).

Four sample districts, one in each region, will be selected, based on the relative concentration of pulse area as the criteria for stratification. Following the identification of the districts, one thana (location) in each of the selected districts will be chosen by adopting the similar criteria for stratification. Within each selected thana, one or more villages will be selected, with the consideration that the sample villages should as far as possible represent the average characteristics of the respective thane. If the number of households in the first village is not adequate to qualify for statistical sampling coefficients, the next adjacent village should be included within the sampling framework. As a rule of thumb, a minimum of 600 farm households should serve as the basis for the ultimate selection of 100 sample farms. Sample villages may be designated as the study sites.

Selection of Sample Farms

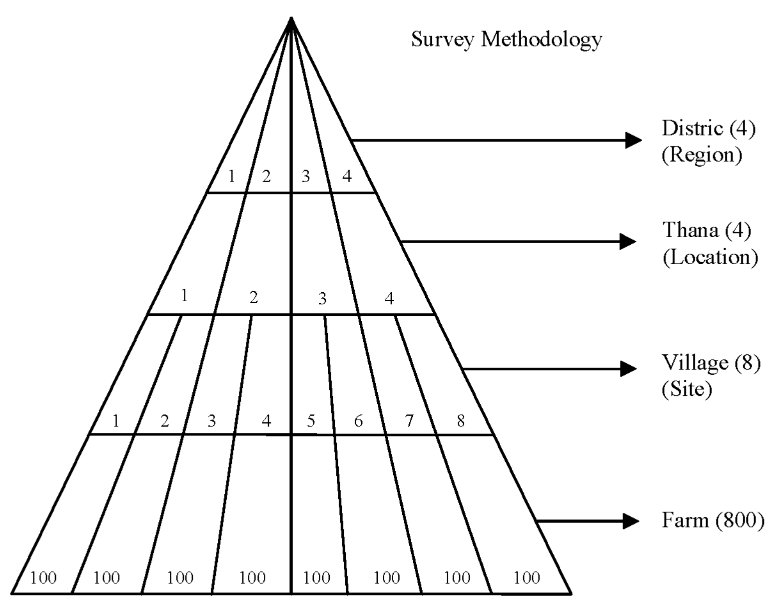
Sample farms should be selected in each of the identified sites following a stratified random sampling technique. The stratification should be based on criteria such as farm size and tennurial arangement. For the final selection of the sample farms, a preliminary survey of all farm households will be undertaken, with stratification according to the predetermined criteria. Finally, 100 sample farms may be selected in each site, proportionate to the distribution of households as per complete enumeration of the farm households.

The selection of sample farms, therefore, will be based on a multi-stage, stratified, proportionate, random sampling design.

Implementation of Farm Surveys

The survey of the selected farms should be undertaken during the growing seasons of the selected pulse crops. Since the selected crops are grown during both summer and winter, the qualified enumerators may be required to continue their survey year round. The enumerators should be carefully selected according to their knowledge, experience and aptitude. They must reside in the study sites and become fully acquainted with the agricultural production and marketing systems in the area. Close contact and friendly relations with the farmers are essential. The farm survey should continue after harvesting of the crop to include the changes in price from harvest to post-harvest. The marketing channels, institutional arrangements and marketing functions with respect to selected pulse crops are to be carefully identified during the post-harvest phase of the survey. The survey should continue for two consecutive years, depending on the policy decisions on the period of study and the availability of required resources.

Figure 1: Sampling Framework



Data Processing and Analysis

After careful scrutiny and verifications, the farm survey data will be processed for computer analysis. The data processing includes conversion and standarization to appropriately fit the analytical techniques to be used in the study. The field data will be transformed first to code sheets and then to diskettes, and finally stored on magnetic tapes to maintain the data file.

Coding formats and code books will be prepared to facilitate the conversion of the field data to the computer medium for analysis. Analysis can be undertaken. either with the mainframe computer available in Dhaka for comprehensive econometric analysis (i.e., profit function and multiple regression for dynamic analysis) or with the micro computers available at BARC and BARI (for less sophisticated analysis such as descriptive statistics).

Analytical Methodology

Various alternative analytical techniques will be employed in this study, depending on the specific objective and nature of the data. Some analyses will be simple and descriptive, while others will follow a mathematical approach with a sophisticated econometric model. In general, the analytical framework of the study may be grouped into the following three types of analysis:

1. Descriptive Statistics
2. Budgeting- Farm Income Analysis
3. Econometric Analysis

Description Statistics

This section presents the general farm characteristics such as size distribution, tenurial status, level of adoption of technology at farm level, inputs use, farm level productivity, price situation (inputs and output), status of farm infra-structure, market characteristics, etc. Simple statistical techniques such as measurements of central tendency, measurements of dispersion, selected non-parametric statistical analysis (X, rank correlation, etc.), and a statistical test of significance will be used for this part of the analysis. Graphic presentation, depicting significant distribution patterns, will also supplement the analysis.

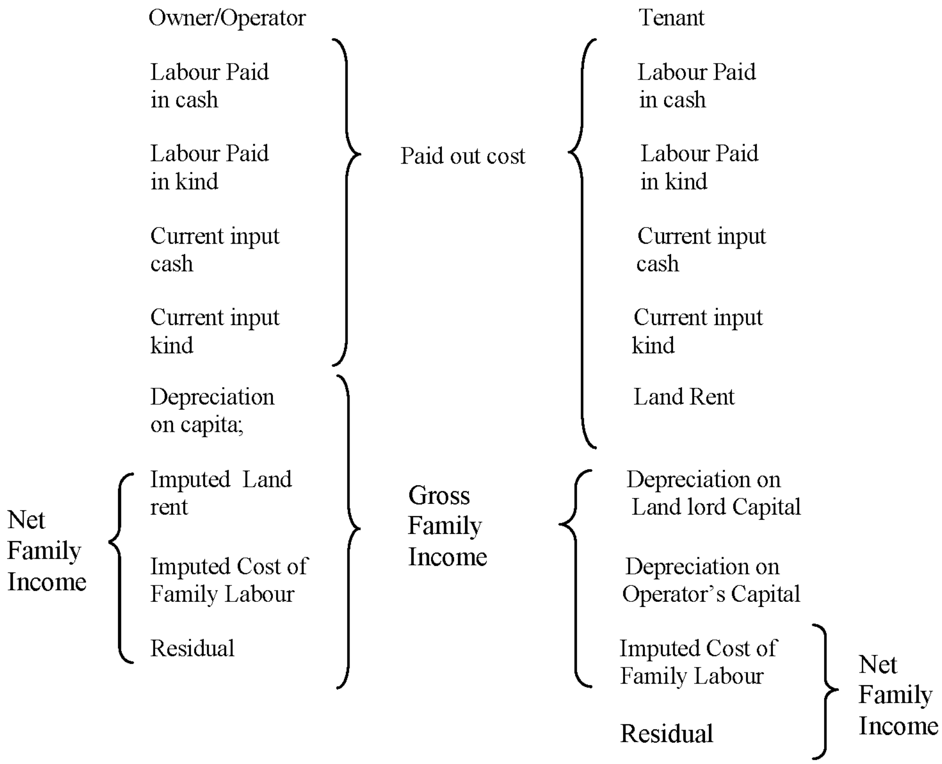
Budgeting

Budgeting and partial budgeting techniques will be used in the cost and return analysis with regard to the cultivation of the selected pulse crops. Analysis aims to depict the farm level economics of cultivation of these crops. The cost and returns analysis also intends to reveal comparative profitability for different crops, regional variations in cost and returns, and variations in income according to farm-size and tenure systems.

Partial budgeting analysis will help to identify remunerating inputs and practices in the cultivation of these crops. Returns on investments in the cultivation of these crops may also be determined, providing an investment prospect at the farm level for the expansion of production of selected crops.

The concept and methods of farm income analysis are not yet standardized, as revealed in various studies. There are a number of ways to measure income and costs. According to standard economic theory, cost items may be divided into fixed costs and variable costs. The various resources used in the production process are valued at their respective market prices. An alternative concept of factor-share approach has been developed which divides total output int the shares going to various classes of individuals involved in the productions. For example, the operator is credited with the labour earnings from his family's contribution, the landlord and the operator divide the earnings of capital (depreciation and interest on capital), and the residual goes to the operator.

The farm income accounting presented below, adopted from Herdt, focuses on the earnings of family resources used in farming and provides a measure of the incentives as well as the welfare of the family reflected by the size of family income.



Gross Farm Family Income - Income received by the farm operator is calculated as the residual after actual payments are made for all the expenditures incurred for production inputs, excluding unpaid family owned resources, such as land, labour, and capital (Total Return - Paid out costs).

Net Farm Family Income - This is calculated by subtracting depreciation from the Gross Farm Family Income and represents the return to all family resources.

The complications with respect to changes in cost structure over time due to price changes have not been explained here. However, the conventional technique of adjustment is to deflate the total cost or the component in current items by an index of the prices paid by farmers.

Another concept of gross income is expressed by the total physical output per unit of the area multiplied by the market prices of the product. The net return is derived by deducting the total operating cost from the gross return. Al l the items of costs and returns are to be expressed by the standard unit of area (acre). The cost and return analysis according to the second concept may be expressed as follows:

$$OC = P_iX_i$$
$$TC = OC + d + I$$
$$TR = r_i\, Q_i$$

where,

OC = operating cost per acre
Pi = price of the ith input factor
X_i = quantity used of the ith input factor per acre
TC = total
d = depreciation on capital
I = interest on operating capital
r_i = price of the ith product
Q_i = quantity of the ith product per acre

If TR is less than TC, the farm incurs a positive net return (profit) and if TR is greater than TC, the farm incurs a negative return (loss).

The production cost is to be categorized according to operations performed in crop production. Thus the cost of production includes (i) land preparation. (ii) seeding/ transplanting, (iii) manuring and fertilizing, (iv) weeding and top dressing, (v) irrigation, (vi) pest management, (vii) harvesting and carrying, (viii) threshing, and (ix) post threshing practices. In all the above cost heads, costs of various inputs such as labour, bullock, machine/equipment, and other materials are to be included.

The gross return is expressed by the physical output per unit of the area multiplied by the market prices of the product. The net return is derived by deducting the total operating cost from the gross return per unit of area.

Non-parametric analysis may be used to determine the factors associated with the adoption of Improved technologies in crop production. Attempts may be made to employ rank correlation technique and chi-square tests to explain such relationships.

Research Sub-Project-11
Estimation of Demand for Pulse crops in Bangladesh

1. In a country like Bangladesh, with a fast growing population and low per capita expenditure, the major food problem has been an inability to provide minimum calories to the people. Efforts have therefore centered on increasing the production of cereal crops. However, it is equally important that a nutritional balance be maintained in the general diet. Pulse crops are rich in the lysine and threonine content of protein and are good supplements to cereal protein. These are the main sources of concentrated protein. It is obvious that in a poor country like Bangladesh, pulse crops occupy a very significant position in the daily diet of the people. Attempts should therefore be made to determine the demand for pulse crops and to identify the factors associated with change in demand.
2. Stagnation in the growth of pulse crops has been of major concern to the policy makers and planners of agricultural development in Bangladesh. The situation can not be adequately analysed unless the demand characteristics of these crops are analysed. It is assumed that the demand is geographically localised to the regions with pulse crop production.
3. Demand for` pulse crops is dependent to a large extent on how the aggregate demand is distributed among different commodities.

Research Methodology

See sub-project 1

The Model (Analytical Procedure)

The model adapted from Chopra and Swang (through cross section data) and presented below aims to estimate an expenditure elasticity and to compute a pooled regression as well as to estimate the own price elasticity of pulses and the cross elasticity, taking cereals as the substitutes and using the following equation:

$$(1) \qquad X_{it_0} = a_1 + b_1 E_{it_0}$$

where,

X = quantity of pulses consumed per person per month (pound)
E = total expenditure per person per month (taka)
i = the expenditure classes taking values 1, 2....N
N = total number of such classes
t = time of the data for consumer expenditure

The expenditure elasticity (b) derived from the above equation is to be used in a time series regression to determine the following equation :

$$(2) \qquad X_t = a_2 + b_1 (E/P_b)_t + b_2 (P_{p/b})_t + b_3 (P_c/P_b)_t$$

where,

X = average quantity of pulses consumed per capita per month (pound)
E = total expenditure per capita per month (taka)
P_p = Price of pulses
P_c = Price of cereals
P = General wholesale price index to base 'b'
t = 1, 2, ... T where T= number of time periods under study.

The co-efficient b in equation (1) is an estimate of the expenditure elasticity of demand when the variables are in log form. We then estimate a new series X , where,

$$(3) \qquad X_t = \frac{1}{N} (\Sigma xi_t - b \sum_{i=1}^{N} \frac{\Sigma it}{Pb}$$

The above parameters have already been explained in equation (2).

X_t then is an estimated time series of the average quantities of pulses consumed per person per month.

We then estimate the following equation

$$(4) \qquad X = a_2 + b_2 \left(\frac{Pp}{Pb}\right) + b_3 \left(\frac{Pc}{Pb}\right)$$

where, Pp = price of pulses
Pc = price of cereals

By definition

(5) $a_1 = a_2 + b_2 (\frac{Pb}{Pb}) + b_3 (\frac{Pc}{Pb})_t$

By substituting average values of $\frac{Pp}{Pb}$ and $\frac{Pc}{Pb}$ in equation (5), we can derive a value for a_1 to compare with the value of a_1 as estimated in equation (1).

The final equation then becomes, $X_t = a_2 + b_1 (\frac{E}{Pb})_t + b_1 (\frac{Pp}{Pb})_t + b_3 (\frac{Pc}{Pb})_t$ as in equation (2).

Research Sub-Project-III

Study on the Area Shift under Pulse Crops.

The concept of area may be defined as the changes in the ratio of area under pulse crops to gross cropped area, i.e. , $P/_{GCA}$

Where, P = Area under pulse crops
GCA = Gross Cropped area

The area shift may occur in two ways:

1) from /into pulses and other foodgrains crops, and
2) from /into pulses and non-foodgrain crops.

This may be expressed as

(1) $P/GCA = P/_F \times F/_{GCA}$

Where P/F is the ration of area under pulses to area foodgrains, and
F/GCA is the ratio of area under foodgrains to gross cropped area.

In the ratio P/GCA falls and F/GCA is accompanied by a fall in the ratio P/F with no change in the ratio F/GCA, then all the changes in P/GCA can be attributed to a shift out of pulses into cereals and vice verse.

If a fall in the ratio P/GCA is accompanied by a fall in the ratio F/GCA, with no change in P/F, then all the shift out of pulses is explained by a shift into non-foddgrain crops and vice versa.

When both the rations P/F and F/GCA change along with a change in the ratio or P/GCA, both areas under foodgrain crops and non-foodgrain crops contribute to such change. The relative contribution of each of these rations can be estimated by the following:

(2) $\text{Log } P/GCA = \text{Log } P/F + \text{Log } F/GCA$

(3) $\text{Therefore, } 1 = \frac{\Delta \text{Log } P/F}{\Delta \text{Log } P/GCA} + \frac{\Delta \text{Log } F/GCA}{\Delta \text{Log } P/GCA}$

The above equation (3) gives the percentage contribution of each of the ratios to changes in P/GCA

In order to explain the causes of such shifts in area, and for an adequate interpretation of such shifts, a regression model is presented here which includes variables such as the yield and price of the competitive crops relative to those of the pulse crops. The other variables, such as the area irrigated under the competitive crops and rainfall, may also be included in the model to further explain the influence of irrigation and rainfall on shifts of area under pulses.

$$A = a_O + a_1 \overset{RY}{}_{t-1} + a_2 \overset{RP}{}_{t-1} + a_3 \overset{Alc}{}_{t-1} + a_5 \overset{A}{}_{t-1}$$

where, A = area under pulses (in acres)
RY = ratio of yield of pulse crops to that of competing crops
RP = ratio of price of pulse crops to the price of the competitive crops
Alc = area irrigated under the competitive crops
R = annual rainfall in centimeters
t = time period

The above model can be used and interpreted either as a log model or an expectation model, depending upon adjustments.

Research Sub-Project-IV

Study on the Allocative Efficiency of Resources Use in the Production of Pulse Crops.

1) The study should analyse the scope for the optimum expansion of the production of pulse crops from the view of resource use efficiency.
2) Increase in the efficiency of crop production systems is the key issue of agricultural development in Bangladesh. The need to understand the factors affecting the performance of crop production systems, particularly among different farm groups, is well recognised.
3) An understanding of the level of efficiency in pulse cultivation will assist policy directors to determine whether productivity increase is feasible through resource allocation for alternative measures, such as structural and/or technological changes to bring about a substantial increase in production.

Research Methodology

Area Selection and Data Collection. (As described in Research Project-1)

The Model (Analytical Procedure)*

The profit function model, popularized by Lau and Yotopoulos (1971), will be used for this study. The profit function model expresses the maximum profit of a farm in terms of price of output and variable inputs and quantities of fixed factors of production. Thus, the framework accomodates the reality that prices, technology and resource endowments may vary among farmers.

A normalized restricted profit function (Cobb-Douglas form) and a set of factor demand equations which will be used are as follows:

(1) $L_n^{\Uparrow} = Ln^{\propto} + B_1 L_n WF + ß_3 L_n P + B_4 L_n S + ß_5 L_n PA + L_n K + U$

$\Uparrow$ = restricted profit (current revenue less current variable crop) per farm normalized by price,
WL = the money wage rate (per day) normalized by output price,
WF = the price of fertilizer (per seer) normalized by output price,
P = the price of pesticides/insecticides (per lbs) normalized by output price
S = the price of seed/seedling (per seer) normalized by output price,
PA = cultivated pulse area in acres,
K = the capital service flows,
U = the disturbance term, and
$\propto$, ß = parameters to be estimated.

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* Prepared by Mr. Akhter Ahmed, Senior Scientific Officer (Agricultural Economics), BARC

The profit function is restricted in the sense that equation (t) specifies the profit realized when the qualities of some inputs are fixed in the short run. It is also specified in terms of normalized prices of variable inputs and quantities of fixed factors.

All the variables were normalized by the farm specific output price. Hence, the levels of variable inputs which maximize short run profit cannot be estimated directly from the profit function. However, the variable input demand function can be derived by partially differentiating the profit function (1) with respect to the normalized price of the inputs (Lau and Yotopoulos 1979 p- 125, Flinn et a]., 1982,p-52).

For the present study the variable input demand functions are as follows:

(2) $- (QF. WL)/\Uparrow i = {}_1 {}^+ V_1$

(3) $- (QF. WF)/ \Uparrow = {}_2 {}^+ V_2$

(4) $- (QP. WS)/ \Uparrow = {}_3 {}^+ V_3$

(5) $- (QS. WS)/ \Uparrow = {}_4 {}^+ V_4$

Where, Q_L, Q_F, Q_P and Q_S	=	the profit maximizing quantity of labour, fertilizer, pesticides and seeds respectively.
W_L, W_F, W_P and W_S	=	the normalized unit prices of labour, fertilizer, pesticides and seeds respectively.
V_1	=	error terms.
r_i	=	parameters to be estimated.

Equations I through 5 comprise a set of simultaneous equations derived from the profit maximizing model. The set of equations can be estimated using Zellners ' seemingly Unrelated Regression Procedure.

APPENDIX

Important characteristic features of major pulse crops*

Lathyrus (*Lathyrus sativus* L.), indigenous to southern Europe and western Asia, is locally known as khesari. It is extensively cultivated in the Indian sub-continent, i.e., India, Bangladesh, Burma, Nepal and Pakistan. Lathyrus is an annual, well branched, semi-spreading to spreading herb. It is a cold season crop and grows in areas where average temperatures range between 10-25. Lathyrus is the hardiest of the pulse crops because it can tolerate flooding and droughts. It can grow 1n areas of low rainfall (300-500 mm) and also in arm of high rainfall (up to 1500 mm), such as in Bangladesh. It can grow on a wide range of soil types, ranging from very poor to heavy clay soils. Lathyrus is often sown broadcast in a standing rice crop, and Is sometimes grown mixed with other crops like mustard. Generally, no intercultural operations, fertilizers or irrigation have been used for growing this crop. The grain is used as a

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* Gowda and Kaul. 1983.

complementary or sole source of calories and proteins, mostly by the poor and landless farmers. The plants are used by many farmers as fodder for livestock.

Lentil (*lens culinaris* medik) is locally known as masur. Lentil is supposed to have originated in southern Turkey (Ladizinsky, 1979), and is widely cultivated in Greece, central and southern Europe, Egypt, Ehtiopla, Afghanistan, the Indian sub-conttnent and China. Although it is a temperate crop, it is also cultivated in the sub-tropics during winter months and at high altitudes in tropics during colder months. Lentil is a small, much branched, semi-erect, slightly pubescent annual. It is reported to be a drought tolerant crop, but Is susceptible to water logging. Lentil normally has been grown on marginal lands, without much care, and in sandy loam, alluvial and clay loam soils. It is generally broadcast as pure or mixed. Lentil seeds are eaten cooked whole, decerticated or as "dal". The straw, broken stems and pod walls make excellent feed for cattle.

Mungbean (*Vigna radiata* (L) Wilczk.) is locally known an mung or sonamung. Mungbean originated in southeast Asia (India, Burma, and Thailand). It is widely grown in India, Pakistan, Bangladesh, Burma, Thailand, Philippines, China and Indonesia. Mungbean is an erect or sub-erect annual herb with a slight tendency to twine. It is a crop of the tropics and sub-tropics and requires a warm temperature region. Mungbean is a fairly drought tolerant crop, but is sensitive to water logging. It can be cultivated on many soils, including sandy loam, laterites, alluvial and clay soils. Mungbean seeds are used either whole or split into "dal" for several dishes. The dried stems and pod walls remaining after threshing are used as cattle feed.

Blackgram (*Vigna Mungo* (L) Hepper) is locally known as mashkalai. Blackgram is native to Asia (Indian Sub-continent). It is widely grown in India, Bangladesh, Burma, Pakistan and Thailand. It is a tropical plant, resistant to high temperature, but is sensitive to cloudy weather and cannot tolerate frost. It is cultivated both in the Kharif and Rabi seasons. Blackgram is a small, bushy, hairy annual. It can be grown in most soils ranging from light red, red loam, loam alluvial to heavy clay. The most popular sowing method in Bangladesh is broadcasting. It is one of the important pulses, providing grain for human consumption and fodder for cattle and is sometimes used as a green manure crop to enrich depleted soils.

Chickpea (*Cicer ariatinum* L.) Is locally known as chola or Boot. According to Van der Maeser (1972), chickpea is not reported in a wild state. Its origin is obscure. It is cultivated in the Mediterranean region, in the middle East and in the Indian sub-continent. Chickpea is an annual plant, normally semierect. It is a temperate crop which has become adapted to sub-tropical conditions. It is also highly sensitive to excess moisture, high humidity, and cloudy weather. In Bangladesh the crop is grown on well drained, sandy loam, alluvial and clay loam soils. Chickpea is drought tolerant and can not withstand water logging. The most common method of sowing is broadcasting the seed followed by laddering. The young pods are eaten raw or cooked, and contain a high amount of ascorbic acid (vitamin C). The mature seeds are cooked as whole seed or in making "dal". The seeds can also be eaten after soaking in water overnight. The dried and broken stems and pod walls are good cattle feed.

METHODOLOGICAL CONSIDERATIONS ON THE ANALYSIS OF SOCIO-ECONOMIC IMPLICATIONS OF EXPANDED PRODUCTION OF CGPRT CROPS IN ASIA*

I. Introduction

It is now generally recognized that CGPRT crops play en important role in the economy of the ESCAP region, particulary with regard to the food supply for growing populations. Furthermore, the crops contribute to world food security. Nevertheless, relatively little attention has been given to these crops, particularly in the areas of research and development. Over the past decade, increasing deficits have been observed for coarse grains, while a balance has held between the supply and demand for pulses. Roots and tubers have been in considerable surplus. A rapid increase in population has been accompanied by an increase in the demand for these crops, Hence, an increase in the production of these crops is necessary to meet the needs of human nutrition, rural welfare, and economic stability. Therefore, for policy and planning purposes, studies should be made on the potential impacts of expanded production of CGPRT crops in the ESCAP region.

The major objective of this paper is to propose appropriate methodologies of socio-economic studies in order to provide guidelines for further in-depth and large-scale studies that can be initiated by national research institutions in the ESCAP region. In view of the great differences in the socio-economic and cultural environments of the member countries of ESCAP, this paper will focus on selected countries of Southeast Asia. However, the general approach to the problems of expanding CGPRT crops and the recommended methodologies should also be applicable to the situations in other member countries.

This paper will first attempt to briefly examine the economics of selected CGPRT crop productions (i.e., maize, cassava and soyabeen) in certain countries of Asia (i.e., Indonesia, the Philippines and Thailand) and to identify major constraints to production within the socio-economic environments of the countries under study. Secondly, research methodologies will be mentioned. Finally, some methods to assess and analyse the potential impacts on rural economy and welfare by the expansion of upland crop productions will be discussed.

II. The Economics of Selected CGPRT Crop Productions in Indonesia, the Philippines and Thailand

Until recently, rice has been the dominant crop in the food policies of Indonesia, the Philippines and Thailand. Rice intensification programmes have received the highest priority, particularly in Indonesia and the Philippines where rice production was inadequate to meet the domestic demand. While the Philippines has been self-sufficient in rice for several years, Indonesia is still rice deficit, and rice will remain the highest priority for research and development in this country. However, at present, other crops are receiving attention from the government. This is evident by the fact that intensive government programmes have been extended to palawija (secondary) crops in Indonesia, to maize and soyabean production in the Philippines, and to maize, soyabean, sorghum and peanuts in Thailand.

There is evidence that agriculture in these three countries has been greatly diversified over the past decade. Rice, though, remains the most important crop, with only a relative decline in

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* Prepared by Tongroj Onchan. Department of Agricultural Economics, Faculty of Economics and Business Administration. Kasetsart University. Bangkok.

research, development, and policy making. Over the policy of 1967-1980, the harvested area of maize in the Philippines and Thailand substantially increased, while it declined somewhat in Indonesia. Maize production increased considerably in the former two countries while only a slight increase was observed in Indonesia. The increase in maize production in Indonesia was attributable to an increase in the yield per hectare while in Thailand it was due to an expansion of area. In Thailand, a decline in yield was observed. Cassava increase was also witnessed in the Philippines.

It is interesting to note that, in Indonesia, the harvested area slightly decreased in recent years while production showed a slight increase. The factors contributing to the declining cassava yield included irrigation and rehabilitation programmes, afforestation programmes, and relatively higher prices for competing staple crops, e.g., peanuts and soyabeans. Another crop which showed a substantial net gain in both area and production in all three countries was sugarcane, particularly in Thailand where Production increased about 4 times during 1967-1980. Finally, soyabean, although relatively a minor crop, had an increase in area and production in all three countries. In the Philippines, the area of soyabean production increased 10 times, from 1,000 hectares to 10,000 hectares; however, soyabean production increased only 2 times during the same period In Indonesia, both the area and the production of soyabean production increased very little. In Thailand, although soyabean production has been steadily increasing, it is still far below the production In proportion to the targets. In fact, considering the actual production in proportion to the targets, the performance of soyabean has been quite disappointing (see a good discussion on agricultural diversification in ASEAN countries in Konjing, 1983).

The economics of the CGPRT crops in Indonesia, the Philippines and Thailand vary according to the type of crop and region, both among and within the countries. Maize and Cassava are basically upland crops and are therefore not usually competitive (with regard to land resources) with rice. By contrast, soyabean competes with rice because both crops are grown on low lands with adequate moisture.

As regards production systems, in Thailand maize may be grown as the first crop after the rainy season, followed by legume crops such as mungbeans and peanuts. However, in the Northeast, the main cassava producing region, most farmers grow only one crop per annum due to in adequate moisture. In Indonesia, intercropping is common, such as in Java, where cassava is intercropped with grains and legumes rather than planted in pure stands. In West Java, upland rice, maize, peanuts and soyabeans are usually intercropped with cassava. Intercropping is not common in Thailand and the Philippines, although an intercropping system with Cassava as the main crop is being tested in Thailand. This method is being adopted in the Eastern Central Plain, although it has not worked well in the Northeast, where the soil is inadequate for crops other than cassava

Soyabeans are usually produced as a cash crop on lowland and/or irrigated rice fields in the northern region of Thailand. The planted area of soyabeans during the dry season largely depends on the relative va1ue of rice and soyabean crops. Although it is considered a valuable rotational crop, soyabean area and yield vary substantially from year to year.

Farms which grow maize, cassava and soyabean are generally small, varying in size according to the type of crop. The average maize farm in Thailand is about 4 hectares, while a relatively large farm may exceed 7 hectares. Most of the large farms are located in the commercialized maize areas of the upper Central Plain and the lower Northern region. In Indonesia, the maize farms are small in size, while in the Philippines, the farms, and particularly the plantations, are larger. Cassava farms in Thailand average about 3 hectares, while in Indonesia, the median cassava farm size in 1913 was only 0.4 hectare, and farms larger than 5 hectares were rare. In the Philippines, cassava farms are somewhat smaller than in Thailand. As mentioned before, soyabean is a minor crop in all three countries, and, except for Thailand, not much data is available on the economics of soyabean farming The soyabean farms in Thailand average about 4 hectares, and soyabean farms in the Philippines and Indonesia are assumed to be smaller.

As regards land tenure, in all three countries and for all three crops under study, most farmers own their land. Tenancy is-rare, except for some areas such as the upper North region of Thailand, where technology is a serious problem in the irrigated areas. Land distribution tends to be skewed toward the commercialized areas in all three countries. Land redistribution programmes are need in all three countries, and the issue has already received some attention in the Philippines.

With regard to agricultural technology, there are variations among crops and countries. Maize technology appears to be further advanced In Thailand and the Philippines than in Indonesia. Thailand has a good varietal base in the Guatemala lines and Suwan 1. At present, most farmers use these improved varieties which perform well under rainfed and low fertility conditions. Fertilizer application is still low in Thailand, partly due to the unfavorable prices of maize and fertilizer. Fertilizer application to maize crops is higher in the Philippines, where a maize intensification programme is underway. There is more fertilizer application for cassava in Indonesia than in Thailand, although maize and upland rice remain the priorities for fertilizer and other inputs. As for soyabean technology, new or improved varieties have been used by many farmers in Thailand and the Philippines. Fertilizer is applied to soyabeans at relatively higher levels than to other cash crops. Again, there is little documentation on the use of fertilizer in Indonesia.

Based on available studies, it may be concluded that the state of agricultural technology with regard to these three crops still leaves much to be desired. For example, in the case of cassava in Indonesia, the yield may be increased from the current 11 metric tons per hectare (in Lampung, 1977-78) to about 20 metric tons per hectare, with the application of recommended practises. This also applies to other crops, such as maize, which may be increased to 4 times the current yield the yield gap in Thailand and the Philippines is also large, and could be narrowed if major constraints were lessened or eliminated.

The future growth of the cassava industry will depend, to a great extent, on the demand situation. At present, the EEC, the dominant export market for cassava from Thailand and Indonesia, imposes quotas on the imports of cassava products. The quantities imported by the EEC will be declining over time. This has already caused great concern, particularly to the government of Thailand. Cassava is one of Thailand’s most important export crops and, furthermore, it is produced in the dry areas of the Northeast where poverty is most prevalent.

The demand problem of cassava may be less serious in Indonesia, where utilization patterns are numerous and diverse. Cassava is consumed as food in both fresh and dry forms. It is also exported, and substantial amounts of cassava are processed into starch. Known as poor man's food, cheaper prices for cassava may contribute to improvements in rural welfare. At least for the time being, foreign demand is not posing a serious problem, and the domestic demand may also be increased by utilization in the feed industry.

The potential demand for cassava for animal feed is also great in the Philippines, where cassava is as yet a relatively minor crop. Human consumption is not significant, and is even lower than the consumption of sweet potatoes. However, since the Philippines is still importing yellow maize for animal feed, cassava may be increasingly used as a substitute by the feed industry. The growth of cassava in the Philippines depends upon the success of the maize intensification programme, which aims for self-sufficiency in maize. If the production falls short of expectations, cassava may assume a larger role in the feed industry.

With regard to maize in Thailand, the export market is still stable. Thailand is the only maize exporting country of the three under study. As a result of the rapid growth of the feed present, the market demand for maize is not a problem in the Philippines or in Indonesia.

Future remand prospects loot: promising. This can also be said for the soyabean remand in all three countries. In fact, the reason that soyabean prices have been relatively high is because the supply and production have not kept pace with the rapidly increasing demand.

The demand aspect of CGPRT crops is particularly important on along run basis. Therefore, demand studies should be undertaken in detail for all three crops, with long-term projections. Utilization studies, particularly for cassava, are necessary, In Thailand, some studies have already been completed.

Another possible constraint to CGPRT crops development is related to marketing systems. Sverak descriptive studies on the marketing of maize and cassava in the Philippines clearly point out the need to improve the efficiency of the marketing system. Marketing aspects that should receive special attention include post-harvest technology, storage facilities, transportation and standardization. The inefficiencies of the marketing system have resulted in lower prices for farmers. Moreover, prices fluctuate severely during the year due to the lack of storage, the lack of credit to finance marketing, and also due to household requirements.

Some improvements in the marketing systems of upland crops in general and selected CGPRT crops in particular have been observed, largely due to pogrammes and the response of the public sector. However, the governmental marketing programmes have been less successful than anticipated, particularly in regard to the provision of infrastructures such as roads (farm to market, in particular) and electrical and telephone facilities. Deficiencies in the marketing systems have kept marketing costs high for most products in the three countries.

Agricultural technology is also an important aspect of the development of CGPRT crops in the three countries. Farming systems which yield the highest returns while maintaining the fertility of the soil are of special interest. Many CGPRT crops may form a component of these systems. Crops such as groundnut, soyabean, and other legumes may be suitable as rotational crops for intercropping. Research on new varieties is increasing in the three countries and is of utmost importance if improvements in productivity and rural income are to be gained. Fertilizer application is another form of technology which has not been fully investigated for the major CGPRT crops. Where improved technologies are available, the adoption rate has been unsatisfactory. The problem of extension is also worthy of investigation.

Another problem which is often mentioned is farm credit. As the majority of CGPRT farmers own small farms, they are generally neglected by both public and private finance institutions. Most farmers resort to borrowing from private money-lenders, who charge unusually high interest rates. Inadequacy of credit also means that the farmers are pressed to sell their produce immediately after harvest, when the prices are lowest. In the case of maize farming in Thailand, many farmers cultivate land for which they have no legal title, and consequently, they cannot use the land as collateral for loans. Therefore, the adoption of yield increasing technologies is limited by the availability of funds, and adoption is generally partial in all three countries. In contrast to the desired goal of improving rural income and welfare, extension programmes usually benefit the large farms which have established credit.

III. A Study on the Social-Economic Constraints to the Development of CGPRT Crops

In the previous section, the major physical and social-economic constraints to the development of three CGPRT crops (maize, cassava and soyabeans) in three countries (Thailand, the Philippines and Indonesia) have been identified. However, to gain deeper insight into the problems, it is necessary to view some of the major constraints in a more systematic and problem-oriented fashion. Alternative methods of alleviating the constraints, via new technologies and/or institutional changes, must be evaluated.

III. 1 Statement of the Problem

The state of development and the relative importance of the three crops to the economics of the three countries may vary considerably. The proposed study, on the social-economic constraints will therefore be somewhat general. Special emphasis should be given to the constraints which are considered important in some countries and not considered important in other countries. Major constraints which are common to all three 'countries and which deserve special attention are marketing, price and credit.

Although these constraints may be important to all three countries, the degree of seriousness and the nature of the problem may vary. For example, marketing facilities appear to be better developed in Thailand and the Philippines than in Indonesia, particularly for maize. The cassava industry in Thailand is relatively well developed since cassava is a main export crop. By contrast, cassava is in an early stage of development In the Philippines. What appears to be of primary importance for the development of cassava marketing in Thailand is transport facilities, including farm to market roads, and improved price and marketing information services to facilitate decision-making by the farmers.

Low prices and price instability are common problems in all three countries. The food demand for the crops is highly inelastic. The prices received by the farmers are likely to drop sharply is the increased supply cannot be met by en increased demand. Studies on the price behavior of CGPRT crops remain inadequate in most countries, particularly with respect to soyabeans and cassava in the Philippines and Indonesia.

Credit constraints w1l1 become more serious when improved technologies are introduced to the farmers. The cash component of the production costs will be greatly increased. Farmers with inadequate credit cannot adopt the technologies nor benefit from yield-increasing methods. It is important, therefore, to examine the credit needs and the credit use of farmers who grow CGPRT crops. In all three countries, the governments have initiated policies to policies institutional credit (through both public and private banks) to the farmers. However, much research remains to be done to understand how much credit is needed and to determine the best method of credit delivery.

Studies on the CGPRT crops and commodities will depend on the depth of information available in the countries concerned. For example, maize has been studied carefully and extensively in Thailand and the Philippines. Cassava has also been investigated recently in Indonesia and Thailand Crops such as soyabeans should also receive some attention. However, this does not mean that a constraints study is not also important. Attention must be given to the commodities research design to insure that it is problem-oriented and covers areas which will represent the national situation. Previous studies, descriptive in nature, are also useful. However, to be relevant for policy and project implementation, research should be able to provide mare specific information on these crops.

For this study, three major constraints, namely marketing, price and credit, will be examined. The general objectives of each topic are:

Marketing (1) Trace the present marketing channels and measure the marketing margin at key points.

(2) Assess the major marketing problems (e.g., processing, transportation and storage) and determine whether they are technological, institutional, economic or political:

- (i) Inventory current stock of marketing technology and determine whether problems could be solved by adoption.
- (ii) Explore alternative institutional arrangements and their possible effects on marketing problems.

(iii) Further explore economic and political problems and their possible solutions.

Price

(1) Analyze the price behavior of maize, cassava and soyabean, e.g., inter-temporal price, inter-special price, and the relationship of price to quality.
(2) Estimate and evaluate the system of price linkage of the selected commodities at various levels of markets, areas and regions.
(3) Study the price policy of CGPRT crops with special reference to maize, cassava

Credit

(1) Study the credit needs of the farmers under both existing and changing technologies
(2) Analyze the sources of credit, particularly with regard to the importance and the terms of credit.
(3) Analyze the repayment of loons by the farmers.
(4) Study the agricultural credit policy of the government with a special reference to CGPRT crops.

111.2 Research Methodology

(1) Area Selection

The study will rely heavily on Intensive surveys in principle CGPRT crop growing areas. The locations of the study for individual crops should, if possible, represent at least two types of producing areas; a relatively progressive area and a less progressive area.

The data obtained by the survey will allow for an analysis, of the factors effecting the development (or production) of the crop in two situations. Our intention is to gain an understanding of the effects of new technologies on the production and income of the farmers.

For each country, the research team must decide on the areas to be covered in the survey. The following areas in Indonesia and Thailand are suggested for consideration.

Indonesia

Maize: East Java, North Sulawesi, Nusa Tenggara Timur, Yogyakarta Special Region, Control Java and Lampung.
Cassava: Central Java, East Java. Southern Sumatra and Lampung.
Soyabean: West Java, East Java, South Sulawesi and South Sumatra.

Thailand

Maize: Lower North (Kamphaeng Phet, Nakorn Sawan, Petchabun), Northeast (Korat, Si Sa Ket), Central Plain (Lop Buri, Saraburi).
Cassava: Northeast (Khan Keen, Karat), Eastern (Rayong, Chon Buri).
Soyabean: North (Sukhothai, Chiang Mai, Central Plain (Makorn Sawan, Lop Buri).

(2) Data Collection

Although most data to be used in the analysis will be collected through field surveys in the selected areas, secondary data will also be needed, especially on the national, regional and provincial levels. Time series data can also be collected from a number of sources, both public and private. Major public agencies with time series data are offices under the Ministries of Agriculture and Commerce, and private companies include Chambers of Commerce, trade associations and private companies.

In the design of the field surveys, attention must be given to the selection of the study areas, the sampling techniques, the questionnaire design, and the interview techniques. For the study, a stratified random sampling may be used. The researchers will have to consider the villages, in order to select stratification with regard to province, district and villages. The questionaire will be carefully designed to ensure that a sufficient amount of data can be obtained. It is also necessary to collect data on the past performances of production, income, and other socio-economic factors of the household. A pretest of the questionnaire should be executed to allow for revision and to facilitate the survey planning and budgeting. Selection and training of the interviewers can follow accordingly. Experienced researchers will be familiar with this process and may also consult survey handbooks prepared by local research teams and/or international agencies (e.g., F AO farm management survey manual; see also Dillon and Hardaker, 1980).

(3) Analytical Procedure

Marketing tabular analysis will be performed to present data on production, distribution, and other related information on marketing structures or channels; an analysis of the marketing margins will follow. Two levels of marketing margins can be studied: 1) Farm to retail margin, and 2) Farm to export margin.

The farm to export margin is important in the case of export crops such as maize and cassava (for Thailand and Indonesia). The farm to retail margin is particularly useful for a marketing analysis of crops that are grown mainly for domestic consumption (such as soyabeans for all three countries).

To compute the marketing margins and costs for the CGPRT crops, the following simple models may be used:

M.1) Farm-Retail: $PF_t = PR_t - MKCDt$

M.2) Farm-Export: $PF_t = PX_t - MKCX_t$

M.3) Farm-Retail Marketing Costs:

$$MKCD_t = HD_{ct} + TD_{cy} + CD_{ct}$$

M.4) Farm-Export Marketing Costs :

$$MKCX_t = HD_{ct} + TX_{ct} + CX_{ct}$$

where,

PF_t = the farm gate price of goods marketed;
PR_t = the price of goods at retail market;
$MKCD_t$ = the farm-retail marketing costs;
$MKCX_t$ = the farm-export marketing costs;
HDct = the farm-retail handling costs;
TD_{ct} = the farm-retail transportation costs;
CD_{ct} = the farm-retail dealers' commission fees and profit margins;
HXct = the farm-export handling costs;
TX_{ct} = the farm-export transportation costs;
CX_{ct} = the farm-export dealers' commission fees and profit margins

The marketing margin identity includes the farm-retail marketing margins identity equation (Model 1) and the farm-export marketing identity equation (Model 2). Both equations state that the farm price of a given commodity is equal to the retail price or export price minus the corresponding marketing costs (Models 3 and 4). The marketing costs include handling and transportation costs, dealers' commission fees, and profit margins. Under the competitive market assumption, the dealers' long-run profit margins are minimal or equal to the opportunity cost of marketing management. The price differential between the two alternative marketing levels equals the transportation plus handling costs. The magnitude of price differentia1 in excess of the transport and handling costs plus the dealers' opportunity costs is the dealers' excess profits, which distort the pricing efficiency of the marketing system.

Price

The analysis of price movement may be applied to several grades (and types) of CGPRT crops. The standard temporal price analysis technique may be used, in which the seasonal, trend, and cyclical components of price fluctuations are separated.

Secular price variations of CGPRT crops should be computed. Four types of variation have to be identified: I) current prices, 2) deflated prices, 3) underflated trend, and 4) deflated trend. The study also computes the seasonal price variations. The least Squares method is a convenient basis for determining the trend component of time series data. A linear trend can be computed as:

$$Y = a + bX$$

where,

Y = the observed time series value
X = the year

A cyclical movement is a pattern that reoccurs regularly over a period of several years. Price cycles usually run opposite to production cycles. Secondary data on monthly price series over a long period of time (e.g., over 20 years) will be required in order to complete the analysis. Simple graphic analysis may be used. Cyclical price movements for the selected CGPRT crops can then be obtained by the division of the deseasonalized values by the trend values and multiplication of the quotient by 100. 1 ha result is called the cyclica1-irregular price movement in percentage terms. The method of binomial moving averages (e.g., 5 month) is then used to remove the irregular price movements from the cyclical-irregular price movement, which yields the cyclical relatives.

Finally, prices ·in spatial markets are determined largely by the transfer costs between regions and the prices of the same commodities in different areas are linked together and move relative to each other, as well. Therefore, it may be useful to mate a simple analysis of the price linkage at farm, wholesale, and export levels, which would, in effect, be an analysis of the pricing efficiency of the marketing system. In theory, the marketing system which establishes prices that are interrelated through space by transportation costs, through form by costs of processing, and through time by costs of storage, is said to perform an efficient and effective pricing mechanism. The following m0031s maybe used to determine the price linkages:

B.1) Farm-Wholesale : $PF_t = f\ (PW_t\ , U_t)$
B.2) Wholsesale -Export : $PW_t = h\ (PX_t\ , U_t)$

Where,

PF_t = the farm gate price of goods marketed;
PW_t = the price of goods at wholesale market level;
PX_t = the price of goods at foreign markets;
U_t = the random error term

Models B. 1 and B.2 are the price linkage models which consist of the farm wholesale (B.1) and the wholesale-export (B.2) price linkage equations the farm-wholesale price linkage equation states that the farm price (PF_t) of a commodity is a function of its wholesale price (PW_t) and the random error term (U_t). In a competitive market with constant marketing margins, it is assumed that changes in the wholesale price of a given commodity will be followed by changes of the same proportion in the farm prices

In the case of constant marketing margins, however, changes in the wholesale prices would be followed by unproportional changes in the farm prices.

The elasticity of price transmission can be calculated by using the following formula:

$$N = \frac{PP_t}{PW_t} \frac{PW_t}{PFt}$$

where N_t is the elasticity coefficient of the price transmission which indicates the percentage change in farm prices following a 1 per cent change in the wholesale price of a commodity. The price transmission elasticity of value 1 suggests the highest intermarket price transmission efficiency of the existing marketing system for that particular commodity. PF_t and PW_t are the farm price and the wholesale price, respectively.

Credit

A descriptive analysis by means of cross tabulation will be made to explain the existing farm production situation and the nature of Indebtedness of the farm family. The supply of credit will also be explained. Then the main thrust of the Quantitative analysis will involve a study of the demand for credit. Two methods may be used: 1) econometrics, and 2) programming techniques.

The following is a simple econometric model which may be used to study the demand for farm loans:

$$D_L = f\ (I, V, Y, 0, D/A, F, E)$$

where,

D_L = demand for loans, in \$
I = interest rate, \$ per year
V = value of investment, in \$
Y = net cash farm income, in \$
0 = debt outstanding, in \$
D/A = debt outstanding/value of assets F •• family expenditures
E = years of schooling

The model may be of a linear form. Cobb -Douglas type. Or of other appropriate forms. The cross-section data from the farm survey are usually used in place of time series data.

The linear programming technique is somewhat more complicated than the econometric model. To study the demand for credit, a careful specification of the conventional linear programming model is required, particularly with regard to financial activities and financial constraints. One advantage of this type of mode1 is that it allows for the introduction of technological changes (by changing the production coefficient or by adding more technological activities to the model). However, one clear disadvantage of this model is that it requires a great amount of data. In addition, a computer programme for the model must be available.

The basic .linear. programming model is now widely known and applied by agricultural economists. For illustrative purposes, a simple submodel of a linear programme on undifferentiated external finances is presented in Table 1.

Table 1. Submodel of a Linear Programme: Undifferentiated External Finance.

Description	Buy		Use		Borrow	Relation	Constraint Level
	M*	S**	M	S			
Cash	1	1			- 1	<	b_1
Machinery	- 1		1			S	0
Livestock		-1		1		<	0
Credit					a	S	b_2
Profit			1. 8	1. 5	- 1.06	=	max

*Machiner **Livestock

In Table 1. there are four choices: buy moct1inery (M) or livestock (5) and use machinery or livestock. The choices are constrained by cash and credit. However, the farmer can borrow (which will add to cash and also to cost). The uses of N and S will contribute to the profit, i.e., 1.8600 1.5, respectively.

The example given above indicates that a complete model, constructed to include details of financial and other matters, will be highly complex. However, depending on the objective of the study, the model can be simplified in order to analyze specific production and credit constraints. This type of model can also be used to study a number of constraints to agricultural development, provide that it is properly specified.

IV. A Study on the Potential Impact of Expanded Production on Rural Income, Employment, Marketing and Prices

IV. 1 Statement of the Problem

It has become clear that an expansion of the production of CGPRT crops is desirable and that the pace of development will be largely determined by both agronomic and social-economic factors. New technology is required for a breakthrough in CGPRT crop productions and increasing efforts are being made in this direction. Over the past 15 years, much attention has been paid to the new rice technologies and their socio-economic consequences on Asian agriculture. Now, if the development effort on CGPRT crops is successful and production is expanded, the potential social and economic impacts, particularly with respect to income, employment, marketing and prices, should be examined.

In search of insights into some of the issues that have arisen, a study of the impact of the expanded production of CGPRT crops is proposed. The primary objective will be to provide information on changes associated with the expansion of production. Answers are sought to the following questions:

(1) How does the expanded production affect rural income? Who benefits from technology, and how are the benefits spent? To what degree are profits capitalized into rising land values? How have the relationships among various groups - - landowners, landless labourers and tenants - - changed?

(2) How does the expanded production affect the level and structure of employment? Has the labour requirement increased? Are labour saving devices being adopted? How does expanded production affect ogg-farm employment?

(3) How does expanded production affect the domestic market as well as foreign trade? It is important to examine the extent of change in foreign exchange earnings and/or savings through the expansion of these crops. How does this affect prices?

IV.2 Research Methodology

(1) Area Selection

The loctions to be selected must be the major producing areas of CGPRT crops. Therefore, the locations of the survey should be among those designated in the study on socio-economic constraints. However, special attention must be given to the producing areas where new technologies have already been adopted by the farmers and in which the production of CGPRT crops has already been expanded.

(2) Data Collection

Primary data will be utilized for this study. An intensive field survey will be conducted. The questionnaire designed for the socio-economic constraints study may be used, with the addition of appropriate questions, particularly concerning new technology and employment factors.

(3) Analytical Methods

To determine the impact of the expanded production of CGPRT crops on income, employment, marketing and prices, the before/after and with/without approaches will be employed. The comparison will be made between incomes, employment, marketing and prices in two situations: a relatively progressive area and a less progressive one.

There are several analytical methods which may be used in the analysis, ranging from the production function approach to programming and budgeting techniques. Production function estimation and analysis has been widely used by agricultural economist, particularly for the study of resource allocation in agriculture. The estimates obtained from this analysis technique can indicate the production elasticities for the inputs under study in different areas and/or for a variety of farming systems. However, for our purposes here, it is proposed that the farm budgeting technique and/or the linear programming technique should be used. In applying these techniques, a careful construction of the model (the L.P.) will have to be made. For this, an experienced and well-trained researcher will be required.

Farm budgeting technique may be used to analyse the income gain from different farming practices and technologies. Some employment aspects may be included in the analysis. The analysis will also be made for different farming areas and for different groups of farmers (e.g. , small vs. large, landowner vs. tenant) to identify the income distribution impact. Since farm budgeting technique is widely used, it will not be discussed further in this report.

The budgeting technique will not be able to provide all of the answers to the questions raised earlier. Linear programming may have to be employed as well. For this type of study, a relatively elaborate or complex model is required as it is an ex-ante type of analysis. For example, a dynamic programming model may be appropriate for the purpose. Though this type of model can provide more detailed information, its disadvantage is that it is less known to many researchers and the necessary computer services are not readily available.

Therefore, a. linear programming model is proposed for use in the analysis of the potential impact of expanded production of CGPRT crops. The submode1 for the analysis of credit activities is presented in the previous section. However, it may be necessary to analyze sequential alternatives with cannot be accommodated in the simple submodel. For intra-year sequential alternatives, there must be a specification of the subyear period -- for example, quarters, months, or other time periods. This is particularly important for multiple crops, such as maize, which can be grown twice a year. The first planting anl1 harvesting will require cash expenses on new inputs (e.g., seeds and ferti1izer). The income from the first crop can be used for the second planting.

The linear programming mode1 elements for the farm fire ore shown in Table 2. This type of model has been described in detail elsewhere (Baker ,et al., I 970)and only a brief outline will be given here. Choice components include alternatives in production, marketing, employment (labour), and finance. The production alternatives include those common to the area in which the farm is located, plus or minus those included or excluded by the decision maker's specific term of reference. Marketing alternatives include time and place alternatives relative to the

Table 2 L. P. Mode1 Elements for the Farm Fir

Row No.	Constraints components	Production $X_1 \ldots\ldots X$	Employment $X_{p+1} \ldots X$	Marketing $X_{m+1} \ldots X$	Finance $X_{f+1} \ldots X$	Constraints levels
1	Land	A		- A		B
2	Labour	A	± A			B
3	Capital	A		- A		B
4	Product	- A		A		O
5	Market			A		D
6	Cash	A	± A	- A	± A	± R
7	Credit	± A		± A	± A	C
8	Debt				± A	O

$$\text{The Objective Function: } Z = \sum_{j=1}^{p} C_{j \times j} + \sum_{j=p+1}^{m} C_{j \times j} + \sum_{j=m+1}^{f} + \sum_{f+1}^{n} C_{j \times j}$$

where, Xj = the activity unit if the j th alternative

Cj = the contribution of the j th alternative to the objective, and

p ,m ,f ,n , = the number of production, employment (labour), marketing and financing alternatives, respectively, farm firm, with respect to purchase or lease of resource services (except labour. which is specified separately here) as well as contracts for sales of farm products.

Financial alternatives include borrowing and management of the debt generated by borrowing (repayment and inter-period transfer of unpaid debt).

Employment alternatives include hiring in and hiring out of 1abour. When labour is hired in, it will add to the labour supply but cash will be used. Hiring out of family labour during certain months or periods will add to the cash income, but will reduce the labour supply of the household.

The interactions of these alternatives are revealed most clearly by reference to the restrictions that constrain the ideal alternatives. Production restrictions (6) include land, and are specified to include the qualitative differences that influence choices in production. They also include labour quantities in the skill and seasonal categories that can be identified. Finally, they include non-cash capital services such as machinery and building (storage). The "A" values in Table 2 show reductions of resource services while "−A" indicates additions.

Row 5, or market, is included to indicate the possibility of introducing market constraints (D) in the model specification, "R" in row 6 indicates the initial sum of cash (either positive or negative). “C” is the Quantity of credit available to the farm firm. It can be differentiated by source and by type. Finally, "0" (zero) in Rows 4 and 8 implies that the model starts with product in storage and no debt.

In order to provide information on the socio-economic impact of the expanded production of CGPRT crops, a careful specification of the model must be m~. For example, production alternatives will have to include CGPRT crops of interest. One or more crops may be specified to have a fixed acreage in the solution (i.e., to set a lower boundary for the activity). Then, in another specification, CGPRT crops may be excluded from the model. A comparison of the results from the two models can offer useful information on the impact on income, employment, marketing and finance or credit. In this type of model, new technology in the forms of new varieties of seeds and fertilizers may be incorporated to analyze the impacts. Once the basic model has been constructed, a number of variations of the model specifications can be made to study potential socio-economic impacts. The mode1(s) can be constructed for all locations under study, with different cropping systems and different levels of inputs.

It should be noted again that other types of programming techniques may be utilized if the expertise and computer services are available. The alternative models are multiperiod linear programmes, recursive linear programmes, dynamic programmes, and simulation. Applications of these models are now more widespread than before. However, a relatively simple standard linear programme with subperiods is more widely used, and has proven to give reasonable and useful results for policy making and planning purposes.

The applications of the L.P. model to farm planning, both at macro and micro levels, have been too numerous to mention here. Recent developments have also been significant, particularly on the technical aspects of the modelling. A whole farm L.P. model of the multiperiod type has been used to study the effects of non-farm enterprises and off-farm employment on production, income, and the employment of rural households in Thailand (Somsak Priebprom, 1984). This type of model may be applied with some modifications, particularly regarding the crops or farm enterprises.

Finally, another more sophisticated L.P. model (i.e., the Quadratic risk programming mode!) can 0150 be used. This whole-farm L.P. model was developed to incorporate all the possible economic activities that a farmer can undertake to increase his level of welfare. Though rather difficult to construct and to obtain data for, this model has proved to be Useful for the impact analysis of new technology on dryland agriculture (Ghadake, 1983). The results obtained from the model will show the potential for technology adoption under the existing resource endowments and other constraints, the impact of improved technology on incomes, cost and risk, the village level impact of improved technology, and the impact on the factor shared and the demand for and repayment potential of credit. Therefore, it can be said that, if there exists a group a qualified researchers, a good set of data, and a good computer facility. the whole-farm quadratic programming mode1 is a useful tool for the analysis of the impact of expanded production of CGPRT crops on production, income and employment. However, in reality, these requirements are difficult to fulfill in most Asian countries, and the applicability of this type of model may still be limited.

V. Summary and Conclusion

Although the Importance of CGPRT crops has been generally recognized in Asian countries, socio-economic research on these crops has been relatively neglected. This has been due partly to the fact that much research effort has previously been directed to the improvement of rice crops. As a result, the research capabilities for CGPRT crops have been somewhat limited.

The production of CGPRT crops can be expanded considerably if the major socio-economic constraints are removed. A review of the situation in Asian countries reveals that marketing price and credit are among the most important constraints. It is therefore proposed that an analysis of these constraints be conducted in a systematic manner in these countries. At the same time, in anticipation of an increase in the production of CGPRT crops, an analysis of the impact on rural welfare should be undertaken.

Research methodologies have been proposed for studies on the constraints and impact of expanded production. As socio-economic environments and resource endowments vary according to country, only three countries, namely, Indonesia, the Philippines and Thailand, have been selected for the proposed study. Furthermore, only three crops, namely, maize, cassava and soyabeans, are included in the study. The methods of analysis are simple and should be accessible to researchers in the developing Asian countries. However, if computer facilities exist, a more sophisticated technique may be employed. Finally, if a comparative study is to be conducted, a training program for researchers should be offered. This may be organized by an international regional center and/or a national research institution.

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REGIONAL NETWORK CO-OPERATION FOR SOCIO-ECONOMIC STUDIES ON CGPRT CROPS; A PROPOSAL*

Networks in international agricultural research

1. Networks were initiated as early as in the 1920s in the United States to promote research on hard red wheat in the Great Plains and on hybrid maize in the Corn Belt. The All-India Co-ordinated crop improvement programmes were initiated during the late fifties.

2. The International Stem Rust Nursery, initiated in 1950 by the USDA, was the first formal multinational network. FAO and UNDP have for many years used a network approach to promote agricultural research and development (R& D). Since the early 1960s, the two oldest International Agricultural Research Centres (IARCs), i.e., IRRI and CIMMYT, have been active in setting up research networks, often beginning with international nurseries.

3. Most networks have been set up to tackle one or several specific problems shared by a number of scientists in different regions or in different countries, with a view toward enhancing impact and cost effectiveness.

4. Some networks are limited to research while others focus on exchange of information or technology transfer, but many have several aims, including research, communication, training and extension.

5. The reasons to form a network may vary. But, as J. Dupont (IDRC) put it, "the basic principle is to bring national and regional research institutions out of isolation and widen their resource bases and ranges of activities".

6. Dupont adds: "Although forming networks entails certain additional co-ordination costs, it makes possible training and experimental programs in which Third World researchers, working on the same problem or in the same discipline, get together to acquire new knowledge and new techniques, develop a common methodology, and place local problems in their true regional or even global context".

7. Structurally, a network involves a number of participants, individuals or institutions; in the latter case formal arrangements are often sought. In all cases there is always a kind of nerve centre, or hub, the minimum role of which is to collect, synthesize and disseminate information, and to stimulate research.

8. Networks are not static. The hub often plays a major role in the early stage, but the network may become more and more collaborative when confidence is gained among the participants. The network is also flexible and may gain in complexity with time and with perceptions of new needs.

A Network for socio-economic studies on CGPRT crops.

9. Networks for socio-economic studies are fewer in number than networks for technical research. The former International Rice Agro-Economics Network (IRAEN), and the East African Regional Economics Program are two examples of networks which have focused work at farm level (on-farm research), and have included agronomists as well as economists.

10. Socio-economic research is fundamentally different from technical research. Two major differences may be stressed here;

*) Prepared by Dr Francois E. Dauphin. Senior Agronomist, ESCAP/CGPRT Centre, Bogor

(i) the social scientist rarely produces his own recommendations for the farmer. His recommendations are addressed to his technical counterparts in the R & D structure (how to better target technical research to suit farmers' conditions) or to the planners (policies needed to remove external constraints);

(ii) the social scientist works by observing; experimentation Is usually not possible. To avoid subjectivism he relies on date, however reliable they may be.

11. Because of these two characteristics of his work, the social scientist has a specific status in the R & D process. He is rarely fully associated in this process, but typically is asked to modulate technical recommendations, or to provide social explanations for their limited adoption. In some cases he works in total isolation producing reports for "whomever it may concern .

12. In such situations the social scientist's work is unproductive; this is also the case with probably much of the technical research. In spite of frequent institutional barriers, we believe that it is possible for the social scientist to play a greater role in research planning, implementation (on farm research), and evaluation. But the must prove his ability to identify problems, to propose researchable solutions, and to answer questions from his technical colleagues in a time-frame compatible with that of technical research. In fact, his capacity to participate in or to lead multidisciplinary programmes primarily depends upon his professional skill and his knowledge of the farmers' situation.

13. Although CGPRT crops may seem a heterogeneous lot, they have many characteristics in common, which require a much broader approach then is necessary for the main staple food. At production level, the farmer may adjust his whole cropping system to gain relatively modest benefits from a new technology related to the main crop, but he is bound to be more conservative when adjusting for secondary crops. Marketing is often week for CGPRT (palawija) crops and prices are more unstable. Demand for traditional utilization may be declining, while new markets may be growing (for which statistics are usually not yet available) and opportunities on the international markets must be sought.

14. It is clearly out of the question that the present small research teems working at a national level can effectively cover all these fields in each country. Networking may be the best way to overcome the difficulty of sharing and co-ordinating work.

15. Since broader fields and different approaches need to be envisaged, there is also a need for new methodologies. While social research is by nature location specific, methodologies can have a much broader validity, as demonstrated by the wide relevance of IRRI's or CIMMYT's conceptual frameworks for on-farm research.

What makes a network successful?

16. The history of international networks in agricultural research is now long enough from which to draw a number of lessons. The Second Review of the CGIAR (1981) concluded that networks function effectively when:

1. The scope of research is well defined;
2. The problem is shared by all the participating countries;
3. Activities are restricted to a geographic region, thereby facilitating communications;
4. Participating institutions are involved as equal partners;
5. Each participant gains from the association and therefore enthusiastically supports it;
6. Participating institutions have funds to fully collaborate; and
7. The lead institution has sufficient capability to provide strong and enlightened scientific direction.

17. Few of these conditions are a priori fulfilled. But certainly a common problem is: "How can research, especially socio-economic research, effectively contribute to the development of CGPRT crops for the benefit of concerned farmers and of rural economies of participating countries?" Finding the answers to this question that are relevant to the various circumstances existing in the region, and helping participating scientists to implement the solutions could be the major raison d'etre of the proposed network.

The proposed network

18. Objective and functions

The main objective of the proposed network is to promote co-operative research on CGPRT (palawija) crops. The network would perform the following functions:

1. Research planning and co-ordination through;
   - Inventory surveys of work already done,
   - reviews of priorities,
   - inter-country work sharing;
2. Enhancement of research capabilities through:
   - exposure to various aspects of similar crops in different situations, and to different approaches followed by other teams,
   - learning from successes or failures of projects undertaken elsewhere,
   - shared experience in problem Identification and research planning,
   - development of common methodologies,
   - training;
3. Widening research coverage, through;
   - development of studies related to marketing and demand, especially for recent utilizations,
   - implementation of studies on regional or international trade;
4. Support to research projects or studies through;
   - provision of technical assistance from the Centre, or IARCs, FAO or other institutions, or from consultants,
   - provision of assistance to secure additional funding when necessary; and
5. Collection, processing and dissemination of information.

19. Structure and participation

A co-operator in each country is needed to serve as the hub of the country sub-system, responsible to channel information from the network to interested researchers in the country and from the country to the network, and to stimulate research in his country.

A leader could be elected from among the co-operators, and would be assisted by a secretary belonging to CGPRT Centre staff.

A formal arrangement may be helpful but may not be strictly necessary.

Participation should not be restricted to social scientists, but, on the contrary, should involve other scientists and development workers concerned with palawija crops.

Most of the study work carried out will be in-country work, which will require the setting-up of appropriate working groups on specific study projects in each of the participating countries.

When such specific projects require the assistance of a consultant, an ad-hoc triangle type of co-operative machinery could be setup between the interested research institutions, the consultant, and the Centre.

20. Activities

Activities of the network may include:

- Annual meetings for planning and co-ordination;
- Workshops on specific subjects (enchange of experience, methodology development);
- Study tours, in connection with the above-mentioned workshops;
- Studies on subjects of common interest to several countries;
- Co-ordinated in-country studies;
- Information collection, processing and dissemination of information, including preparation of bibliographies, of state-of-the-art reviews, and publication of a newsletter and of a directory of scientists.

21. **Costs**

As is a rule in networking, most of the costs are to be met by sharing the existing resources of the participants, thereby reducing the fixed costs to a strict minimum. The following are only tentative indications of the magnitude of recurrent costs:

		US$ per annum
Annual meetings		30,000
Workshop and study tours		40,000
Training		50,000
information services		(mostly to be provided by the Centre)
Allocation for co-operative or	)	
co-ordinated research Consultants	)	100,000 to 200,000
Consultant	)	

COUNTRY PAPER

BANGLADESH

SOCIO-ECONOMIC CONSTRAINTS TO PRODUCTION, UTILIZATION AND MARKETING OF SELECTED GRAIN LEGUMES*

Introduction

The acute shortage of food legumes in the diet of Bangladesh and the declining acreage under these traditional legume crops in the country call for immediate measures to improve the situation. Pulses have traditionally been considered as the "poor man's meat", and are the cheapest source of proteins and the essential amino acid "lysine", the deficiency of which is likely to lead to mental and physical dwarfism. Traditionally, grain legumes, besides providing calories, proteins, minerals and vitamins in the diet of the rural poor, have served as the source of valuable nitrogen and organic matter to improve the soil, and have provided a major amount of feed and fodder for livestock. In addition, the legume crops, unlike rice, wheat and maize, can be grown an marginal lands with low inputs. These advantages are significant, particularly in Bangladesh, where soils are deficient in nitrogen and organic matter and the majority of the population are subsistence-level farmers. Therefore, the grain legumes play a significant role in the agriculture of Bangladesh.

The daily per capita availability of pulses in Bangladesh is 8 grams, far below the estimated minimum of 28g and optimum of 65g (Khan, 1983). The 1982-83 production of 0.2 million metric tons (Bangladesh Bureau of Statistics) needs to be more than doubled by 1984-85 to meet the estimated total requirement of 0.55 million metric tons for a population of over 100 million at a minimum consumption rate of 15 g/per capita/per day. The nutrient qualities of major pulses of Bangladesh are summarised in Table 1. All the available local pulses contain a good quantity of protein and other nutrients. It is also interesting to note that pulses play an important role in balancing the protein quality of a cereal based diet (Table 2). The prospect of shifting the diet from rice to wheat, maize and potato as the important sources of calories requires that the minimum proportion of at least 1 pulse to 10 cereals (1:10) be maintained.. The 2nd five Year Plan of Bangladesh aims to provide at least 12 grams of pulses/caput/day, which only ensures a proportion of I pulse to 30 cereals (1:30). This proportion, though nutritionally inadequate, would still require doubling the production of pulses, which is already a difficult task.

The climate and soil seem to be the main determinants of Bangladesh agriculture. Wet season flooding, at varying depths for up to six months, favours wetland crop culture, as is indicated by the nearly 80 per cent of total cropped area which is devoted to different rice crops (Table 3). The rest of the area is devoted to nearly 60 other crops, depending on their suitability to specific agro-climatic conditions. All pulse crops together constitute about 2.13 per cent of the total cropped area, and 3.29 per cent of the net cropped area in Bangladesh.

The cultivation of pulse crops is characterized by the diversity of the crops as well as by their locational distribution, according to specific agro-climatic conditions. All pulse crops have the advantage of being able to utilize residual soil moisture and soil nutrients more efficiently than cereal crops. The pulse crops are therefore traditionally grown in non-irrigated, nutrient deficient soils and on marginal lands.

The area, production and yield of pulse crops in Bangladesh, in general, have decreased over the period from 1969-70 to 1981-82 (Table 4). During this period, it has been observed that the area, production and yield of all pulses decreased at an annual rate of -0.96 per cent,

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* Prepared by Md. Shahadad Hossain and Ekramul Ahsan, Member-Director, Bangladesh Agricultural Research Council.

-2.98 percent and -2.10 percent, respectively. This is an alarming situation, considering the importance of pulse crops to the national health and nutrition needs, besides the benefits to soil structure and fertility.

Lathyrus (khesari), lentil (masur), blackgram (mashkalai), chickpea (chola), and mungbean are the major pulse crops grown in Bangladesh. The relative concentrations of cultivation of all pulses produced in Bangladesh in 1978-79 are illustrated in Figure 1.

The improvement of pulse crops through research efforts has been rather negligible until recently, compared to the efforts on rice, wheat, and some other crops. The recent thrust in research on some selected pulse crops, and the potential for improvement of production through market support, offers tremendous prospects for the food sector, especially for the improvement of the nutritional status of the rural poor.

It is rather disappointing to note that little research has been done in Bangladesh on pulse crops, particularly on the socio-economic aspects. Efforts in technological developments for pulse crops have not been significant. Farm level constraints to the increase of pulse production have not been adequately identified and analysed. Effective policy parameters have not been properly specified for promotion and growth of the pulse crops.

Farm level constraints, in general terms, are listed as low productivity, competition among crops, lack of institutional support, instability in price levels, and post harvest problems (including storage and marketing). However, the entire situation is not known and quantitative findings identifying policy parameters have still to be determined.

The proposed research projects on selected pulse crops are recommended based on an initial analysis of the present situation of CGPRT crops, in Bangladesh, and in consideration of the potential of these crops.

National Economy and Pulse Crops

The national development goals of Bangladesh pertaining to agriculture include the following:

i. self-sufficiency in food production,
ii. improvement of the nutritional standard,
iii. expansion of import substituting crops, and
iv. generation of productive employment.

In order to attain the national goals in agricultural development, agricultural research is imperative to determine the alternative methods of achieving targets. Strategies consistent to the immediate national objectives call for a high priority of research on food production systems. This implies that relatively greater emphasis be put on the improvement of food crop production.

The priority considerations for improvement of food production are an increase in cereals, an improvement in grain legumes production, and the nutritional balancing of the diet.

The relative priority of research on different food crops is based on an assessment of their relative contribution to the diet of the majority of people. Rice and wheat are the major components of the diet and provide most of the calorie requirements. The/ particularly meet the protein need. It is, however, desirable to have diversification in diet composition, which can be attained by the inclusion of pulses, and, to a limited extent, by animal products.

The grain legumes, commonly known as pulse crops, are the major source of protein and lysine, the essential amino acid which is usually deficient in cereal grains. Although some research on pulse crops has been done over the past few years, significant break-throughs have not been made in many aspects of pulse production, namely, advances in productivity and/or resistance to pests and diseases. The area under cultivation of pulse crops shows that during 1960- 1970, there was an increase in the cultivation of pulse crops whereas during the period of 1970- 1983, there was a net decrease in cultivated area, production and yield (Figure 2).

Figure 1. Area under Pulses by Subdivision, Bangladesh, 1978-79.

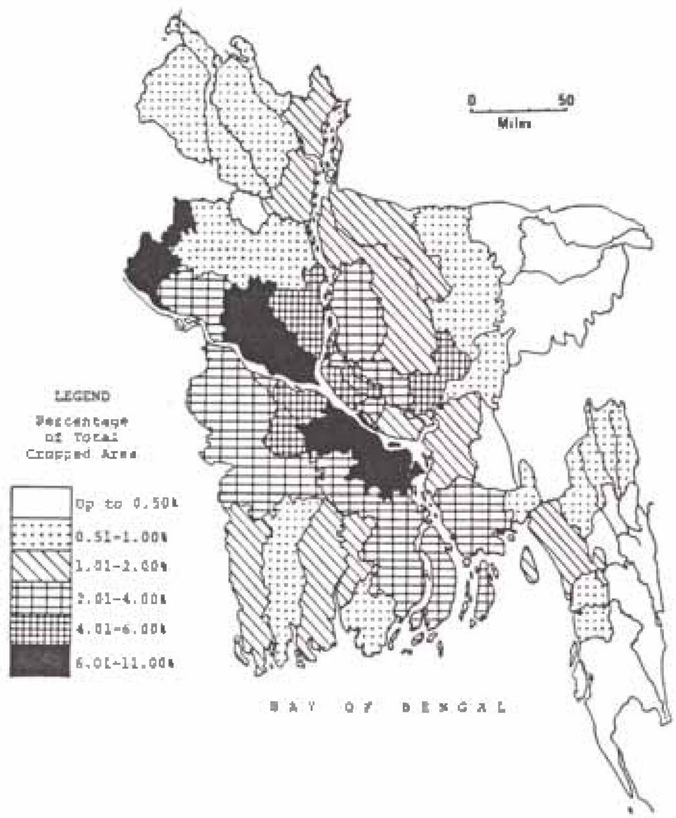


Figure 2. Land Use by Crops, Bangladesh, 1982-83.

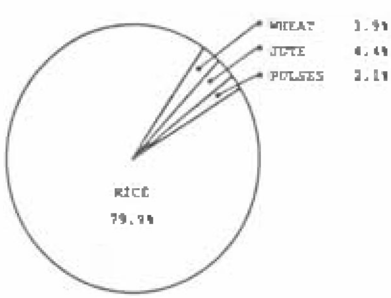
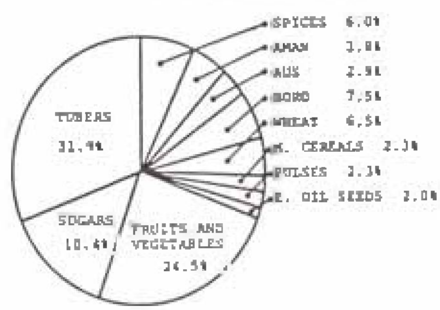


Figure 3. Production of Food Crops in Bangladesh, 1982-83.



The different pulse Crops grown in. Bangladesh include lathyrus (Khesari), lentil (Masur), chickpea (Gram), greengram (Mungbean), blackgram (Maskalai), pigeon pea (Ar har), peas and beans.

All the pulse crops together constitute about 3.29 per cent of the net cropped area, but from the production point of view these crops contribute only 1.05 per cent of all food production. The farm level productivity of pulse crops is quite low, making them weak competitors against cereals and other crops.

Nitrogen Fixation by Grain Legumes

It is a recognized fact that nitrogen is one of the key elements in soil fertility. Most of the developed countries are harvesting high yields and maintaining the soil nitrogen level by heavy application of nitrogen fertilizers. Nitrogen is generally depleted by leaching, denitrification, nitrogen immobilization, and by removal along with the crops. The cost of chemical fertilizer in Bangladesh is increasing at a fast rate, and the poor and marginal farmers are not able to afford the fertilizers. Legumes, and primarily pulses, play a vital role in maintaining the nitrogen balance of the soil. Legumes derive nitrogen from the air through the symbiotic relationship they form with Rhyzobium bacteria, and *they* release a significant amount of nitrogen to the soil. The amount of this symbiotic nitrogen depends upon the pulse species and the growing conditions (Table 7). On average, legume crops can fix 10-200 kg N/ha/yr.

Legumes as a Source of Fodder

The general health conditions of livestock in Bangladesh are poor. This is primarily due to the inadequate supply of quality fodder, hay, husks, cakes or concentrates for the estimated number of 50 million cattle, 2.67 million buffaloes, 25 million goats and sheep, and 163 million poultry birds. Cattle are fed mainly rice, straw, and to a small extent straw of wheat, joar, barley, etc. These have little protein content (rice straw consists of about 2.5-3.5 per cent protein).

Legume crops such as mungbean, blackgram, cowpea, lathyrus and pigeon pea are of better protein quality and could be profitably used as animal feed. Cowpea and lathyrus have the potential of yielding up to 10 tons per acre of fodder within 60-70 days. They contain a high amount of crude protein, have balanced amino acids and minerals (Ca, Fe), and are rich in vitamins A and D.

Pulse Crops in Cropping Systems

Except for some beans (grown in home gardens) and a few selected summer pulses, all pulse crops in Bangladesh have been traditionally grown during the winter period. The cultivation of pulse crops has been threatened by the large-scale expansion of wheat crops as well as by the expansion of irrigated areas which are being cultivated with bororice. As the pulse crops are being pushed out of the irrigated lands to make room for rice and wheat, cultivation of pulse crops remains more concentrated in the marginal lands, causing a decrease in the total area under pulse crops as well as declining production.

Different pulse crops are cultivated under different soil and water conditions, fitted in with various cropping sequences. Growing conditions identified by Gowda and Kaul (1982) are as follows:

1. Flat marginal nonirrigated lands where pulses are cultivated as a sole crop or as a mixed crop with various cereals and oilseeds such as barley, millet, mustard, linseed, etc.
2. Low- lying areas where lentil and lathyrus are grown after deep-water paddy rice.
3. Relatively high land, subject to periodic drought, unsuitable for the cultivation of any cereal or oilseed crop during the winter season.

The cropping patterns with pulse crops in different regions are depicted in Table 8.

Figure 4. Area, Production and Yield Average of All Pulses, Bangladesh, 1972-73 to 1982-83

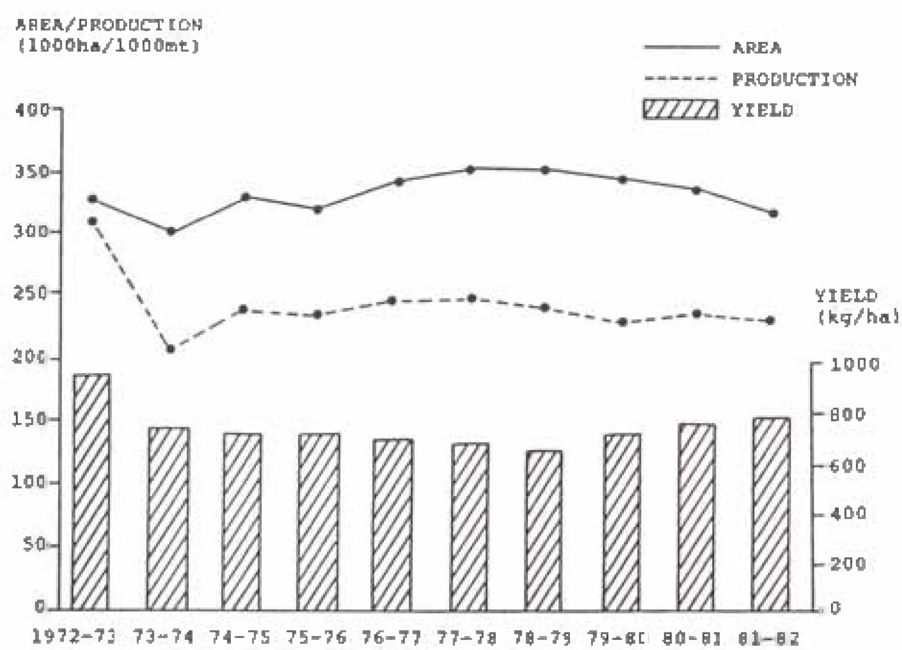
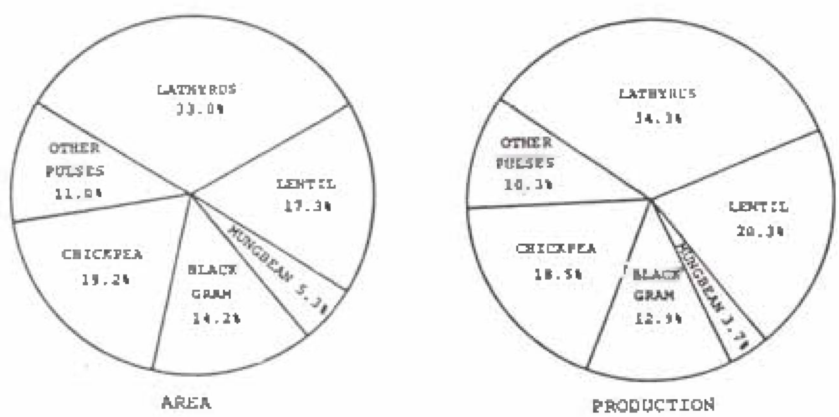


Figure 5. Distribution of Different Pulse Crops, Area and Production, Bangladesh, 1982-83.



Pulse as a pure or mixed crop - Pulse crops are grown as a sole crop or mixed with other crops. A recent farm survey showed that pulses were grown as a pure stand by 32 per cent, as a mixed crop by 6E per cent, and as both by 2 per cent of the farmers (Table 9). Mixed cropping was preferred for all major pulses.

Relay Cropping of Pulses - Farm survey results reveal that, of the farmers growing pulses, about 28 per cent plant pulses as a relay crop. Lathyrus is most commonly grown as a relay crop, i.e., by about 87 per cent of the farmers growing lathyrus.

Mixed Cropping - According to the farm survey, 70 per cent of the farmers with pulse crops grow pulses as a mixed crop. Mustard is the preferred crop to mix with pulses, as reported by S 1 per cent of the farmers. Mixed crops are planted by 77 per cent of the lathyrus farmers, 53 per cent of the lentil farmers, and 27 per cent of the chickpea farmers. The second most preferred crop to mix with pulses is linseed, as reported by 29 per cent of the farmers who plant mixed crops, 43 per cent of the lentil farmers, 32 per cent of the chickpea farmers, and 11 per cent of the lathyrus farmers (Table 10).

Intercropping of Pulses - The farm survey reveals that 96 per cent of the farmers did not intercrop pulses with other crops (Table 10). Farmers who do intercrop, plant pulses with potatoes, chillies, tobacco, watermelon and sugarcane. Cowpea was intercropped most frequently with pulses.

Economics of Pulse Production

The importance of the cultivation of pulse crops for the social and economic benefit of the rural poor has been mentioned previously. Traditionally, the pulse crops are grown with minimum investment and on marginal lands which are not appropriate for the cultivation of major cereals, namely rice and wheat. The pulse crops are also the major sources of protein, carbohydrates, fat, minerals and vitamins, and are therefore important in the diet of the rural poor.

Because there are few empirical studies on the socio-economic aspects of pulse crops in Bangladesh, the complete picture of the economics of pulse cultivation is not yet clear. The theory that pulse crops are not profitable cannot be assumed to be correct because detailed cost benefit analyses on pulse crops have not been done yet. Adequate specifications of the qualitative and quantitative benefits of pulse crops in terms of their contributions to human nutrition, soil improvement, and livestock feed should be incorporated in a cost benefit analysis of pulse crop production.

A 1978-79 survey of rabi (winter) crops undertaken by the Agro-Economic Research Cell of the Ministry of Agriculture in the Kushtia district revealed that gram and lentil yielded a negative net return when all variable costs were considered. However, the cost and return pictures show a positive net return for both of these crops if calculations are based on cash cost only, and the corresponding benefit/cost ratio was 1.28 and 2.33 for gram and lentil respectively.

The 1982-83 sample survey conducted by the Economics Division of the Bangladesh Agricultural Research Institute reveals a net margin of Tk. (Taka) 1,953 per hectare for lentil considering all variable costs, and the per hectare return goes as high as Tk. 3,079 when only cash costs are used as the basis of calculation. Similar studies on mungbean and lathyrus conducted by the Economics Division of Bangladesh Agricultural Research Institute reveal even higher net returns end relatively higher benefit/cost ratios (Table 11).

This implies that the cultivation of selected pulse crops, namely, lentil, mungbean and lathyrus, is relatively more profitable than the cultivation of wheat.

Consumption and Marketing of Pulse Crops

Consumption of Pulses - A significant proportion of the pulse crops is consumed by the farm families, while a part of the total harvest is used as seed, and the remainder is sold intermittently. Farm survey results on lentil cultivation reveal that, on average, 16 per cent of the total pulse production were consumed by the form families, 47 per cent were sold immediately after harvest, 19 per cent of the product were sold some time after, harvest, and 18 per cent were used as seed (Table 12). The share of home consumption decreased as the farm size increased. On the other hand, the share of total products sold increased with the increase in farm size (Table 12).

Price of pulses - The trend of pulse crop prices has been observed to be increasing during the last four years. For example, the harvest price indices of pulse crops, taking 1975-76 as the base year (100), show that a price Increase was observed for all pulses crops during the period from 1977-78 to 1981-82 (Table 13). The table also shows that the increases in the prices of almost all the pulse crops were comparatively higher than those of other competitive crops such as paddy, wheat, mustard and potato during the same period.

Different farm surveys on pulse crops reveal that there is a variation in the market price for different pulses at different periods of the year. The market prices of all pulses are generally higher at planting time than at harvesting time, when the bulk of the produce is sold. The average price per kg received by the farmers was Tk. 6.39 for lentil, Tk. 0.77 for mungbean, Tk. 7.71 for blackgram, Tk. 6.43 for chickpea and Tk. 3.74 for lathyrus (Table 14). The wholesale and retail prices of all the pulse crops are much higher than the farm gate prices, indicating that farmers do not receive their actual price. In general, farmers receive the highest price for mungbean and the lowest price for lathyrus.

Marketing of pulse - The marketing system of pulse crops in Bangladesh is very complex. The pulse growers sell their produce to different agencies, wholesalers, retailers and other farmers. Farm level survey results (Khan, S. H. and Khan, T. A., 1984) show that 57 per cent of the pulse producers sell most of their pulses at the village market (Table 14). Wholesalers and retailers purchase 1 1 per cent of the produce, 10 per cent are sold to other farmers, and 22 per cent of the farmers did not sell any of their produce (Table 15).

Lathyrus producing farmers reported that they sold mainly to the village market (45-per cent) as did the farmers selling chickpea (52 per cent) and lentil (78 per cent). Twenty-six per cent of the lathyrus producers do not sell their grain, compared to 25 per cent of the chickpea farmers and 10 per cent of the lentil farmers.

Another survey conducted in the major pulse growing areas of Bangladesh showed that about 35 per cent of the farmers sold their produce to wholesalers and 25 per cent to retailers (Table 16). More than one-third of the farmers disposed of their produce at the wholesale markets and about one- third sold at the local market (Table 17).

Available Technology and Levels of Adoption

The National Agricultural Research Plan of Bangladesh recognized that little was yet achieved in the development of improved technology for pulse production and utilization, and for that reason, intensive research on pulse crops is recommended by the Plan. Researches on the selection of improved genetypes, the development of appropriate agronomic practices, the development of technology for post-harvest storage, and resistance to pest and diseases are the major components recommended in the Research Plan.

Recognizing the importance of pulse crops, a co-ordinated pulse improvement programme has been recently initiated and sponsored by the Bangladesh Agricultural Research Council.

To enrich the germplasm base, valuable plant material is being collected systematically in collaboration with the following international centers: International Crop Research institute for the Semi-Arid Tropics (ICRISRAT, India), International Centre for Agriculture Research In the Dry Areas (ICARDA, Syria), Asian Vegetable Research and Development Centre (AVRDC, Taiwan), and International Rice Research institute (IRRI, Philippines) under the Asian Cropping System Research Programmes.

Agronomic trials on soil fertility and cropping systems have been initiated and other areas of research, namely, microbiological studies, research on pest and diseases, and post-harvest storage studies, have been incorporated in the co-ordinated programme. Farmers' field trials are also being conducted by the On-Farm Research Division of BARI (Bangladesh Agricultural Research institute) and the Department of Agricultural Extension.

Current technologies which are available elsewhere and adaptable to the conditions in Bangladesh have not yet been widely practiced at farm level, primarily because the technologies have not been adequately tested within the soclo-economic context of the Bangladesh farming environment.

A number of lines of lathryrus with low neurotoxin content have been screened and selected, but their acceptability at farm level is not yet known. Short duration summer pulse crops like mubarik (mungbean) and haromashi (blackgram) have been developed by the Bangladesh Agricultural Research Institute; these have a reasonable high-yield potential, but are yet to be adopted by the farmers on a large scale. Introduction of these crops in the summer time may result in significant changes in the cropping patterns under rainfed agriculture. The social and economic Implications of these crops in the context of the farming system have not yet been adequately analysed.

The short-duration dwarf varieties of pigeon pee (lines 76012, 76013, ICPL-2 and ICPL-4) are appropriate for intercropping. Deep rooted and insensitive to day-length, these appear to be promising varieties for dry arm in early summer. On the other hand, the traditional long-duration pigeon peas are a source of fuel wood for the rural people. Economic analyses of the options offered by dwarf short-duration and tell long-duration crops in the context of the farm system are required.

A number of cowpea lines developed under the Asian Cropping Systems programme are being tested in farmers' fields and have already demonstrated good yield potential. The lines have been tested fn cropping systems under farmers' conditions. Economic analyses of their impact at farm level are recommended, to determine incentives for wider adoption.

While it is recognized that there are possibilities for improvement in the pulse crops, no major technological breakthroughs are apparent yet in some selected aspects of pulse production The technology transfer aspect is also quite slow. There is a serious technology practice gap a the farm level. One of the many reasons for this situation is the gap in the socio-economic and social science studies to identify farm level constraints to the production of pulse crops, an analyses of the socio-economic impact of the expanded production of these crops.

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Table 1. Approximate Chemical Composition of Major Legumes (Percent).

Legume	Moisture	Carbohydrate	Protein	Fat	Mineral	Vitamins
Lathyrus	10	46	29	5	2	0.3
Lentil	11	55	27	1	2	0.5
Mungbean	10	51	26	3	4	0.3
Blackgram	9	56	25	2	4	0.4
Chickpea	8	54	21	4	3	0.8

Source: Annual report of Pulses Improvement Project
Bangladesh Agricultural Research institute (BARI).
Joydebpur, 1980

Table 2. Improvement of Cereal Diet through Complementation, with Pulses.

Protein Source	Average wt. gain*	PER**
100% Rice	43	2.15
90 Rice + 10 Pulses	56	2.32
100 Maize	13	0.87
90 Maize + 10 Pulses	32	1.40
100 Wheat	19	1.05
90 Wheat + 10 Pulses	41	1.73
100 Sorghum	12	0.88
90 Sorghum + 10 Pulses	30	1.39

Source: Annual report of Pulses Improvement Project, BART,
Joydebpur. 1960.
* Based on an experiment conducted on albino rats.
** PER = Protein Efficiency Ratio, an index of protein quality (PER of egg is around 3.0).

Table 3. Land Use in Bangladesh, 1982-83.

Land use	Area		% of TCA
	million acres	million hectare	
Total area	35.31	14.29	
Total cropped area (TCA)	32.91	13.32	100.00
Net cropped area	21.28	8.61	64.66
Rice	26.16	10.49	79.49
Wheat	1.28	0.52	3.89
Jute	1.43	0.58	4.35
Sugarcane	0.41	0.17	1.25
Tea	0.11	0.04	0.33
Tobacco	0.13	0.05	0.39
Potato	0.27	0.11	0.82
Sweet Potato	0.16	0.07	0.49
Oil Seeds	0.73	0.29	2.22
Pulses	0.70	0.28	2.13
Spices	0.37	0.15	1.12
Vegetables	0.42	0.17	1.28
Other cereals including Millets	0.14	0.06	0.43
Fruits	0.38	0.15	1.15
Cotton	0.05		0.15
Maize	0.004	0.02	0.01
		-	

Source: Bangladesh Bureau of Statistic (BBS)

Table 4. Trends in Area, Production and Yield of important Pulse: during 1969-70 to 1981-82

	Trends during 1969-70 to 1981-82 (percent/amount)						
	Lath-yrus	Lentil	Mung-bean	Black-gram	Chick-pea	Other pulses	Total pulses
Area (hectares)	37	1.54	- 1.87	-1.44	-2.22	-5.82	-0.96
Production (metric tons)	-1.28	-0.50	-4.52	-3.13	-3.81	-6.83	-2.98
Yield (kg/ha)	-1.59	- 1.95	-2.50	-1.85	-1.45	0.72	-2. 10

Source: Adapted from BBS.

Table 5. Production of Different Food Crops in 1982-83

Food Crop	Production (000 metric tons)
Cereals	15 357
Rice	14 216
Wheat	1 095
Others	46
Tubers	1 862
Potato	1 149
Sweet potato	713
Sugar crops	629*
Sugarcane	595
Palms	34
Oilseeds	253
Edible oil seeds	166
Others	87
Pulses	219
Fruits/Vegetables	2 362
Spices	300

Source: Adapted from BBS

Table 6. Yield of Different Crops in Bangladesh, 1982-83.

Food crop	Yield (Kg/ha)
Cereals:	
Aman Rice	**1268**
i) Broadrast	**1013**
ii) Transplant	**1357**
Aus Rice	**971**
Boro Rice	**2474**
i) Local	**2862**
ii) High Yielding Variety	**2110**
Wheat	**966**
i) Local	**2158**
ii) High. Yielding Variety	**774**
Minor cereals	
Tubers	**10580**
Sugars	**3467**
Edible Oil Seeds	**667**
Pulses	**777**
Fruits/Vegetables	**8129**
Spices	**2002**

* Adapted from BBS.

Table 7. Symbiotic Fixation of Atmospheric Nitrogen by Some Legumes.

Legume	N fixed (kg/ha/annum)
Sesbania Cannabina	542
Psophocarpus Tetragonolobus	250
Cajanus Cajan	224
Vigna Unguiculata	198
Arachis Hypogea	124
G'ycine Max	103
Cicer Arietinum	103
Lens Culinaris	101
Pisum Sativum	65
Vigen Radiata	61

Source: Cowda and Kaul, "Pulses in Bangladesh". 1983.

Table 8. Cropping Patterns in Different Agro-Climate Regions of Bangladesh with Pulse Crops as Components.

	Kharif I (mid March- mid July)	Kharif II (mid July- mid Nov.	Rabi (mid Nov. mid March)
A. For North-West region (Bogra, Dinajpur and Rangpur)			
	Mungbean/Blackgram	T. Aman*	Fallow
	Mungbean/Blackgram	T. Aman	Potato
	B. Aus**	T. Aman	Mungbean
	Fallow	T. Aman	Chickpea
B. For North-West region (Pabna, Rajahahi, Jessore, Kushtia & Faridpur)			
	B. Aus	T. Aman	Peas
	Jute	Mungbean	Chickpea/lentil/wheat
	Jute	T. Aman	Lathyrus/ Chick. pea/lentil/wheat
	B. Aman	-	Lathyrus/ Chick pea/lentil/wheat
	Maize/Mungbean or Blackgram (intercrop)	T. Aman	Lathyrus
	Jute	Fallow	Rabi pulses/ wheat
	Jute	Mungbean	Pigeonpea
C. For Central region Dhaka, Tangail, Comilla & Sylhet)			
	Jute	T Amsn	Lathyrus/ lentil/ Chickpea/wheat
	Mungbean/Biackgram	T Aman	Wheat/Chickpea/lentil/ lathyrus
	Deep Water Aman	-	Mustard/lathyrus/ lentil/ linseed
	Jute	Mungbean	Pigeonpea

* Transplanted Aman Rice
** Broadcast Aus Rice

(Table 8, continued)

Cont.Table 8

D. For South and South East region (Barisal, Noakhali, Chittagong Hill Tracts)

B. Aus	T. Aman	Cowpea
Pigeonpea/Mungbean/ Blackgram (Intercrop)	T. Aman	Cowpea
Mungbean/Blackgram	T. Aman	Fallow
B. Am an	-	Rabi pulses/wheat

Table 9. Pulse Crops Grown as Sole Crop or Mixed Crop

Pulse crop culture	All pulses	Lathyrus	% of farmers Chickpea	Lentil	Cowpea
Pure	32	32	20	32	100
Mixed	66	65	78	68	-
Both	3	3	2	-	-
All	100	100	1001	100	100

Source: Constraints to increased pulse production in Bangladesh, Agriculture Sector Team/Canadian International Development Agency (AST/CIDA), September, 1964.

Table 10. Pulse Crops Grown as Relay/Mixed/intercrops

	Percentage of farmers				
	All pulses	Lathyrus	Chickpea	Lentil	Cowpea
RELAY	28	87	2	-	-
Yes	72	13	98	100	100
No					
	100	100	100	100	100
B. Aman*	96	98	-	-	-
Others	4	2	100	-	-
MIXED					
Yes	70	73	82	70	-
No	30	27	18	30	100
Mustard	51	77	27	53	-
Linseed	29	11	32	43	-
Barley	12	6	27	2	-
Other	8	6	14	2	-
	100	100	100	100	100
INTERCROP					
Yes	4	2	2	2	45
No	96	98	98	98	55
	100	100	100	100	100
Sugarcane	25	100	100	100	-
Potato	42	-	-	-	56
Chili	17	-	-	-	22
Tobacco	8	-	-	-	11
Watermelon	8	-	-	-	11
	100	100	100	100	100

Source: Constraints to increased pulse production in Bangladesh.
AST/CIDA, September, 1984.

* Broadcast Amnan rice.

Table 11. Average Cost and Return of Lentil, Mungbean, Lathyrus and Wheat Cultivation (per hectare) in Some Selected Areas of Bangladesh.

Parameter	Lentil	Mungbean	Lathyrus	Wheat
Yield of main product (kg/ha)	502	672	1013	1636
Yield of by product (kg/ha)	422	273	1453	1818
Price of main product (Tk/kg)	6.08	8.30	4.47	3.70
Price of byproduct (Tk/kg)	1.17	1.18	1.18	0.25
Cost of main product (Tk/ha)				
Full cost basis	1593	2021	1646	4526
Cash cost basis	467	614	492	2158
Gross return (Tk/ha)				
Value of main product	3052	5582	4528	6053
Value of by product	494	321	1715	454
Gross margin (Tk/ha)				
Full cost basis	1953	3882	4597	1981
Cash cost basis	3079	5289	5751	4349
Return to labour (Tk/day)				
Full cost basis	48	66	99	27
Cash cost basis	68	217	367	37
Benefit/cost ratio				
Full cost basis	2.23	2.92	3.79	1.44
Cash cost basis	7.59	9.62	12.68	3.02

Source: Research Reports, Division of Agricultural Economics, BARI.
Note : Returns to labour per day = (Gross return minus total cost except labour cost) - total mandays. Benefit/cost ratio = Gross return - total cost.

Table 12. Disposal Pattern of Lentil Produced by Survey Farmers

Farm size	Percentage of total lentil produced: Consumed	Sold immediately after harvest	Sold later in the year	Use for speed
Small	24	42	20	14
Medium	20	42	23	15
Large	13	49	18	20
All farms	16	47	19	18

Source: Elias & Sikder lentil production in Bangladesh, Division of Agricultural Economics (DAE), Bangladesh Agricultural Research Institute (BARI). 1964

Table 13. Sale of Grain/Seed Produced by Sample Farmers.

Amount of Sale Product	All-pulses	Lathyrus	Chickpea	Lentil
	% of farmers reporting			
Half	5	7	-	6
More than half	35	30	-	76
All	20	5	57	2
Less than half	24	26	40	7
None	16	32	3	9

Source: Constraints to increased pulse production in Bangladesh, AST/CIDA, 1984.

Table 14. Harvest Price Index of Major Pulse Crops and Some Competitive Crops.

(Base year 1975- 76 - 100)

Crops	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Pulse crops						
Lathyrus	80	122	111	150	247	198
Lentil	96	121	142	160	235	248
Mungbean	61	121	108	142	212	205
Blackgram	77	136	142	161	155	179
Chickpea	74	96	91	144	207	228
Other crops						
Paddy Boro	96	103	152	155	151	176
Wheat	139	142	138	180	194	236
Mustard	99	119	102	118	149	128
Potato	63	77	112	95	105	84

Source: Adapted from BBS.

Table 15. Average Prices of Different Pulses, 1982-83, Tk/kg.

Pulses	Farm Gate √a	Wholesole √b price	Retail √ b price
Lathyrus	3 74	8.04	9.02
Lentil	6.39	11.31	12.64
Mungbean	9.77	13.88	14.88
Blackgram	7.71	-	11.54
Chickpea	6.43	10.80	12.47

Source: √a Annual Report. Legume Postharvest Technology (Bangladesh), BARI, 1982-83.
√b Bangladesh Bureau of Statistics (BBS).

Table 16. Sale of Grain/ Seed of Pulse Crops by Sample Farmers in Different Markets.

Farmers selling pulses to	Percentage of farmers All pulses	Lathyrus	Chickpea	Lentil
Other farmer	10	18	10	2
Middleman	11	11	13	10
Village market	57	45	52	78
Did not sale	22	26	25	10
Total	100	100	100	100

Source: Constraints to Increased Pulse Production in Bangladesh, AST/CIDA, 1964.

Table 17. Distribution of Farmers Selling Pulses to Different Intermediaries in the Suryey Areas.

Survey areas	Whole-salers	Farmers (%) selling pulses to: Retailers	Other farmers	More then one agency	Total
Ishurdi	36	31	19	14	100
Jessore	37	18	19	26	100
Feni	33	28	22	17	100
Jamalpur	25	20	38	17	100
Kishorgonj	40	30	14	16	100
All areas	35	25	22	18	100

Source: Annual Report. Legume Post-harvest Technology (Bangladesh), BARI, 1962-63.

Table 18. Distribution of Farmers Selling Pulses from Different Sale Centres in the Survey Areas.

Survey areas	Farmers (%) selling pulses from:				
	Home	Local	Whole-sale market	More than one place	Total
Ishurdi	14	39	39		100
Jessore	8				100
Feni	15	28	37	20	100
Jamalpur	5	25	42	28	100
Kishoregonj	7	28	30	35	100
	10	40	30	20	
All areas	11	32	36	21	100

Source: Annual Report, Legume Post-harvest Technology (Bangladesh), BARI, 1982-83.

Table 19. Area, Production and Yield of Pulse Crops.

Year	Area (000 hectares)	Production (000 M tons)	Yield (Kg/ha)
1969-70	375.2	297.7	793
1970-71	372.3	300.8	808
1971-72	359.4	285.5	794
1972-73	314.5	297.7	947
1973-74	284.5	211.3	743
1974-75	309.6	226.6	732
1975-76	305.1	223.5	733
1976-77	333.1	233.7	702
1977-78	337.9	239.8	709
1978-79	338.3	228.6	676
1979-80	329.8	220.7	669
1980-81	321.9	216.4	672
1981-82	308.0	222.5	722
1982-83	282.5	219.5	777

Table 20. Average Yield of Pulses : 1969-70 to 1982-83 (Kg/ha)

Year	Lathy-rus	Lentil bean	Mung-gram	Black-pea	Chick-pulses	Other	Total pulses
1969-70	837	737	706	819	827	795	793
1970-71	820	760	695	849	833	818	808
1971-72	815	737	695	900	837	753	794
1972-73	751	697	648	794	673	701	947
1973-74	777	708	676	769	728	706	743
1974-75	782	683	604	806	708	695	732
1975-76	771	681	659	781	712	725	733
1976-77	717	655	646	739	728	685	702
1977-78	720	653	614	745	783	680	709
1978-79	697	606	614	704	765	642	676
1979-80	698	583	554	708	684	620	669
1980-81	693	594	473	714	649	942	672
1981-82	710	652	526	688	875	823	722
1982-83	808	912	540	708	749	723	777
	-1.59	-1.95	-2.50	-1.85	-1.45	-0.72	-2.10

Table 21. Production of Pulses: 1969-70 to 1981-82 (in 1,000 metric tons)

Year	Lathy-rus	Lentil	Mung-bean	Black-gram	Chick-pea	Other pulses	Total pulses
1969-70	79.3	54.9	16.3	45.7	57.9	43.7	297.7
1970-71	79.3	56.9	13.2	47.8	61.0	42.7	300.8
1971-72	78.2	52.8	13.2	44.7	59.9	36.6	285.5
1972-73	65.0	43.7	9.2	38.6	40.6	29.5	297.7
1973-74	57.9	42.7	7.1	36.4	40.6	25.4	211.3
1974-75	62.0	47.8	8.1	42.7	39.6	26.4	226.6
1975-76	63.0	44.7	9.1	41.7	38.6	26.4	223.5
1976-77	71.1	48.8	10.2	38.6	40.6	24.4	233.7
1977-78	71.1	51.8	10.2	38.6	44.7	23.4	239.8
1978-79	69.1	50.8	10.2	35.6	42.7	20.3	228.6
1979-80	65.0	49.8	9.2	33.5	39.6	18.3	220.7
1980-81	64.0	49.8	7.1	33.5	37.6	24.4	216.4
1981-82	66.1	48.8	8.1	29.5	46.7	23.3	222.5
1982-83	75.2	44.7	8.1	28.4	40.6	22.5	219.5

Table 22. Area Planted to Pulse Crops: 1969-70 to 1981-82 (in 1,000 ha)

Year	Lathy-	Lentil	Mung-bean	Black-gram	Chick-pea	Other pulses	Total pulses
1969-70	94.7	94.5	23.1	55.8	70.0	55.0	375.2
1970-71	96.7	74.9	19.0	56.3	73.2	52.2	372.3
1971-72	95.9	71.6	19.0	52.6	71.6	48.6	359.4
1972-73	86.6	62.7	14.2	486	60.3	42.1	314.5
1973-74	74.5	60.3	10.5	47.3	55.8	36.0	284.5
1974-75	79.3	70.0	13.4	53.0	55.9	38.0	209.6
1975-76	81.7	65.6	13.8	53.4	54.2	36.4	305.1
1976-77	99.2	74.5	15.8	52.2	55.8	35.6	333.1
1977-78	98.7	79.3	16.6	51.8	57.1	34.4	337.9
1978-79	99.2	83.8	16.6	50.6	55.8	31.6	338.3
1979-80	93.1	85.4	16.6	47.3	57.9	29.5	329.8
1980-81	92.3	83.8	15.0	46.9	57.9	25.9	321.9
1981-82	93.1	74.9	115.4	42.9	53.4	28.3	308.0
1982-83	93.1	49.0	15.0	40,1	54.2	31 1	282.5
	.37	1.54	-1.87	-1.44	-2.22	-5,82	-0.96

INDIA

PULSES: PERFORMANCE, POTENTIALS, PRODUCTION CONSTRAINTS AND PRIORITIES FOR RESEARCH*

III. Introduction

The advent of high-yielding varieties, the increase in production and utilization of fertilizers, the increased irrigation potential and the development of production and protection technology have all significantly contributed to changing the face of Indian agriculture from gray to green. The institution of Crop Improvement Co-ordinated Projects has added impetus to this breakthrough in agriculture. The green revolution of the sixties and seventies would have been greener still, had there been concurrent improvement in all the crops, had the scientific efforts been stepped up to break the barriers to genetic potential, had the transfer of technology been more effective, and had the translation of technology to the farmers' level been complete.

Grain legumes are classified as food grains in India. Next to cereals, pulses provide protein requirements. Chickpea and pigeonpea account for about 32 and 12 per cent of area and 45 and 18 per cent of the production of pulses in India (1975-83). Any fluctuation, therefore, in the production of pulses adversely affects dietary components and the nutritional balance of the diet of the Indian masses. The performance, demand and net per capita availability, and the potential, constraints, opportunities, and research priorities in the production and utilization of pigeonpea and chickpea have been analysed in the following sections.

II. Growth of Foodgrains

The progress of agriculture has been substantial in the recent past. The production of food grains increased at the rate of 2.7 per cent per annum between 1975-80 and 1980-83 (Table 1). The rate of growth is slightly higher than the rate of growth of the population (2.1 per cent from 1971 to 1981), creating the feeling that satisfactory progress has been made in food production. The growing reserves of food grain further accentuate this feeling. But, in reality, food grain growth rate has been entirely accounted for by cereals (2.3 per cent) at the cost of pulses whose growth rate has actually declined in the period 1975-80 to 1980-83, reflecting the different developments of cereals and pulses. Regional imbalances of food production, consumption, incomes and levels of living resulted from the region-specific cultivation of crops.

I. Performance of Pulses

Pulses provide supplementary protein foods in India. Pulses are cultivated in the semi-arid tropics of India. As they are efficient moisture and nutrient users, pulses in India are cultivated under rainfed conditions - during the rainy or monsoon season or during the post-rainy season with receding moisture conditions. A variety of pulses are grown in India with local, state and regional adaptation.

Pulses occupied 18.4 per cent of food grains area and contributed to 9.5 per cent of food grain production during 1975-80 (Table 1). The area under pulses decreased marginally (-2.1 per cent) during the next three years. The production also decreased (-1.8 per cent), but the

* Prepared by G. Harinarayana, Project Co-ordinator. All India Co-ordinated Millets Improvement Project, Indian Council of Agricultural Research

productivity was nearly maintained. Pigeonpea and chickpea together accounted for 44.1 and 61.6 per cent of area and production, respectively, among pulses (Table 2).

2. Pigeon pea: Chiefly cultivated during the rainy season, pigeonpea growth extends into the post rainy and winter seasons,. particularly in the states of Maharashtra, Medhya Pradesh, Karnataka and Andhra Pradesh. Pigeonpea was cultivated in 2.9 million ha during 1980-83. The increase in area under pigeonpea at a compound growth rate of 9.5 per cent as compared to 1975-80 (2.6 million he) marginally arrested the decline in area under pulses. The area under pigeonpea increased in almost all the states where it is cultivated with the exception of Uttar Pradesh, the increase ranging from 1.6 to 86.8 per cent (Table 3). The area is increasing in the non-traditional states of Gujarat (86.8 per cent) and Andhra Pradesh (19.6), and the traditional bowl, Maharashtra (5.4 per cent.

The production has increased from 18.80 lakh tonnes in 1975-80 to 20.37 lakh tonnes during 1980-83 at a compound growth rate of 2.1 per cent. Gujarat and Andhra Pradesh again showed higher compound growth rates, corresponding with the increase in area. The production in Maharashtra, with nearly 25 per cent of the area under pigeonpea in India, remained constant, while in Utter Pradesh it declined at a compound growth rate of 2.3 per cent. Madhya Pradesh showed a 4 per cent increase in production.

The productivity of pigeonpea did not change over the years. Rather, it marginally decreased during 1980-83 in Uttar Pradesh (CGR: 2 per cent), and Maharashtra (CGR: 0.2 per cent), besides Karnataka and Tamil Nadu. Gujarat (CGR: 10.3 per cent), Madhya Pradesh (CGR: 3.1 per cent) and Andhra Pradesh (CGR: 2.2 per cent) recorded increases in productivity.

3. Chickpea: Chickpea is cultivated in the post rainy season under receding moisture conditions. Chickpea accounts for 32.4 per cent of the area and 44.9 per cent of the production of pulses in India. Madhya Pradesh, Uttar Pradesh, Rajasthan and Haryana alone account for nearly 80 and 85 per cent of the chickpea area and production in the country. The area under chickpea has considerably decreased over the years, at a compound growth rate of 7.3 per cent. The wee in almost all the states, with the exception of Madhya Pradesh, decreased A similar trend was observed in the production and productivity of chickpea, with Punjab and Haryana leading the states of Rajasthan and Maharashtra. However, production and productivity increased in Madhya Pradesh and Uttar Pradesh , the major states.

I. Demand, Supply and Per Capita Availability

The demand for pulses has been on the increase over the years. However, the production has been fluctuating between 10.6 and 13.0 million/tonnes over the period 1975-83, barring 1979 when the production dipped to 8.6 million/tonnes. This compares unfavourably with the requirements which ranged from 17.6 to 20.6 million/tonnes during the same period (Table 4). The chronic shortage of pulses artificially inflates the prices and deprives the poor of a nutritional food The per capita net availability of pulses has been 17.2 kg/annum during 1971, as against the nutritional standard of 25.6 kg/annum and has further come down to 14.1 kg/annum during 1982-83. To achieve the requirement of 24.2 million/tonnes during 1990, and to fill the gap in per capita net availability and attain reasonable nutritional standards, the growth rate of production of pulses has to be around 9.6 per cent per annum from 1982.

Pigeonpea accounts for 16.4 per cent of the production of pulses while chickpea accounts for 44 per cent at the 1982 level. Pigeonpea production has to be increased by 9.4 per cent and chickpea by 9.6 per cent at the 1982 level to meet the demand for pulses by 1990.

II. Production Potential

Considerable yield grains have been achieved by research stations in potential (highest) and realizable (lowest) grain yields during the periods 1975-80 and 1980-83 (Table 5). Yield gap analysis also indicated that a vast potential exists for increasing the grain yields of pigeon pea and chickpea on farmers' fields. However, the farmers have not even realised the lowest grain yields of the research farms. There are also wide variations in the yields obtained from year to year and region to region.

1. Potential Gap: The ratio between the farmers' yields and the highest yields represents the potential yield gap of the crop in question.

The highest grain yields of pigeon pea ranged from 1006 to 3149 kg/ha during 1975-80 as compared to the farmers' yield of 455 to 1350 kg/ha, Indicating a total yield gap of 36.2 to 81.2 per cent. This yield gap further increased during 1980-83. The yield gap variation was more during 1980-83 than during 1975-80, being highest in the non-traditional areas of the northwest. During 1980-83, the yield gap variation was the highest in the Peninsular Zone where pigeonpea is a major crop. This is a disturbing trend.

The total yield gap in chickpea ranged from 63.2 to 75.6 per cent in 1975-80, and from 59.5 to 73.0 per cent in 1980-83. The variation in total yield gap was much less then that of pigeonpea, indicating a stability in chickpea production over both the years and the regions.

1. Research Gap: This gap reflects the genetic potential of the crop, and the difference between the lowest and the highest yield levels. There is a considerable research gap both in pigeon pea and chickpea. The research gap in pigeon pea ranged from 30.9 to 84.7 per cent in 1975-80 and 1980-83. This indicates that the research capabilities in terms of investment and manpower are used more effectively on chickpea improvement programmes than on pigeon pea.

Traditional breeding methodology, a lack of information on biochemical processes, and a lack of application of biotechnology appear to chiefly limit the efforts to reach or even to breakthrough the yield barriers. Tissue culture and recombinant DNA technology offer immense possibilities for bridging this gap. However, these technologies call for great investments in material and human resources. There is need to train "down-to-earth` scientists who are capable of matching the genetic engineering techniques with classical breeding and genetic methods. They could transgress the carriers of heredity (DNA), hasten recombination, end even reduce the "generation gap" in elevating and stabilizing the genetic potential at newer end greeter heights.

2. Adoption Gap: It may not be possible, particularly under rainfed conditions, to elevate the farmers' yields to the level of potential yields. However, it would be desirable to raise the productivity to the level of realizable yields. The adoption gap represents the difference between the farmers' yields and the realizable (lowest) yields on trial farms, and truly reflects the constraints to the transfer of technology.

Contrary to the research gap, the gap in adoption was wider in chickpea than in pigeon pea. The variation in adoption ranged from 22. 1 to 27.8 per cent in pigeon pea as compared to 33.7 to 43.8 per cent in chickpea during 1975-80. Similarly, the gap ranged from 8 to 36.2 per cent in pigeon pea, and 26.1 to 42.1 per cent in chickpea during 1980-83. This variation between pigeon pea and chickpea is understandable, as pigeon pea is grown during the rainy season, and chickpea in the post rainy season under receding moisture conditions. This indicates that chickpea is more "risk-prone" than pigeon pea

The variation in yield gap also reflects the variation in seasonal conditions. However, the realizable Yields were much higher then the farmers' yields during 1975-80 as well as during 1980-83, with the exception of. Pigeon pea in North East. This suggests that the recommended technology has the possibility to reduce the importance of weather risks. Given the infrastructural and institutional support, the recommended technology appears to have the necessary push to bridge the gap between the farmers' yield and the realizable yield, the potential being 125 to 175 per cent in pigeon pea end 200 to 210 per cent in chickpea on a national basis.

III. Constraints and Opportunities

1. Agro-Ecological Constraints: Pulses are cultivated in a wide range of agroclimatic conditions. Chickpea and pigeon pea areas overlap to a greet extent, and hence they share common agroclimatic conditions. Pigeon pea is chiefly cultivated in the rainy season, while chickpea is a post rainy season crop under receding moisture conditions. Pigeon pea production depends on the rainfall pattern, while chickpea production depends on the soil type. Both pigeon pea in the post rainy season and chickpea in areas above 20 degrees N face cooler temperatures and frost during the initial stages of pod development and grain formation.

Pigeon pea growing areas receive 600 to 1000 mm of rainfall with a coefficient of variation ranging from 20 to 25 per cent. The annual rainfall and the number of rainy days, therefore, fluctuates widely from year to year. The water availability is further affected by the water holding capacity and depth of the soils. Pigeon pea is chiefly cultivated in Indoganetic alluviums and deep vertisols, where intermittent water logging adversely affects the growth of the crop. In shallow light looms and alfisols, soil moisture retention often becomes critical.

1. Diversion of Pulses Area - A Disturbing Trend: The area under pulses is constantly being diverted to high value, highly productive cereals, particularly wheat and rice, because the pulses are low value and low profit return crops. Chickpea is greatly contributing to this area decrease. Almost all the states, with the exception of Madhya Pradesh, reported a decrease in chickpea area ranging from 3.3 to 22.8 per cent (Table 3). The greatest decreases are in the states of Punjab (37.5 per cent), Haryana (22.8 per cent) and Bihar (19.7 per cent), where the area under irrigation is constantly increasing.

2. Crops of Poor Resource Base: Pigeon pea and chickpea are more efficient users of soil moisture and nutrients than rice and wheat. Secondly, *they* produce grain even under the most adverse weather conditions. *They* are, therefore, preferred by farmers as low cost, low risk options, not by choice but by necessity. Hence they are relegated to marginal areas -- areas with low soil fertility and a paucity of soil moisture. Consequently, *they* are permanently deprived of a more productive resource base. This is adversely affecting the cultivation of pulses, in more than one *way.* Firstly, the fact that they are partners in the management of marginal areas is not well appreciated. Secondly, the marginal productivity of pulses in marginal lands is construed as the potential yield. Pulses, therefore, permanently occupy a second place. This significantly contributes to differential resource allocation, not only at the farmers' level but also by national planners and policy makers.

3. Managing Soil Moisture: Both rainfed pigeon pea as well as the post rainy season chickpea face soil moisture deficits during pod formation and seed development. Soil moisture conservation through amendments (grading, land shaping, drainage, erosion control) is, therefore, pivotal for the success of any technology. These practises often transcend the individual farm boundaries and involve community and group action. Large-scale adoption of soil amendments requires huge capital investments for equipment and technical know-how. The necessary infrastructural and institutional support is often wanting in the rainfed areas.

4. New Technology - A Must: New technology plays a key role in increasing the productivity of pigeon pea and chickpea. Tailor-made technology to suit small, medium and large farms as well as moisture and fertility gradients, and, most important, technology which is "viable" has been developed by the various All India Co-ordinated Projects - Pulses and Dryland. These national research efforts are being supplemented by international efforts through ICRISAT. These technologies have been time-tested on farmers' fields through the Minikits, National Demonstrations and Operational Research Projects:

5. Block Transfer of Technology - Full Kit: The technology developed on research stations in India is transferred to the end-users by demonstrations on farmers' fields. Three types of demonstrations are adopted in India.

The Minikit demonstrations are carried out on larger plots for the demonstration of the cost benefit ratios of the newly-developed or modified technology.

Both the Minikit and National Demonstrations do not involve the direct participation of research workers. The direct dialogue between the farmers and the researchers is achieved through Operational Research Projects where entire villages are "adopted" for the block transference of technology by a group of scientists. This serves as a vehicle for a two-way transfer of technology.

6. Graded Technology: The adoption levels of the improved technology vary depending on the size of the holdings (marginal, small, medium and large) and on resource allocations In the areas of finance and technical knowledge. Field studies have also revealed that technologies which are based on low monetary inputs, such as the introduction of high-yielding varieties, have been widely adopted by all classes of farmers. It is, therefore, necessary to develop graded technologies to suit the varying levels of adoption. Grading technologies involves determining the relative contributions of each of the inputs and their capacity to suit farmers of divergent resource bases who operate at different levels of skill and management.

7. Door-step Technology Delivery System: The small and marginal farmers are yet to benefit from the newly developed production technologies. These farmers are concerned with earning their daily bread W do not have time to keep appointments for information transfer. It is therefore, necessary to rech the farmers where they are, by developing a system for delivering the technology to the door steps.

8. Management Factor: Significant differences have been identified in the managerial performances in dryland farming villages of India. Farmers born in traditional farming households, and farmers who receive hands-on farm training prove to be better managers in terms of making use of production methods and in efficiently allocating resources. Variations in personal characteristics (age, education, etc.) and social stratification partly explain inter-farm variations in productivity.

9. Farm Prices: The cost of inputs, particularly fertilizer and labour, has steeply risen in recent years, but not the prices of the form produce. The fertilizer prices increased by 60 per cent from 1980-81 to 1981-82. While large and efficient farmers can rapidly adjust to the fluctuations, the small and medium farmers are caught in the web. It is, therefore, essential to caught establish some parity in farm prices in the interest of the farmers.

The support prices currently announced by the Agricultural Prices Commission need to be improved in two respects. Firstly, the support prices should be as close to the actual cost price as possible, and secondly, the support prices must be announced well in advance of the agricultural season to enable the farmers to plan the production.

1. Credit and Insurance: The farmers' goals do not necessarily include maximizing physical yields, particularly in an economy of subsistence based an diversified farming. In particular, small and marginal farmers do not have the ability to mobilize resources and cannot afford to take risks. For example, next to improved seed, fertilizer brings about the greatest visible changes in productivity. Large farmers readily adopted the recommended fertilizer practices. The small and marginal farmers are convinced of the utility of fertilizer application, but cannot fully adopt the recommended dose due to financial and risk constraints. The fertilizer consumption rate was 4.9, 9.5 and 10.8 per cent in the 1980-83 period owing to a raise in price and the non-availability of credit. Although relief to the extent of 7.5 per cent in fertilizer prices was given, the growth rate will be on the order of 12 per cent only during

1983-84. It is, therefore, essential to provide cheap credit and to cover it with an insurance to protect the farmers from the vagaries of weather.

1. **Transport:** Small and marginal farmers have limited marketable surpluses. It is uneconomical to take the produce to regulated markets. Middlemen are the ultimate beneficiaries. It is, therefore, necessary to devise means to increase the share of the small farmers and to reduce the profit losses.

1. **Rural Warehouses:** It is necessary to develop a network of rural go-downs for the stockpiling of surplus production, and to provide credit or advance payment against these commodities. This would partly ease the financial limitations of small and marginal farmers.

2. **Processing:** Pulses need to be processed for human consumption. It processing could be organized at places of production, several benefits would accrue to the producers. Bulk transportation could be avoided, rural employment opportunities would be expanded, and the by-products and wastes would be available to the producing farms. This kind of vertical integration of production and processing is yet to be fully explored (Dwarkinath, 1980).

1. Alternate Food Uses: Pulses can be directly consumed. Germinated whole grains and split grains are cooked and consumed. Flour is made into sweets and savouries. Pulses could also find a place in infant and invalid foods, provided their digestability is improved. Recently, weaning foods based on pulses, particularly chickpea, have been developed Research could be directed at developing protein concentrates, and supplementing food and bakery products.

I. Priorities for Research

1. Crop Improvement

i. Development of early maturing (100 to 120 days) and high-yielding varieties.
ii. Development of varieties suitable for different intercropping and sequence cropping systems.
iii. Breeding of disease and pest resistant varieties - in particular, for sterility mosaic virus in pigeon pea and for blight in gram.
iv. Development of new plant types for intensive agricultural practices.

1. Production Technology

i. Development of location- specific and graded technologies for different pulse growing regions, and studies on the contributions of individual inputs and their interaction effects.
ii. Technology for low and variable monetary inputs for marginal and small farmers.
iii. Cropping Systems
   a) Refinements in intercropping systems for increasing Land Equivalent Ratio.
   b) Refinements in sequence cropping systems for increasing basal productivity of the system.
iv. Fertilizer Use
   a) Fertilizer response studies for intercropping and sequence cropping systems with a legume component in conjuction with moisture harvesting and native fertility.
   b) Fertilizer economy through fertilizer use in rainy and post rainy seasons.
   c) Conjuctive use of manures, fertilizers, crop residues, etc. v. Use of Biofertilizers
v. Use of Biofertilizers
   a) Identification of efficient strains for varieties and soils
i. Water Management
   a) Overall effects of mulches on soil moisture, temperature and organic enrichment.
   b) Water use by crops in relation to edaphic characteristics.

c) Water balance calculations using rainfall and potential evapo-transpiration data in conjuction with soil water storage.
d) Evaluation of soil cracking in vertisols and stoniness in alfisols in relation to their water balance characteristics.
e) Development of rainfall run-off models for small agricultural watersheds.
f) Intensification of studies on reduction of percolation and evaporation losses in small tanks and dug-outs.
g) Investigations into the use of watersheds for improving crop productivity through life-saving or supplemental irrigation increasing cropping intensity in rainy season, pre-sowing irrigation for post-rainy crops, etc.

2. Management of Diseases end Pests

a) Control of sterility mosaic virus in pigeonpea and blight in chickpea
b) Development of integrated crop protection methods, to control disease, pests and weeds.

3. Agricultural Implements

a) Development of a single bullock harness
b) Development of efficient draft animal machinery for various species of draft animals and agroclimatic zones.
c) Development of prototypes of more efficient tools end implements for pre-sowing tillage, line sowing, inter-row weeding, fertilizer placement, harvesting am post harvest operations.
d) Development of renewable energy gadgets/systems involving solar energy, wind energy, biogas, producer gas, etc.
e) Tillage and energy studies for various cropping systems.

4. Socio-Economic Research

a) Detailed economic evaluation of operational research on farmers' fields and impact on dryland farming.
b) Investigations into individual and joint input-output effects.
c) Watershed approach in the operational research projects.
d) Location-specific yield gap analysis, including diagnostic research and farm structure studies for Complementing and not substituting field testing.
e) Difficulties in procuring inputs, and determining pricing structures and market behaviour.
f) Providing consultancy and training support to the developmental agencies.
g) Feedback research relevant to the farmers' problems.
h) Education of farmers on soil and water conservation.

VIII. Epilogue

Agriculture is a dynamic activity and is the backbone of the Indian economy. It generate more than 50 per cent of the gross net product, provides employment to three-quarters of the Indian population, and supplies raw materials to industry. The population of 548.2 million in 1971 reached 685.2 million in 1981 with an annual growth rate of 2.1 per cent. The food production rate, which was 94 million/tonnes during 1971 has increased to 129 million/tonnes during 1981, recording an average growth rate of 3.2 per cent. Thus, we are barely able to balance the population and food grain growth rates and still maintain some buffer stocks. The population is expected to touch 976.7 million by the turn of the 20th century. It is, therefore, necessary to step up the production of food grains considerably to outweigh the population growth.

Indian agriculture is mainly rain-dependent. Of the 143 million ha of cultivatible area, 40 per cent are irrigated. Therefore, 86 million ha are perpetually subject to the vagaries of weather. Rainfed farming offers many challenges, particularly since the risks are unpredictable. A dynamic approach is essential for increasing the productivity of the farming system through a judicious combination of inputs and a change in the attitude of the planners, policy makers and the people. Id my view, the following long term measures need to be implemented for elevating and stabilizing food production.

1. Delimitation of Crops: Traditional agriculture depended upon a variety of crops for meeting the dietary needs. Modern agriculture is intensive, and demands material and human resource allocation. The multiplicity of crops (cereals, pulses, oilseeds, fibres, etc.) is diluting the efforts. It is, therefore, necessary to identify crops with present and future potential. Rice, wheat, sorghum, pearl millet and finger millet among the 12 cereals grown in India; chickpea, pigeonpea, greengram and blackgram among the 10 pulses; end groundnut, mustard, sunflower and soyabean among the 10 oilseeds need increased attention and production efforts.

2. Demarcation of Areas: Crops in India are cultivated under a range of agro-ecological conditions. The same crop is raised in both limited moisture and irrigated conditions, in both the depleted loans and infertile rich alluviums, and under a diversity of management factors, including seeds, fertilizers, skills, resources, etc. Intensive agriculture requires a contiguity of crops and areas. It would be, therefore, ideal and useful to identify and demarcate the areas best suited for each particular crop.

3. Distribution of Inputs: Seeds, fertilizers and investment are the chief ingredients of the productive farming systems. The coverage by high-yielding varieties is not complete or evenly distributed. Similarly, 60 percent of fertilizers are consumed by irrigated farms. Risk aversion is preventing input investment in rainfed agriculture. An even and equitable distribution of inputs would ensure higher productivity and a uniform balanced growth of the Society.

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Table l. Changes in Area, Production and Productivity of foodgrains in India

Year	Food Grains			Cereal			Pulses		
	A	P	Y*	A	P	Y	A	P	Y
1975	128.2	121.0	943	103.7	108.0	1041	24.5	13.0	531
1976	124.4	111.2	894	101.4	99.9	985	23.0	11.4	496
1977	127.5	126.4	991	104.0	114.4	1100	23.5	12.0	511
1978	129.0	131.9	1022	105.5	119.7	1135	23.7	12.2	515
1979	125.2	109.7	876	102.9	101.1	983	22.3	8.6	386
Mean	126.9	120.0	945	103.5	108.6	1048	23.4	11.4	488
Food Grains%	-	-	-	81.6	90.5	110.9	18.4	9.5	51.6
1980	126.7	129.6	1023	104.2	110.0	1142	22.5	10.6	471
1981	129.1	133.3	1033	105.3	121.8	1157	23.8	11.5	483
1982	123.3	128.4	1041	100.9	116.8	1158	22.4	11.6	518
Mean	126.3	130.4	1032	103.5	119.2	1152	22.9	11.2	491
Food Grains%	-	-	-	81.9	91.4	111.6	18.1	8.6	27.6
Compound Growth Rate (%)	-0.1	2.7	2.2	0	2.3	2.3	-0.6	-0.4	0.2

*A: Area (million ha); P: Production (million tonnes), Y: Productivity (kg/ha).

Table 2. Changes in Area, Production and Productivity of Pulses in India

Year	Food Grains			Cereal			Pulses		
	A	P	Y*	A	P	Y	A	P	Y
1975	24.5	13.0	531	2.7	2.1	786	8.4	5.9	709
1976	23.0	11.4	496	2.6	1.7	672	7.8	5.4	683
1977	23.5	12.0	511	2.6	1.9	734	8.3	5.5	660
1978	23.7	12.2	515	2.6	1.9	715	7.9	5.8	741
1979	22.3	8.6	386	2.7	1.8	643	6.8	3.3	479
Mean	23.4	11.4	488	2.6	1.9	710	7.8	5.2	654
Pulses%	-	-	-	11.1	16.7	145.5	33.3	45.6	134.0
1980	22.5	10.6	471	2.8	2.0	689	6.7	4.7	692
1981	23.8	11.5	483	3.0	2.2	744	7.8	4.6	584
1982	22.4	11.6	518	2.8	1.9	679	7.2	5.1	708
Mean	22.9	11.2	491	2.9	2.1	703	7.2	4.8	660
Pulses%	-	-	-	12.7	18.8	143.2	31.4	42.9	134.4
Compound Growth Rate (%)	-0.6	-0.4	0.2	2.8	2.1	-0.2	-2.1	-2.1	0.2

* A: Area (million ha); P: Production (million tonnes), Y: Productivity (kg/ha).

Table 3. Changes 1n Area, Production and Productivity of Pigeonpea and Chickpea In India

State	Area			Production			Productivity		
	1975 -80	1980 -83	Change (%)	1975 -80	1980 -83	CGR* (%)	1975 -80	1980 -83	CGR (%)
				A. PIGEONPEA					
Maharashtra	6.61	6.97	5.4	3.78	3.95	1.1	572	666	- 0.2
ttar Pradesh	5.19	5.10	- 1.7	6.99	6.38	-2.3	1350	1249	- 2.0
Madhya Pradesh	5.02	5.20	3.6	3.21	3.76	4.0	636	720	3.1
Karnataka	2.98	3.00	1.6	1.80	1.71	-1.3	599	560	- 1.7
Andhra Pradesh	1.99	2.38	19.6	0.38	0.50	7.1	191	288	2.2
Gujarat	1.21	2.26	86.8	0.63	1.72	28.5	517	763	10.3
Tamil Nadu	0.99	1.02	3.0	0.45	0.40	-3.0	459	414	- 2.6
India	26.46	28.97	9.5	18.80	20.37	2.1	710	703	- 0.2
				B. CHICKPEA					
Madhya Pradesh	19.47	20.11	3.3	10.29	12.87	5.8	490	639	6.9
Rajasthan	17.36	16.49	- 5.0	13.34	11.41	-3.8	757	693	- 2.2
Uttar Predesh	16.43	15.31	- 6.8	11.49	12.46	2.1	697	817	4.1
Haryana	9.82	7.58	-22.8	8.12	4.14	-18.4	802	584	- 8.2
Maharashtra	4.57	4.42	- 3.3	1.60	1.58	-0.3	350	358	0.6
Punjab	3.39	2.12	-37.5	2.92	1.26	-22.9	851	573	-10.4
Bihar	2.29	1.84	-19.7	1.28	1.34	1.2	568	728	6.4
Karnataka	1.72	1.58	- 8.1	0.71	0.77	2.1	407	488	4.7
India	78.34	72.56	-7.3	51.71	47.70	-2.1	654	660	0.2

* Compound Growth Rats (R)

Table 4. Requirement, Gross (Actual) Production and Net Per Capita Availability of Cereals ad Pulses in India

Year	Popu-lotion(1)	R.(2)	Cereals GP(3)	NPC (4)	R.	Pulses GP	NPC	R	Pigeonpea GP	NPC	R	Chickpeea GP	NPC
1971	548.2	87.4	94.1	145.9	16.1	11.1	17.2	2.5	1.7	2.6	7.4	5.1	7.9
1975	599.4	95.6	108.0	153.2	17.6	13.0	18.4	2.8	2.1	3.0	8.0	5.9	8.4
1976	612.9	97.8	99.9	138.5	18.1	11.4	15.8	2.7	1.7	2.4	8.6	5.4	7.5
1977	626.8	99.9	114.4	155.1	18.5	12.0	16.3	2.9	1.9	2.6	8.5	5.5	7.5
1978	640.9	107.2	119.7	158.8	18.9	12.2	16.2	2.9	1.9	2.5	9.0	5.8	7.7
1979	655.3	104.5	101.1	131.1	19.0	8.6	11.2	4.0	1.8	2.3	7.3	3.3	4.2
1980	670.1	106.8	119.0	150.9	19.8	10.6	13.4	3.7	2.0	2.5	8.8	4.7	6.0
1981	685.2	109.2	121.8	151.1	20.1	11.5	14.3	3.8	2.2	2.7	8.0	4.6	5.7
1982	699.6	111.6	116.8	141.9	20.6	11.6	14.1	3.4	1.9	2.3	9.1	5.1	6.2
1990	820.6	130.9	-	-	24.2	-	-	-	-	-	-	-	-
2000	976.7	155.8	-	-	28.8	-	-	-		-	-	-	-

Notes:
1. Population (millions): 1971 and 1981 Census Figures
2. R: Requirement (M tomes)
   Cereals: • 138.7 kg/annum/capita (380 g/day/capita) + 15 % seed, feed, wastage etc.
   Pulses :• 25.6 kg/annum/capita, (70 g/day/capita) + 15 % seed, feed, wastage etc.
   Pigeonpea : Ratio of GP of Pigeonpen to pulses X Pulse requirement
   Chickpea : Ratio of GP of chickpea to pulses X Pulse requirement
3. GP : Gross Production (m tonnes) Actuals
4. NPC : Net per capita availability (kg/ha) = Net availability (85% GP) - Population

Table 5. Production Potential of Pigeonpea and Chickpea in India

Zone	Area 1975-83 (% India)	Research Stations (kg/ha) Potential 75-80	Potential 80-83	Realizable 75-80	Realizable 80-83	Farmers' Fields (kg/ha) 75-80	80-83	Yield Gap (%) 1975-80 Total	Research	Adoption	(1980 – 83) Total	Research	Adoption
A. PIGEON PEA													
Peninsular	46.9	1006	1964	695	1148	455	437	54.7	30.9	23.8	77.7	41.5	36.2
Central	24.7	1249	1635	853	872	577	742	53.8	31.7	22.1	54.6	46.7	8.0
North East	18.5	2115	2155	324	1023	1350	1249	36.2	84.7	48.5	42.0	52.5	10.5
North West	2.0	3149	2419	1466	1413	592	731	81.2	53.4	27.8	69.8	41.6	28.2
India	2.8*	1702	2125	880	1250	710	703	58.3	48.3	10.0	66.9	41.2	25.7
B. CHICKPEA													
North West	37.6	2180	2281	1545	1425	803	617	63.2	29.1	34.0	73.0	37.6	35.4
Central	26.2	1816	2209	1286	1569	490	639	73.0	29.2	43.8	71.1	29.0	42.1
North East	23.8	2587	1910	1703	1272	632	773	75.6	34.2	41.4	59.5	33.4	26.1
Peninsular	8.2	1612	1301	923	851	379	423	76.5	42.7	33.7	67.4	34.6	32.8
India	7.5*	2049	1999	1364	1332	654	660	68.1	33.4	34.7	67.0	33.4	33.6

Peninsular Zone : Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu
Central Zone : Madhya Pradesh, Gujarat
North East : Uttar Pradesh, Bihar
North West : Rajasthan, Haryana, Punjab
* : Million hectares

INDIA

PEARL MILLET: PERFORMANCE, PROSPECTS AND PROBLEMS *

I. Introduction

Pearl millet is the fourth major food crop of India, comprising I 1 per cent of the cereal areas (103.5 million ha) and 4.5 per cent of the cereal production (119.2 million tonnes) Pearl millet is a major component of the dry farming system. However, it is ideally adapted to both rainfed and irrigated conditions, making it a potential food crop. Nutritionally superior to super cereals, pearl millet is an ideal food for infants and invalids and for the poor. Pearl millet can be directly consumed or mixed with pulses, and can be used as a substitute for wheat and rice in baked goods.

Pearl millet has substantial genetic and developmental potentials. The production potential has not yet been fully exploited and has so far been limited to the partial use of quality seeds of high-yielding hybrids and varieties, with low or no inputs and practically no use of water harvesting technologies. Given the quality seeds, small amounts of fertilizer, and the necessary "will to succeed", the productivity of pearl millet could be increased and stabilized at a higher level than the present 470 kg/ha.

II. Changes in Area, Production and Productivity

The pearl millet area remained nearly constant during 1975-80, fluctuating between 10.6 and 1 1.7 million ha. The annual production varied between 3.9 and 5.9 million tonnes during the same period.

The area increased slightly (2.9 per cent) during 1980-84 (11.4 million ha) over 1975-80 (11.1 million ha) (Table 1). Production and productivity also increased. Production reached 5.4 million tonnes during 1980-84, as compared to 5.2 million tonnes during 1975-80. The productivity increased from 465 to 469 kg/ha over the same period.

Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana are the major pearl millet growing states, accounting for 85.7 per cent of the area and 89 per cent of the production during 1980-84.

The area under pearl millet decreased in all the states during 1980-84 over 1975-80, with the exception of Rajasthan which showed an increase in irrigation and the diversion of areas to other crops. All the states except Karnataka recorded increased productivity at a growth rate of 0.2 to 6.1 per cent, a direct effect of the high-yielding varieties and hybrids. However, the production increased at the rate of 0 5 to 5.1 per cent in the major pearl millet producing states. Gujarat recorded a marginal decrease (-0.3 per cent); Punjab (-5.5 per cent). Tamil Nadu (-4.1 per cent), and Karnataka (-3.7 per cent) followed suit.

III. Requirements and Per Capita Availability

The requirements of pearl millet were estimated at between 4 and S million tonnes over the period 1975-83, while the production (3.9 to 5.9 million tonnes) exceeded the demand. The net

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* Prepared by G. Harinarayana, Project Co-ordinator, All India Co-ordinated Millets Improvement Program, Indian Council of Agricultural Research.

per capita availability ranged from 6.2 to 8.1 kg/annum. The requirements for 1985, 1990, 1995, and 2000 A.D. are estimated at 5.2, 5.7, 6.3, and 6.8 million tonnes, respectively, requiring a compound growth rate of 1.6 per cent at the 1982 level until 2000 A.D.

IV. Yield Gap Analysis

The total yield gap, the difference between the farmers' yields and the potential yield, is divided into research, management and adoption gaps (Tables 2 and 3). Yield gap analyses for hybrids (Table 2) and varieties (Table 3) were carried out separately.

1. Hybrids versus Varieties: The total yield gap in hybrids was greater than for the varieties, with the exception of Andhra Pradesh and Tamil Nadu, during 1975-80. Seed availability appears to be the chief limiting factor. The hybrid seed has to be replaced every year while the varieties are self-perpetuating.

The research gap in the hybrids was also greater than in the varieties. Hybrid breeding requires the development of new, high-yielding and disease resistant male steriles, the breeding of restorer lines, the identification of specific combiners, etc. Success in research depends upon investment in scientific manpower and other material resources.

The management gap in hybrids appeared to be greater than in the varieties. As the varieties are more akin to the locals, management limitations appear to be minimal.

The adoption gap was in general less in the case of hybrids than in the varieties.

2. Hybrids The total yield gap ranged from 43.4 to 89.6 per cent in 1975-80 to 62.3 to 86.6 per cent in 1980-84, indicating the advances in hybrid breeding.

The research gap was less in many states during 1980-84 over 1975-80, revealing an improvement in research management for hybrids. The management gap increased during 1980-84, indicating a lack of trained personnel.

The adoption gap was less during 1980-84, with the exception of Rajasthan and Kanataka. The nonavailability of hybrid seeds and the fact that they produce less fodder appears to discourage hybrid cultivation, particularly in the developing states such as Rajasthan where the adoption gap was 70.7 per cent during 1980-84.

3. Varieties: The total yield gap ranged from 47.1 to 84.1 per cent during 1980-84, as compared to 39 to 85.2 per cent during 1975-80. The yield gap was greater in Rajasthan, Maharashtra, Gujarat, Karnataka and Madhya Pradesh in 1980-84 than in 1975-80.

The research gap in Rajasthan, Haryana, Andhra Pradesh, Madhya Pradesh and Punjab was greater In 1980-84 than in 1975-80, indicating the need to intensify research activities.

The management gap was observed to be significant in Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka and Punjab, indicating the need for greater efforts by the extension agencies.

The adoption of varieties during 1980-84 was encouraging. The adoption gap was less during 1980-84 (5.4 to 53.1 per cent) than during 1975-80 (19.3 to 116.9 per cent). The farmers response to the varieties was better during 1980-84, as varieties equal in performance to the hybrids became available and the farmers could save their own seed. The improved varieties are also more akin to the local cultivars. Further, the high vulnerability of hybrids to diseases, particularly downy mildew, and the recurring and increasing costs of seeds and inputs discourage their adoption by the farmers.

V. Areas of Research

1. Varietal Improvement
   (a) Development of multiple disease resistant hybrids, including evolution of disease resistant and diverse male steriles and breeding for high-yielding and disease resistant restorers
   (b) Development of varieties, particularly synthetics
   (c) Development of white grained pearl millets with superior protein content and quality

2. Management of inputs
   (a) Development of graded technology
   (b) Use of biofertilizers
   (c) Management of intercropping systems
   (d) Identification of sequence and relay cropping systems
   (e) Water use

3. Management of Diseases
   (a) Development of stable multiple disease resistant lines
   (b) Genocropping systems research
   (c) Fungicidal management

Table 1 Changes in Area, Production and Productivity of Pearl Millet

State	Area			Production			Yield		
	1975-80 (lakh/ha)	1980-84 (lakh/ha)	Change (%)	1975-80 (lakh/t)	1980-84 (lakh/t)	Compound Growth Rate (%)	1975-80 (kg/ha)	1980-84 (kg/ha)	Compound Growth Rate (%)
Rajasthan	40.38	48.81	20.88	8.89	11.11	5.1	225	227	0.2
Maharashtra	16.76	16.73	- 0.18	6.11	6.61	1.7	367	404	2.2
Gujarat	15.13	13.78	- 8.92	13.11	12.91	-0.3	880	920	1.0
Uttar Pradesh	9.96	9.95	- 0.01	6.20	7.13	3.1	624	727	3.5
Haryana	9.11	8.31	- 8.78	4.21	4.97	3.8	455	595	6.1
Andhra Pradesh	5.54	5.11	- 7.76	3.25	3.49	1.6	590	672	2.9
Tamil Nadu	4.21	3.08	-26.84	3.60	3.00	-4.1	857	903	1.2
Karnataka	6.05	5.35	-11.57	2.81	2.40	-3.7	473	436	-1.8
Madhya Pradesh	1.80	1.76	- 2.22	0.94	0.96	0.5	518	544	1.1
Punjab	1.17	0.55	-52.99	1.19	0.66	- 5.5	1019	1142	2.6
India	110.69	113.91	2.9	51.56	53.62	0.7	465	469	0.2

Table 2. Production Potential of Pearl Millet Hybrids

State	Grain Yield (q/ha)								Yield Gap (%)					
	Potential		Realizable		Demonstration		Farmers' Fields		1975-80*			1980-84		
	1975-80	80-84	75-80	80-84	5-80	0-84	75-80	80-84	1	2	3	1	2	3
Rajasthan	17.6	15.0	12.6	12.4	11.8	12.9	2.3	2.3	28.4	4.5	54.0	17.3	-3.3	70.7
Maharashtra	25.6	29.9	20.0	23.2	13.4	11.1	3.7	4.0	21.8	25.8	37.9	22.4	40.5	23.7
Gujarat	23.7	30.7	18.9	26.3	13.1	12.5	8.8	9.2	20.3	24.5	18.1	14.3	450	10.7
Uttar Pradesh	22.5	30.9	17.3	17.7	15.6	13.1	6.2	7.3	23.1	7.6	41.8	42.7	14.9	18.8
Haryana	44.1	36.9	33.6	28.9	14.2	13.5	4.6	6.0	23.8	44.0	21.8	21.7	41.7	20.3
Andhra Pradesh	17.5	25.5	13.4	20.0	14.3	11.8	5.9	6.7	23.4	5.1	48.0	21.5	32.2	20.0
Tamil Nadu	15.2	23.9	11.9	16.2	11.6	10.0	8.6	9.0	21.7	2.0	19.7	32.2	25.9	4.2
Karnataka	21.2	20.9	15.3	15.3	9.6	10.3	4.7	4.4	27.8	26.9	23.1	26.8	23.9	28.2
Madhya Pradesh	30.0	35.2	22.1	26.1	10.4	9.4	5.2	5.4	26.5	39.0	17.3	25 9	47.4	11.3
Punjab	38.6	37.6	28 6	28.5	19.7	11.3	10.2	11.4	28.9	23.1	24.6	24.2	45.7	0.2
India	21.8	25.2	18.7	21.7	12.5	14.8	4.6	4.7	14.2	28.4	36.2	13.9	27.4	40.1

* 1) Research Gap; 2) Management Gap; 3) Adoption Gap

Table 3. Production Potential of Pearl Millet Variation

State	Grain Yield (q/ha) Potential		Realizable		Demonstration		Farmers'Field		Yield Gap (%) 1975-80			1980-84		
	1975-80	80-84	75-80	80-84	75-80	80-84	75-80	80-84	1	2	3	1	2	3
Rajasthan	12.6	14.5	10.8	11.3	9.2	10.0	2.3	2.3	14.3	12.6	54.8	22.1.	8.9	53.1
Maharashtra	20.6	23.2	16.1	20.1	12.9	9.0	3.7	4.0	21.8	15.5	44.7	13.4	47.8	21.6
Gujarat	20.2	24.8	16.3	21.3	12.8	10.2	8 8	9.2	19.3	17.3	19.8	14.1	44.8	4.0
Utter Pradesh	18.9	19.1	14.5	15.9	12.2	12.6	6.2	7.3	23.3	12.2	31.7	16.8	17.3	27 7
Haryana	31.1	28.9	25.4	23.2	11.4	12.2	4.6	6.0	18.3	45.0	21.9	19.7	38.1	21.6
Andhra Pradesh	19.2	20.7	17.0	17.2	10.8	8.8	5.9	6.7	1 1.5	32.3	25.5	16.9	40 6	10.1
Tamil Nadu	19.8	17.0	14.7	13.3	12.6	12.5	8.6	9.0	25.8	10.6	20.2	21.8	4.7	20.6
Karnataka	7.7	16.8	4.4	12.8	13.7	11.2	4.7	4.4	42.9	-120.8	116.9	23.8	9.5	40.5
Madhya Pradesh	22.1	27.8	24.2	20.0	12.4	6.9	5.2	5.4	-9.5	53.4	32.6	28.1	47.1	5.4
Punjab	20.7	30.9	24.3	23.6	22.2	18.0	10.2	11.4	15.3	7.3	41.8	23.6	18.1	21 4
India	17.9	19.3	16.3	17.8	11.9	11.4	4.6	4.7	8.9	24.6	40.8	7.7	33.2	34.7

* 1) Research Gap; 2) Management Gap; 3) Adoption Gap

INDONESIA

SOYABEAN MARKETING IN INDONESIA: A CONSTRAINT TO PRODUCTION*

Introduction

In the last decade, the total harvested area of soyabeans in Indonesia increased from 554,000 he in 1969 to 810,000 he in 1981. Up to now, more than 80 per cent of Indonesia's soyabean production have been produced on Java island, where the production was 341,000 tons in 1969, and increased to 579,000 tons in 1981 , which showed about a 70 per cent increase during that period. At the same time, soyabean production outside Java rose from 48,000 tons to 125,000 tons, indicating an increase of about 160 per cent. This tendency shows that there is a larger potential for increasing the soyabean production in the area outside Java.

However, the production increase cited above seems to be relatively slow when compared to that of other crops, such as rice. In any case, it has not been able to meet the expanding reeds of the population for tempe, tofu and animal feeds. Increasing quantities of imports have been required to fill the widening gap in domestic supply. These imports have, in turn, prompted the government to put more efforts into improving the soyabean production, similar to the efforts expended on rice, i.e., through BIMAS and floor price policies.

The reluctance of BULOG (the National Procurement Agency) in the procurement of soyabeans becomes apparent when we consider that the cost must be exceedingly high when production is spread in small pockets over large distances. BULOG must have realized that there is no need to improve domestic soyabean marketing at the present stage of production, and that it is more realistic to set up the marketing channels for soyabean import. Yet, because soyebean importation is easy and profitable, it may have been carried out to the extent that it has pushed the domestic price of soyabean down, wiping out the necessary incentive to promote soyabean production.

Supply and Demand Considerations

In Table 1, harvested area, production, and yield are presented for the period 1971-1983, which is subdivided into Pelita I, Pelita II, and Pelita III Periods. Note the slow growth of production, productivity, and yield, reflecting the virtually static soyabean economy in Indonesia Moreover, it explains soaring imports of soyabean in recent years, reminding us of the rice import situation in the previous decode.

When time series data are used,[1] income elasticity of demand for soyabean was estimated to be about 0.98. Thus, when income growth is set up at 5 per cent per annum, the rate of increase of demand will become:

$$5.0 \times 0.98 = 4.8\% \text{ per annum.}$$

On the other hand, when cross section data are used, income elasticity ranged between 0.9 and 1.1 for pulses.[2] If, for example, income elasticity is taken to be 1.0, the increase in

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* Prepared by Hidajat Nataatmadja, Senior Agricultural Economist, Centre for Agro-Economic Research, Agency for Agricultural Research and Development.

1 Delima Azahari and Chairil A. Rasahan, 'Pemasaran Kedele di Indonesia'. Center for Agro-Economic Research. 1984. Seminar Paper.

2 See John A. Dixon (1982). Food Consumption Patterns and Related Demand Parameters in Indonesia: A Review of Available Evidence. Working Paper No. 6. International Food Policy Research Institute

demand will be simply equal to the rate of growth of income, namely:

$$(5.0 - 2.32) \times 1.0 + 2.31 = 5.0\% \text{ per annum}$$

These estimates are based on the absence of changes in price.

Table 1. Soyabean Production in the Period 1974 -1983.

Year	Harvested Area (000 ha)	Production (000 ton)	Yield (qt/ha)
1974	768	589	7.67
1975	752	590	7.85
1976	646	522	8.07
1977	646	523	9.09
1978	733	617	8.41
1979	784	680	8.67
1980	732	653	8.97
1981	810	704	8.69
1982	806 *	683 *	8.47*
1983	713 **	625 **	7.67**
Rate of change % /annum,	0.05	3.12	2.94
1979-83, % /annum	0.69	1.73	0.86

Source: Director General for Food Crops, 1983

* Preliminary figure **Estimated

By using a simple model, the following is an effort to show reasonable estimates of consumption by using production and income date from the lest nine years. It is believed that significant changes should occur in the consumption behavior of Indonesians, since rice self-sufficiency has been achieved in recent years. Production plus import will be considered equal to consumption. Three year averages are taken, based on apparent changes in consumption, and thereby reducing the problem of carry-over stock. The data are shown in Table 2.

Between 1975/1977 and 1978/80 the real rate of growth of consumption was estimated at 5.81 per cent per annum, while between 1978/80 and 1981/83 it was 9.06 per cent per annum. Chairil A. Rasahan, using time series data, obtained an income elasticity of 0.96. In fact, income elasticity of soyabean consumption may be even higher than 1.0. Let; us try to simulate using some questimates:

For income growth of 7% per annum

$e = 0.8$: $r = (7.0 - 2.32) \times 0.8 + 2.32 = 6.06\%$ per annum

$e = 1.0$: $r = (7.0 - 2.32) \times 1.0 + 2.32 = 7.00\%$ per annum

$e = 1.2$: $r = (7.0 - 2.32) \times 1.2 + 2.32 = 7.94\%$ per annum

$e = 1.4$: $r = (7.0 - 2.32) \times 0.8 + 2.32 = 8.87\%$ per annum

The simple simulation technique suggests that income elasticity of soyabean consumption may in fact change, with the changes in the rates of growth of consumption. In the period 1975-79 it was assumed that e = 0.8, while in the period 1979--83 it was e = 1.4 which is a very high increase indeed. This large change hardly seems possible.

Table 2 The Development of Production, Import and Consumption of Soyabean, 1975-1983.

Year	Production (000 ton)	Import (000 ton)	Total Consump-tion	Three Year Average	Rate of Change %/annum	Simulated Consump-tion
1975	590.0	17.8	607.8			607.8
1976	522.0	171.7	693.7	637,868		642.3
1977	523.0	89.1	612.1		5.81**	679.6
1978	617.0	130.6	747.5			719.1
1979	680.0	176.6	856.6	786,000		760.8
1980	653.0	100.9	753.9			829.8
1981	704.0	361.33	1,065.33		9.06	905.0
1982	683.0	360.96	1,043.96	1,070,763		986.9
1983*	600	503.0	1,103.0			1,076.4

Source: Quoted from CGPRT preliminary report on soyabean study, 1984.
* Estimate, see Indonesian Commercial Newsletter.
** Note that the length of each period is 4 rather than 3 years.

It is possible that some of the soyabean import was also used by the feed industry when the import of soyabean cake was deficient, in which case the change was only for a short run.

Soyabean cake is used solely for feed mix and is imported in increasing amounts. As a feed mix it is much cheaper than the grain form of soyabean. Presently, no soyabean cake is produced in Indonesia, although a plan to construct a soyabean oil factory has been proposed, using imported raw material for the time being with a total capacity of 2,200 tons of grain per day.

The amount of soyabean cake import is high and increasing. According to the estimation made by the Directorate General of Livestock Production, the rate of growth of demand for soyabean cake should be 12.8 per cent per annum to reach the planned targets of livestock production (Table 3).

Table 3. Growth of Demand for Imported Soyabean Cake.

Year	Cake (000 ton)	Soyabean Eg. (000 ton)
1978	56.5	74.3
1979	66.6	87.6
1980	143.0	188.2
1981	153.8	202.4
1982	167.5	220.4
1983	195.8 (est.)	257.6
1984	224.1 (planned)	294.9

Source: Directorate General of Livestock Production.
Cake to soyabean ratio is assumed to be 0.76.

As previously shown in Table 2, the gap between production and consumption is already great and increasing. Probably the gap will cease to widen and level off, at which time, based on a simple speculation, income elasticity should change back to the earlier value of 0.8. At the rate of 7 per cent income growth this means a 6.06 per cent increase In soyabean consumption per annum; while for the assumed lower income growth of 5 per cent, the increase would be around 4.6 per cent per annum. In 1984 the target income growth is only 5 per cent per year, yet this rate is too small when a longer time period is considered.

Assuming the level of production of 700,000 ton in 1983, we can calculate the level of production growth to achieve self-sufficiency in soyabeans within the next 10 years as follows:

For an assumed income growth of 5 per cent:

$$700(1+r)^{10} = 1{,}076\ (1 + 0.046)^{10}$$

$$r_5 = 9.29 \text{ per annum}$$

If it is an assumed income growth of 7 per cent:

$$700(1+r)^{10} = 1{,}076\ (1 + 0.046)^{10}$$

$$r_7 = 10.7\% \text{ per annum}$$

When self-sufficiency includes soyabeans for feed use, the relations become: For an assumed income growth of 5 per cent:

$$700(\ 1+r)1^{0} \quad = 1.076\ (\ 1.046)^{10} + 257\ 0 + 0.91)^{10}$$

$$r_5\ * \quad = 12.6\% \text{ per annum}$$

Whereas, for an assumed income growth of 7 per cent:

$$700(\ 1+r)10 = 1.076\ (1.0606)^{10} + 257\ (1 + 0.128)^{10}$$

$$r_7* = 14.8\% \text{ per annum}$$[3]

The magnitude of soyabean imported for feed is a problem, for which the solution should utilize several alternatives, such as feed mix formulas using available domestic materials.

Up until this point we have not mentioned any price changes, while the magnitude of demand shown in this section suggests strongly that a proper pricing policy is called for the curb domestic consumption and to offer incentive to the soyabean growers, while equalizing production and consumption. On the other hand, the magnitude of both the gap and the required rate of change to eliminate the gap suggests that the soyabean subsector was not properly taken care of for a considerable time in the past.

Price Changes and Price Policy

It may be shown that the relative prices of soyabean with respect to rice have been, surprisingly, constant or even decreasing within the last five years. It is surprising because we know that soyabean deficits were high in the domestic market. From this simple fact it is easy to understand why the growth of soyabean production has been so slow.

When the price of soyabean is compared with the price of nine basic commodities in rural areas, the same conclusion is also reached. Domestic prices of soyabean must be under a strong

[3] This is about to the Pelita IV target in soyabean production.

pressure from the price of soyabean imports, considering the virtually unbounded import policy. It is also not surprising that under the heavy pressure of soyabean imports, Delima and Rasahan do not observe any trace of significant influence of soyabean price on consumption, as if the changes in the consumption of soyabean occurred in a perfectly price elastic market! This is a very effective policy indeed, but not necessarily good. Unfortunately, effectiveness and goodness are different animals, and may be hostile to each other.

Table 4. Soyabean Prices, 1980-82

Year	Floor Price (Rp/kg)	Farm Price (Rp/kg)	9 Commodity Index*	Deflated Price Floor Price	Deflated Price Farm Price
1980	210	284	463	45.36	61.34
1981	240	321	534	44.94	60.11
1982	270	346	599	45.08	57.76

*Based on constant price in 1971

The data in Table 4 show what happened in the soyabean market in the period 1980-1982. Note that the floor price was, in general, lower than the farm gate price, meaning that the floor price was not effective, as shown 1n BULOG's soyabean procurement (Table 5).

Table 5. Soyabean Procurement in the Provinces (metric ton)

Year	North Sulawesi	North-East Sulawesi	Eastern Island	West Irian	Total
1979	87	-	-	-	87
1980	4,137	-	1,339	-	5,476
1981	3,882	405	285	23	4,595
1982	735	607	417	-	1,759

Source: BULOG. 1983

Note also that the farm price decreased, which to a slight extent was also true for the floor price. The small amount of procurement and its yearly changes suggest that the system must be far from effective. In fact, facing the current level of production, there is no need to talk about soyabean procurement and market improvement.

The farm gate price is compared with the retail price paid by the consumer, and marketing cost and profit margins are shown in Table 6.

The farm gate in terms of retail price percentage is relatively high, showing the relatively efficient marketing. The lower prices in NTB and Lampung are reasonable, as the two provinces are located_ outside Java, with less accessible marketing and transportation facilities. With the relatively high (percentage-wise) farm gate price, it is hardly meaningful to talk about marketing improvement.

That domestic procurement price and cost are much higher then the soyabean import price

Table 6. Soyabean Marketing Cost and Profit Margins.

	West Java	Central Java	East Java	NTB	Lampung
Farm Price	78.98	80.12	80.91	64.46	69.15
Market Cost	12.79	8.99	6.92	5.48	14.01
Profit Margin	18.23	10.89	12.17	30.06	16.84
	100%	100%	100%	100%	100%

Source: Fatemeta IPB, 1976

Table 7. Domestic Procurement versus Import of Soyabean in 1983

	Domestic Purchase	Import
Purchase Price	283.00 Rp/kg (62.9%)	254.00 Rp/kg (56.4 %)
Procurement Cost	84.22 Rp/kg (19.7%)	77.71 Rp/kg (20.7 %)
BULOG Cost Price	367.22 Rp/kg (81.6%)	331.71 Rp/kg (77.1 %)
Retail Price	450.00 Rp/kg (100%)	450.00 Rp/kg (100 %)

and cost is shown in Table 7.

BULOG channels imported soyabeans directly to KOPTI, the Co-operative of Soyabean Processors (tempe-tahu industry), at the price of Rp. 432/kg franco, or at the quoted price of Rp. 400/kg loco BULOG's go down, as was the case in West Java in February 1984. The CIF price was at that time about Rp. 280/kg, showing that the CIF price was 61.9 per cent of the selling price. The retail price in the free market was Rp. 523/kg at that time.[4]

The data suggest that soyabean imports yield a high profit, and, it not, that the marketing channel operated by BULOG must be inefficient. The level of domestic procurement price is too low in 1983, only 62.9 per cent of the retail price, showing that the floor price was not effective, i.e., farm gate price was higher than the floor price.

From here on, we should examine the domain of price policy and the normative domain of economic theory. Price policy, as any other policy, manifests itself as a double edged razor with respect to consumers and producers. It can hurt one side and benefit the other; I have the feeling that the razor cuts the production side too deeply. We see how farmers, in this case soyabean farmers, are sacrificed for the sake of the consumers' welfare.

At this point it is interesting to compare the relative advantage of soyabean imports versus the attempt to increase soyabean production using available domestic resources. On the surface, soyabean importing has an apparent advantage, because price itself can be regarded as a measure of efficiency. Free market economic theory suggests that a free import and export market is to the advantage of the countries involved. Yet, on closer examination, commodity prices are not easily comparable in real terms. This reminds us of the oil price situation, especially before OPEC's offensive strategy: Who can tell us what is the "real" market price of

[4] Quoted from preliminary report of CGPRT soyabean in Indonesia, 1984.

oil? When we look at the International price of soyabean, a question may arise: How much subsidy do American farmers receive from their government? It is a great irony that economists use a free market concept which can not be applied to actual circumstances.

More importantly, there are cases where domestic production has nothing to do with the international market, and where serious unemployment problems arise. Whatever the reason, it is hard to justify soyabean imports while at the same time Indonesian farmers are desperately looking for additional jobs. Domestic economic stability is probably the most serious problem that should be approached in policy making, when designing the proper economic policy for a country. [5]

Theories are available, however, to determine whether domestic production will offer higher benefit to the economy than imports. The mathematics involve calculating the "shadow prices", including the "shadow price" between the currencies concerned. Using the so-called "domestic resource cost", we are then able to decide whether to continue importing or to promote domestic production to reach self-sufficiency. Unfortunately, t can show no references to justify the present import policy in the case of soyabeans.

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[5] Whatever the cost, it is necessary for Indonesia to maintain the current level of rice self-sufficiency.

KOREA
SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON THE PRODUCTION, UTILIZATION, MARKETING AND DEMAND FOR SOYABEANS AND MAIZE*

1. Transformed Agricultural Structure due to National Economic Growth

Korea was primarily an agricultural country in 1945, when approximately 80 per cent of the population were farmers. The value of agricultural products has enlarged significantly since 1965. However, the proportion of its value to the gross national product has decreased from 33 per cent in 1965 to 14.2 per cent in 1982, due to the more rapid growth of secondary and tertiary industries (Table 1).

Table 1. Major Economic indicators from 1965 to 1982 in ROK

Item	Unit	1965	1975	1980	1982
GNP, A	Bil.won	806	9,793	34,222	48,268
Agri. products, B	"	266	2,124	4,644	6,840
B/A x 100	%	33.0	21.7	13.5	14.2
GNP/capita	$	105	574	1,481	1,678
Export	Mill. $	176	5,003	17,214	21,616

Due to the rural depopulation, the farming population of 15.8 million in 1965 has decreased to 9.7 million in 1982. The proportion of the population to the total national population decreased from 55.1 per cent to 14.6 per cent (Table 2). The farm land size per farm household of 0.91 ha (paddy and upland fields) in 1965 enlarged to 1.09 ha in 1982, an increase of about 20 per cent (Table 2). However, the farm land size per household is very small when compared with other countries, and most of the upland fields are located on sloped hillsides.

The differences in cultivated acreage in 1982 from 1965 for various agricultural products are shown in Table 3. The total acreage for agricultural products in 1965 was the largest and the acreage in 1982 decreased by 22 per cent. Only the rice acreage has been maintained consistently, as it is the most important staple food resource in Korea. However, the acreage of winter cereals (wheat and barley), potatoes, coarse grains (corn, italian millet, sorghum and other millets), pulses (soyabean, mungbean, azukiabean, pea, peanuts and others) and mulberry have decreased enormously. Vegetables, orchard fruits and industrial crops greatly increased in cultivation. Red pepper, citrus " sesame are the most expanded of the increased crops.

Generally, the number of head of major livestock raised during the last 20 years has increased significantly, particularly dairy cattle, swine and chicken. The consumption of

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* Prepared by Keun Yong Park

Table 2. Changes of Farming Population and Cultivated Land Size per Farmhouse

Year	Population, mil.			Cultivated land, 1,000 ha			
	Total (A)	-Farm (B)	A/Bx 100	Total	Paddy	Upland	Farm land size per farm house
1965	28.7	15.8	55.1	2256	1286	970	0.91
1975	34.7	13.2	38.2	2240	1277	963	0.94
1980	38.1	10.8	28.4	2196	1307	889	1.02
1982	39.3	9.7	24.6	2188	1311	869	1.09

Table 3. Difference in Cultivated Acreage of Various Crops in 1982 from 1965.

YeNumber ar	Rice	Winter cereals	Pota- toes	Coarse grains	Pul- ses	Vega- tables	Orch fruits	Indus- trial	Mul- berry	Total
1965	1228	933	213	215	362	144	43	95	51	3284
1982	1188	339	91	57	242	355	101	155	24	2552
Diff (%)	97	36	43	27	67	247	235	163	47	78

Table 4. Number of Heads and Consumption of Major Livestock

Year	No. of Of Heads, 1,000				Consumption, Kg/man/year					
	Beef cattle	Dairy cattle	Swine	Chicken	Meat Total	Beef	Pork	Chicken	Milk	Egg Man/yr
1965	1,314	7	1,302	11,893	3.5	1.0	2.0	0.5	0.3	30
1975	1,556	86	1,247	20,939	6.4	2.0	2.8	1.6	4.6	82
1980	1,363	180	1,653	40,999	11.3	2.6	6.3	2.4	10.8	119
1982	1,526	228	2,183	46,592	11.3	2.7	6.1	2.5	15.0	115

Table 5. Changes in Consumption of Food Grains, Potatoes, Fruits and Vegetables.

Unit: Kg/man/year

Year	Rice Polished	Barley	Wheat Polished	Maize	Soyabean	Potatoes	Fruits	Vegetables
1965	122	37	14	1	4	7	11	56
1975	124	36	30	2	6	7	14	63
1980	132	14	29	3	8	4	16	120
1982	130	14	30	3	9	5	23	124

meat, milk and egg has increased accordingly. Recently, a considerable amount of beef was imported to meet the demand (Table 4).

Barley consumption has decreased significantly while the consumption of rice, wheat corn, soyabeans and potatoes is consistently maintained, and the consumption of fruits an vegetable has increased significantly (Table 5).

2. Current Production, Utilization and Problems in Maize and Soyabeans

With the contribution of hybrid maize since 1979, the yield of maize has been raised from 1 ton level to 4 tons level per hectare, and the total production increased considerably even though its acreage decreased. However, more than one half of the maize acreage is still being cultivated with local open pollinated varieties which produce only about 3 tons level per hectare, while the hybrids yielded more than 6 tons level per hectare in farmers' fields. Besides the grain maize production in the mountainous areas, the silage maize acreages are increasing to about 20,000 ha in suburban plain areas where most of the dairy cattle are raised.

The soyabean production is now faced with the need to cross the threshold of lower production. Yield level was slightly increased, but the tendency of decreasing acreage is faster than that of increasing yield(Table 6).

Mostly due to the rapidly increasing feed demand for livestock and the demand for processing, soyabean and maize imports have increased enormously in recent years. The total value paid for grain imports in 1982 reached one billion US dollars (Table 7,8).

The processing of soyabean includes the products of soyasource; bean paste, beancurd, oil extraction, soyamilk and beansprout. Maize grain is mainly processed into starch, which is then used in the alcohol and textile industries.

The price difference between domestic grains (soyabean and maize) purchased by the government and imported grains is shown in Table 9. The domestic price of soyabeans is about three to four times greater than the imported, and maize grain is about two to 2.5 times greater. Generally, the government purchasing prices are slightly higher or almost similar to those of market sales. The large difference in prices is caused by the high production cost of conventional farming systems in small-scale fields.

The utilizers of soyabean and maize grains are reluctant to use the expensive domestic products because the difference in price between the domestic and the imported grains is imposed directly on the utilizers.

The main reasons why the acreages of soyabean and maize are decreasing can be illustrated by the comparison of the income with other crops (Table 10). With the exception of hybrid maize, soyabeans and maize rank the lowest in the unit area cultivated as well as in income per labour hour.

The yield levels of soyabean and maize in Korea are not low when compared with those of other tropical regions. However, these levels are still far behind the temperate regions. This might be due to the difference in yield levels between experimental or demonstrated extension plots and farmers' fields. Although this would suggest the possibility of elevating the yield level in farmers' fields, it should be considered that field conditions vary widely, and the variationis are greater among farmers' fields than among experimental and selected demonstration plots (Table 11).

With the above mentioned status of production and utilization in soyabeans and maize in Korea, major problems could be summarized as follows:

a. Decreasing and aging farming population.
b. Decreasing acreage for maize and soyabean production.
c. Large gaps between domestic and international prices.
d. Increasing demands for feed and processed foods; unbalanced trade

Table 6. Maize and Soyabean Production in Recent Years.

Years	Acreage 1,000 ha	Maize t/ha	Production 1,000M/T	Acreage 1,000ha	Soyabeans t/ha	Production 1,000M/T
1965	49	0.81	40	308	0.57	175
1970	47	1,45	68	295	0.79	232
1975	32	1.72	54	274	1.13	311
1980	35	4.36	154	188	1.15	216
1981	33	4.38	145	201	1.27	257
1982	28	4.12	117	183	1.27	233

Table 7. Current Status of Grain Import by Source.

Year	Rice	Wheat	Soyabeans	Maize	Others	Total
1975	481	1,703	61	548	-	2,793
1980	580	1,810	417	2,234	10	4,529
1981	2,245	2,095	529	2,355	9	7,233
1982	269	1,940	536	2,814	387	5,937
(Mill. $)	(95.6)	(351.2)	(147.6)	(396.3)	(46.4)	(1,037.1)

Table 8. Utilization of Soyabean and Maize Grains.

Crop	Food	Proc-essing	Feed	Seed & losses	Others	Total
Soyabean Amount,t	126	209	431	26	-	792
Ratio, %	15.9	26.4	54.4	3.3	-	100.0
Maize Amount,t	89	492	2,301	2.6	22	2,930
Ratio, %	3.0	16.8	78.6	0.9	0.8	100.0

Table .9 Comparison of Soyabean and Maize Prices (Government Purchased and Imported).

	Soyabeans			**Maize**		
Year	Government purchased(A)	Imported (B)	A/Bx100	Government Purchased(A)	Imported (B)	A/Bx100
1975	451	240	188	192	127	151
1980	885	296	299	337	135	250
1981	1,017	347	293	342	180	190
1982	1,091	275	397	342	141	243

e. Lower income from domestic soyabean and open-pollinated farming.
f. Farmers' yield levels we still far behind those of experimental and demonstration plats.

3. Research Programs for Expanded Soyebean and Maize Production

Confronted with problems such as low incomes from maize and soyabean farming, low self-sufficiency in domestic production to meet the increasing demands for feed and processing, unbalanced trades, and large differences between domestic and international prices, the expanded production of maize and soyabeans is expected to be very difficult without political consideration and support. Fortunately, the government is maintaining the policy of supporting production by means of government purchasing at appropriate prices. However, it seems to be very difficult to have the acreages of maize and soyabean production maintained or expanded without the assurance of better or at least similar incomes compared with other cash crops. The possible alternatives to elevate the incomes from maize and soyabean farming would be to raise the productivity in unit area and in unit labour hours, or to cut down the production costs of small-scale farm lands.

A. Development of Small Farm Machinery and Farming Operating Systems

Farm mechanization is necessary to cut down production costs and to raise labour productivity. Major mechanized farming methods include plowing, harrowing (or rotavating), planting, spraying of pesticides, harvesting, shelling and transportation, etc. Mechanization of seed planting and harvesting are the most important of all.

Considering the small size of Korean farm lands, tractors and other large farm machines are rarely used. The number of small power tillers of 8-15 horse power has increased up to 422,000 throughout the country since the early 1970s. These power tillers are used for plowing, rotavating, transportation, and as power sources for water pumping, pesticide spraying and for shellers, etc. If seed planters, harvesters and other useful attachments can be connected, the power tillers will become fully effective in rural areas.

Other useful small-scale farm implements will be collected from advanced countries, even though already several kinds of small seed planters and harvesting machines have been introduced from foreign countries. These are operated by hand or by independent power sources. Agricultural engineers and agronomists are jointly participating in developing and/or selecting new machines adaptable to the Korean farming systems.

B. Development of Mechanized Farming System Cost Reduction in Soyabean and Maize Production

For the reduced cost of soyabean and maize production or for the elevation of labour productivity, mechanized farming systems are inevitable in Korea As previously mentioned, there are several useful farm machines such as seed planters, harvesters and others.

It is true that the efficiency of farm machinery is closely related with factors such as farm land size and topography. The objective of this study is to estimate the possibilities of cost down by use of different power-scaled machines in combination with different farm sizes. All the available machines and means of farming operations for the cost down of farming and yield increasing factors are to be involved.

This study could provide information on the appropriate power scale and the kind of machines to be recommended to the farmers. Agricultural economists and engineers and agronomists are engaged co-operatively to design and analyse the study.

Table 10. Field, Income and Labour Productivity for Various Crops.

Crops	Yield Kg/ 1 000m2	Gross Income (A) $	Manage-ment Cost (B) $	Income (A-B) (C) $	Labour hrs (D)	Income/ labour hrs. Income (C/D)
Rice (polished)	438	396	117	279	94.5	2^{95}
Barley (polished)	252	151	61	96	90.7	1^{06}
Soyabean	127	138	60	78	97.3	0^{80}
Maize hybrid	663	252	98	154	132.8	1^{16}
Maize, O.P.	337	134	78	56	119.5	0^{47}
Potatoes	1,506	343	182	160	145.6	1^{99}
Chinese cabbage	8,147	627	131	496	170.2	2^{91}
Red pepper	138	564	210	354	270.6	1^{31}
Sesame	53	263	92	171	111.5	1^{53}
Tobacco	240	673	230	443	435.4	1^{02}
Apple	2,019	952	411	541	406.9	1^{33}

Source: Agri. Management Research Report for 1982.

Table 11. Yield of Maize and soyabeans in Experimental, Demonstrated plots and Farmer's Fields (national average) in 1982.

	Soyabeans				Maize			
	Exper-iments	Demonstrations Average	Demonstrations Max.	Farmers' Fields	Exper-iments	Demonstrations Average	Demonstrations Max.	Farmers' Field
Yield Kg/ha	2,353[1]	2,312[2]	4,090	1,270	8,173[3]	8,350[4]	11,760	663(337)[5]
Index %	100	98	174	54	100	102	144	81(41)

1) Average of 21 locations
2) Average of 417 plots (1 ha each)
3) Average of 6 locations
4) Average of 79 plots
5) Yield of open pollinated varietas white theabove Figure indicates hybrids

C. Causal Analysis of Difference of Soyabean Yields between Experimental end Farmer's Fields

Several hundreds of demonstration plots have been exhibited to the farmers every year since the 1960s, which utilized various factors for yield elevation based on results from the research activities. The demonstration plots utilize recommended varieties, improved fertilization, improved pest control practices, adaptable planting methods and other agricultural techniques. The yields of soyabeans resulting from the demonstration plots average about 2.3 tons per hectare (Table 11). If soyabean farmers can produce 2.3 tons/ha, their income will be increased above the income from hybrid maize, and the farmers will be encouraged to grow soyabeans.

This study would aim to discover the barriers to disseminating the high-yield production techniques to the low-yielding farmers. The current status of transportation, field conditions, marketing, utilizations, relations with extension workers, constitutions of farm income and family members, educational backgrounds and other factors are to be investigated and analysed.

D. Productivity and Economic Possibility of Soyabean and Maize Production on Newly Opened Fields .

A soil survey team proposed that there are 1.4 million ha throughout the country which could be opened and utilized for agricultural production. This land could be divided into three categories: 158,000 ha for upland crops; 288,000 ha for orchards and mulberry trees; and 954,000 he for grasslands, depending on the soil slope and fertility conditions.

Several experiments were conducted on newly opened fields for soyabean end maize in the early 1970s. Soil structure, fertility, and soil acidity of the fields were discovered to be the main problems facing the production of soyabean and maize.

This study aims to evaluate the productivity of maize and soyabean on the newly opened fields, with the application of integrated technologies, advanced fertilization and planting methods, and other management methodologies. The experimental sites are to be classified according to elevation, latitude and soil characteristics. The results from past experiments we to be analysed to determine the economic validity of expanded maize and soyabean production on the newly opened lands.

LAOS

RESEARCH ACTIVITIES ON MAIZE AND LEGUMES PRODUCTION*.

Introduction

The Leo Peoples Democratic Republic, with a total area of 23.7 million hectares, is situated in Southeast Asia, approximately between latitude 14-22 North and longitude 100-1 07°East.

From an administrative point of view, Laos is composed of 17 provinces, 107 districts, 842 sub-districts and 11,298 villages. The total population In 1984 was estimated at above 4.1 million inhabitants, of whom 80 per cent depend upon agricultural production. The population density is about 17 persons per square kilometer, the lowest in mainland Southeast Asia. The national economy is characterized by the predominance of agricultural and forestry sectors, and a developing industrial sector.

The climate is a typical monsoon dominant with two well separated seasons, the dry season and the monsoon season. The annual cumulative temperature is about 8500-9000° Centigrade, the annual precipitation is about 1800-2500 millimeters, and the annual sunshine is about 230025D0 hours. Altogether, the conditions are greatly favourable for agricultural production.

Rice occupies the first place in crop production throughout the country. After rice, upland crops, including maize, root crops (mainly cassava), legumes, tobacco, sugarcane and other industrial crops play en important role in the rural occupations.

In this report, we would like to point out some of the problems in maize and legumes production in Laos and present the current research *activ*ities on these crops.

I. Development of Maize Production

Maize, which is considered the second crop of importance after rice, is sown in both the rainy season, from May to June, and in the dry season, from November to December. The maize production has increased during the last 3-4 years, at about 2-3 per cent per annum. Two kinds of maize are cultivated: sweet maize, grown for eating "green", and hard maize, used for animal feed. Sweet maize cultivation accounts for nearly 80 per cent of the total cultivated area.

Before the initiation of the first five-year plan, for 1981-85, maize cultivation was limited to about 20,000 ha, whereas currently it occupies about 30,000 ha or 4 per cent of the total cultivated area.

After 30 years of struggle for national liberation, and particularly after the establishment of the Leo Peoples Democratic Republic on Dec. 2, 1975, the security of the country has been gradually improved, and the people are now able to produce their food crops in a normal manner.

The government encourages maize production (as well as other crops) by initiating policies on such matters as the price of maize, the prices of agricultural commodities, agricultural credit, the national commercialization system, and other stimulating factors.

Despite these policies, maize production appears to be insufficient. The average yield is still low, about 1 ton/ha. The feed demand for maize is ever-increasing **end** every year, thousands of tons are imported to cover the deficit in animal fodder.

* **Prepared by Soukaseum Bodhisane and Dr. Hatsadong, Director of the Department of Agriculture, Ministry of Agriculture, Irrigation and Co-operatives, Vientiane National Co-ordinator Project, and Director of Salakham Rice Research Station, Deputy National Co-ordinator Project, MAIC, respectively.**

Constraints

The agricultural production in Laos is predominantly peasant farming. The cultivated land per farm family varies according to the quality of the land and the size of the household, but generally it is slightly larger than 1.5 hectare. A family holding of this size is likely to be of a mixed and fragmented character, i.e., it will consist of some paddy land and some upland fields. The holdings are often situated at a considerable distance from the homestead. Large-scale farming is rare, although some state farms have been established.

The extension of agricultural techniques is limited, due to the lack of inputs such as quality seeds, chemical fertilizers, pesticides, and farm implements. Manpower of various levels, including managers and technicians as well as extension workers, is not available in the required numbers. Labour may constitute the most serious problem among many constraints.

Another factor which restricts increased production is a **low** average per capita income and the inability to Invest In new methods of production.

The poor road system and difficult transportation situation causes problems in commercialization.

The market price of sweet maize is higher than that of the hard maize, which hinders the production of raw materials for animal feed.

In some co-operatives and in the large-scale farming on some state farms, where maize production is emphasized, there are some problems during the harvest season which add to the labour requirements, not only for maize but also for other crops.

Pest and disease infestations, particularly downy mildew, blast, stem-borer, cut-worm and leaf folder, are constraints to increased production.

The upland terraces where maize is grown are composed of mainly laterite acid soils with a low water-holding capacity and a low nutrient content.

Storage facilities, where they are available, are usually inadequate.

Perspectives

Maize production in the coming years will be increased in two manners: by extension of the land area and by Improved cultivation (extension and Intensification methods).

Extending the cultivated area appears to be the more popular method, because the land areas which can potentially be planted to maize are considerable. However, some problems arise with the deforestation and preparation of the new lands. Land preparation is undertaken with primitive tools, such as machetes, axes, mattocks and spades. The extension process is therefore labourious and slow, except for some co-operatives and state farms where land preparation can be carried out with modern methods and equipment.

Improved cultivation, or the intensification method, can be accomplished with the application of simple technologies such as the use of high-yielding varieties with good seed quality, the adoption of an agricultural calendar, good preparation of the land and adequate weeding, etc. Agricultural inputs such as quality seeds, chemical fertilizer, pesticides and machinery are necessary, and extension workers will have to be trained.

In order to assure an increase in maize production, as well as an improvement in other crops, existing agricultural support services, such as research, seed production, and extension services, and input supplies, agricultural credit, price regulations, and agricultural education must first be improved.

Research Activities on Maize

The government of Laos attaches great importance to research activities, which are also essential to extension work.

Concerning farm trials with maize and legumes, at present we have only one research centre, Fiat Oak Keo Agricultural Research Station, situated close to the Mekong River, about 10 kilometers from Vientiane.Three new agricultural research stations are now under construction:

(i) The first in Naphok situated about 30 kilometers from Vientiane;

(ii) The second in Savannakhet province, to serve the central part of the country,

(iii) And the last, in Champassak province, to serve the southern part of the country. The construction of these stations shouldbe completed by early 1986.

Agricultural Research Orientation Stations

The general orientation of agricultural research is toward methodological sciences and mass characteristics, which means that the results of the research can be readily transferred to the farmers. It also means that research activities are not carried out exclusively on research stations, but also on farmers' fields, in a "lab to land" programme.

Targets of Research

In the past few years, research on maize has centered on the production of starchy maize for animal feed, rather than on sweet maize for human consumption. For the research on starchy maize, varietal trials of foreign and idigenous varieties have been undertaken to select the best-yielding lines. Also, the new synthetic pool varieties are being improved, with emphasis on the composites rather than the hybrids. Agro-technical trials are as follows:

(i) organic and inorganic fertilizer trials

(ii) control of pests and diseases

(iii) weed control by mechanical methods

(iv) use of small and appropriate machines

Until the present, 50 imported and 45 local germplasms of maize varieties have been experimented upon, and 15 of the former and 12 of the latter are expected to be selected and released in the next two years for large-scale farming, if their performance confirms higher yields.

Improvement of the new synthetic pool variety will be achieved within the next two seasons. The new variety has shown promise and is likely to be released.

The above achievements are only some preliminary results -- a great deal more research remains to be done.

II. Production and Research Activities on Legumes

Legumes play a large role both in crop rotation and in the national diet. The major legumes are mungbeans, soyabeans and groundnuts. They are cultivated during both the rainy and the dry seasons, but the yield is somewhat higher in the dry season with irrigation.

The total cultivated area of legumes production represents about 20,000 ha or 2.5 per cent of the cultivated land, producing 12,000 to 14,000 tons with a 0.6 to 0.7 ton yield per hectare.

The government's intention is to promote the production and increase the yield of legumes, primarily for human consumption and also for agro-industrial processing (vegetable oil, oil-cake for feed, etc.). Over the past years, hundreds of tons of vegetable oil have been imported to meet the growing demand.

Research activities

In order to increase legumes production through intensification methods, extension efforts, and rehabilitation, constraints have to be resolved. Major yield constraints are:

(i) Use of low-yielding varieties and poor seed quality

(ii) inadequate land preparation

(iii) low prices and poor incentive

(iv) lack of agriculture credit)
(v) inadequate marketing and storage facilities
(vi) gaps in the transference of technology.

III. Conclusions

For agricultural development and research purposes, in particular in the held of maize and legumes research, we have received assistance from a UNDP/FAO and EEC grant, under the sponsorship of the Mekong Comm itee.

In the initiation of these projects, many difficulties have been encountered, such as a shortage of staff in different disciplines and at different levels. Education and training as well as research projects are prolonged activities that require time and patience

We hope that the results of our research projects, in co-operation with, different countries in the region, will be useful for the research and development of food legumes and coarse grains in our country.

MALAYSIA

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON MAIZE PRODUCTION*

1. Introduction to The Malaysian Agricultural Sector.

The agricultural sector continues to play a dominant role in the overall economic development of the country. In 1982, the sector accounted for about 23 per cent of the Gross Domestic Product (GNP), about 35 per cent of the total export earnings and 40 per cent of the country's work force.

In the last few decades, however, the sector's share in the economy has been on the decline with its contribution to the GDP declining from 50 per cent in 1950 to about 38 per cent in 1960 and to about 24 per cent in 1980. In absolute terms, however, the contribution of the agricultural sector to the total output increased significantly from $M 646 million in 1960 to some $M 6,926 million in 1982. This declining relative contribution is to be expected as it is a normal result of structural changes in a country undergoing economic development in which other sectors, e.g., manufacturing, grow faster than the agricultural sector.

The agricultural sector is characterised by:

- (i) the predominance of several export perennial crops, e.g. rubber, oil-palm coconut and (more recently) come.
- (ii) the presence of an efficient, well organised plantation agriculture and a relatively less developed non-organised smallholder sector, and
- (iii) dependence on the export of agricultural commodities and the import of food and feeds.

The agricultural structure in Malaysia Is quite unlike those found in many developing countries. In most of these countries more than one-half of the population is engaged In food production, either for direct consumption or for the local and foreign markets. However, in Malaysia, less than 20 per cent of the labour force is engaged in food production. Out of the labour force engaged in agriculture, about 60 per cent are engaged in the production of export crops. The low percentage of the labour force engaged in food production is the result of the agricultural production pattern in a country which is dominated by export oriented plantation crops.

The predominance of the perennial export crop agriculture is indicated by the land area under various crops. Out of a total area of some 3.25 million ha. of land under cultivation in Peninsular Malaysia, about 82 per cent are under the main export crops of rubber, oil-palm, coconut and cocoa.

Rice being the nation's staple food , it is the only food crop which occupies a relatively significant proportion of the cultivated acreage (11%). Miscellaneous crops such as other food crops (sugarcane, cassava, vegetables, groundnuts, sweet potatoes, maize and soyabeans) and fruits, beverages and spices occupy the remaining acreage, amounting to about 7 per cent of the land under cultivation. Out of this 7 per cent, "other food crops", including the CGPRT crops, occupy only about 2-3 per cent of the cultivated acreage.

In terms of the CGPRT crops, ony maize, cassava, groundnuts and sweet potatoes are of significance in terms of acreage under production, occupying some 13,000 ha, 7000 ha., 5000 ha., and 2000 ha., respectively. For other CGPRT crops, such as soyabean, mungbean and wingedbeans, the acreages under production are negligible.

* Prepared by Hashim Noor. Director. Techno-Economic and Social Research Division. Malaysian Agricultural Research and Development Institute (MARDI).

Several reasons can be put forth to explain the low and sometimes negligible acreages devoted to the production of these crops. The most important factor is their economic viability. Since rubber, oil-palm and cocoa are the dominant crops, their economic viabilities have generally been used as yardsticks against which to gauge the viabilities of the other crop production enterprises. Based on the current level of technology, the production of these crops is not as economically viable as that of rubber, oil-palm and cocoa.

Secondly, unlike those for rubber, oil-palm, cocoa, coconut and rice, there are no sizeable areas identified and designated for the production of these crops. Instead, they are usually planted in a scattered manner by the smallholders. Consequently, the production of these crops has been subject to instability both in terms of the acreages under cultivation and the locations of production. In other words, the production of these crops has not been a permanent feature of the Malaysian farming system, in terms of both well defined production areas and established crop rotation programmes.

For this paper, maize is selected as the crop for discussion. This is based on the fact that of the four CGPRT crops occupying any significant acreage in the country, maize is of the greatest economic significance to the economy in terms of acreage potential and the possibility of import substitution.

2. Status of Maize Production

Maize in Malaysia is mainly grown for fresh cob consumption. It is normally grown on a small scale In the paddy areas as an off-season crop providing additional income to the farmers. The crop is also grown along the fertile river banks of the states of Kelantan, Trengganu and Pahang, as well as being intercropped with the newly replanted rubber holdings. The acreage and quantity of maize production in Malaysia is given in Table I.

Table 1. Acreage and Production of Maize (1972-1982)

Year	Acreage (ha.)	Production (metric ton)
1972	2400	16,000
1973	1800	12,000
1974	2050	19,300
1975	2600	8,100
1976	3550	12,700
1977	3950	10,000
1978	4050	9,300
1979	3800	10,500
1980	3850	11,700
1981	3500	12,500
1982	3000	12,600

Source: Acreage of Miscellaneous Crops, Ministry of Agriculture Malaysia (various issues).

It should be noted that the data given in the table are, at best, rough estimates. Due to the scattered and small-scale nature of production, reliable statistics on the crop are hard to come by. Since maize is neither a staple nor a significant food item in the Malaysian diet, but is taken more as snack food, the country is self-sufficient in this commodity despite the low volume of production.

Maize for animal feed, however, presents a completely different picture. The country's livestock industry, particularly for poultry and swine, is heavily dependent on imported feeds, which currently amount to some $M 400 million.

The major portion of the feed imports is comprised of grain maize, amounting to about $M 250 million, thus causing a heavy drain on the country's foreign exchange. The quantity and value of maize grit import for animal feed is shown in Table 2.

As can be seen from the table, both the quantity and value of grain maize imports have been increasing rapidly in the last decade. This increasing trend in imports is expected to continue with the increasing demand for livestock products resulting-from the increasing income of the population.

3. Constraints to Maize Production

3.1 Non-Remunerativeness of the Crop

The primary constraint to the production of maize for feed is the non-remunerativeness of the crop relative to the production of other crops, such as the export crops, fruits, vegetables and tobacco. This is considered as the primary constraint, as other constraints can be considered as consequential to it. The relatively low profitability of maize production can be traced to two major factors, e.g. low productivity and the high cost of production.

Table 2. Imports of Grain Maize (1973 - 1983)

Year	Quantity (tonne)	Value $M '000
1973	128,709	33,133.4
1974	151,863	53,009.2
1975	166,281	58,749.1
1976	137,711	46,564.5
1977	287,323	89,533.9
1978	308,803	88,131.4
1979	429,355	144,378.6
1980	418,728	160,398.7
1981	459,580	180,977.8
1982	672,940	226,522.0
1983	742,217	256,648.9

Source: Import and Export Trade in Food and Agricultural Products. Ministry of Agriculture, Kuala Lumpur, (various issues).

In terms of productivity, the several composite lines of gratin Win, such as MARDI Composite 1 and Suwan which are available to the growers do not yield high enough to encourage production of the crop, particularly on a large scale. With the present attainable yield of about 3-3.5 tonne/ha, production is not economically viable. Moreover, with the current technology, maize productions is a labour intensive enterprise. It has been estimated that the labour requirement per ha of maize production amounts to 55 man-days with labour costs comprising about 40 per cent of the total production costs excluding labour for land preparation which is done by contract (Table 3).

Table 3. Estimates of Costs and Returns to Grain Maize Production (per ha).

Types of Operation	Input ($M)	Labour		Total cost ($M)
		man-days	cost($M)	
Land preparation	-	-	-	250.00
Liming	83.00	5	45.00	128.00
Planting	-	8	72.00	72.00
Seeds	20.00	-	-	20.00
Fertiliser	227.00	8	72.00	299.00
Weeding	58.00	10	90.00	148.00
Pest and disease control	60.00	10	90.00	150.00
Harvesting	-	10	90.00	90.00
Shelling	50.00	4	36.00	86.00
Total	498.00	55	495.00	1243.00

Source: Estimates of Costs and Returns to *Crop* and Livestock Enterprises, MARDI, 1984.

1. Yield: 3 Tonne/ha.
2. Price (ex-farm): 0.35 cents/kg.
3. Gross income: $1050.00
4. Net income: $ - 193.00
5. Returns to family labour: $302.00
6. Cost of production/ton: $414.00 or (0.41 cents/kg.)

The high proportion of labour cost reflects the high labour costs in Malaysia (about $M 9- 12 per day) as compared to Thailand, Indonesia, and the Philippines. In fact, agricultural labour costs in Malaysia have been rising steadily over the years, due to the current shortage of labour in the agricultural sector resulting from the rapid rural-urban migration of the agricultural youth.

The low productivity and the high production costs make maize production in Malaysia non-competitlve with that of the exporting countries such as Thailand and Indonesia, and with the present technology the country finds it cheaper to import maize for its livestock consumption.

As Table 3 indicates, it costs around $M 400 to produce a tonne of grain maize. This can be compared to the price (c.i.f.) of imported maize which amounts to about $M 350 per tonne. Hence, the country is highly dependent on imported maize for its livestock industry.

Table 4 presents the estimated average returns to production of some selected crops. The low profitability of maize indicated in the table beers clear testimony to the unattractiveness of maize production to the farmers.

Table 4. Estimates of Average Returns to Production of Selected Crops (per ha).

Crops	Net Returns $M	Family Labour Returns $M
Maize	-193	302
Chilli	13,400	16,900
Cabbage	3,500	5,500
Tomato	4,600	7,100
Leafy Vegetables	4,500 - 8,500	7,800 - 12,000
Ginger	3,500	5,800
Groundnuts	1,800	2,700
Tobacco	700	3,800
Cassava	1,100	1,700
Cocoa	1,500	1,800
Manggo	9,600	10,200
Bananas	2,700	3,300
Guava	5,200	5,900
Durian	10,300	11,000
Rambutan	5,300	5,900
Rice	800	900

Source: Estimates of Costs and Returns to Crops and livestock Enterprises. MARDI. 1984

As a result of the non-remunerativeness of the crop, maize production is relegated a low priority status in the country's agricultural development. This is clearly reflected in the National Agricultural Policy launched early this year which states that: "Recognising the high cost of local production of feed ingredients, the country will continue to import the major part of its requirement".

3.2 Land Availability

It has been estimated that, at the present yield level, Malaysia would need to devote at least some 200,000 ha of land to meet the animal feed requirements. However, a serious constraint in achieving such an ambitious acreage is the limitation imposed by the availability of suitable land.

As emphasised earlier, the major portion of the cultivated area in Malaysia has been taken up by the export-oriented plantation crops. Moreover, these crops are planted mostly on the prime agricultural land Thus, the land available for grain maize production is limited to the marginal lands in the rainfed single-cropped rice areas. Opening up new lands for maize production is not economically feasible, given the present level of technology in the production of the crop. New land development schemes almost exclusively give preference to the production of the more economically viable export crops, such as rubber, oil-palm and cocoa.

In light of the above considerations, the potential areas for grain maize production would be limited to the single-cropped rice areas, with maize being the second crop after rice, and the peat areas.

There are some 1200,000 ha of single-cropped reinfed rice areas which presumably can be used for maize production. However, these areas are widely scattered among the various states and even within the states. Moreover, some of these areas are subject to flood and drought and thus are not conducive to maize production. Heavy infrastructural investments, particularly in terms of drainage and irrigation facilities, are required to bring these marginal single-cropped rice areas into production. Even in areas where the conditions are suitable for maize, the crop has still to compete with other more remunerative crops such as tobacco and vegetables. Currently, the extent of the single-cropped rice areas suitable for maize production is not known.

The vast areas of peat in the country do provide a potential for maize production. The major part of the nearly 1.3 million ha of peat in Peninsular Malaysia is found in the states of Johor, Selangor, Perak, Pehang and Trengganu. However, bringing peat land into maize production would require large investments, particularly for land clearing, removal of stumps, soil amelioration practices, and provision of drainage facilities. Furthermore, large-scale maize production requires a high degree of mechanization such as the use of combine harvesters and tractors. The use of these machines is seriously inhibited by the spongy nature and low-bearing capacity of the peat soil as well as by the presence of semi-decomposed stumps. The high cost associated with bringing peat land into maize production can only be justified if and when the productivity and returns to production of this enterprise are increased substantially. Until such a time, peat land will remain an unexploited potential insofar as maize production is concerned.

Intercropping of maize with rubber is another proposal consideration worth consideration. Rubber, which covers some 1.9 million ha, provides ample opportunity for the production of cash crops during the first two or three years after planting. Beyond this period, intercropping is not continued as the spreading canopy tends to limit light penetration to the cash crops. Intergrown crops normally grown with the young rubber include bananas, pineapples, vegetables, groundnuts and maize (for human consumption).

At first glance, it seems that the estimated 30,000 ha of rubber being replanted annually should provide ample opportunity for intercropping grain maize with the young rubber. However, several factors have to be considered before this opportunity can be exploited.

Firstly, rubber replanting is not undertaken in a given or several locations annually, but rather 1s undertaken on scattered farms. This presents the problem of securing a sufficient volume of production in any given location, and marketing difficulties arise particularly with respect to transportation from scattered locations to the mills. Secondly, because intercropping is limited to only two to three years after replanting, problems arise in terms of obtaining regular supplies from any given location over a reasonable period. Thus, it con be seen that intercroppinq maize with rubber is limited by the problems of attaining a sizeable concentration and stability of both area and production at any given location. These problems are not conducive to any serious efforts at large-scale grain maize production to lessen the country's heavy dependence on maize imports.

3.3 Marketing

Maize being currently produced for fresh consumption is normally directly retailed by the producers at roadside stalls, and no wholesaling is involved.

The import and subsequent marketing of grain maize, however, is controlled by large multinationals and local importers who provide the feedmillers with the grain requirements for feed formulations. Any local production of grain maize will have to compete with these imports For the importers to switch, at least partially, from imported grain to local produce, three major factors will have to be taken into consideration: price competitiveness, volume of production, and stability of production.

In terms of price competitiveness, it was indicated earlier that based on the present available technology, local production of the grain is not price competitive with the imported grains. Even with substantial increases in productivity and cost reduction in the local production, such that local production becomes price-competitive with the imports, marketing difficulties will still be encountered. These difficulties relate to the volume and stability of production.

Before the importers and the feedmillers can (even partially) substitute local production for the imported maize, they must be assured of a reasonable volume of supply and, more importantly, the stability and consistency of the supply. The importers and the feedmillers cannot be expected to reduce their reliance on imported maize unless the above conditions are met. Hence, attempts to venture into local grain maize production to reduce the country's heavy reliance on imported grain must be directed towards large-scale production of the grain on a continuing basis. This calls for the identification and designation of specific areas for grain maize production.

The provision of adequate marketing facilities is essential to support the local grain maize production, particularly production by the smallholders. The facilities required include collection centres for drying and storage. With these facilities, the smallholders can sell their produce to collection centres where the produce is accumulated, dried, and stored for sale to the feedmillers.

The lack of these facilities has resulted in the failure of several previous production schemes. For example, during the period 1965- 1970, a concerted effort was made to produce grain maize to partially meet the requirements of the feedmills. This rather ambitious project, undertaken in the Kuala Brang area of the state of Trengganu, failed because of the lack of marketing facilities. As a result, the cultivation of maize in the area rapidly reverted to its original role in meeting the fresh cob requirement.

With the provision of adequate marketing facilities,which would largely solve the three previously mentioned conditions, it is not inconceivable that some restrictions could be imposed on the feedmillers with regard to the mix of locally produced and imported grain to be used in their feed formulations.

4. Research Priorities

As Indicated earlier, maize and the other CGPRT crops have been accorded lower priority in the country's agricultural development than export crops, rice, fruits, vegetables and tobacco. Insofar as maize is concerned, research emphasis is geared towards removing the constraints facing its expanded production, namely low productivity and high production cost, in order to raise the economic viability of the crop. Thus, productivity improvement and development of cost-saving technology are the two areas of emphasis in maize research. However, the major emphasis is on productivity improvement.

4.1. Productivity Improvement

This research programme involves the intensification of germplasm collection and selection of the introduced varieties. The objective of " programme is to develop high yielding varieties capable of producing 5-6 tonnes/ha at the farm level. A hybridization programme is also being drawn up and is expected to be implemented next year.

As part of its productivity improvement programme, MARDI is currently collaborating with CIMMYT to procure and test lines suitable for the Malaysian environment. Besides collaborating with CIMMYT, exchange of planting materials is also being undertaken on a personal contact basis between MARDI and other research institutions in neighbouring countries.

With the present stage of maize development in Malaysia, the country welcomes collaboration in the exchange of planting materials as part of the inter-country breeding and selection programme.

4.2 Production Efficiency

In order to reduce the currently high cost of maize production, emphasis is being given to the development of efficient production systems, particularly for large-scale production. So far, there is a dearth of local data on large-scale maize production, as the country's experience in large-scale production of the crop is very limited.

In view of the labour shortage in the agricultural sector and the labour intensity of maize production, some emphasis is also being given to research on mechanization in maize production, particularly for large-scale production and including the post-harvest operations.

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PAKISTAN

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON PRODUCTION, UTILIZATION, MARKETING AND DEMAND FOR SELECTED UPLAND CROPS*

Introduction

Population growth has remained the dominant cause of expanding food demand in Pakistan. Although Pakistan has achieved self-sufficiency in wheat, rice and sugar, the present rate of growth in population could reverse this attainment, if the food production is not sustained and increased accordingly. The population in Pakistan has been increasing at the rate of more than 3 per cent per annum. If current per capita consumption levels of food are maintained, Pakistan will be required to double the level of food production every 35 years or so. Besides population growth, rising Income levels also account for an ever-increasing proportion of demand. The per capita income has increased side by side with the population growth; therefore, the demand for quality goods has increased accordingly. The per capita per annum income was Rs. 549 during 1971-72, and reached Rs. 2030 in 1979; an increase of about 370 per cent over a period of eight years (Pakistan Economic Survey, 1982-83).

The per capita increase in income level has also affected the food consumption pattern in Pakistan. About ten years ago, consumption of food grains was only 134 kg per person per annum during 1982-83. There has been a shift in the consumption of higher protein foods, but it is still behind that of the developed countries of the world. For example, in terms of demand for basic food grains, namely, wheat, maize and rice, the people of the less developed nations consume approximately 181 kg per person per annum. Nearly all of this is consumed directly as breed, corn meal and rice to meet the minimum energy requirements. The average North American consumes over 450 kg per year. Out of this total, only 65 kg is consumed in the form of bread, pastry and breakfast cereals. The remaining 385 kg per capita is consumed indirectly in the form of meet, milk and eggs; that is, 385 kgs of cereal grains per capita are used to feed livestock and poultry, which are then consumed by the average North American (Todero, Micheal, 498).

The most widely used food in Pakistan is wheat, comprising about 151 kg per capita per annum and almost 15 per cent of the average family income. The consumption of maize comes third in the order of intake of cereals after wheat and rice, at about 7.5 kg per person per annum. The intake of maize is higher in rural areas (11 kg per person per annum) than in urban areas. Income elasticities of demand for food are generally high in rural areas, indicating the capacity to consume higher quality food, if the economic mews can be provided. Thus, a programme which increases food production will almost certainly have a direct impact on rural welfare by simultaneously increasing the availability of food and income.

An increased consumption of goods from the market economy has several advantages. First, it provides the basis for increasing the marketing of agricultural commodities so that, as the farmers increase their sales in order to enlarge their cash purchases, they also support the non-farm sector. This added market contact may have the additional advantage of getting the farmers to the market, where they may purchase improved production supplies. The primary disadvantage of an increase in welfare is the pressure it places on the resources with substantial opportunity costs, particularly in the non-farm sector. Nevertheless, an increase in the production of maize in Pakistan can play a positive role in the welfare of the populace.

* Prepared by Qazi Tauqir Azam, Principal Investigator (AERU), National Agricultural Research Centre.

Figure 1. Comparison of Prices of Maize and Wheat (1960-61 to 1982-83).

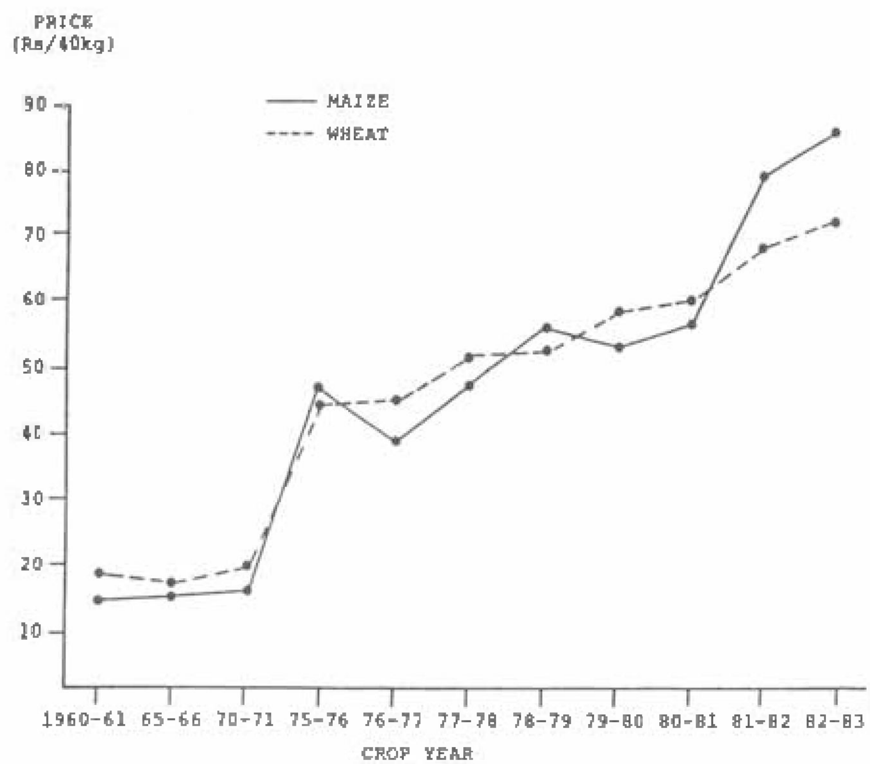
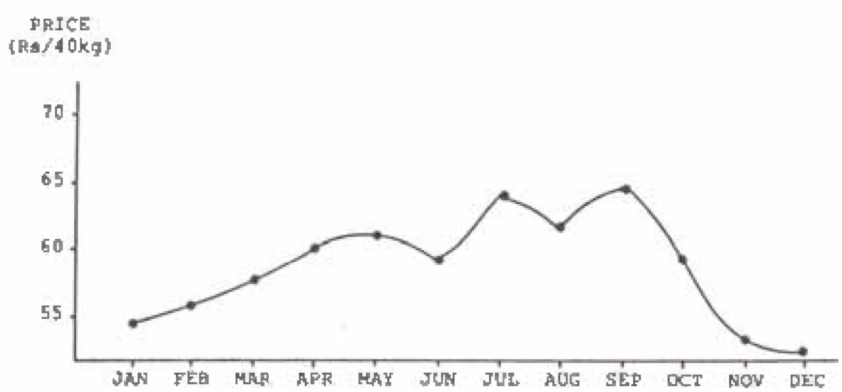


Figure 2. Price of Maize During Different Months (1975-83 Average).



Maize Production in Pakistan

Maize is an important food and feed crop in the Northern areas and central plains of Pakistan. Maize as a food supplement and wheat as a staple diet of farm families are consumed in most parts of NWFP, Northern Punjab and some areas of Sind and Baluchistan Provinces. Maize is a dual purpose crap; the grains are used for food and the stalks provide fodder for livestock. Prior to the 1960s, maize was a staple food in the Northern areas of Pakistan and was cheaper than wheat. Due to heavy imports, availability, and government policies for increasing wheat production, maize is no longer a staple food, even in the main producing areas, and the supply has remained almost static.

More than one third of the area cultivated under maize is located in the rainfed regions of the country. During 1983-84, 0.79 million hectares of maize were cultivated in Pakistan and an all time high production of 1.01 million tons was achieved during the some year. Data presented in Table 1 reveals that there has been little change in the per hectare productivity of maize. Even during 1983-84, the production of maize increased by only 0.3 per cent and yield increased by only 0.1 per cent, whereas the area increased by 3 per cent over 1982-83, signifying that the contribution of area toward the increase in production was greater then any other factor.

Table 1. Area, Production and Yield of Maize (1960-61 to 1983-84)

Crop Year	Area (Hectare)		Production (Tons)		Yield (kg/ha)	
	Actual	Percentage change	Actual	Percentage change	Actual	Percentage change
1960-61	480	-	439	-	915	-
1965-66	542	13	540	23	996	9
1970-71	640	18	718	33	1122	13
1975-76	620	-3	802	12	1295	15
1980-81	769	24	970	21	1295	3
1981-82	739	-4	930	-4	1258	-0.3
1982-83	790	7	1005	8	1272	1
1983-84	792	3	1008	0.3	1273	-0.1

Yield per Hectare.

The average yield per hectare of maize in Pakistan is low, when compared to the yield of other countries. The average yield of maize during 1983-84 was 1273 kg per hectare, which was only 18 per cent of the per hectare yield obtained in the United States. Pakistan ranks No. 8 In terms of yield per hectare among the nine leading maize producting countries of the world (Appendix I). However, the yield of maize obtained on the fields of progressive farms, research stations and experimental farms was in the range of 4000 to 5000 kg per hectare (Appendix II). Unfortunately, the higher yields obtained on research stations and by progressive farmers have shown little impact on the general maize production, mainly due to the lack of proper extension programmes and other socio-economic reasons. The improved varieties of maize, developed and imported, are grown on only 25 to 30 per cent of the maize acreage, which is also a factor in the low productivity of maize.

Socio-Economic Constraints to Maize Production

In view of the general food scarcity, in terms of food quality and quantity in proportion to the population growth, the possible solution lies in Increasing the production of summer season grain crops in the long run. Maize has a good change of success due to its production potential and the increasing demand for yellow maize in Pakistan. Since the poultry production in Pakistan is growing at a rate of more than 25 per cent per annum, and feed mills at the rate of more then 16 per cent per annum, it is estimated that the demand for maize for animal and poultry feed will increase accordingly. The per hectare productivity of maize is high enough to make it economically feasible to be grown on fertile irrigated lands. The major problems in production and the reasons for almost static production are

a) The crop is cultivated mostly by small farmers on hilly tracts where there is a restricted scope of horizontal expansion due to an inelastic supply of arable land. Farmers have limited resources and can not afford the risks of adopting improved technology.

b) The crop is usually grown for dual purposes, i.e., for food grain as well as green fodder. The dual purpose crop yields less grain and even less fodder.

c) The crop is subjected to heavy attacks by stemborer, stalk rot and leaf blight. Adequate plant protection measures and coverage are cumbersome, risky in terms of responses, harmful for the farmer's livestock, and costly. Moreover, weeds, unpredictable rains, and impaired pollination also cause problems.

d) There is no organized market for maize. The price is not considered as renumerative by large farmers, and maize is not considered as a cash crop by farmers.

e) Large farmers grow wheat for market and for their own requirements. They rarely consider growing maize as a supplementary food grain.

f) The harvesting and separation of grain are labour intensive operations. Except for family farms, labour is becoming scarce and costly for farm operations. Large farmers find it difficult to allocate available labour resources for the maize crops.

g) The price per kg of maize is higher than the price per kg of wheat and even of coarse rice, which eliminates maize as a food for the common populace. The demand will remain inelastic.

h) There is no support price for maize. Farmers fear that if they increase production, they will have a setback because of the low price.

i) There is no public procurement system. Farmers are dependent upon middlemen and intermediaries.

Demand and Supply of Maize

Maize is not a preferred food for daily consumption. It is no longer a staple of the diet even in the major producing areas. It is consumed mostly in the winter, and then at usually one meal a day. At present the demand for maize as a food grain is inelastic. But the industrial demand for maize is growing at a fast rate. Besides starch and oil extracting industries, animal and poultry feed industries are demanding more maize. The demand for yellow maize as a poultry feed ingredient has greatly increased in comparison to the demand for white maize which is mostly consumed by humans. The supply situation of maize has not improved. Table 2 shows that Pakistan is deficit in maize, milk and meat production. Increased maize production can help to solve the deficit.

Relative Profitability of Maize

Maize is grown in the summer (kharif) season. It does not compete directly with rice and cotton which are grown during the same season, because maize is grown in different areas. It is the major crop in reinfed areas. However, in irrigated areas it competes with rice and cotton. The relative profitability of the maize crop in relation to rice, cotton and wheat is shown in

Table 3.

Table 2. Demand and Supply of Selected Commodities, 1982-83 (000 Tons)

Particulars	Wheat	Maize	Rice	Meat	Milk
A-DEMAND					
Food	13640	660	2006.4	944.2	7334.0
Feed*	-	302	-	-	-
Seed*	124.1	100	344	-	-
Waste	124.1	100	344	97.0	781.0
Export	13.7	-	4	-	
Total	13901.7	1162	2694.4	1041.2	8115.0
B-SUPPLY					
Production	12414	1005	3445	970	7811
Imports	-	-	-	-	412
Stocks	10158	-	-	-	-
Total	22572	1005	3445	970	8223
Deficit (-) Surplus (+)	+ 8672.3	-157	+ 751	-71.2	+108

Population: 88 million: Per capita consumption/annum: wheat. 151 kg; Maize, 7.5; Rice, 22.8 kg; Meat. 10.73; Milk 83.34.

* at 10% of production.

Table 3. Relative Profitability of Maize (in rupees/hectare)

Crops	Cost of Production	Gross Benefits	Net Benefits	CostBenefit Ratios
Maize (irrigated)	2409	3650	1241	1.51:1
Maize (rainfed)	1264	2100	636	1.66:1
Rice (fine paddy)	2630	3450	820	1.31:1
Rice (cow-se paddy)	2150	3160	1010	1.46:1
Cotton	1847	2305	458	1.25:1
Wheat	1426	1920	494	1.35:1

The cost benefit ratio of maize under irrigated conditions is around 1.51:1. This means that the returns will be 51 per cent greater for every rupee spent on maize under irrigated conditions. In rainfed conditions, maize is even more profitable than in irrigated conditions. The cost benefit ratio for maize in rainfed conditions is in the ratio of 1.66:1. That is, the return is 66 per cent greater than the cost of the production of maize. The maize production function is more remunerative to the farmers due to the low production cost in rainfed areas. The productions of cotton, rice (fine), rice (coarse), and wheat yield a cost benefit ratio of 1.31:1, 1.46:1, 1.25:1 and 1.35:1, respectively.

On-Form Organization and Operation

There are about 4.1 million farms in Pakistan with an average size of about 4.7 hectares. The average cultivated wee per farm is about 3.9 hectares. The average cultivated area per farm is about 3.9 hectares. The average cultivated wee is so small that most farmers we operating at below subsistence level. About 34 per cent of the farm area is owned by 74 per cent of the total farming community who have an average holding of less than 5 hectares per farm. Ninty-one per cent are less than 20 hectares, constituting 77 per cent of the total farm area (Appendix III).

There are three tenure] classes, namely, owner cultivator or peasant proprieter, owner-cum-tenant and tenant. Out of 4.1 million farms, 55 per cent of the farms we opereted by individuals who both own and cultivate the land with an average holding of 4.5 hectares. Owner-cum-tenant farmers are 19 per cent of the total with en average farm size of 6.4 hectares, and 26 per cent of the farms are operated by tenant farmers who cultivate an average size of 3.9 hectares. It can be noted that owner-cum-tenant farms are 42 percent and 64 per cent larger then the farms owned by owner cultivators and tenants, respectively. (Appendix IV).

Input Accessibilities

In Pakistan, an average of 20 million hectares are cropped annually. Out of this, 8 million hectares are sown in the summer (kharif) season and 12 million hectares in the winter (rabi) season. About 15.5 million hectares, or 75 per cent of the cropped area is irrigated, and 4.5 million hectares are cultivated in rainfed (barani) and river-rain areas. The overall availability of irrigated water at the farm gate has greatly increased during 1982-83 over 1972-73. During 1972-73, 80.06 million acres were irrigated, and the total readied 101.51 million acres during 1982-83, an increase of about 27 per cent over a period of ten years. This was possible mainly due to the increased availability of water from tubewells. Though the tubewells installed during 1982-83 were only 52 per cent of the tubewells installed during 1973-74, the cumulative number of tubewells in Pakistan has greatly increased over the past ten years. A fairly large number of tractors have also been imported to facilitate the production of crops. The number of tractors imported during 1982-83 was 315 per cent higher than the tractors imported during 1975-74 (Appendix V and VI).

In order to enhance the production of crops per unit of area, the government has taken steps to distribute through private dealers. As a result, the distribution of fertilizer has grown at a fairly rapid pace and its use has acquired fairly wide acceptance among the farmers. The average annual growth rate in fertilizer consumption has been 18 per cent. The average application per hectare of cultivated area has readied 63 kg. Phosphate fertilizer has been imported in fairly large quantities, and has helped in improving the N:P ratios. (Apendix VII). Availability of agricultural credit has been Improved. Agricultural credit disbursed during 1982-83 was to the tune of Rs. 6,314.95 million. This was more than 2000 per cent higher than the credit disbursed among farmers during 1972-73 (Appendix VIIl).

Government Subsidies

The government has provided subsidies for improved seeds (mainly wheat, rice and sugarcane), tubewells and fertilizer. The subsidy for fertilizer is being withdrawn progressively. Subsidies for all the above mentioned inputs will be withdrawn completely in the near future because the uses of improved seed, tubewells, and fertilizer have become evident to farmers. They recognize that these inputs pay their costs. However, an amount of Rs. 1624 million was given as a subsidy for improved seed, tubewells, and fertilizer during 1982-83. This amount was 12 per cent less than the amount given as a subsidy during 1981-82 (Appendix IX).

Research Priorities on Maize

In order to systematically enhance the production of maize in the country, a Co-ordinated Maize Research Programme has been established by the Pakistan Agricultural Research Council (PARC). At present, research work on different aspects of maize crop is being carried out at three major research stations of Pakistan, namely, Cereals Crops Research Institute (NWFP), Maize and Millet Research Institute (Punjab), and National Agricultural Research Centre, (Islamabad). Research activities are mainly concerned with four major disciplines, namely; (i) Breading and Genetics; (ii) Production Agronomy; (iii) Plant Protection; and (iv) on-Farm Research.

Broad-base open pollinated varieties have been developed through breeding for each ecological zone. Since wheat follows maize In all the maize growing areas, short-duration early maturing varieties are being developed without affecting the yield of maize per unit area. Drought stress varieties are also being developed for insufficiently irrigated conditions and even for scanty rainfall areas. Hybrid maize varieties are also being developed for interested growers.

A package of technology requiring different levels of fertilizer, water, plant density, planting time, and weedicide and insecticide has also been developed and is partially being practiced in different maize producing areas. This type of research is important because increased maize yields can only be obtained when the crops are grown under optimum input conditions.

Leaf blight and stalk rot, diseases which affect maize, have a significant economic impact on the country. Therefore, varieties which are resistant to these diseases are being selected in breeding nurseries under artificial and natural infestations. The tropical germplasm is being incorporated as a source of resistance in local and improved varieties.

Research on the socio-economic aspects of maize crop has been somewhat neglected. Research endeavours require a sharp focus on the socio-economic aspects of the maize crop. Some of the socio-economic researches to be undertaken may be policy research on profitability in the farming system, research on the marketing infrastructure, price variation, product and factor marketing of maize, production price response studies, and research on the processing, storage, and alternate uses of maize, with production and consumption projections.

Maize Marketing and Utilization

Maize is marketed in a number of ways. Primarily, it is traded in the open market. The forces of supply and demand fully operate at wholesale and retail levels. Maize marketing begins when the cobs are not even fully ripe. The cobs are removed from the standing crop and marketed in towns for sale through vendors and vegetable stores. Maize is also marketed under pre-contracted sales to the processors of maize starch, oil gluten, glucose and dextrose. Since the dried gluten yields meal with a protein content of about 50 per cent, it is used in the cattle feed manufacturing industries. Therefore, maize is also being marketed directly to the animal and poultry feed industries. Maize grain which is sold by the producers to the grain merchants or local flour mills is usually produced with loans obtained by the farmers through these agencies.

A recent study conducted by the Planning Unit, Ministry of Food and Agriculture, Government of Pakistan reveals that out of the total maize production, 52 per cent are sold in the market, 30 per cent are retained and consumed as food, 8 per cent are paid to labour and artisans, 2 per cent are retained for seed, 1 per cent are fed to animals, about 2 per cent are wasted between production and consumption, and 5 per cent are paid as charities to the poor. In towns, maize is consumed mainly during the onset of the winter season, when it provides a change of taste from other vegetables. In towns and also in rural areas, maize grains are roasted and eaten as snacks between meals. In rural areas and even in the major producing areas maize is not consumed throughout the year, mainly due to the availability of wheat flour. It is consumed once a clay as bread (chapati) during the winter months. After shelling, the residue from the maize grains and the stalks are chopped and fed to animals. About 70 per cent of the maize fodder (by product) is fed to the grower's own livestock and the rest is sold.

Prices

The price of maize grain oscillates periodically. Usually, the prices are low during the harvest season and move upward as the season passes. The lowest prices prevail during the months of October and November and the highest prices are charged during the months of July, August and September. These are the months when maize is mainly in the seedling stage in almost all parts of the country. Eight year data of average monthly prices of maize in Pakistan indicate that the highest price of maize was Rs. 68 in the month of September and the lowest price was Rs. 50 in the month of December (Figure 1 1).

PROPOSED RESEARCH PROJECT

Title:

To Study the Demand, Supply Marketing and Utilization of Maize and Grain Crops in Pakistan.

Objectives:

The main objectives of this research study are to study the marketing infrastructure, estimate the marketing margins, analyse the seasonal price variation, study the utilization of maize (for humans and animals) and the demand and supply situation of maize and gram in Pakistan. This will provide analytical data with which to frame policies for an efficient marketing structure and the proper utilization of maize, and will also be helpful in formulating projections regarding demand and supply of these commodities. More specifically; the objectives of the research are:

i) To appraise and describe the existing marketing infrastructure, marketing functions, and organization of maize and gram crops.
ii) To identify principal marketing agencies and to appraise their impact on the development of a efficient marketing system.
iii) To estimate the demand and supply of maize and gram in Pakistan and to explore the marketing potential of these commodities as export items.
iv) To investigate the utilization of these commodities at the different stages of production in the country.
v) To inquire into the per unit weight prices of maize and gram at different stages of marketing.
vi) To estimate the cost of marketing and storage, the extent of spoilage and waste, and the cost of production accrued to the farmers for producing these commodities.
vii) To measure the seasonal price variations, compute the marketing margins, and break-down the consumers' expenditure by function as well as by agencies.
viii) To determine the impact of the incidence of cost on prices.
ix) To determine the price differential caused by various agencies due to grading, storage and processing.

Importance of Research

Economic prosperity depends upon both farm production and marketing, which should improve together, hand in hand. Technological inovations adopted so far in Pakistan have resulted in increased farm production. In order to sustain the growth in the agricultural sector, farmers will have to make additional cash outlays to modernize farm operations. They will have to replace subsistence agriculture with commercial farming. The producers of agricultural comodities will only continue their endeavours for increased volume of production if they can expect to benefit from the additional cost or additional efforts. Unless farmers have confidence that return prices will beer a definite relationship to cost outlays, they will hesitate to incure additional expenses to increase output or raise quality. The production efforts of farmers should not be nonplussed enroute. This can be ensured by an efficient marketing system. Unless all the aspects of a particular commodity are known, improvements in the existing marketing system can not be accomplished. No research work seems to have been carried out in the fields of agricultural marketing, utilization, and the demand and supply of maize and gram crops in Pakistan. This study will be helpful in the estimation of demand and in regulating the supply, and will provide a vantage point for the improvement of the marketing system for maize and gram in Pakistan.

Methodology

The proposed research work will be carried out by the survey method A sufficient number of farms producing maize and gram on a commercial scale will be selected for study. The utilization of these commodities from production up to consumption will also be investigated by a survey of consumers. Samples from different industries and intermediaries will also be drawn, for study of the assembly, central, and distribution markets.

In order to estimate the demand and supply prospects and the utilization of maize and gram crops in Pakistan, cross section survey data will be collected to estimate expenditure regression elasticities. (Generalized Least Square (GLS) regression will be run on expenditure survey data using the ratio semilog inverse functional form. This form automatically satisfies the Engle Aggregation conditions of consumer budget shares.

Duration of Research

A minimum of three years is recommended for the proposed research project.

Appendix I. Trend in Maize Yield in the Nine Main Producing Countries (Kg/ha).

COUNTRIES	1978-79	1979-80	1980-81	1981-82	1982-83
U.S.A.	6342	6883	5711	6891	7205
ITALY	6704	6617	6771	7213	6758
CANADA	5150	5583	6004	5877	5743
YUGOSLAVIA	3563	4480	4231	4269	5017
TURKEY	2241	2308	2127	2069	2373
MEXICO	1520	1477	1780	1812	1948
INDONESIA	1332	1390	1459	1526	1407
PAKISTAN	1228	1248	1262	1249	1273
INDIA	1076	797	1159	1146	1121

Appendix II. Yield per Hectare and Genetic Potential of Eight Maize Varieties (Kilograms)

VARIETY	FARMERS FIELD	GENETIC POTENTIAL	UNACHIEVED POTENTIAL(%)
NEELUM	3700	6900	86
AKBAR	3700	6900	86
SUNEHRI	2750	4700	71
SADAF	3350	4800	43
SARMAD	3750	4600	23
CHANGEZ	3650	3700	34
ZIA	2750	3700	34
SHAHEEN	1650	2600	58

Appendix III. Number and Area of Farms Classified by Size, 1980 (Million hectare).

SIZE OF FARM IN HECTARE	FARM Number (Million)	%	FARM AREA Total	%	CULTIVATED AREA Total	%
Under 0.5	0.33	8	0.10	*	0.09	*
0.5 to under 1.0	0.37	9	0.28	1	0.25	2
1.0 to under 2.0	0.69	17	0.97	5	0.89	6
2.0 to under 3.0	0.68	17	1.63	9	1.51	9
3.0 to under 5.0	0.92	23	3.57	19	3.28	21
5.0 to under 10.0	0.71	17	4.70	25	4.12	26
10.0 to under 20.0	0.26	6	3.39	18	2.78	17
20.0 to under 60.0	0.10	2	2.80	15	2.03	13
60.0 and above	0.01	*	1.62	8	0.92	6
TOTAL FARMS	4.07	100	19.06	100	15.87	100

Source: Pakistan Census of Agriculture, 1984
* Less than 5 per cent

Appendix IV- A. Number, Area and Average Size of Farms Classified by Tenure, 1980

TENURE	FARMS		FARM AREA		
	NUMBER	PER CENT	TOTAL (million hectares)	PER CENT	AVERAGE SIZE (hectare)
OWNER CULTIVATOR	2.23	55	9.93	52	4.45
OWNER-CUM-TENANT	0.79	19	5.02	26	6.35
TENANT	1.05	26	4.11	22	3.91
TOTAL	4.07	100	19.06	100	4.68

Source: Pakistan Census of Agriculture. 1980.

Appendix IV-B. Per Cent Share of Important Crops in Total Cropped Area, 1980

	ADMINISTRATIVE UNITS				
Particulars/	Pakistan	Punjab	Sind	N.W.F.D.	Baluchistan
Total cropped area (million hectare)	19.33	13.18	4.10	1.28	0.77
WHEAT	38	40	27	43	50
RICE	12	10	22	2	7
COTTON	12	13	16	*	-
SUGARCANE	3	4	3	6	*
MAIZE	3	2	*	24	1
SARGHAM MILLET	4	2	9	3	20
PULSES	8	8	6	8	1
OILSEED	3	2	4	3	6
FODDER	14	17	9	5	2
OTHER	3	2	4	6	13
TOTAL	100	100	100	100	100

* Less than 0.5R.

Appendix V. Water Availability at Farm Gate in Pakistan During 1973-74 to 1982-83 (Million acre feet).

YEAR	RABI Canal	RABI Tube-well	RABI Total	KWARIF Canal	KWARIF Tube-well	KWARIF Total	TOTAL	INDICES
1973-74	19.59	11.21	30.80	38.05	11.21	49.26	80.06	100
1974-75	14.16	12.58	26.74	37.70	12.58	50.28	77.02	96
1975-76	21.66	12.80	34.46	37.76	12.80	50.56	85.02	106
1976-77	23.32	13.09	36.41	35.08	13.09	48.17	84.58	105
1977-78	22.90	13.90	36.80	38.72	13.90	52.62	89.42	112
1978-79	21.92	14.71	36.63	36.06	14.71	50.77	87.40	109
1979-80	22.21	15.50	37.71	40.93	15.50	56.43	91.11	117
1980-81	22.70	16.29	38.89	42.51	16.29	58.80	97.79	117
1981-82	22.99	17.77	40.76	41.64	17.77	59.41	100.17	125
1982-83	24.05	18.13	42.18	41.19	18.13	59.33	101.51	121

Source: Agriculture statistics of Pakistan, 1983.

Appendix VI. Tubewells Installed and Tractors Imported in Pakistan During 1972-73 to 1982-83 (in 000 number).

YEAR	TUBE WELLS NUMBER	TUBE WELLS CUMULATIVE	TRACTORS NUMBER	TRACTORS CUMMULATIVE
1973-74	8.48	8.48	5.22	5.22
1974-75	8.86	17.34	7.19	12.41
1975-76	8.85	26.19	10.81	23.22
1976-77	8.77	34.96	15.55	38.77
1977-78	8.82	43.78	11.90	50.67
1978-79	8.74	52.52	15.18	65.85
1979-80	8.79	61.31	19.31	85.16
1980-81	6.16	67.47	16.14	101.30
1981-82	6.20	73.67	19.29	120.59
1982-83	4.38	78.05	22.91	143.50

Appendix VII. Production and Consumption of Fertilizer in Pakistan During 1973-74 to 1982-83.

YEAR	PRODUCTION			CONSUMPTION				
	N	P	TOTAL	N	P	K	TOTAL	N:P
1973-74	300	4	304	342	50	3	405	6:1
1974-75	321	6	327	363	61	2	426	6:1
1975-76	315	12	327	443	109	2	554	4:1
1976-77	312	13	325	511	118	2	531	4:1
1977-78	313	15	328	553	157	6	717	3:1
1978-79	337	29	366	684	188	8	880	3:1
1979-80	390	52	442	806	228	10	1044	3:1
1980-81	586	59	645	843	227	10	1079	4:1
1981-82	717	67	784	832	226	23	1081	3:1
1982-83	972	72	1044	953	265	26	1244	3:1

Appendix VI I I. Disbursement of Agricultural Credit Through Different Sources in Pakistan During 1972-73 to 1982-83 (Million rupees).

YEAR	ADBP*	TACCAVI	COOPERATIVE	COMMERCIAL BANKS:	TOTAL	INDICES
1972-73	169	10	42	86	307	100
1973-74	415	67	144	286	913	297
1974-75	396	12	82	521	1010	329
1975-76	532	25	92	808	1458	475
1976-77	637	13	95	970	1717	560
1977-78	430	9	138	1291	1868	609
1978-79	417	12	414	1381	2224	725
1979-80	711	8	709	1587	3016	983
1980-81	1067	8	1126	1828	4028	1313
1981-82	1557	10	1101	2436	5105	1664
1982-83	2310	3	1321	2681	6315	2059

Source : Economic Survey of Pakistan, 1983-81
* Agricultural Development Bank of Pakistan (ADBP)

Appendix IX. Subsidies to Improved Seed, Tubewells and Fertilizer During 1979-80 to 1982-83 (Million rupees).

YEAR	SEED	TUBEWELL	FERTILIZER	TOTAL	INDICES
1979-80	29	20	2457	2506	100
1980-81	2	24	2457	2483	99
1981-82	8	24	1794	1826	72
1982-83	8	16	1600	1624	64

PAKISTAN

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON GRAM*

Introduction

Gram is one of the most important pulse crops in Pakistan. It has been cultivated for centuries and is considered to have originated in the area between the Caucasus and the Himalayas. As gram requires little water, it is the only crop that is successfully grown in the vast rainfed (barani) areas of Pakistan. Although gram Is a winter crop, it is not produced in the high mountainous regions where winter temperatures are continuously low. Punjab Province is the major gram producing area and contributes about 70 per cent of the total production. Sind Province is the second most important area in terms of production. The rest of the production is shared by NWFP and Baluchistan Provinces. Gram was cultivated on an area of 0.8 million hectare during 1982-83 with a production of 0.5 million tons achieved during the same year.

Gram is rich in protein and contributes substantially to the qualitative improvement of the national diet. Gram provides about 17.5 per cent of the required daily protein, newly twice the amount that is provided by wheat and rice in lysine and thiamine, which would make It an Ideal supplement for cereals which are deficient in lysine. At present, the per unit price of gram protein is lower than that of animal protein.

Gram is mainly cultivated on marginal)ands, without the application of fertilizers. Improved production technologies are not known to the farmers. The varieties grown are highly susceptible to a number of diseases. Pest and disease control measures are not applied because their use is highly technical and considered risky by the farmers. The lasses resulting from pest and disease attacks greatly reduce the productivity of gram. A further cause of low yield is the practise of topping the crop for animal fodder before the pods are set. This reduces the vigour and subsequent growth of the crop. Gram blight and wilt are the two most common diseases, which may even destroy an entire crop.

Factors Responsible for Low Yield:

(i) Lack of meaningful production policies and a price stabilization programme
(ii) Lack of high-yielding seed production, seed distribution systems, and effective pest and disease controls
(iii) Lack of improved production technologies and their transfer to the farmers
(iv) Lack of organized marketing
(v) Lack of credit for the capital -deficient farmers

Research Priorities:

In order to increase the protein content and enhance the production of gram, the Pakistan Agricultural Research Council has established a co-ordinated Pule Programme. Research is being conducted on different aspects of grant cultivation. The potential areas for research include:

(i) Plant brooding and genetics
(ii) Agronomy
(iii) Pathology
(iv) Physiology
(v) Entomology

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* **Prepared by Oazi Tauqir Azam, Principal Investigator (AERU). National Agricultural Research Centre.**

(vi) Soil fertility
(vii) Farming systems
(viii) Economic aspects
(ix) Agricultural machinery and on-farm testing and research

Utilization of Gram

Gram (chickpea) is consumed in a hundred and one ways in Pakistan. The grain is mixed with wheat and rice, or it is used as a pulse. Gram is cooked with both vegetables and meet. It can be split ("wholi'), dried, parched and boiled; It can be consumed while still green or as a fine or coarse powder. In fact, gram has multi-uses in the national diet, and is also used as livestock fodder in both the green and dried forms.

SRI LANKA

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON PRODUCTION, UTILIZATION, MARKETING AND DEMAND FOR SELECTED UPLAND CROPS*

1.0 Introduction

Among the food crops of Sri Lanka, a number of coarse grains, pulses and root crops, long with rim and other spice and horticultural crops, are grown. In the past, emphasis has been given to the achievement of self-sufficiency in rice; a goal which is now within Immediate reach. The Subsidiary Food Crops (SFC) that are commonly grown could be categorized as follows

(i) Coarse grains	:	Maize, Kurakkan, Sorghum
(ii) Pulses	:	Cowpea, Greengram, Blackgram, Soyabean
(iii) Root and Tuber Crops	:	Potato, Cassava, Sweet Potato, Yams
(iv) Oil Seeds	:	Gingelly, Sesame Seed, Groundnuts
(v) Spices	:	Chillies and Onions
(vi) Horticultural Crops	:	Passion fruit, Pineapple, Mango, Banana etc.

Most of these crops have been grown over time in the country under varying climatic and agronomic conditions. However, until recently no substantial efforts have been made to organize a production programme with the specific objective of increasing production. In this paper, the constraints that have restricted the expanded cultivation of selected crops, namely, maize, cowpea, greengram, soyabean, and cassava will be discussed A research proposal which will be undertaken to study the problems facing these crops will then be presented.

2.0 Background

Sri Lanka is an island in the Indian Ocean, 6 degrees north in latitude. The population is estimated at 15.1 million (Census of Population in 1984, Preliminary Report). The country's major resources are land and water. Agriculture plays a significant role in the economy of the country, accounting for 43 per cent of the G.D.P., 68 per cent of the total export earning, and 49 per cent of the total employment.

Three distinct physiographic regions within the island can be identified; a lowland peneplain with elevation ranging from see level to 305 meters above mean see level (M.S.L.); a highly dissected middle peneplain with an elevation of 915 meters; and an upland peneplain of about 915 meters, the peeks of which rise to over 2440 meters above M.S.L.

Characteristic of the climate are the low variations in temperature and the heavy variable rainfall. The mean temperature ranges from 70-89 degrees F. The precipitation is distinctly bi-modal and the country receives rainfall from two monsoons, the north-east (November to January), referred to as the 'Maha' season, and a south-west monsoon (May to September), known as the "Yala" season. During the intermonsoonal periods, convectional storms occur and are supplemented in October by cyclonic depressions which move from the east.

Topography plays a major role in determining rainfall distribution. The whole island benefits from the north-east monsoon. The mountains intercept the south-west monsoon, a result of which is that the highlands and the south-west part of the island receive 190-508 cm. of rain per year. This is the wet zone of the country, covering 1.53 million ha. The remaining 75 per cent of the island benefits little from the south-west monsoon and receives 89- 190 cm

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* Prepared by Dr. Nimal F. C. Ranaweera, Deputy Director of Agriculture. Division of Agricultural Economics and Projects. Department of Agriculture. Peradeniya.

of rain per annum. This area is divided into a dry and an intermediate zone. The dry zone is comprised of 4.17 million ha and the intermediate zone, 0.8 million ha.

3.0 Problem Identification

The problems that have constrained the increasing production of CGPRT crops are both historical as well as institutional. A brief discussion of the two factors is presented initially.

3.1 Historical

During the last two decades or more, the main aim in the agricultural sector has been to achieve self-sufficiency in rice. Up until the middle 1950s Sri Lanka benefited from a strong export market for tea at very good prices. The balance of payment situation of the economy was positive and, consequently, much of the food needed by the population was imported This was true of rice, the staple food, as well as most of the other subsidiary food crops.

With the decline in tee prices and the negative balance of payment and terms of trade, the government focussed attention on achieving self-sufficiency in the main food items, with special emphasis on rice. In this process, large scale investments were made in irrigation development, agricultural research, as well as other infrastructures. Consequently, there was e relative neglect of the subsidiary crops, which resulted in low production. This necessitated continuous imports of these items.

Most of the subsidiary food crops were grown on the non-irrigated highland, commonly referred to as the "chena", in a form of shifting cultivation which required little or no investment. However, there is a marked regional differentiation in the types of crops that are grown on chenas. Basically, the system of chena cultivation is a form of subsistence agriculture where inputs are maagre. A variety of crops are grown, essentially as a kind of risk insurance in which the failure of one crop will be compensated by the success of another the productivity of these crops has been low and little effort has been made to upgrade them.

3.2 Infrastructure Development

The development of the infrastructures was biased towards the cultivation of rice. Inputs in agricultural research, marketing, processing, and credit and other facilities by and large benefited the paddy sectors more than the other food crop sectors. This was not entirety a planned approach; rather, the economic and political committment to achieve self-sufficiency in rice determined the emphasis on infrastructures for paddy cultivation.

3.3 Present Situation

The present problems facing the subsidiary food crops sector are:

1. Meeting the internal demand for human consumption.
2. Eliminating imports of these crops.
3. Meeting the increasing demand for livestock products.
4. Possible export of these crops.
5. The development of processing industries.

3.4 Constraints to Increasing Production of S.F.C.'s

A number of constraints can be Identified as having precluded the Increased production of subsidiary food crops. The major constraints are:

(i) Land holding size of the farmers.
(ii) Income levels of the households and the demand for human consumption.
(iii) Relative profitability of the crops.
(iv) Availability of credit and other facilities.
(v) Lack of processing facilities.
(vi) Post harvest losses

3.4.1 Land.-Holding Size of the Farmer

A summary of the holding sizes in the agriculture sector is shown in Table 1.

A characteristic of the small farm sector in Sri Lanka is the high proportion of small farmers operating on small holdings of land The farmers generally tend to grow a combination of crops, rather then a monocrop, which makes it difficult to develop an organized production programme.

3.4.2 Income Levels of Households

An analysis of the income levels of households in Sri Lanka illustrates that there is no significant demand for the CGPRT crops. Table 2 summarizes the incomes received.

The study disclosed that the median income levels were higher in the urban sector (Rs.539.00 per month) compared to the rural and estate sectors. The highest income earners are in the urban sector, which also shows the widest income disparity.

The Census of Population of 1971 indicated that 68.5 per cent of the population live in the rural sector. Consequently, the distribution of income as a whole is influenced by the distribution of income in the rural sector.

Comparing the socio-economic surveys of 1973 and 1978/79, an increase in the disparity of income within the rural sector is shown when measured through the Gini coefficient (Table 3). A sharp increase in the degree of inequality in the rural sector, from 0.37 to 0.49, is indicated by the Gini coefficient.

In absolute terms, however, the average income level in the rural sector increased, which can be attributed to the increased productivity in paddy cultivation.

An examination of household expenditures on food indicates a low consumption of most of the CGPRT crops (Table 4).

Mean expenditure on rice per capita was Rs. 26.79, constituting 26 per cent of the total food expenditure. The rural sector spent 29 per ant of its total food expenditure on rice. An analysis of the expenditure by income groups, however, indicates that there is a greater consumption of pulses as income Increases. This is reflected In Table 5.

The increase in expenditure on starch foods such as cassava is also significant.

The above discussion indicates that there still exists a demand, particularly for pulses and other starchy foods. The demand for grains could then be from the livestock sector. To assess the demand requires a careful examination of the elasticities of income and price, as well as the per capita consumption levels.

3.4.2.1 Income and Price Elasticities

There has been no formal attempt made to determine the elasticities of either income or price for the CGPRT crops in Sri Lanka Attempts to calculate approximate values hove so far been inadequate. The main reason for this has been the lack of reliable price and income data.

Estimates of income and price elasticities were made by the FAO in 1967, by Jogaratnam and Poleman in 1969, and by the Central Bank in 1983, for selected crops. Estimates of income elasticity for coarse grains range from 0.4 to 0.1, the coefficients covering the use of grain for both human and livestock consumption. In assessing the elasticities for coarse grains, the demand for livestock products must also be considered. The estimates for pulses range from 0.5 to 0.2, while for root crops and tubers it ranges from 1.3 to 0.7.*

Estimates of price elasticities of demand have been sketchy. The main reason for this has been the lack of adequate time series date from which these could be calculated

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* These estimates we from the FAO Study on Agricultural Commodites, projects for 1975 and 1985. FAO. Rome 1967: Jogaratnam and Poleman 1969; and the Consumer Finance Survey 1976/79, Center Bank of Ceylon.

Difficulties in estimating accurate values of price and income elasticies have led to a situation in which accurate estimates of demand cannot be calculated for these crops. However, approximate demand figures are provided in section 3.6. These have been calculated based on the nutritional requirements of the population and the rate of population increase. The above discussion highlights the difficulties in expanding CGPRT crops, since income levels of the population are low, and also because the expenditure pattern does not indicate a significant demand for these crops.

3.4.3 Relative Profitability of CGPRT Crops

The profitability of a crop varies under varying conditions. Most of the CGPRT crops, though considered cash crops, have to compete with spice and other horticultural crops. Moreover, paddy still takes first place as the most profitable crop, under both Irrigated and rainfed conditions, and under upland and lowland situations as well. Table 6 indicates that, by and large, paddy cultivation is the most profitable. Therefore, the competition for land to cultivate paddy is quite significant.

Along with the profitability also lies the question of yield per hectare. The yields obtained under upland conditions vary widely. Depending on the rainfall conditions, the yield fluctuates quite significantly. However, by and large, the yields of most CGPRT crops have not been verb high under field conditions. The relative profitability is an index of the production potential of these crops. Table 7 indicates the production of the different crops during the last ten years.

There has been an overall increase in the extent of the selected crops during the last fifteen years. The cultivation of some of these crops is closely related to the production and imports a rice. For example, the relatively high expansion of cassava in 1975 is related to adverse weather conditions in Sri Lanka during which paddy production was extremely low.

The cultivation of cowpea, greengram and soyabean have also shown some increase in extension, due mostly to the increasing demand and the relatively good market prices existing overtime. The cultivation of maize, on the other hand, has been rather stagnant, except recently when the Ceylon Oils and Fats Corporation increased their purchases, which resulted in increased extension.

3.4.4 Availability of Credit and Other Facilities

The two State Banks, namely, the Peoples Bank and Bank of Ceylon, operate a comprehensive, credit scheme for the agriculture sector in Sri Lanka. In addition, a few commercial banks also offer credit schemes for the benefit of farmers in selected districts. However, most of the schemes are directly geared to the benefit of the paddy sector, and few farmers have recourse credit for the cultivation of CGPRT crops. Cassava cultivation is not covered by any credit scheme.

Another interesting factor is the relatively low input level for most of these crops, which also makes the need for credit minimal. There are no significant high cost items, such agrochemicals or hired labour. However, credit for marketing facilities is one aspect that has been relatively neglected

3.4.5 Lack of Processing Facilities

Most of the CGPRT crops, particularly cassava and soyabean, have a market potential after processing. However, at present little attention is given to this aspect, resulting in a lack exploitation of the potential of these crops. The making of cassava products such as chips starch is not yet popular, although the processing technologies are well known.

3.4.6 Marketing Constraints

Marketing problems have greatly limited the expansion of CGPRT crops. A formal marketing organization is lacking, and even at present, marketing is mainly concentrated with the private sector. ,

In order to encourage the growing of these crops, a floor Price Scheme (FPS) was initiated in 1978 by the government. Previous to that, there existed a guaranteed price scheme, where the government was the main purchaser, but due to a number of operational problems, this was replaced with the floor price scheme.

The basic objective of the floor price scheme is that a'floor' has been established below which the price will not fall. It is not an incentive price, but rather a price of last resort, so that the farmer is assured of receiving at least his investment. Floor prices are fixed by the government on the basis of production studies, giving the farmer between 50-100 per cent over his costs. The floor prices for the selected crops are given in Table 8.

The institutional arrangements for the operation of the floor price scheme are through the Paddy Marketing Board (PMB) and other state organizations such as Marked, Oils and Fats Corporation, and the Co-operative Wholesale Establishment (CWE), to mention a few. However, it is the PMB that has been identified as the main purchaser. Table 9 Indicates the percentage of purchases by the various organizations. As can be seen, very little of the produce is handled by the government organizations.

3.5 Import Policies

The import volumes of some of these crops generally have had a depressing effect on the development of local production potential, particularly since earlier high production levels were achieved during periods of severe import restrictions. More recently, however, there have been sharp increases in imports of some of the CGPRT crops, and particularly of a few substitutes, which have led to a depression in market prices and, more important, have been reflected in a reduction in overall production. Often, the arrival of the imports has coincided with the arrival of produce coming into the market from the major producing areas. This has been mainly due to a lack of co-ordination between the producer organizations and import agencies. More recently, due to adverse weather, there has been a greater dependence on imports, which has resulted in an overall drop in prices at periods of excess availability in the market.

Unfortunately, this is a situation that both producers and import agencies have to live with in Sri Lanka. The lack of precise production data with specific information on the time of availability of produce in the market, and the uncertainties of the landing of the imported items will often lead to surpluses in the market at particular periods. Closer co-ordination of the two sectors has to be worked out.

3.6 Future Demand

Demand estimates of the SFC's and particularly of the CGPRT crops is difficult. As identified earlier, this is mainly due to a number of factors, particularly the lack of adequate price and income elasticity data Furthermore, due to the complementariness of some of the commodities in an individual's diet, as well as the possible substitutability, the linear consumption cannot be relied upon. It is not possible to isolate the individual consumption levels in order to determine possible combinations.

The Department of Agriculture projected possible demands for the different crops, based on nutritional requirements for the consumption of each of the crops. The assumptions were made based on information given by the Medical Research Institute of Sri Lanka. These requirements are given in Table 10. Based on these assumptions, a demand estimate has been made for the selected crops.

Agroskills Limited, using the elasticities as well as per capita demand, has developed a demand schedule in their study. The assumptions made in this study areas follows.

Coarse grains:

(i) Income elasticities ranging from 0.4 to 0.1, the coefficients covering both human and livestock consumption.

(ii) Population increases of a low and high variant of 1.5 and 3.5 per cent.

(iii) Consequently, the demand to grow from a low of 1.5 to a high 3.4 per cent. For purpose of projections, a rate of growth in demand of 2.5 per cent per annum.

Pulses:

(i) Soyabean is included as a pulse crop, as well as cowpea, greengram and blackgram.

(ii) Income elasticity varies from 0.5 to 0.2.

(iii) Demand is estimated to grow at ranges between 1.5 per cent to 3.75 per cent per annum.

(iv) For the purpose of calculating demand, a high of 3.8 per cent per annum is assumed.

Roots and Tubers

(i) Cassava and potato fail into this category.

(ii) Income elasticities are not available for cassava and hence an elasticity of 0.2 is assumed based on FAO estimates for starchy roots for countries in Asian region.

Table 11 presents the demands estimated for the selected CGPRT crops over the next five years, as computed by the Department of Agriculture. The figures provide a substantial increase in production compared to the present availability. In the instance of soyabean, it reflects en almost seven fold increase while in most cases it is a two-fold or more increase.

3.7 Proposed Production Programme

For the successful implementation of a programme to meet the requirements listed in Table 11, a strong committment is needed in terms of personnel, funds, infrastructure and marketing. The Department of Agriculture has drawn up a plan which envisages extensions in all districts of the country. In this manner, the impact on a particular district is minimized and, at the some time, the principle as comparative advantage is made use of. Districts which traditionally grow these crops will continue growing them, and with greeter impetus.

However, in order to achieve this successfully, it is necessary to have a number of supporting facilities. For example:

(i) A Strong Research Back Up

New cultivars and cultural practices will have to be developed and tested out in farmers' fields. It may not be possible to achieve significant results in the short run, but efforts will have to be Initiated to develop new cultivars.

(ii) Trained Personnel for Extension Efforts

The extension personnel will have to be trained, and more intensive coverage should be given in the field, covering these crops. Farmers will have to be trained in the cultivation of these crops, using new cultural practices when necessary.

(iii) Quality Seed for Planting

One of the major problems for farmers is the lack of quality seed for planting. The Seed and Planting Material division of the Department of Agriculture should be provided with the staff and facilities to provide the seed.

(iv) Assured Credit and Input Supply

While the technical know-how is being developed and disseminated among the farmers, they will also need credit and an assured supply of inputs to achieve the potential yield of the new cultivars.

(v) Guaranteed Market for the Crops

Last but not least, an assured, market at a reasonable price has to be developed either through the private or public sector. In order to achieve this, substantial investments will have to be made by the government as [w211] as by other organizations.

4.0 Proposed Research Study

From the ensuing discussion it is apparent that a substantial increase in the extension and production of the selected CGPRT crops can be achieved. The success of this programme depends not only on the availability of the technical know-how, but also on the willingness of the farmers to cultivate these crops. This in turn will depend on the following, among others:

(i) Assured supply of quality seed at the time of planting.
(ii) Timely availability of credit and other inputs.
(iii) Guarantee of a market et a reasonable price.
(iv) Relative importance of the crop in the overall cropping or farming system.

The above need not necessarily be in the identified order. For instance, item iv probably would take "pride of place".

The question is, how can the aspects listed above be monitored and observed in a manner which will allow for any corrective decisions that may be required? The proposed research study attempts to answer this.

Title: Development of policy measures to enhance a production programme for the cultivation of selected CGPRT crops in selected districts.

Objective:

(i) To ensure that a planned production programme is implemented on schedule.
(ii) To identify possible bottlenecks that may be faced by farmers in (i).
(iii) To develop policy measures that will eliminate bottlenecks and create a positive environment for farmers to further cultivate these crops.
(iv) To recommend to the government specific policy measures to be adopted in order to guarantee the success of the production programme.

Methodology:

(i) One district will be selected for each of the identified crops for the cultivation year 1984-85.The selection of the districts will be based on the principle of comparative advantage, as well as on their contribution to the total production for the year. Since cassava is mainly a wet zone crop, a wet zone district will be selected: a similar district will be selected for maize. For the other crops, either a dry or intermediate zone district will be selected

(ii) A sample group will be selected from among the farmers who cultivate these crops. Stratified 2 stage random sampling will be done, to ensure a large enough sample to capture all the possible variations.

(iii) The selected sample will be closely monitored throughout the year in order to obtain date which is as accurate as possible.

(iv) Through a process of partial budgeting, after providing for possible interactions, relative profitability indices will be developed for the crops.

(v) While the micro-level monitoring and analysis of data is going on, a study will be made of the income and price elasticities for these crops. This will be done primarily in order to ensure that the data gap that now exists is corrected.

Figure 1. Extent and Production of Maize
(3 Year Moving Averages).

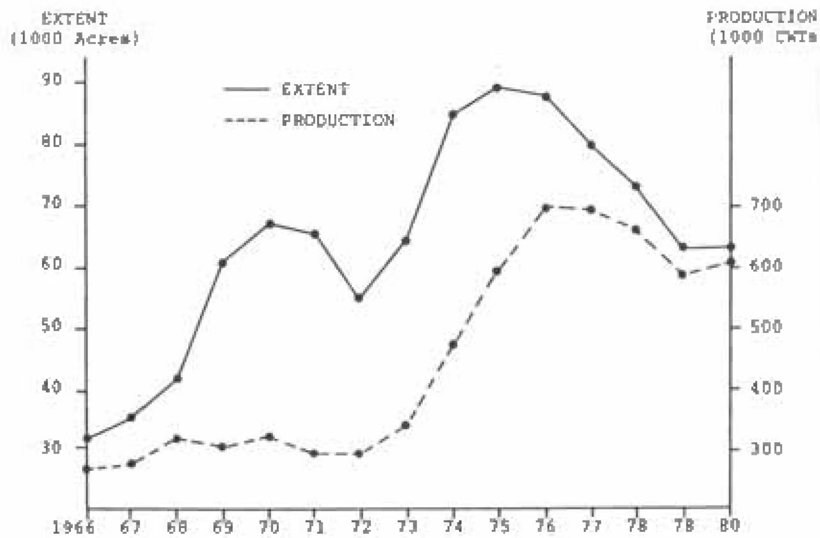
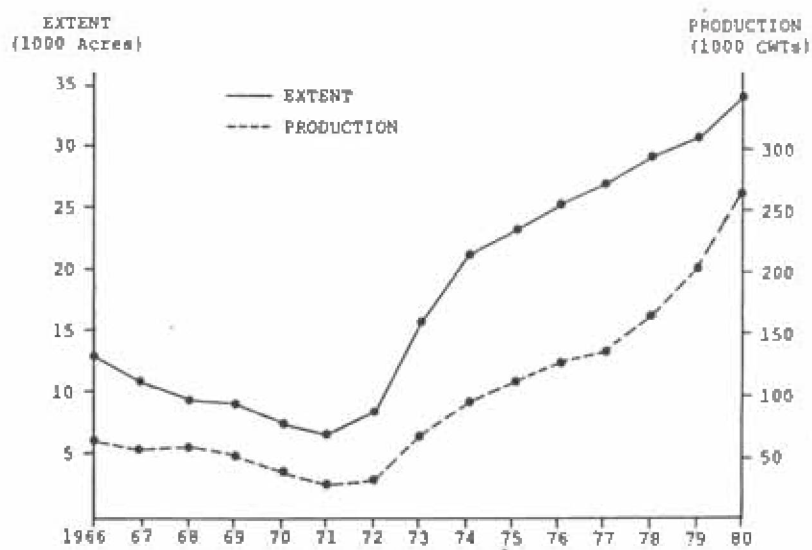


Figure 2. Extent and Production of Greengram
(3 Year Moving Averages).



5.0 Methodological Experiences on Similar Studies

As identified earlier, there has been little experience in Sri Lanka in the development of positive policy measures to enhance the production of selected CGPRT crops. Jogaratnam and Poleman (1969) used Food Balance sheets to develop certain income and price elasticities. However, this data needs to be updated. Aldeman and Timmer (1973) estimated price elasticity of pulses using cross sectional data. The presence of import restrictions and subsidies tends to cloud the reel effect of price changes. Gavan and Chendrasekera (1979) reported that the introduction of production data directly into the function proved to be more helpful in explaining the changes in rice consumption than income and price data.

Recent studies which projected demand for food have relied mainly on the okkawa equation which could be represented as follows: $d = p + gn$

where, d = future demand

p = rate of growth of population

g = rate of growth of per capita real income

n = income elasticity of demand

A renewed attempt will be made to develop a reliable data base which can help to identify the production potential as well as the constraints.

6.0 Collaborative Work with Other CGPRT Studies

Since most of the CGPRT crops are relatively underrated in the Asian region, similar studies could be developed in other countries. Assuming that the data base is generally poor, the development of accurate beta is of vital importance. Furthermore, a methodology is lacking which would analyse production programmes with the risk component of shifting cultivation. More recent methodological works on crops and cropping systems, such as Zandstra at al., Basic Procedures for Agro Economic Research (IRRI), and the CIMMYT handbook, concentrate on date obtained in good or assured environments. CGPRT crops are grown in more varied environments. Therefore, the development of a methodology for the researchers is of vital importance.

In fact, Sri Lanka has had considerable excperience in collaborative studies, having participated in the Asian Farming Systems Network (7 years), the International Rice Agro Economic Network (IRAEN), as well as other networks dealing with farm mechanization and soyabean utilization. The Department of Agriculture has been the focal point for such collaborations: The Divisions of Research, Extension, Education and Training, and Economics all work in the close collaboration which is necessary for multidisciplinary research.

Conclusions

The CGPRT crops, though Important in the rural and estate workers' diets, are still relatively neglected, as reflected in the nearly static extensions. The demand for these crops is significant. However, in order to organize a strong programme, certain constrain have to be overcame. The lack of adequate and reliable data to some degree precludes this.

The proposed research study offers methods to improve this situation, at least in the selected districts.

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Figure 3. Extent and Production of Soyabeans (3 Year Moving Averages).

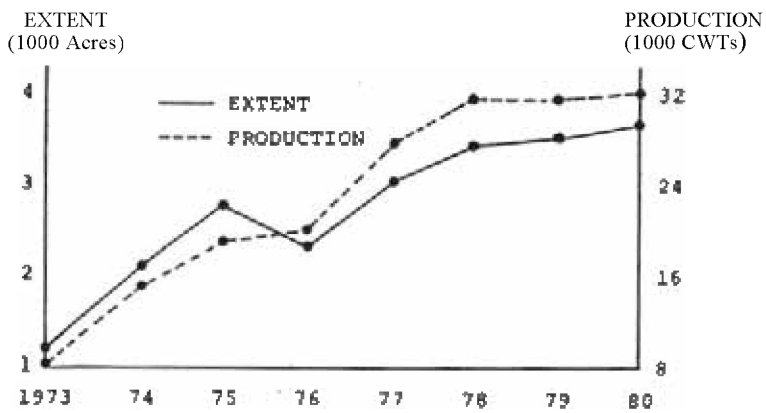

Table 1. Size and Number of Agricultural Holdings

Size Class of Holding (hectares)	Number of holdings	Percentage	Total area holdings (hectares)	Percentage
0 - 0.40	767,076	42.43	114,628	8.11
0.40 - 0.80	395.814	21.89	201,084	14.23
0.80 - 1.52	245,524	13.58	219,122	15.52
1.52 - 8.00	399,283	22.10	877,665	62.14
Total	1.807,697	100.00	1,412,499	100.00

Source : Sri Lanka Census of Agriculture, 1982 (Preliminary Report)

Table 2. Percentage of Income Received by Each Twenty Per Cent Ranked Income Receives - By Sector (1978/79)

Ranked Income Receives	Percentage of Total Income		
	Urban	Rural	Estate
Lowest 20%	3.34	3.49	7.73
Second 20%	8.49	8.60	13.21
Third 20%	13.24	14.11	16.76
Fourth 20%	19.26	20.82	22.22
Highest 20%	55.67	52.98	40.07
Medium Income(Rs) (One Month)	538.91	428.64	252.48
$ equivalent *	21.55	17.15	10.09

Source: Report on Consumer Finance and Socio Economic Survey, 1978/79, Sri Lanka, Central Bank of Ceylon. Colombo, March, 1963.
" Converted at 1 US $ = Rs. 25.00

Table 3. Gini Coefficient for Income Receiving by Sector

Sector	Gini Coefficient	
	1973	1978/79
Urban	0.40	0.51
Rural	0.37	0.49
Estate	0.37	0.32
All Island	0.41	0.49

Source: Report on Consumer Finances and Socio Economic Survey 1976/79, Sri Lanka. Central Bank of Ceylon, Colombo, starch 1983

Table 4. Average Expenditure per Spending Unit for One month on Selected Food Items by Sector

Food Items	Urban	Rural	Estate
		Rupees	
Rationed Rice/Paddy free	10.82	19.31	4.87
Rationed Rice/Paddy paid	23.90	43.90	12.62
Rice own produce	4.52	34.38	1.09
Rice open market	68.45	44.67	114.43
Other grains	1.30	2.26	1.32
Flour preparation	8.20	2.76	0.96
Bread	38.72	25.35	7.08
Meet, Fish and Eggs	82.30	47.82	40.54
Pulses	10.13	10.05	15.42
Starch Foods	10.44	14.56	10.15
Vegetables	27.80	33.66	37.80

Source: Report on Consumer Finances and Socio Economic Survey 1978/79, Sri Lanka, Central Bank of Ceylon, Colombo, March 1983.

Table 5. Average Expenditure for One Month on Food Items Per Head by Income Groups - All Island

Income Group (Rs)	Food Items Rice Open Market	Other Grains	Pulses	Starch Foods
0 - 100	9.46	0.80	1.73	2.24
101 - 200	10.20	0.60	1.69	2.90
201 - 400	7.90	0.34	1.82	2.43
401 - 600	9.05	0.37	1.75	2.38
601 - 800	10.17	0.34	1.89	2.59
801 - 1000	12.73	0.38	2.15	2.64
1001 - 1500	14.62	0.46	2.55	2.78
1501 - 2000	15.59	0.39	2.89	3.05
2001 - 2500	16.20	0.41	2.89	3.28
2501 - 3000	17.05	0.50	2.95	3.29
Over 3000	14.95	0.46	3.22	3.91

Source: Report on Consumer Finances and Socio Economic Survey 1978/79. Sri Lanka, Central Bank of Ceylon, Colombo. March 1983.

Table 6. Profitability of Selected Crops (Maim 1982/83)

Items	Paddy √1	Cowpea √1	Greengram √1	Maize √2	Soyabean √3
Cost of Production/ha	4096.50	1147.72	1621.10	1217.22	2642.68
Net return/ha	7021.88	3140.3	3424.98	1982.85	5407.63
Return per unit of capital	1.71	2.73	2.11	1.63	2.04
Return per man-day	16.72	7.41	15.63	0.92	12.89
Average price of product (kg)	3.52	6.34	8.84	2.49	5.88
Yield/ (t/ha)	3.0	0.66	0.22	0.50	0.53
National average yield/ (t/ha)	3.5	0.70	0.57	1.08	0.79

Source: Agricultural Economics Study, No. 35 Division of Agricultural Economics and Projects. Department of Agriculture, Peradeniya. December 1983.

√1 Kurunegala district
√2 Badulla district
√3 Anuradhapura district

Table 7. Extent and Production of CGPRT Crops (1971-1983) ('000 ha and '000 mt)

Crop		1971	1975	1979	1980	1981	1982	1983
Maize	Extent	25.7	40.0	23.6	24.3	28.1	34.1	47.3
	Production	16.3	34.6	26.0	31.4	35.3	38.6	51.1
Cowpea	Extent	1.0	8.8	30.2	25.6	38.2	32.8	45.1
	Production	0.52	7.6	18.7	23.5	39.0	35.2	31.4
Greengram	Extent	2.5	9.3	12.2	14.2	18.2	20.6	28.6
	Production	1.3	5.9	9.6	12.9	18.9	18.4	16.2
Soyabean	Extent	-	1.2	1.2	1.1	2.2	7.6	14.6
	Production	-	1.2	1.3	1.1	2.3	10.1	11.6
Cassava	Extent	n.a	78.4	33.9	26.9	36.8	51.0	31.9
	Production	n.a.	847.0	360.3	329.3	40.6	49.5	62.0

Source: Department of Agriculture, Sri Lanka.

Table 8. Floor Prices of Food Crops (Rupees per ton)

	1978	1979	1980	1981	1982	1983
Maize	1254	1540	1540	2300	2500	2500
Greengram	-	-	6600	6600	6750	-
Cowpea	-	-	4750	5500	5500	-
Soyabean	5600	5600	4950	7500	7000	7000
Cassava	-	-	-	-	-	-

Table 9. Purchase of Food Crops by Government Organizations

	Paddy Marketing Board %	Other State Organizations %
Maize	1.7	55.2
Cowpea	-	2.2
Greengram	-	0.56
Soyabean	-	-
Cassava	-	-

Table 10. Per Capita Consumption Requirements of Different Crops Based on the Nutritional Requirements set by the Medical Research Institute of Sri Lanka

Crop	Kgs/Annum
Maize	3.33
Other grains	1.70
Manioc	36.66
Other Yams	9.00
Cowpea	4.67
Greengram	2.33
Soyabean	0.53

Table 11. Requirements of Selected CGPRT Crops try Year ('000 mt)

Crop	Average Annual Availability (1979-81)	Projected Requirements				
		1984	1985	1986	1987	1988
Maize	30.93	51.05	51.95	52.8	53.7	54.60
Cowpea	27.70	71.5	72.7	73.95	75.2	76.45
Greengram	13.80	35.75	36.35	36.95	37.6	38.25
Soyabean	1.70	8.15	8.25	8.4	8.55	8.70
Cassava	370.10	562.40	571.95	581.65	591.55	601.60

Source: Five Year Development Plan for the Cultivation of Subsidiary Food Crops. Department of Agriculture. Mimeo. 1983.

THAILAND

SOCIO-ECONOMIC CONSTRAINTS AND RESEARCH PRIORITIES ON THE PRODUCTION, UTILIZATION AND MARKETING OF SOYABEANS*

I. Introduction

Soyabeans are an important econimic crop in Thailand. Although the crop consitutes a small part of the national agricultural output, its importance affects the foreign exchange position of the country. In recent years, the domestic needs for soyabeans have exceeded the domestic production, resulting in increasing amounts of imports. The trend of increasing imports is expexted to continue unless the domestic production of soyabeans can be substantially increased.

The Royal Thai Government is concerned about the increasing level of soyabean imports, and desires greater domestic production. A subsidy policy of supplying improved seed inputs and rhizobium inoculant has been established in order to encourage farmers to grow more of the crop.

It is estimated that as much as 20 per cent of Thailand's agricultural land area is suitable for growing legume crops such as soyabeans. The issues can be stated as: "Why do farmers grow so few soyabeans in spite of the fact that domestic demand has expanded?" 'what are the major constraints to expanding domestic production?" " What are the alternatives for the government to encourage domestic production of soyabeans? " These issues as well as others will be considered in this report.

2. Overview of Soyabean Production, Utilization and Marketing

2.1 Production

The total production of soyabeans has trended slightly upwards over the years. During the period 1979-80 to 1983-84 there was an increase in annual production from 102 to 172 thousand tons. A further increase to 190 thousand tons is expected during 1984-85. These increases, however, are falling far short of the soyabean production targets set forth in the Thailand 5-year plan.

The area planted to soyabeans ranges from 800,000 to 1,000,000 rais with nearly 50 per cent of the production occurring in the provinces of Sukothai and Chiang Mai. Soyabean is grown largely as an upland crop in the rainy season in Sukothai, and as a dry season, irrigated crop on paddy land at Chiang Mai. The rainy season crop accounts for approximately 60 per cent of the total annual production.

Upland soyabeans are planted in late April-early June and are harvested in July-August. Land is prepared either with animal or by custom plowing with hired equipment. Planting dates vary depending upon the onset and frequency of rains. Paddyland soyabeans, on the other hand, are sown directly into the rice stubble in December-February and then irrigated. The average seeding rates of 10-15 kilograms per rai reflects the low germination of most of the seed supplied to farmers by merchants. With seed of good germination, the seeding rate should be no more than 5-7 kilograms per rai.

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* Prepared by Kajonwan Itharattana, Senior Economist, Division of Policy and Agricultural Development Plan, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives.

Hand weeding is commonly done for the rainy season crop, but seldom for the dry season crop. Harvesting is done by hand, the sheaves are dried in the sun, and then threshed by beating the pods with sticks. Harvesting losses and damage vary depending upon management practices, but are relatively high because of repeated handling and the damage caused by hand treshing.

The planted area of soyabeans has increased by about 7 per cent annualy over the past five years (see Table 1). With improved seed, the farmers can improve production by about 12 per cent. However, because of the lack of other improved practices the soyabean yield in Thailand is very low compared to major soyabean producing countries. For example, in Argentina in 1982-83 the yield was about 356 kilograms per rai, and in the U.S. during the same year it was about 334. This is almost double the yield in Thailand (Table 2).

Table 1. Planted Area of Soyabean, Production and Yield

Year	Planted area (thousand rais)	Production (thousand tons)	Yield/ rai (kg)
1979/80	679	102.0	150
1980/81	788	100.0	127
1981/82	797	131.5	165
1982/83	778	113.4	146
1983/84	970	172	174
1984/85	1.002	190.0	190

Table 2. A Comparison of Soyabean Yields Per Rai Among Major Producing Countries, 1982/83

Country	Yield/rai (kg)
Argentina	356.94
USA	334.08
Brazil	284.80
Paraguay	253.01
Japan	233.28
Thailand	146.00

Source: FAO

The production cost for soyabeans has been relatively high during the past few years. In 1982-83 the cost was 6.38 baht per kilo (23 baht = US$ 1.00) and in 1983-84 it was 5.89 baht per kilo. When comparing Thailand's production cost with the U.S. , it is found that the U.S. cost was lower except in 1983-84 (Table 3).

Table 3. A Comparison of U.S.A. Versus Thailand Soyabean Production Costs

Item	Thailand			U.SA		
	1981-82	1982-83	1983-84	1981-82	1982-83	1983-84
Variable cost (B/rai)	804.21	806.64	899.84	950.64	1,012.09	1,000.28
Fixed cost (B/rai)	109.09	124.50	124.56	647.35	630.74	753.09
Total cost/ rai (B)	913.30	931.20	1,024.40	1,597.98	1,642.83	1,753.37
Variable cost/ kg (B)	4.87	5.52	5.17	2.94	2.95	3.65
Total cost/ kg (B)	5.54	6.38	5.89	4.95	4.79	6.40
Yield/rai (kg)	165	146	174	323	343	274

2.2 Utilization

Soyabeans grown in Thailand are used for both human consumption and for supplying the livestock feed industry. The former includes the extracted oil, as well as products such as soyabean curd, fermented soyabeans, etc. Some traditional varieties (e.g., black soyabeans) are grown for only human consumption.

About 60 per cent of domestically grown soyabeans go to processing plants for oil extraction. The oil from this source is mixed with other vegetable oils to make the final product for the consumer.

In recent years, the rapidly expanding commercial livestock sector has provided a growing market for soyabeans (see Table 4), with a significant proportion of the meal coming from imports. Recently, most of the meal imports have come from Brazil (see Table 5). The larger the volume of soyabean meal imported, the cheaper the meal becomes to the feed manufacturing firm. Therefore, imported meal is used primarily by the larger firms.

Table 4. Annual feed consumption by livestock class (1,000 tons)

	Swine	Poultry	Others	Total
1977	446.88	234.14	43.98	725
1978	644.88	337.48	62.64	1,045
1979	776.65	406.92	76.43	1,260
1980	862.94	452.13	84.93	1,400
1981	924.58	484.43	90.99	1,500
1982	959.10	502.45	94.45	1,556

Source: Agricultural Economic Research Division.

Table 5. Quantity of Soyabean Meal Imports (Tons)

Source	1980	%	1981	%	1982	%
Brazil	90,547	58.50	28,010	33.94	31,320	59.19
India	44,478	28.74	29,530	35.78	4,853	9.17
USA	16,891	10.91	9,267	11.23	1,066	2.01
China	2,615	1.69	2,900	3.51		
Taiwan	-		248	0.30	1,233	2.33
Japan	51	0.03	694	0.84	1,403	2.65
Total	154,782	100	82,523	100	52,917	100

2.3 Marketing

The principal market channels for soyabeans are from the farm through the local merchants and assemblers to the central markets in districts and provinces. From the central markets the soyabeans go to the Bangkok market. The Bangkok market is important because most processing and feed industries are in a close proximity to this city.

The soyabean market in Thailand is smell and susceptible to rather wide price swings as local merchants and middlemen speculate on prices. Farmers generally do not have storage facilities and most beans are handled by the middlemen at harvest. Depending upon the supply and demand situation, the middlemen will often hold the crop in hopes of a higher price, and then. sell quickly if they expect that the price will not hold. When the middlemen hold the bean in anticipation of higher prices, there is a disruption in the soyabean supply to the processing mills.

The local merchants have a larger role than just the assembly and transfer of the crop to central markets. They are the suppliers of inputs for soyabean production, as well as for other crops, and they also provide financing services to farmers. The latter gives the merchants considerable influence on where the farmers market their soyabeans, and on the terms of sale.

There are, however, other factors which limit the extent to which soyabean prices can very. International price levels influence domestic prices of soyabeans and their products. There are also many substitutes which affect prices. In livestock feed manufacturing, for example, other bean meals as well as fishmeal can substitute for soyabean meal. The same situation exists for soyabean oil. Actually, vegetable oil products marketed to consumers can be a mixture of two or three kinds of oils. Within limits, the mixture of oils can be varied to keep its cost as low as possible.

In the past, the government has used tax and import/ export controls to limit price fluctations in soyabeans, soyebean products, and their substitutes. Import taxes or quotas which are imposed to raise price levels of soyabeans above the market level may improve the profitability of soyabean production, but when these higher-priced soyebeans are processed meal the result is higher prices for consumers of vegetable oil, and also for meal processed by the feed manufacturers.

3. Problem Indentification

3.1 Constraints to Higher Soyabean Yields

3.1.1 An adequate supply of high-quality, pure seed of the recommended varieties is critical to improve the productivity of the soyabean grower. At the present time, the Ministry of Agriculture and Co-operatives can supply only 5 per cent of the needed seed (10,000 metric tons). The private sector is not presently engaged in multiplying or supplying the better seed, and only supplies grain soyabeans (mixtures, unimproved strains, etc.) of extremely low germination and quality.

3. 1.2 Rhizobium Is a relatively Inexpensive input for farmers to use and is a very effective way to increase the yield of soyabeans (and the successor crop) without a large cash expenditure. The cost of the inoculant is about 10 baht per rai. However, the Department of Agriculture is unable to produce sufficient rhizobium to meet the needs of the growers. In addition, there is the difficulty in supplying fresh rhizobium, which has not been exposed to excessive heat and sunlight. Another problem has been timely delivery to the farmers in advance of the planting season.

3.1.3 The supply of phosphate fertilizer is limited and that which is available is expensive. This is because the crops which have been fertilized in the past have used rations composed of both nitrogen and phosphate. When phosphate is purchased as part of a nitrogen based fertilizer, the farmer is wasting his money on the nitrogen portion which is not needed for grain legumes. If the farmer wishes to purchase single nutrient phosphate fertilizer, he finds that it is very expensive because the marketing system does not handle sufficient volumes to reduce the distribution costs.

3.1.4. It is estimated that only 30 per cent of the farmers practice adequate weed control in their soyabean fields. This situation exists largely because of the opportunity costs of weeding labour. Soyabean prices are perceived as the major constraint by the farmers, although it is also the lack of other practices which inhibits soyabean yield and quality.

3.1.5. Harvesting losses vary considerably but are relatively high everywhere. Losses are due to repeated handling and threshing damage.

3.2 Constraints to Expansion of Soyabean Production

One aspect of the study of the possibilities for expanding soyabean production was to investigate the profitability for farmers to grow soyabeans. A breakeven analysis was used to measure the relative profitability of growing this crop compared to alternative crops. A breakeven price for soyabeans which makes soyabean production equally profitable with the substitute crops was calculated by using the following formula:

$$BP_S = \frac{P_A^{*} \quad Y_A - C_A + C_S}{Y_S}$$

Where,

BP_S = breakeven price for soyabeans
P_A = price for alternative crop A
Y_S = expected yield for soyabeens

Y_A = expected yield for alternative crop A
C_S = variable costs for soyabeans
C_A = variable costs for alternative crop A

This formula is derived in the following way:

(1) $P_S * Y_S - C_S$ = Return from soyabean production. P is price for soyabeans

(2) $P_A * Y_A - C_A$ = Return from alternative crop A production.

Set the return from soyabeans equal to the return from the alternative crop and solve for P_S :

(3) $P_S * Y_S - C_S = P_A * Y_A - C_A$

(4) $P_S * Y_S = P_A * Y_A - C_A + C_S$

(5) $P_S = \frac{P_A * Y_A - C_A + C_S}{Y_S}$

There are specified as follows:

P_A average over the years 1980/81 to 1982/83

Y_S, Y_A average over the years 1980/81 to 1982/83

C_S, C_A for 1980/81

Once BP_S has been determined, it can be compared to the actual price of soyabeans. If BP_S is higher then this price, then soyabeans are not as profitable as the alternative crop. If the breakeven price is lower, then soyabeans are more profitable than the substitute crop. The low relative profitability of soyabean can be used to consider a constraint to the expansion of soyabean production.

The study shows that soyabeans, on average, have not been the most profitable crop for the farmer to grow. There is, however, considerable variation in the relative profitability of soyabean production among the provinces. To evaluate this variability, a study is made using provincial cost and yield data. The results of this study we shown in Tables 6 and 7, for the rainy season and the dry season, respectively. To make the results easier to understand, he provinces are classified as follows: Category I is for those provinces in which the actual, farm level soyabean price was greater than the breakeven price, i.e., soyabeans are more profitable than any other crop; Category II is for those provinces in which the breakeven price was moderately greater than the soyabean price, that is, the breakeven price was 30 per cent higher than the average price for soyabeans over the three years studied; Category III is for those provinces in which the breakeven price was substantially greeter then the soyabean price.

To summarize the results for the dry season crop;

Table 6 Classification of provinces by the results of the breakeven analysis for the rainy season soyabean crop.

Province	Planted Area*	Breakeven Price	Soyabean Price
Category I Provinces in which the soyabean price was greater than the breakeven price			
Kamphaeng Phet	11,617	5.28	7.86
Tak	2,935	5.77	7.86
Lampang	1,101	5.17	6.38
Uttaradit	19,895	5.24	6.38
Phrae	6,284	5.44	6.38
Suphar Buri	928	6.24	6.47
Sukhothai	256,491	6.36	6.38
Category II Provinces in which the breakeven price was moderately greater than the soyabean price			
Saraburi	35,093	6.55	6.04
Kanchanaburi	5,091	7.49	6.50
Chiang Mai	9,104	7.07	6.02
Lop Burl	29,025	7.26	6.04
Loei	10,006	7.68	6.33
Phetchabun	27,839	9.47	7.42
Category III Provinces in which the breakeven price was substantially greater then the soyabean price			
Petchaburi	2,586	11.23	6.50

*Average planted area over the years 1980-81 to 1982-83

24 per cent of total dry season planted area is classified as Category I,
70 per cent of total dry season planted area is classified as Category II,
6 per cent of total dry season planted area is classified as Category III.

For the rainy season crop:

70 per cent of the total rainy season planted area is classified as Category I,
21 per cent of the total rainy season planted area is classified as Category II,
1 per cent of the total rainy season planted area is classified as Category III.

Although soyabeans were not, on average, a profitable crop, there were regions where soyabeans were the most profitable crop for farmers. For both the dry season and the rainy season crops, a moderate improvement in the price situation would have made soyabeans the most profitable crop for most of the country.

In summation there are important constraints to the expanded production of soyabeans. Probably the most important constraint to increasing both planted area and yields is the lack of relative profitability compared to alternative crops which farmers might grow. The difficulties for farmers to obtain high quality seed, rhizobium and phosphate fertilizers are also important constraints to increasing yields.

4. Production Development Activities of MOAC

The objective of MOAC in soyabean development is to improve productivity through the use of high yielding seed with high germination and high oil content. The promotion of the use of

Table 7. Classification of provinces try the results of the breakeven analysis for the dry season soyabean crop.

Province	Planted Area*	Breakeven Price	Soyabean Price
Category I Provinces in which the soyabean price was greater than the breakeven price			
Tak	22,104	5.91	7.86
Loei	19,942	5.91	6.33
Phrae	18,470	5.98	6.38
Uttaradit	3,840	6.00	6.38
Category II Provinces in which the breakeven price was moderately greater than the soyabean price			
Lampang	8,162	7.01	6.38
Chiang Mai	134,481	6.95	6.02
Kamphaeng Phet	45,712	9.96	7.86
Category III Provinces in which the breakeven price was substantially greater than the soyabean price			
Sukhothai	14,933	12.99	6.38
Suphan Buri	939	15.07	6.47

* Average planted area over the years 1980-81 to 1982-83.

rhizobium fertilizer and other practices, are considered to increase yeld and are implemented in some areas of Thai land.

4.1 Seed Exchange Project

At present, the MOAC seed exchange projects are implemented as follows:

Year 1983/84 The rainy season soyabeans are grown in eight provinces with 68,158 rais and can provide 331 tons of seed for production. The dry season soyabeans are grown in six provinces with 6,741 rais.

Year 1984/85 The rainy season soyabeans are grown in eight provinces which can provide 800 tons of seed for production. The dry season soyabeans are grown in 12 provinces and can provide 293 tons of seed for production.

The result of this programme can increase the rainy season soyabean yield about 46 kg per rai, which is higher then the average increased yield in the whole country. The costs of production per kilogram for farmers in the project decrease from 5.24 baht per kilogram to 4.35 baht (Table 8).

Table 8. Cost of production of the rainy season sayabean in 1983/84.

	Farmers outside the project	Farmers in the project.
	Baht/rai	
Variable cost	720.36	783.55
Fixed cost	83.14	86.66
Total cost/rai	803.50	870.21
Yield/rai	153.42	199.78
Total cost/kg	5.24	4.35

4.2 Production and Distribution Development Programme

The MOAC, in co-operation with the private sector, has developed a programme at Sukhothai which can result in increased productivity for the farmers. This is accomplished by jointly providing inputs such as high yielding seed, rhizobium and fertilizer, by technology transfer, and by product marketing guarantees. The programme was expanded to Chiang Mai during the dry season of 1984-85. There are plans to expand the programme to other provinces in future years.

5. Policy Options

The key objective of the government in the soyabean sector is to improve the foreign exchange position of the country. This can be achieved by a strategy which includes substituting domestic production for imports of both soyabean meal and oil. The policy issue to be considered then, is how to increase the domestic production of soyabeans (Table 9).

The policy options to increase domestic production should focus on removing, or at least reducing, the constraints mentioned previously. It is expected that the planted area can be expanded through the MOAC promotion programmes in those areas where soyabeans are more profitable than competing crops. However, expansion in many areas is constrained because soyabeans are less profitable than the competing crops. The government can improve the profitability of soyabeans by raising the farm-level price of soyabeans relative to the price of the other crops. This higher price will make soyabeans the more profitable crop in areas where other crops are now more profitable, thus providing a financial incentive for farmers to switch their land to soyabeans. The resulting increase in production can be used to substitute for imports of soyabean oil and meal. However, when production is expanded to land where soyabeans are not the most profitable crop under the free-market prices, the country will suffer a net loss in its foreign exchange position. This loss occurs because the price intervention in the market makes it profitable for farmers to grow soyabeans when there are other crops, such as maize and rice, which can earn more foreign exchange through export than is saved by the reduction of imports of soyabean meal and oil.

A second policy option for the government is to expand the present programmes of the MOAC, supplying more improved seed and rhizobium. The use of these inputs combined with fertilizer and adequate weed control will increase yields, thus increasing the total production of soyabeans. In addition, the increase in productivity from the use of these inputs will reduce the cost of producing a kilogram of soyabeans. This reduction in production cost will improve the profitability of sayabeans relative to the competing crops.

According to the government policy of an increase in soyabean productivity, there should be some measures or guidelines to increase the effective demand for domestically produced soyabeans. The measures will include en importation control of soyabean grain, oil, and/or meal for a given period. The importers will be required to ask for permission to import these products, and they must guarantee that they will purchase a given proportion of domestically produced soyabean grain at a given price for each kilogram of soyabean products that they import. This practice should help increase the development of soyabean in the country.

Table 9. Production, Export, Import, and Domestic Disappearance of Soyabeans (Unit: 1,000 tons).

Year	Production	Export	Import	Domestic Disappearance
1979-80	102.1	9.8	73.2	165.5
1980-81	100.0	3.5	208.8	305.3
1981-82	131.5	2.9	178.8	307.4
1982-83	113.4	1.6	257.5	369.3
1983-84	172.0	1.2	233.9	404.7
1984-85	190.0	0.52(Jan-Jul)	169.7(Jan-Jul)	359.18
Growth rate	+14	-41	+15	+15

VIET NAM

RESEARCH IMPLICATIONS OF EXPANDED PRODUCTION OF SELECTED UPLAND CROPS IN TROPICAL ASIA*

Solving the food problem in Viet Nam is now of prime importance, even though in the last few years, initial achievements have been recorded in this field. It should be noted that we have made progress in rice production with an average increase rate of about 7-8 per cent. However the subsidiary crops have not seen such an advance. In the meantime, the population growth remains high, at about 2.2 per cent per annum. As Is well known, there was an unusual cold spell during the 1983-84 rice crop and there were also August and September floods, with an early November floods which swept away a lot of food, respite the people's efforts.

As far as subsidiary food crops are concerned, we have attached importance to coarse grains, pulses, roots and tubers (CGPRT) crops, such as maize, potato, cassava, sweet potato, and other legume crops such as soyabean and groundnut.

In the Northern mountains, the Western High lands, and the East of South Viet Nam, the CGPRT crops make up 30-40 per cent of the energy in the people's diet. Attention has been paid to the cultivation of legume crops to raise the protein content in the daily diets. However, the CGPRT crops are not increasing sufficiently I with an annual fluctuation in area from 1.2 to 1.3 million hectares. The following are the principal constraints on the crops:

- Shortage of technical facilities and materials such as chemical fertilizers and pesticides to promote intensive cultivation.
- Lack of facilities to convert fresh tubers into preserved products, and shortage of transportation from the CGPRT crops growing areas to other regions.
- Lack of productive CGPRT varieties appropriate to the cultural conditions or to the rotation systems of different ecological regions.
- Traditionally, the Vietnamese prefer rice to the CGPRT crops. Therefore, more efforts have been focussed on rice cultivation. If facilities to convert the CGPRT into different kinds of foods, or into synthetic feed to encourage livestock breeding, are not available, then the development of the CGPRT cultivation will meet with difficulties. The average per capita consumption is now about 6 kilograms of maize and 65-70 kilograms of tubers per year.

The cultivation of maize and soyabean are of the greatest importance to the Vietnamese.

Maize Production and Research Priorities

Annually, the Vietnamese put 370,000 to 400,000 hectares under maize with an average yield of 0.9 - 1. 1 ton per hectare per crop. The maize growing areas are in the mountains of the Northern provinces, three provinces of the Western High Lands, and almost all the provinces of Central Viet Nam and Eastern South Viet Nam.

New varieties ore grown in some of the areas, such as the V. M. N- I, K. T -5, a Western yellow, Early Thai composite, with 2-A and 2-8 synthetics. So far we haven't produced the simple, double, and three-way hybrids. Fertilization is usually 2-4 tons of farmyard manure and 10-40 kilograms of nitrogen per hectare, while the crop density is about 4,000-6,000 plants/ha, with two hand weedings. The most common pests are the Helminthosporium Maydis, the cut-worm (Agrotis Ypsilon), borers and aphids.

The seasonal crops are as follows:

- Winter crop: Sowing from September to early October in the Northern Delta and the Midlands

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* Prepared by Chi and Quang Hanh

- Winter-Spring crop: Sowing from November to early December in the North and the coastal areas of Central Viet Nam.
- Spring crop: Sowing from January to February in North Viet Nam and North of Central Viet Nam.
- Summer-Autumn crop: Sowing in May in the Northern mountainous region, the Western High Lands, and the East of & South Viet Nam.
- Autumn-Winter crop: Sowing from September to early August in the North of Central Viet Nam, the West High Lands, and the East of South Viet Nam.

Maize is often used as human food, therefore about 10 per cent of the area is planted to glutinous maize, with the rest harsh Flint and Dent maize. An insignificant quantity is used in the processing industry and in animal husbandry.

The following are the major constraints to a speedy expansion of the maize-growing areas:

1. Crop multiplication of maize is located, and so it is necessary to have short-term varieties. However, due to the harsh climatic conditions, the production never experiences a good vegetative growth. The yield remains low, about 0.5-0.6 ton/ha, mainly because of drou ght.

2. The regions where compatible soils are available often lack manpower, processing facilities, and means of transportation. The Western High Lands may produce two crops of maize during the rains, but the first crop is usually harvested in the rains, which also causes difficulties in the soil preparation for the second crop. It is imperative to obtain a long-term maize variety with 4,400-4,500 degrees of accumulated temperature to be harvested in the post-rain periods.

3. The input of N fertilizer is necessary for maize as well as rice, with at least 28-30 kilograms of N per ton of grain; however, the market price of maize is equivalent to only 80-85 per cent of the paddy price.

4. So far, we have not produced maize seeds of high quality, compatible with different ecological regions, to release to the various maize-growing areas, and there is also a lack of storage facilities for seed. Our farmers often preserve their own corn seeds.

For long-term benefit, the policies of Viet Nam intend to raise maize to an importance second only to rice, since maize constitutes food for man and feed for animals. It is our hope that after a short period of time, we may be self-sufficient in rice for human consumption and use maize entirely as feed for animals and for the processing industries.

We are making efforts to further expand the areas under maize with an average yield of 1.8 -2.0 ton/ha/crop by 1990, or a yield increase of 70 per cent. To achieve this goal, the following must be accomplished:

1. Re-planning and re-programming of the areas which specialize in maize cultivation to increase the production that can be transported to other regions.

2. Expansion of the maize seed production, to release seeds to the maize-growing areas with a scheduled change in variety every 2-3 tears.

3. Construction of maize-processing units to produce synthetic feed for animals.

4. Expansion of the net-work of varietal adaptation tests of new varieties to select those compatible with the rotation systems and crop multiplications of various ecological regions.

5. Supplying of N.P.K. and pesticides to the maize-growing areas and investigating the mechanization of maize cultivation.

6. Creating maize-growing regions making up about 40 per cent of the total areas with a possible yield of 2.5-3.0 ton/ha/crop.

Soyabean Production and Research Priorities

In the 5-year plan, 1981-85, our government has promoted the cultivation of the soyabean as a popular crop in all regions to combat the shortage of protein in the diet and increase the supply to animal husbandry. From 1980 to 1984 we have doubled the areas under soyabean with an average yield of about 0.5-0.6 ton/ha/crop.

Soyabean is grown in the following seasons:

- A winter soyabean crop is added to the double- rice crop lands of the North, a Spring crop to the lands of the South, and a Summer crop to the midlands of North Viet Nam, and to the coastal areas of central Viet Nam.
- A Spring-Summer soyabean crop is added to the long-term rice region of the South.
- In the up-lands, a Spring soyabean crop is practised in the North, a Summer crop and an Autumn crop in the South, and an Autumn-Winter crop after the maize crop in the northern mountainous regions.

We are now growing more than 10 verieties with a growth period of 70-130 days ands have identified the varieties compatible with different seasons and regions. Our initial achievements are considerable, but not as greet as expected, due to the following causes:

1. There is a shortage of varieties resistant to rust and borers, ands a lack of effective pesticides.
2. As a crop for crop multiplication in some regions, the soyabean is of a short-term variety, but for the last two years, the rice crop was prolonged by cold weather, and the soyabean was not planted in time.
3. In some of the soyabean growing areas, the crop is still affected by the aborted grain, hence the fall of yield. Sometimes, the rain during harvest prolongs the drying process, and the grain becomes mouldy. The soyabean growing regions are more often then not sufficient in food, and the lock of mechanization has brought about a competition between soyabeans and other food crops.
4. The motivation and the dissimination of techniques of on-the-spot processing and consumption of the soyabean are not yet developed in the new growing regions.

We are making efforts to triple the area under soyabean with a yield of 1.0-1.2 ton/ha/crop by 1990, or a yield increase of 60- 70 per cent.

To achieve this goal, the following plans are in progress:

1. The expansion of the regions specializing in soyabean cultivation with emphasis on crop multiplication as a method to increase area.
2. Continuing the cross-breeding and selection of varieties resistant to diseases (particularly rust) and insects, and testing the varieties for adaptation in order to select the ones compatible with the rotation systems and the crop multiplications in the various ecological regions.
3. Investigating fertilization methodologies, ryzobium inoculation, density, and studying the technology of storage of high-protein seeds in the humid conditions of a tropical country.
4. Increasing the accessibility of chemical inputs for soyabean cultivation, particularly phosphorous, lime, organic fertilizers, nitrogen for basal dressing and pesticides.
5. Developing the processing of soyabean into a nutritive powder for children, and into soyamilk and soyacheese.
6. Exempting agricultural taxes for the regions of soyabean multiplication, and giving priority to the supply of fertilizers and chemicals to the regions.

Summary

Maize and soyabean are the two crops of major importance, considered by our government as key crops after rice, not only for short-term interests but also for long-term benefits, until the year 2,000 or longer. Our long- term efforts do not cease at the expansion of the areas and yields mentioned above. However, to achieve our goals we must overcome many constraints, first and foremost the lock of technical facilities, expertise, agricultural machinery and processing equipment, not to mention the various climatic conditions which greatly hamper our advance.

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PARTICIPANTS

MEMBER COUNTRIES AND REPRESENTATIVES

AUSTRALIA

Mr. Peter R. Perkins, Officer-in-Charge, Grain Marketing Section, Bureau of Agricultural Economics, P.O. Box t 563, Canberra City, A. C. T. 260 I.

BANGLADESH

Dr. Ekramul Ahsan, Member-Director, Bangladesh Agricultural Research Council, Farm Gate, New Airport Road, Dhaka-I5.

Dr. A. K. Kaul, Advisor, Crops and Forestry, Bangladesh Agricultural Research Council, Farm Gate, New Airport Road, Dhaka-15.

INDONESIA

Dr. Soetatwo Hadiwigeno, Head, Bureau of Planning, Department of Agriculture, Jl. Imam Bonjol 29, Jakarta.

Dr. Ahmad Syarifuddin Karama, Director, Sukarami Research Institute for Food Crops (SARIF). P.O. Box 34, Padang, West Sumatra.

Dr. Rusli "Hakim. Chairman of the Governing Board of CGPRT Centre, Central Research Institute for Food Crops, Jl. Merdetka 99, Bogor.

Dr. Dibyo Probowo, Assistant Professor, Faculty of Economics, Gadjahmada University, Yogyakarta.

Dr. Hidayat Nataatmadja, Senior Agricultural Economist, Centre for Agro-Economic Research, Jl. Ir. H. Juanda, Bogor.

Dr. S. Baharsjah, Secretary General, Ministry of Agriculture, Jl. Imam Bonjol, Jakarta.

JAPAN

Mr. Masaru Kagazume, Research Staff, Ministry of Agriculture, Forestry and Fisheries, National Research Institute of Agricultural Economics, 2- 2- t Nishigara, Kita-ku., Tokyo.

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Mr. Phothisane Soukaseum, Director of Department of Agriculture, National Co-ordinator, Ministry of Agriculture, Irrigation Co-operatives, Vientiane.

Mr. Hatsadong, Deputy National Co-ordinator, Ministry of Agriculture, Irrigation and Co-operatives, Vientiane.

MALAYSIA

Dr. Hashim Mohd. Noor, Director of Techno-Economic and Social Research Division, Malaysian Agricultural Research and Development Institute (NARD I), Serdang, Selangor, Telex: MA 37115, Telephone: Kuala Lumpur 356601/12

PAKISTAN

Mr. Oezi Tauqir Azam, Principal Investigator (AERU), National Agricultural Research Centre, P.O. National Institute of Health, Islamabad.

Dr. Muhammad Qesim Chatha, National Co-ordinator (Maize, Sorghum & Millet, National Agricultural Research Center, P.O. National Institute of Health, Islamabad.

PHILIPPINES

Dr. Aida R. Librero, Director, Socio-Economic Research Department, Philippines Council for Agriculture & Resources Research & Development, Los Banos, Laguna.

Dr. Dely P. Gapasin, Director, Crops Research Department, Philippines Council for Agriculture & Resources Research & Development, Los Banos, Laguna, Cable: AGRESPHIL . MANILA, Telephone: 63-833-50015 to 19.

Mr. Celestino C. O1alo, Head, Policy Analysis Staff and concurrently Officer-in-Charge, Economic Research Division, Bureau of ,agricultural Economics, Ministry of Agriculture, 582 Delos Santos Bldg, Quezon Avenue, Quezon City.

REPUBLIC OF KOREA

Dr. Keun Yong Park, Chief, Upland Crop Division II, Crop Experiment Station, Office of Rural Development, Suweon 170.

SOCIALIST REPUBLIC Of VIET NAM

Mr. Tran Viet Chi, Director of Department of Agriculture, Ministry of Agriculture, Hanoi.

Mr. Le Quang Hanh, Vice Director of National Pulse Crop Research Center, Dinh- Twong, Thieu - Yan District, Thanh-Hoa Province.

SRI LANKA

Dr. G. W. E. Fernando, Director, Department of Agriculture, Ministry of Agricultural Development and Research, Peradeniya

Dr. Nimal F. C. Ranaweera, Deputy Director, Division of Agricultural Economics and Projects, Department of Agricultural, P.O. Box 7, Peradeniya

THAILAND

Dr. Tongroj Onchan, Professor, Department of Agricultural Economics, faculty of Economics and Business Administration, Kasetsart University, Bangkok 10900.

Dr. Kajonwan Itharattana, Senior Economist, Division of Policy and Agricultural Development Plan, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives, Rajademnern Avenue, Bangkok 10200.

Dr. Chumnarn Sirirugsa, Senior Economist, Division of Agricultural Economic Research, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives, Rajademnern Avenue, Bangkok 10200

Dr. Wisut Wangworawut, Chief, Computer Center, Office of Agricultural Economics , Ministry of Agriculture & Co-operatives, Rajademnern Avenue, Bangkok 10200.

Mr. Chingchai Lohawatanakul, Group Vice President, Charoen Pokphand Group of Companies, 36 Soi Yenchit, Chan Road, Bangkok 10120.

SPECIALIZED AGENCY

Food and Agriculture Organization of the United Nat ions (FAO)

Dr. Ram Badan Singh, Regional Plant Production and Protection Officer, FAO Regional Office for Asia and the Pasific, Bangkok.

United Nations Development Programme/food and Agriculture Organization of the United Notions (UNDP /FAO)

Dr. Ed B. Pantastico, UNDP/fAO c/o Box 618. UNDP, Bangkok

NON-GOVERNMENTAL ORGANIZATION

International Maize and Wheat Improvement Center (CIMMYT)

Dr. Larry W. Harrington, CIMMYT P.O. Box 9- 188, Bangkok 10900

European Communities Delegation for South-east Asia

Ms. Nopmanee Somboonsub, Delegation of the Commission of the European Communities for South-east Asia, Thai Military Bank Bldg, 9th floor 34 Phayathai Road, Bangkok 10400

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Dr. R. D. Ghodake, Economist, ICRISAT Patancheru, P. O. Andhra Pradesh, 502324, India.
International Soybean Programme/Asian Vegetable Research and Development (INTSOY/AVRDC)	Dr. Chris Steern, Representative, International &Soyybean Programme (INTSOY), P.O. Box 42, Shanhua Taiwan 741, Taiwan
International Rice Research Institute (IRRI)	Dr. Donald W. Puckridge, Representative IRRI, P.O. Box 9-159, Bangkok 10900
Agricultural Development Research Project in North-east Thailand	Dr. Sadao Hatta, Project Leader Department of Agriculture, Bangkhen, Bangkok 10900

SECRETARIAT

Mr. Koji Nakagawa	Deputy Executive Secretary
Mr. Enam A. Chaudhury	Special Assistant to the Executive Secretary

----

Mr. Sultan Z. Khan	Chief, Agriculture Division
Mr. S. K. Kim	Senior Economic Affairs Officer, Agriculture Division
Ms. Kannika Wongprasat	Administrative Assistant, Agriculture Division

----

Ms. Seiko Takahashi	Chief, Programme Co-ordination and Monitoring Office

----

Mr. Chhor Kylin	Chief, Division of Administration
Mr. Hunter H. T. Chiang	Chief Conference and General Service Section, Division of Administration

----

Mr. F. M. Rosales	Officer- in-Charge, Information Service

Mr. Shiro Okabe	Director, ESCAP CGPRT Centre Jl. Merdeka 99, Bogor ,Indonesia. Telex 48369 AARD IA, Cable: L1TANAN BOGOR. Telephone: (0251)-26290
Mr. Francois Dauphin	Senior Agronomist, CGPRT CENTRE. JI Merdeka 99, Bogor, Indonesia.
Mr. Irlan Soejono	Senior Ag. Economist, CGPRT Centre, JI. Merdeka 99, Bogor . Indonesia.
Mr. Yoshinori Morooka	Agricultural Economist, CGPRT Centre. JI. Merdeka 99. Bogor. Indonesia.