

HULSE
20-51
15084

IDRC-Lib. 15084

Received from: AFNS
IS
PHS
SSHR
PRES
Hulse

COMMONWEALTH MINISTERIAL MEETING
ON FOOD PRODUCTION AND RURAL DEVELOPMENT

LONDON, 4-12 MARCH 1975

RESEARCH AND DEVELOPMENT REQUIREMENTS
ON POST-HARVEST SYSTEMS

JOSEPH H. HULSE
DIRECTOR
AGRICULTURE, FOOD AND NUTRITION SCIENCES
INTERNATIONAL DEVELOPMENT RESEARCH CENTRE
OTTAWA, CANADA
MARCH, 1975

ARCHIV
HULSE
NO. 51

IDRC-264

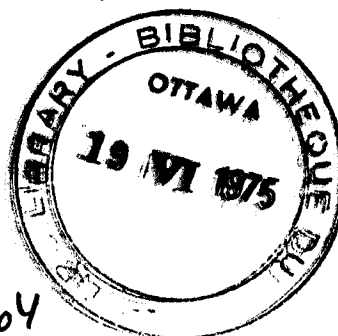
014697

TABLE OF CONTENTS

BACKGROUND	1
THE NATURE OF THE PROBLEM	
(a) Inadequate Concern for Post-Harvest Systems	2
(b) Cooperation Among Donor Agencies	3
(c) The Total Post-Harvest System	4
(d) The Influence of Post-Harvest Conditions Upon Production Levels	5
(e) Ill-conceived Transfers of Technology	6
(f) Export Crops Versus Food Crops	7
(g) Misdirection of Existing Institutions	8
(h) Improved Information Systems	8
THE BENEFITS OF EFFICIENT POST-HARVEST SYSTEMS	
(a) Encouragement to Increased Production	9
(b) Reduced Losses	9
(c) Increased Rural Employment	10
(d) Reduction of Imported Food Grains	10
SUMMARY AND RECOMMENDATIONS	11
SPECIFIC PROPOSALS	
(a) Regional Technical Advisory Teams	13
(b) Integration with Crop Production Research and Development	14
(c) Coordination by Policy Advisory Groups	15
(d) Financial Implications	17
FINAL COMMENT	17

ARCHIV
HULSE
no. 51

IDRC-doc-264



IDRC-doc-

RESEARCH AND DEVELOPMENT REQUIREMENTS
ON POST-HARVEST SYSTEMS

BACKGROUND

This paper is addressed to the problems of post-harvest losses and, in broader context, to the total post-harvest system as it concerns certain important cereal grains and legumes grown in tropical Asia and Africa.

The paper will argue that more serious attention and material support be given to improving post-harvest grain systems, and will recommend certain courses of action for consideration by the Governments of the Commonwealth Nations.

There are two appendices:

- A. the report of a study on Post-Harvest Rice Technology in four countries of Southeast Asia written by Dr. Dante de Padua of the University of the Philippines, Los Banos; 625.18 I 2
- B. the report of a mission from the University of Alberta which studied the Post-Harvest Food Grains Industry in several semi-arid areas of Africa. ARCHIV FORBES NO. 01

Financial support for each of these activities was provided by the International Development Research Centre.

Only two crop producing regions are covered by this report but it is recognized that the improvement of the post-harvest systems is necessary in many other areas of the less developed world.

It is probable that with IDRC support a working group on post-harvest research in Latin America will meet in that region during the summer of 1975.

THE NATURE OF THE PROBLEM

(a) Inadequate Concern for Post-Harvest Systems

The main objective of most international and national agricultural research programs is to create improved food crop varieties and to implant these varieties in farmers' fields. An equally important, yet largely ignored problem for the whole international agricultural community is how to protect and transport food crops from the points of harvest to needy consumers; how to convey food crops surplus to the farmers' own needs from the regions and seasons of abundance to those of scarcity.

It is to the post-harvest problems as they relate to subsistence grains¹ that this paper is addressed. "Post-harvest"² refers to the system of activities which occur from the place and time of harvest until the edible portion of a crop reaches the point of consumption.

¹It is recognized that tropical root crops, fruits and vegetables, fish and animal products, also suffer from inadequate post-harvest research. Since however cereal grains and legumes provide most of the calories and protein for the poorest people in the LDCs, this report concentrates upon cereal and legume crops.

²Perhaps "post-production" would be more accurate than "post-harvest" since the techniques of harvesting are themselves a critical component of the system. However, since it is the term most accepted, "post-harvest" will be used in preference to "post-production" throughout this text.

Many scientists, technologists and others have examined various individual components of existing or imagined post-harvest systems. Entomologists have studied insect control; engineers - storage structures and crop drying; food technologists - transformation processes; economists - pricing and marketing; nutritionists - general estimates (e.g. food balance sheets) of food grain availability. The findings reported in Appendices A and B and in the published literature strongly suggest that, for the most part, post-harvest research has concentrated upon components of rather than upon the whole post-harvest system. The research has tended to be widely fragmented rather than integrated.

(b) Cooperation Among Donor Agencies

Communication and cooperation could have been better among different scientists studying the same component of a post-harvest system in the same or similar geographic regions. To some extent this is the result of inadequate cooperation among multilateral and bilateral agencies who have sponsored post-harvest projects. In one African country the mission (Appendix B) encountered three grain storage techniques each significantly different in principle and design, being promoted by three different agencies to essentially the same subsistence grain farmers. Such competitive diversity is more likely to confuse than to enlighten the intended beneficiaries.

It is appreciated that any single technical problem may be solved in more ways than one, and that different solutions may satisfy different circumstances. The mission reported more than 100 different small farm grain storage designs in use in East Africa. Hence, before proposing

one or more new techniques, it would seem logical to compare technically and economically the new alternatives with what is already in use, to determine which is best suited to the post-harvest system which exists or is planned.

(c) The Total Post-Harvest System

The development of new storage, drying and processing techniques should not be undertaken without a prior investigation of the total system. The de Padua report (Appendix A) refers to rice milling technologies unsuited in scale, versatility, labor demand and cost of operation to the system into which they were placed. It refers to drying mechanisms ill-designed and located too far from the point of harvest. A number of innovations proposed for or introduced into post-harvest rice systems in Southeast Asia reveal an inadequate awareness of the difficulties of threshing, storing and milling high moisture rice crops harvested during rainy seasons. Rice harvested with a moisture content in excess of 25% deteriorates rapidly and may be completely spoiled if the nearest dryer is located at a rice mill several days journey from the point of harvest.

The reports from Africa and Asia testify to the inadequate concern given to the economics and logistics of post-harvest systems, and to the climatic, social and political environment in which the systems must function.

The de Padua report specifies post-harvest difficulties resulting from the replacement of traditional varieties with new high yielding and early maturing rice varieties. It refers also to the difficulty of adapting imported milling machines designed to process well-graded rice of uniform grain size, to the widely heterogeneous mixtures of different rice varieties which are delivered to many small Asian rice mills.

Additional post-harvest problems may be anticipated if and when more productive multiple cropping systems are adopted by Asian and African farmers. In fact, the extent to which technologically superior production technologies are adopted by farmers will be largely influenced by the worthiness of the coexistent post-harvest system.

(d) The Influence of Post-Harvest Conditions
Upon Production Levels

The present average yields of food grains in semi-arid tropical Africa are of the order of half-a-ton per hectare. Recent research offers promise of technologies which will yield ten times or more the present average. It can be predicted however that in much of Africa, improved grain production may be utterly frustrated unless matched by an equally imaginative investment in appropriate post-harvest systems, systems which provide the mechanisms and offer the incentives necessary to enable farmers to deliver food crops through efficient marketing and delivery systems to the consumers who need them.

The African mission report lays stress upon the interdependence of pre- and post-harvest systems and the influence of each upon the other. In essence, it asserts that subsistence farming will continue as the dominant pattern of agricultural life in semi-arid tropical Africa until post-harvest systems come into being which encourage farmers to produce food grains surplus to their personal needs. It was the consensus of those interviewed by the mission that farmers in the Sahel could have grown more sorghum and millet during the recent years of drought. The Sahelian subsistence farmers were discouraged from growing more grain by the absence of an organized post-harvest system including markets in which the farmers could trade with confidence.

Both the de Padua and African mission reports emphasize the dependence of the grain production system upon the marketing component of the post-harvest system. Markets exist to serve customers and consumers as well as producers. It appears that more sympathetic attention could profitably be given to the needs and demands of consumers since they are the end point of every post-harvest system.

(e) Ill-conceived Transfers of Technology

In part, many of the frustrations of the past result from an oversimplified concept of the transfer of technology. Various agencies and advisers have sought to translocate post-harvest technologies of drying, storage, preservation, processing, etc. between environments widely dissimilar in climate, and with diverse economic, technical and human resources. Coincident with this ill-conceived attitude to the "transfer of technology" one finds remnants of the philosophy that "research precedes extension by two years". This has led to machines, devices and techniques being elaborated in research institutions far distant physically, philosophically and intellectually from the farmers and other peoples of the LDCs they propose to serve, presumably in the expectation that local extension services will adapt all to work satisfactorily.

Several of the international agricultural research centres have demonstrated the benefits of planning and pursuing their production research objectives in close cooperation with the farmers whom the results are intended to benefit. A similar approach to post-harvest research appears desirable. Most farmers have inherited centuries of collective experience and their opinion is worth seeking before any research project for their benefit is formulated.

More effective communication and cooperation between agricultural production technologists and post-harvest technologists was urged by a recent meeting of Asian scientists sponsored by the International Union of Food Science and Technology (IUFoST). It is important to recognize that post-harvest research be closely associated with pre-harvest production research, since the two are entirely interdependent.

One could overburden this text with countless examples of technological efforts wasted because the relevant post-harvest system was neither defined nor understood. It is not the purpose of this paper to point the finger of blame but rather to encourage the community of international development agencies and governments of the LDCs they seek to serve, to take a serious look at post-harvest problems and to create mechanisms which can significantly strengthen existing systems and design and implement more reliable post-harvest grain systems wherever they are needed.

(f) Export Crops Versus Food Crops

The appended reports draw attention to developing countries in which comparatively efficient post-harvest systems exist for export crops while the food crops for their indigenous peoples are almost totally ignored. Many LDCs rely heavily upon imported cereal grains, which in large part are processed to feed expanding urban populations. If they are to reduce their dependence upon foreign grain supplies, LDC governments must assign higher priorities both to increased grain production and to effective post-harvest grain systems, including technically and economically sound methods of protection, preservation, processing, distribution and utilization.

(g) Misdirection of Existing Institutions

One somewhat delicate matter which concerns the governments of the LDCs deserves brief comment. A number of Asian and African nations have established research institutions whose mandate includes some components of the post-harvest system. Unfortunately, in common with similar institutions in developed countries, they do not all address themselves to the urgent practical post-harvest problems with which their farmers, small processing factories and distribution channels are confronted. Rather, some appear to opt for research which appears more scientifically ingenious than pragmatically useful. This point is made not as a scornful criticism, but because it has relevance to facilities which exist in the LDCs but which are inadequately used for urgent, relevant post-harvest technology research and training.

(h) Improved Information Systems

The meeting of Asian agricultural and food research scientists which stated the need for a closer cooperation between agricultural production research and post-harvest research, also drew attention to the need for better regional communication and information systems. Scientists in the LDCs are often better informed on scientific progress in North America and Europe than on what has been achieved in neighbouring countries. Information and training services are as important as research and development in programs which seek to improve post-harvest systems.

THE BENEFITS OF EFFICIENT POST HARVEST SYSTEMS

(a) Encouragement to Increased Production

An inefficient post-harvest system is a deterrent to food grain production; an unreliable or quixotic post-harvest system confronts the grain farmer with a greater risk than he can contemplate. Conversely an orderly post-harvest system creates the climate of confidence essential if subsistence grain farmers are to be persuaded to produce grains in excess of their subsistence needs.

(b) Reduced Losses

The appended reports (see Appendix B, page 21) present estimates of post-harvest losses. It is recognized that these figures are approximations. Nevertheless, the most conservative estimates suggest annual post-harvest grain losses of the order of millions of tons. Whether viewed in economic terms or in terms of human nutrition in the LDCs, such losses are intolerable. Consequently, the principal gain from more efficient post-harvest systems would be a substantial increase in the food grains available in the LDCs. In turn, this should serve to improve nutritional well-being, reduce outflow of foreign currency and result in general economic benefit. Post-harvest systems, rationally conceived and administered, promote consistency of supply, and discourage cycles of regional and seasonal surpluses and deficiencies with their resultant pendulistic price fluctuations. They permit a more uniform and economic distribution and utilization of food grains.

It is submitted that these potential benefits justify a considerably increased investment in post-harvest research, development, information and training.

(c) Increased Rural Employment

In developed countries where less than 10 percent of the population are farmers, many millions are employed in the component activities of the post-harvest system. An orderly post-harvest system offers many opportunities for increased rural and rural-urban employment: employment in harvesting, grading, storing, transportation, processing and marketing the grains; employment in constructing the facilities and distributing the machines necessary to the various post-harvest activities. It is urged that, in future, more attention be given to designing post-harvest machines and devices which can be built in the LDCs using local materials and labour, and to identifying the means by which to encourage such indigenous manufacture.

(d) Reduction of Imported Food Grains

Appropriate post-harvest processing technologies reduce spoilage and enhance the acceptability, utility and nutritional quality of food grains. Urban populations in the LDCs display an increasing demand for processed foods. The demand for North American and European types of bread is increasing in Africa in almost perfect correlation with increase in urban population. Much of this bread is made from imported grains. Cereal-based weaning and infant foods are also imported in substantial quantities by many LDCs. There is ample evidence to suggest that technologies can be developed to permit significant proportions of indigenous sorghum, millet, maize and tropical legumes to be used in place of imported cereals. These technologies, if commercialized, would provide employment opportunities and, perhaps more important, a comparatively stable and consistent year round demand for locally produced food grains. Thus, they would constitute an incentive to increased food grain production.

The missions' reports suggest that larger, capital-intensive grain processing mills are often ill-suited to the needs of developing countries. Smaller labour-intensive, more flexible and versatile mills have been shown to suit the needs particularly of small rural towns and communities where a variety of different grains are grown and need to be processed.

SUMMARY AND RECOMMENDATIONS

In both Asia and the semi-arid tropics of Africa, the need is urgent for increased research, development, information facilities and training in post-harvest food grain systems.

It is not recommended however that any new research institutions need be created. Rather, it is recommended that existing international, regional and national facilities for post-harvest research, training and information be considerably strengthened, that their individual efforts be more effectively coordinated, and that adequate mechanisms for technical guidance, cooperation and exchange of information be created.

International action is necessary to help governments in the LDCs to a better understanding of what steps are necessary to create efficient post-harvest systems. Individual components of such systems, including crop drying, storage, processing, transportation, and marketing can each benefit from imaginative applied research. But unless the relevance of each component, relative to the total system, is understood, imagined improvements in component technologies may prove more detrimental than beneficial to the system as a whole.

It is recommended that more attention be given to the economic, human and social factors within each post-harvest system, particularly as they relate to the attitudes and demands of the consumers to whom the post-harvest system is ultimately directed.

It is recommended that more of the applied research in post-harvest systems, and the components of these systems, be undertaken under real-life rural conditions, rather than within laboratories. Where laboratory or experimental station research is necessary, it is recommended that the problem be defined in consultation with, and the proposed solution tested by, the relevant farmers, processors and consumers.

Where the result of a research and development project is a new or modified machine, following apparently successful prototype development and testing, it is recommended that the project be pursued to the point of determining the feasibility of manufacture in the country or region of proposed use. Feasibility studies should take account of engineering, economic and marketing factors, and the means by which local manufacture and distribution would be encouraged.

SPECIFIC PROPOSALS

(a) Regional Technical Advisory Teams

Earlier, it was stated that the creation of new post-harvest research institutions is not recommended either for Asia or for Africa. Nevertheless, in each region a central coordinating advisory and information service is believed to be necessary. It is suggested that such services could be created through international action and be supported through multi-donor participation. It is believed that such action might best be coordinated through the World Bank (IBRD) Consultative Group on International Agricultural Research, of which several Commonwealth Governments are members.

It is recommended that a number of post-harvest technical advisory teams be established in Asia and Africa to serve the nations of those regions. The teams would be composed of several relevant specialists including both technical and economic disciplines. The responsibilities of these advisory teams would include:

- (i) to advise interested governments of the region upon the post-harvest systems for their locally produced cereal grains and legume crops;
- (ii) to identify constraints and problems in existing post-harvest systems, particularly problems common to several countries;
- (iii) to define programs and projects of research, development, demonstration, training and information by which to solve the problems defined;

- (iv) to identify institutions in the region where the necessary research, development, demonstration and training could be undertaken; to assist these institutions to draw up project proposals and to seek adequate financial and technical support from single bilateral donors or groups of donors;
- (v) to provide an information service on post-harvest systems and through regional technical and planning workshops to promote and encourage cooperation among governments of the region and their appropriate research, development and training facilities;
- (vi) to encourage more purposeful cooperation between scientists and technologists of the less developed and the developed nations in creating new and/or improved post-harvest systems for food grains.

(b) Integration with Crop Production
Research and Development

It is believed desirable that post-harvest research and development programs be closely associated with crop production research facilities. It is therefore recommended that the proposed Post-harvest Technical Advisory Teams be located at existing agricultural research institutions. For example, in Southeast Asia, an ideal location would appear to be the International Rice Research Institute in the Philippines.

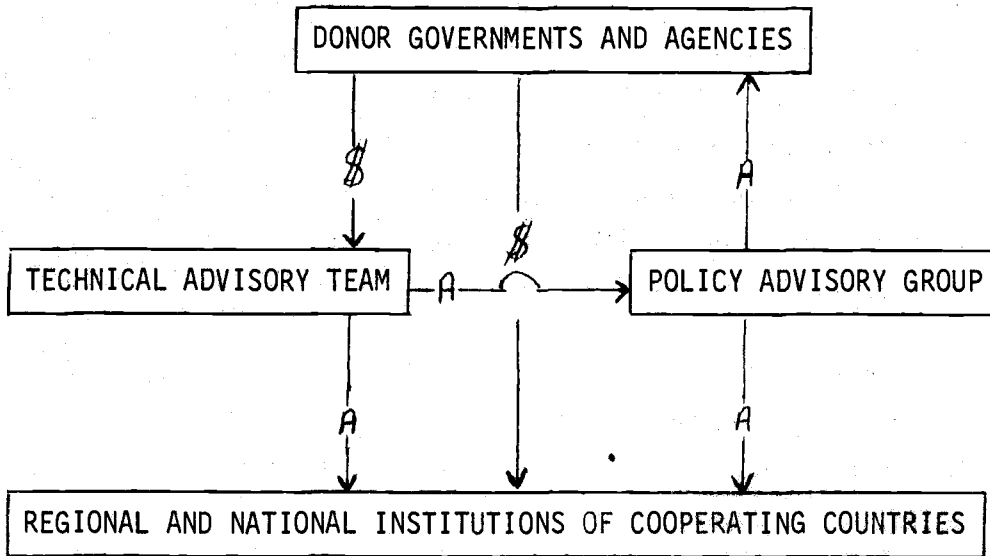
At this point the author is not prepared to recommend at which location(s) in Africa the proposed advisory team(s) be located. It is recommended however that first consideration be given to the semi-arid regions of East and West Africa.

(c) Coordination by Policy Advisory Groups

To ensure a well-coordinated program with a minimum of duplication of effort, it is urged that for each region to be served, a regional Policy Advisory Group of senior administrators and scientists from each of the participating countries be created. The Policy Advisory Group, having representatives from each of the cooperating countries' national organizations, would be the body through which agreement could be reached on the distribution of research effort among the cooperating countries. The Group, in consultation with the Technical Advisory Team could also make recommendations to donor agencies concerning bilateral aid needed by countries within the cooperating network.

The diagram on the next page provides a schematic representation of the envisaged interaction among (a) the donor governments and agencies, (b) the Technical Advisory Team, (c) the Policy Advisory Group, and (d) institutions in cooperating countries.

The direct involvement of a Policy Advisory Group drawn from the cooperating countries is considered essential to the style of the program proposed. In proposing that the technical advice and research be provided by the Technical Advisory Team, but undertaken largely by the existing national institutions, it is believed that the program would address the problems common to many countries, thus minimizing duplication of effort. At the same time, it would serve to strengthen national post-harvest systems and national research and development capacities.



\$ = FUNDS

A = ADVICE

(d) Financial Implications

It is believed that initially each Technical Advisory Team should consist of not less than three and not more than five persons. The cost of maintaining such teams, including technical and administrative support, travel and consultant services should not exceed \$500,000 annually per team. Research, development, training and demonstration projects proposed by each team would of course require additional funds, but if carried out, as recommended, on farms, among rural communities and within existing institutions, these costs should not prove exorbitant. A special fund for these purposes could be created and possibly channelled through the Consultative Group on International Agricultural Research (CGIAR) or some other appropriate agency, though close affiliation with CGIAR is urged to avoid unnecessary conflict or duplication of effort.

FINAL COMMENT

It is clearly implied in the foregoing that urgent attention be given to post-harvest systems particularly as they concern the food grains produced by the less developed nations. Notwithstanding the valuable technical and economic assistance which the more prosperous members of the Commonwealth might contribute, it must be emphasized that the extent to which post-harvest systems can be improved rests largely with the developing nations. Not only are the necessary political and policy decisions theirs alone to make, but most of the applied research, development, training and implementation of consequent new or improved technologies must occur in territories under their jurisdiction.

As the background papers make amply clear, the direct transfers of post-harvest technologies between the richer nations of the temperate zones, and the less privileged nations of the tropics have been of very limited success. Nevertheless, the more developed nations can offer a considerable amount of basic knowledge and experience in addition to financial support of research, development and training programs.

It is essential and urgent that governments of the LDCs recognize that post-harvest problems exist, and that these problems can largely be attacked through institutional and other facilities which already exist, though strengthening and in several cases a shift of emphasis in present programs may first be desirable.

It is important that those post-harvest problems which in the past have received greatest attention (eg. storage, pest control, processing, etc.) be recognized as components of a total system, and that before any significant progress can be made, the desirable post-harvest system must first be defined and understood.

There exists considerable opportunity for regional and international cooperation in creating more efficient post-harvest systems. It is upon this belief that we base the recommendation that the activities of the proposed Technical Advisory Teams be coordinated by Policy Advisory Groups composed of senior administrators, scientists and planning officials from each of the participating developing countries.

It is firmly believed that, given the political will on the part of all nations concerned, and using the mechanisms proposed, that major progress can be made quickly in creating economically and technically effective post-harvest systems in the regions discussed.