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June 1, 1990

To: TAC/SCOPAS

From: Doris Calloway

Re: Background Paper on Human Linkages

The "thought piece" follows as promised. Part 3 was contributed by Professor Louise Fortmann, at my request. I believe part 3 addresses Kamala's concerns but she may wish to add something for your consideration.

I am sorry to miss the meeting and a chance to see all of you.

cgiartac.dhc

Human Linkages

The ultimate aim of the CGIAR is "to improve the nutrition and well-being of low-income people [in the developing countries]." This means that assignment of priorities for the research agenda of the System should be based on ex-ante analyses that characterize the target populations in ways that permit reasoned judgements about the probable impact of competing research strategies. Such analyses would also form the basis for ex-post assessment of impact. Acquisition of the information needed for these analyses, or their refinement, is a research activity in itself.

1. Nutrition.

The incorporation of nutrition objectives into agriculture, fisheries and forestry (AFF) research programs requires functional classification of the target population. One needs to know who and how many they are, where they are, what they lack, when and why. The data bases available for such classification vary from essentially nil (even census data are in question) in many countries, to "spotty" in terms of coverage (e.g. lacking data on rural populations, inadequate sampling frame) and content. (See Tables 1 and 2 kindly provided by Mike Collinson).

Some nutritional gaps have been identified with the less-than-ideal information at hand. Past priority-setting has been based, implicitly, on international production and consumption statistics, adjusted for demographic characteristics and the distributional effects of income. Information of this type, if valid, permits reasonable prediction of total food availability but does not permit functional classification of the malnourished. Operating at this level, it is understandable that IARCs have focussed almost single-mindedly on

research strategies for increasing production of staple crops. An urgent priority for international research is to identify more robust indicators of malnutrition that can be used to classify populations in terms effective for the formulation of research strategy and policy.

The international agencies have recommended systems for monitoring food consumption and nutritional state of populations, and continue to promote surveillance by governments (See, e.g., FAO: COAG /89/5, Urbanization, Food Consumption Patterns, and Nutrition). A strong advocacy position by the CGIAR would be most helpful in the agencies' efforts to fund and implement adequate surveillance systems. In view of the urgent need for this information, however, the CG system should be actively involved in its acquisition. The IARCs should promote research on household food consumption linked with key social and economic variables, spanning the seasons within the geographic, agroecologic zones. The research should seek to identify the commonalities that would best guide international AFF research. For their part, NARS could provide disaggregated information on food production and consumption by rural households as a component of projected on-farm research studies. Because the parameters being studied are not static, this research is, perforce, an ongoing activity.

Deficiencies of specific nutrients, in contrast to overall food deficit, have usually been identified by the presence of characteristic signs and symptoms (e.g. goiter due to iodine deficiency). Often, clinical signs, particularly of lack of trace minerals, have been recognized first in farm animals. Of the 14 trace minerals probably essential for humans and higher animals, only 6 are required by most plants. Forage grown on deficient soil (one that lacks a trace element required by animals but not by plants) fails to support

animal health and growth. Deficiency in humans also is seen where the population subsists largely on locally-produced crops, without a well-developed interregional marketing system. Animal-source foods, with the possible exception of milk, do not vary greatly in content of essential nutrients; if the diet of animals is low in nutrients, the animal may be small or fail to reproduce, but the composition of the flesh is little affected. Foods of animal origin are more consistent, reliable sources of the nutrients such foods contain, providing a rationale for their inclusion in the AFF research agenda.

Where frank, clinical deficiency exists in some individuals, many more people in the same population are found to suffer from lesser degrees of deficiency. The presence of marginal to moderate deficiency states is difficult and costly to detect because the malfunctioning due to marginal deficiency is often quite subtle. If food consumption patterns and the nutrient yield of the foods eaten are known, it is, however, possible to predict which essential nutrients are liable to be in short supply relative to need. Ideally such predictions would be validated by gathering additional evidence (e.g. blood levels) but reasonable estimates of the probability of deficiency can be assigned for many nutrients with dietary information alone, if it is sufficiently disaggregated. This information could guide the design of appropriate regional AFF production strategies. Regional data bases on both food consumption and composition need major improvement.

Nutrient content and bioavailability can be modified by plant breeding and agronomic practices. In almost all cases, a goal of AFF research should be to retain or improve the content of key nutrients, i.e. those nutrients for which the commodity makes a significant contribution to total diets in the region. A parallel goal is to diminish the content of interfering or antinutritional factors in foods and feeds. There is a risk that the

characteristics that make a plant more resistant to pests or environmental stresses may also make it less digestible or even unsafe. Use of biocides may pose additional risks.

Research is needed to determine if hazardous or undesirable components are present and/or being modified inadvertently. IARCs would be advised to monitor the content of nutrients, and undesirable compounds in food and forage crops in their purview.

A sufficient and safe drinking water supply is a critical requirement. AFF practices that damage water quality or reduce the supply conveniently available for household use and stock-watering pose additional burdens and costs. The potential for such effects should be investigated and practices monitored to avoid them.

Concluding thoughts. The current wisdom among nutritionists is that the principal nutrition problems of low-income countries are chronically/seasonally marginal intakes of total food, lack of vitamin A, anemia of mixed origin, and lack of iodine. Selenium-deficiency is a recognized problem in China. Zinc-deficiency was first identified in the WANA region but probably is quite common. The list is almost certainly longer than this and multiple deficiencies are more usual than lack of a single nutrient.

Urban populations that subsist at the same low levels of intake as rural populations are often in better state than the latter. The explanation is likely to be found in the lower energy-demand of urban life (access to transportation, lighter occupations, mechanical aids). Reducing energy demand in agricultural and household labor is one approach to closing the food gap.

Deficiency of vitamin A is a very serious problem in Asia, and may be in Africa and parts of Latin America. An idea to examine is the contribution of provitamin A from the dominant staple crop, which may make a critical difference if intakes from other

sources are equally low across regions. The prevalence of vitamin A-deficiency is a persuasive reason to promote consumption of β -carotene-rich vegetables and fruits, and of milk-fat, eggs and some fishes. The AVRDC research finding that bioavailability is low in leafy greens, if verified, suggests that horticultural crop emphasis needs to be examined carefully. Red palm oil should be considered as well. It is probably necessary to raise fat intake and to cook coarse leaves thoroughly to assure efficient absorption of β -carotene, particularly for children.

Evidence is accumulating that animal-source foods are a critical factor in the diets of children (and, perhaps, pregnant women). This appears to be true even where the food supply is quantitatively adequate. The effect is more likely to be due to the presence of certain vitamins and minerals than to protein, but both protein and fat may play a role. (I should have better information to offer at the October meeting.)

Problems due to trace element deficiency in soil ought to be responsive to application of fertilizer. This has been done for selenium-deficiency in Finland but I do not know if it has been tried for iodine. This scheme would seem to work best where the element is adventitious in terms of plant nutrition, but I do not know enough about plants to guess whether or not content of plant-essential nutrients (e.g. zinc) is "homeostatically" regulated in plants. For some elements, the potential for toxicity exists as well.

Increasing attention is being directed to substances present in foods that are not nutrients but that affect nutrient utilization and/or health. To cite some well-known examples: minerals tend to be less well absorbed from bulky, fibrous diets so intakes must be higher to achieve the same level of nutritional effectiveness; the risk of cancer of the colon is inversely related to the fiber content of the diet and positively related to fat

intake; hemoglobin-iron is more absorbable than plant-iron and the latter is absorbed better if vitamin C is present in the same meal. The IARCs need to have a systematic way of keeping up to date on this sort of information, as the Centers review their opportunities to focus on the best options and because developed-country markets are responsive to these health-related findings.

2. Occupational Health

Infectious agents. Control of vectors of human disease and of livestock diseases transmissible to humans is a serious problem in agriculture and forestry operations. Many vectors are well-established in the tropical habitats, accounting for the continued presence of diseases for which there presently is no vaccine, such as leishmaniasis (sand flies), onchocerciasis (black flies), filariasis (mosquitoes, midges), malaria (mosquitoes), African trypanosomiasis (tsetse flies) or Chagas' disease (kissing bugs), equine or Venezuelan encephalitis (mosquitoes), schistosomiasis (mollusks) and dracunculiasis (water fleas). Yellow fever and dengue remain a threat because the mosquito vector *Aedes aegypti* remains widespread, as are the *Anopheles* and *Culex* species that transmit malaria and filariasis; these mosquitoes are generally resistant to DDT as a result of prior efforts at eradication. Such vectors often exploit disturbed environments, where the temperature is permissive, as when irrigation schemes are introduced or new areas are brought into cultivation.

A number of transmissible diseases that also affect animal production persist. Most domestic animals and many wild species constitute a reservoir for trypanosomiasis. Leptospirosis, which causes infertility and abortion in livestock, also is transmitted to humans through exposure to infected urine of farm animals, dogs and rodents. Horse

populations are affected by and serve to amplify the reservoir of encephalitis virus.

Brucellosis, rabies, tuberculosis, cysticercosis, trichinosis and anthrax are variably controlled in farm animal populations.

The persons most likely to be affected are the rural poor. They may be compelled to accept employment under the most adverse, pestilential conditions when other opportunities are few. They have the poorest housing, the least resources available for preventive measures and live in close proximity to domestic animals. Humans, like animals, are more susceptible to the ravages of disease when they are also malnourished. The presence of chronic debilitating disease diminishes the quality of the labor force and increases dependency ratios.

There is a direct role for the IARCs involved in livestock-disease control. As well, the potential for aggravating or improving the spread of disease should be assessed in determining which agricultural and forestry production systems to promote or discourage.

Agricultural chemicals. Exposure to pesticides and herbicides is a concomitant of technologically advanced agricultural systems. In the Philippines, "econometric analysis showed the magnitude of the chronic health effects and health costs to be directly related to: the quantity of chemicals applied; the number of applications made; and unsafe procedures used by the farmer/applicator in handling chemicals and spray equipment." (Pingali and Marquez, IRRI consultants). Some risks are yet to be examined internationally. A recent U.S. study found that toxic work environments lower sperm quality in men. Elevated levels of pesticides have been measured in pregnant women in rural agricultural households and in the blood present in the umbilical cord of their newborn infants. Many biocides are extremely damaging to the nervous system and it is

suggested that chronic exposure, even to low dosages, may have cumulative effects that cause disability at later ages.

Persons likely to be at greatest risk of acute exposure probably are farm laborers employed under conditions of inadequate supervision owing to callousness or carelessness, and the least educated farmers.

For these reasons, and other environmental concerns, IARCs should give high priority to reduction in the dependence on biocides and accept responsibility for adequate training in the safe management of the biocides they recommend.

3. Social Structures

The Social Structure of Production. Socio-economic understanding of how a particular crop is produced and used in a given rural production system is critical for the production of effective and usable innovations. Research is necessary to determine who grows a particular crop, where, for what purposes, when, how and why. This information is necessary to determine how a given technological innovation can be linked with a functioning agricultural enterprise. Such research is more complicated than it might appear at first blush because in some countries, the farm is not unified at the household level. Thus, the question "who" must be answered not only for different classes and ethnic groups but also for agricultural enterprises managed by different members of the same household. The question "where" must be answered not only in terms of geographic locations and categories (such as soil type and rainfall) but also for social categories such as tenurial niche (including common property). The question "for what" is important both because of the need to take competing and sometimes incompatible uses into account and because varying production objectives dictate varying evaluation criteria. Yield per unit area is not

always an appropriate evaluative criterion. A farmer may be more interested in a crop, variety or practice which allows him/her to circumvent constraints such as shortage of labor or shortage of cash or to meet a particular consumption need. Social science research is also needed to enable technical researchers to take into account what other crops and land uses may be displaced or how the division of labor may be changed if the production parameters for this crop are changed. Finally, social science research is frequently the only kind of research which reveals the existence and function of strategic crops and technologies that are rarely covered by traditional research institutes - for example, the importance camels in dryland Africa, the importance of fodder trees for livestock production, or the importance of millet or amaranthus as food crops. Similarly, given the more narrowly focused disciplinary boundaries within which most biological scientific research is organized, social science research with its mandate to explain the context of agricultural production, is more likely to reveal practices and technologies that cross disciplinary boundaries - the fodder benefits of sorghum, for example. Thus, in depth social science research allows the discovery of linkages to packages of practices and knowledge missing from disciplinary views of agriculture. In sum, social science research is essential to match crop research to the messy reality of on-the-ground indigenous technical knowledge and practices.

The Social Structure of Research. The increasing centralization of an already highly centralized system of research should be approached with the greatest caution. It is not realistic to treat agricultural crops as if they were bolts or valves which can be produced centrally and placed interchangeably in any rural production system. The same crop is grown for different purposes, in conjunction with different crops in different social

contexts, in a variety of micro-environments, and different production systems. Cowpeas and maize, for example, can be grown for fodder or human consumption. Thus, while identifying the genetic source, of resistance to streak in maize, for example, might be most efficiently done under a centralized system, the actual plant breeding and development of agronomic techniques need to be compatible with the wide diversity of on-the-ground production objectives and systems. Thus, much more emphasis needs to be placed on decentralized on-farm research.

Implementing decentralized on-farm research need not be a daunting task, if the need and opportunity for redundancy in research settings is recognized. The potential for using local and international NGOs as research partners has been neglected. This is particularly important in the marginal areas (high stress, low potential) where high input packages are less relevant. Local research systems often can not afford to reach these areas, whereas these are the very places that NGOs may have a comparative advantage.

It cannot be stressed enough that on-farm research must be iterative not just diagnostic. A serious problem with the use of various farming systems research techniques is the tendency to overlook the intention of their designers that they be used iteratively and to retreat behind the walls of the experiment station after a single foray. Such approaches are almost as likely to produce inappropriate products as wholly on-station research.

The CGIAR needs also to pay greater attention to the structures and processes by which its research products reach and are utilized by rural producers and local scientists. Attention should be focused on the resources to which farmers must have access if they are to be able to exploit the opportunities provided by AFF research. Part of the new emphasis on sustainable agriculture must also include research on the structures and

processes necessary to facilitate unified (or at least complementary) action by the separate bureaucratic units in which various components of sustainable agriculture, in particular, forestry and agriculture, are housed. Equally important, if the centers are to continue to launch packages of research and practices into local systems, is an understanding of processes, interests and structures which affect the setting of priorities in and the productivity of local research and extension systems.

Finally, despite good intentions and sincere efforts, the gap between researchers and farmers has been frequently noted. One means of reducing this gap is to provide all research scientists with a grounding experience. For example, all new employees could begin their employment with a period of studying a local language and spending some time in residence with a farming family in a local village during the cropping season. As he/she continues with his/her scientific research, this experience would provide each scientist with a real producer as a tangible example not just of a specific site but more generally of the kinds of complexities, uncertainties and constraints producers face. Such experiences, a routine part of the training of international volunteers, are easily arranged. The need for grounding experiences to be iterative is clear and compelling. The one-shot approach is suggested here as an initial step only.

Table 1

List of recent¹ Household Consumption Surveys of Developing Countries and Corresponding sets of Data Available in ESS

Country and Period of survey		Households by calorie consumption classes (Set A)	Average calorie consumption by income ² classes (Set B)	Average food quantities consumed by income ² classes (Set C)	Average food Expenditure by income ² classes (Set D)	Households by income ² classes (Set E)
<u>AFRICA</u>						
	Algeria	(1979/80)				X
D	Botswana	(1985/86)			X	X
	Lesotho	(1986/87)				X
D	Malawi	(1979/80)			X	X
	Mauritius	(1980/81)			X	X
D	Morocco	(1984/85)			X	X
	Nigeria	(1980/81)			X	
	Reunion	(1976/77)			X	X
D	Seychelles	(1983/84)				X
D	Swaziland	(1985)			X	X
D	Tunisia	(1980)	X	X	X	X
	Tunisia	(1985)	X	X	X	X
<u>ASIA</u>						
D	Bangladesh	(1973/74)		X	X	X
D	Bangladesh	(1981/82)		X	X	X
	Bangladesh	(1985/86)*			X	X
D	China	(1984)				X
D	Cyprus	(1984/85)			X	X
D	Hong Kong	(1984/85)			X	X
D	India	(1983)			X	X
D	Indonesia	(1978)		X	X	X
D	Indonesia	(1980)		X	X	X

¹Surveys where the data became available after the last (Fifth) World Food Survey exercise.²Or expenditure taken as proxy for income.

D = Entered into computer data bank.

*in Statistical Yearbook of Bangladesh 1989.

Country and Period of survey		Households by calorie consumption classes (Set A)	Average calorie consumption by income classes (Set B)	Average food quantities consumed by income classes (Set C)	Average food Expenditure by income classes (Set D)	Households by income classes (Set E)
<u>ASIA (CONT'D)</u>						
D	Japan	(1985)		X	X	X
	Jordan	(1986/87)		X	X	X
D	Korea, Rep.	(1985)			X	X
	Korea, Rep.	(1985)			X	X
	Korea, Rep.	(1988)			X	X
	Macau	(1981/82)			X	X
	Nepal	(1977)				X
	Oman	(1977)			X	X
D	Pakistan	(1979)		X	X	X
D	Pakistan	(1984/85)		X	X	X
D	Pakistan	(1985/86)		X	X	X
	Pakistan	(1986/87)		X	X	X
D	Philippines	(1978)	X	X		X
D	Philippines	(1982)	X	X		X
D	Philippines	(1985)			X	X
D	Singapore	(1982/83)			X	X
D	Sri Lanka	(1981/82)	X	X	X	X
D	Taiwan	(1985)			X	X
	Taiwan	(1987)			X	X
	Taiwan	(1988)			X	X
	Thailand	(1986)				X
	Thailand	(1988)**				X
D	Turkey	(1981/82)		X	X	X
D	Malaysia Pen.	(1980)			X	X
D	Mal. Sabah	(1982)			X	X
D	Mal. Sarawak	(1982)			X	X

**Preliminary report of the 1988 household socio-economic survey.

Country and Period of survey		Households by calorie consumption classes (Set A)	Average calorie consumption by income classes (Set B)	Average food quantities consumed by income classes (Set C)	Average food Expenditure by income classes (Set D)	Households by income classes (Set E)
<u>NORTH & CENTRAL AMERICA</u>						
	Bahamas (1977)					X
	Bahamas (1979)					X
	Bahamas (1986)					X
D	Bermuda (1982)				X	X
D	Cayman Is. (1983/84)				X	X
	Grenada (1985)					X
	Guadeloupe (1984/85)				X	X
	Guatemala (1979/81)				X	X
	Guyane (1984/85)				X	X
	Honduras (1978)		X	X		X
	Martinique (1984/85)				X	X
	Mexico (1977)				X	X
	Neth. Antilles (1981)					X
	Trinidad & Tob. (1975/76)				X	X
<u>SOUTH AMERICA</u>						
	Argentina (1983)					X
	Argentina (1986)				X	X
	Peru (1985/86)***				X	X
	Uruguay (1988)					X
	Venezuala (1980)					X
<u>OCEANIA</u>						
	Fiji (1977)				X	X
	New Caledonia (1980/81)					X

***Data by "esholum".

To: All Members of the Standing Committee
for Priorities and Strategies

10 June 1990

From: Guido Gryseels
Secretary



Subject: Analysis by CAEZ of priorities for CGIAR supported research
and related activities

As agreed by the Standing Committee for Priorities and Strategies during TAC 51 last March, a major input in the review of CGIAR priorities and strategies will consist of an analysis by region by agroecological zone of priorities for CGIAR-supported research and related activities. For this purpose, the TAC Secretariat will prepare for each CAEZ an analysis of demand and supply for food and feed by the year 2010 and of the major constraints to natural resource management and conservation. Simultaneously, an analysis will also be made of potential for food production in each of these CAEZ, assuming intermediate levels of input as defined by FAO. In assessing future food production, attention will be given both to production from already available arable land, and from land potentially available for cultivation. The possibilities for exports of industrial crops will also be scrutinized.

Such an analysis will provide adequate information to enable an evaluation of tensions between future supply and demand, of the potential for self-reliance, of the major constraints to resource management, and of the resulting needs for research on agriculture, forestry and fisheries.

The Secretariat hopes to present the results of this analysis at TAC 53 in October 1990. Major inputs have been requested from FAO through contributions by Dr. David Norse from the ADG Office and the Soil Service headed by Dr. R. Brinkman. We will also make use of available information at FAO on population supporting capacities, and Dr. Kassam particularly will coordinate our efforts in this matter. The results of the contributions requested from IFPRI and ISNAR will be essential complements to this CAEZ analysis.

Attached to this note you will find some preliminary results obtained in the analysis. For each major region I enclose basic aggregated data on trends in growth of population, income, arable and irrigated land, demand for food and feed, exports of individual crops and caloric intake. In addition, I enclose examples from the warm and humid tropics of sub-Saharan Africa and from the warm and seasonally dry tropics of Asia to show how this information is also available at the AEZ level.

I also attach a note prepared by Eric Craswell that summarizes tentative results of an agroclimatic analysis of soil constraints to agricultural production.

The Secretariat would greatly appreciate any comments you may have on the approach taken, preliminary results obtained, and future work to be done including the format you wish to see the results presented at TAC 53.

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

Alex F. McCalla
Chair

May 17, 1990

To: TAC Members, TAC Secretariat and CGIAR Secretariat
From: Alex F. McCalla, Chair TAC 
Re: Future Structural Options

Attached is a discussion paper prepared by Selcuk Ozgediz and myself. It contains possible ways of accommodating our tentative discussions on the Non-associated Centers and Forestry. The paper has three time frames--a long term vision, a medium term scenario and a short term and transition scenario.

The set of options are by no means complete. Further what is in the paper should not be viewed as our "recommendation". We simply lay out options to get the discussion started.

It is critically important that this document not be shared with anyone except TAC members and the two Secretariats. If it were to fall into the hands of anyone who does not understand its role in the process, it could be interpreted as TAC's position which it is not.

I look forward to our discussions in Ibadan.

Confidential Draft
For TAC discussion only
Not to be circulated or
quoted without the
explicit permission of the
Chair of TAC

The Expansion of the CGIAR: Implications and Options
for Its Future Structure.

(prepared by Alex McCalla and Selcuk Ozgediz)

I. Introduction:

The CGIAR has always been a dynamic and expanding international entity. From its inception in 1971 to 1980 it added 9 additional activities/institutes to its original compliment of 4 centers. In the 1980s it substantially expanded its intended subject matter coverage by: (1) encouraging a farming systems approach to research problem definition; (2) explicitly including in its priority criteria, the potential for technical change to generate income and employment; (3) recognizing that increased food production was a necessary but not sufficient condition for reducing hunger and malnutrition; (4) including long-term sustainability of production systems to provide increased food supplies as an explicit part of its goal statement; (5) identifying resource conservation and management as an explicit goal of co-equal importance with productivity improvement and (6) replacing an implicit goal of contributing to national food self-sufficiency with an explicit reference to achieving food self-reliance in the developing world. Each of the changes implies expanded and adjusted mandates for the existing 13 centers.

Beyond this in 1988 and 1989 the CGIAR asked TAC to evaluate (1) the possible inclusion of the subject matters represented by 10 additional entities (non-associated centers) and (2) the ways in which the CGIAR could expand its efforts in natural resource management with explicit attention to elements of tropical forestry research which lend themselves to international initiatives. As this process has proceeded TAC has approached the reevaluation of the CGIAR in an iterative fashion. First, TAC evaluated potential global macro needs to the year 2025 to determine the broad parameters that should guide international agricultural research in the CGIAR, recognizing that the CG was a relatively small part of the overall global research establishment. In particular TAC addressed questions of sustainable production systems on the full spectrum from mono crop annual cropping systems through mixed cropping/livestock/tree systems (agroforestry) to commercial forestry activities. These

analyses were initiated first at a regional level and then integrated globally.

The second step was to begin with fact finding activities regarding the specific entities (non-associated centers) in terms of the role they played in specific subject matter areas (micro analysis). Since October 1988, TAC has iterated between global macro evaluation and micro subject matter evaluation which, after initial reviews of the non-associated centers (NAC), was broadened to include both NACs as well as existing CGIAR institutes.

At TAC 51 (March 1990) TAC was presented with the recommendations of the subject matter panels (bananas and plantains, livestock diseases in sub-Saharan Africa, fisheries/aquaculture, natural resource management, forestry, crop protection and interfaces with national programs). An eighth panel's recommendation on vegetables will be received at TAC 52. TAC acted in a tentative fashion on each of the panel's recommendations and initiated broad discussions of the implications for the long-term structure of the CGIAR of accepting these recommendations. At the conclusion of the discussion the TAC Chair agreed to write a thought piece on possible structural adjustment in the CGIAR. In this effort he has collaborated with Selcuk Ozgediz. This paper is a result of that joint effort.

We begin by identifying what we see as some long-term strategic trends which will likely influence the role of the CGIAR. From these trends we suggest a possible role of the CGIAR in the long term. We next turn to the potential role of the CGIAR in the medium term. These sections obviously are not completely comprehensive and all may not agree with the specific points. That is not critical because one purpose of the paper is to stimulate thinking on these strategic concerns. The next section (Section V) looks at the current structure of the CGIAR to evaluate its rationale. It then lists some strengths and weaknesses of the current structure.

The next section addresses possible future structural scenarios. The first part presents a possible vision of the long-term future of the CG, with two variants. Next we look at a medium term scenario which reflect a possible progression from where the CGIAR is now to where it could be in the long term. Finally we look at the short-term to see first what is immediately necessary to accommodate the panel recommendations on the non-associated centers and forestry. We then identify what could be done in terms of restructuring the CGIAR almost immediately as a transition to the medium term

Finally we raise some crucial questions that TAC must address if its recommendations are to be credible with the CGIAR.

This paper should be viewed as a discussion piece. We hold no firm positions on any of the particular rearrangements. We do believe however that something of the form discussed was implied by TACs discussions in March. Please regard the paper as confidential for discussion only with TAC and the staff of the two Secretariats.

II. Long-term Strategic Trends that Seem to be Emerging

We define "long-term" not in terms of a precise number of years, but more pragmatically in terms of the level of maturity of most national agricultural (including forestry and fisheries) research systems¹⁾ in developing countries. Thus, long-term refers to the period when most of the national systems are strong enough to meet their research needs, by their own efforts or in collaboration with others.

By definition, the first long-term trend which would have a bearing on the role of the CGIAR is the gradual strengthening of the developing country national systems.

Second, and parallel with the first, the number and capacity of regional institutions engaged with agricultural research are likely to expand substantially in the long-term. This is likely to be an outcome of increasing regional collaboration among developing countries and strong interests of donor agencies in building indigenous capacity in the developing world. Institutions like CATIE and SACCAR are likely to mature and similar institutions are likely to emerge in other regions.

Third, as a result of increased capacity of national systems and regional institutions and the trend towards increased collaboration, more and more research is likely to be conducted in a networking mode than at present. This would parallel the present use of collaborative research networks in the developed countries. Also, further advances in information technology could facilitate operating in a networking mode.

Fourth, there could be wider sharing of responsibilities for basic, strategic, applied and adaptive research among developed and developing country and regional and international institutions.

- Developing countries should be in a position to conduct adaptive research by themselves, with inputs as necessary from regional institutions.

¹⁾ For the reminder of the paper read agricultural research systems as agricultural, forestry and fisheries systems. However we refrain from inventing a new acronym for this such as NAFFRS.

- Applied research responsibilities should be increasingly carried out by developing country and regional institutions.
- Regional institutions will begin playing some role in strategic research. Institutions with global mandates could carry out mostly strategic research, in collaboration with regional and national institutions in developing countries and basic research institutes around the globe.
- Basic research will not be done solely in developed country institutions. Today's more advanced developing countries will strengthen their basic research capacities.

Fifth, "ownership" of international institutions carrying out research at a global level could shift gradually from developed countries towards developing countries and regional organizations. Those benefitting from such research should increasingly share its financing. Regional institutions could be financed primarily by the countries that benefit from the work of such institutions.

Sixth, in the developed countries, research responsibilities (particularly in the germplasm area) will shift increasingly from the public sector to the private sector. As more basic research in these countries is carried out by private sector institutions, there could be an increasing global need for international strategic research.

Seventh, research agendas of national and regional institutions will continue to be broadened to expand work on extension, agricultural development and sustainability of natural resources. Research, training and information activities of these institutions will cover the full spectrum from basic research to farmers' fields. Also, emphasis on production will be increasingly supplemented with work on environmental, institutional and broader agricultural and resource development concerns.

Although the scenario drawn above is somewhat speculative, the trends noted reflect an extension of recent developments, colored by our notions of what might be a realistic scenario. Even if this were to reflect more a "desirable" than a "realistic" scenario, its consideration could be useful in figuring out structural alternatives that can help achieve this desired future state.

III. Role of the CGIAR in the Long-Term

Historically, the CGIAR has played primarily a "bridging" and a "gap filling" role in agricultural research. It has served as a bridge between basic and strategic research institutions in advanced countries and national research institutions in developing countries. It has seen as one of its roles the filling of gaps in the basic-strategic-applied-adaptive research continuum in order to keep that continuum intact at the developing country, region, and international levels.

Bridging and gap filling should remain as the principal roles of the CGIAR in the long-term. However, if the trends noted above are realized, the gaps in the research spectrum should be of a different nature than they are at present because of the likely changes in the roles played by the other actors in the global scene. Our expectation is that the number of gaps should also diminish with the maturity of national and regional institutions. However we should be realistic and recognize that there will always be heterogeneity, i.e. not all national programs will be strong even in the long-run. This is the issue of the length and characters of the menu of research that the Centers will need to offer.

Stronger national and regional institutions would imply that the CGIAR should have a much smaller role to play in adaptive and applied research in the long-term. This would leave strategic research as an area that can be contributed to by the CGIAR, in collaboration with regional and national institutions. Gaps in international research created by devolution of responsibilities from public to private sector institutions in developed countries could also create a vacuum in some areas that may need to be filled by an international institution with a global mandate, like the CGIAR.

In the long-term, perhaps a principal responsibility of an institution like the CGIAR would be in the germplasm area. While the work would involve primarily plant germplasm, germplasm work on livestock, fisheries and other living organisms would also gain importance. Collection, conservation, characterization, evaluation and basic manipulation of germplasm would continue to require a global, international and apolitical effort. Research on the use of germplasm to develop usable varieties and animals, on the other hand, would be handled primarily by regional and national (both public and private) institutions in today's developed and developing countries.

Although it would involve research, germplasm work would be carried out primarily as a service to the global community. Other related services, such as international training and germplasm information dissemination, could also be carried out.

Second, global strategic research related to the expanded research agenda mentioned in point seven above would require some international focal point, although the research itself could be carried out by many institutions in a collaborative fashion. This research would relate to solving problems of international significance in areas like germplasm, resource management, extension, research policy and management and agricultural development. As national and regional institutions would also play strong roles in strategic research, it is not possible to spell out a precise division of labor except to indicate that the CGIAR would be concerned primarily with research problems of global significance.

Third, there may be a need for an international focal point to provide wide ranging information services to institutions and individuals worldwide. Such an institution might maintain and update databanks on insects, pests, diseases, etc., provide abstracting and literature search services, catalogue current and completed major research projects and programs, and generally facilitate linkages between institutions by helping match the supply of researchers and research institutions to specific manpower demands from a variety of clients from developed and developing countries.

Thus, in the long-term, the CGIAR would function more as an international service institution than at present. Its research role would be limited essentially to strategic research on problems of global significance. It would be supported by all countries and institutions it serves, most likely on a cost-recovery basis, not only by advanced countries on a grant basis. Its role would shift from development towards facilitation of agricultural research and development on a global basis.

IV. Role of the CGIAR in the Medium-Term

If in the long-term the CGIAR would function essentially along the lines described above, its primary role in the medium-term would be to facilitate the global system's transition towards the long-term scenario. This would entail, among others:

- strengthening of regional²⁾ and national institutions;
- gradual devolution of all adaptive and most applied research responsibilities to these institutions;

²⁾ For our purposes we are defining regional institutions as indigenous regional institutions such as CATIE and SACCAR.

- strengthening and broadening as necessary its own capacities in the germplasm area and in strategic research and global information services;
- gradual shifting of the System's ownership towards developing countries and regional institutions.

Establishment and/or strengthening of regional research institutions and devolution of regional research responsibilities will perhaps be the greatest challenges facing the CGIAR in the medium-term. The CGIAR's success during this period will be measured to a large extent by the extent to which it was able to work itself out of several businesses, e.g., strengthening of national research systems, adaptive research, applied research, regional research.

There are several ways the CGIAR could develop and strengthen national and regional research institutions. One approach would be to have each of the current institutions continue to interact with and help strengthen aspects of each national system and regional institution in their (the centers') own areas of activity. While this approach might serve the current interests and missions of the CGIAR centers well, the resulting strengthening effort would be quite disjointed and the recipient institutions would need to negotiate the terms of collaborative work with each CGIAR institution separately.

An alternative approach would be to assign the major responsibility for the development and strengthening of a particular regional institution and the affiliated national institutions to a single agro-ecology/regional CGIAR center³⁾. This regional CGIAR center would also be responsible for applied and some adaptive research on all problems faced in the region. The CGIAR center would help develop and work side-by-side (like in a twinning arrangement) with one regional institution and the national programs in that region. Gradual devolution of responsibilities could be better programmed, depending on the rate of development of the capacities of the regional and national institutions.

While variants of these two approaches could be developed depending on the specific circumstances of each region, a regional center approach appears to suit the medium and the long-term scenarios for the CGIAR better than continuing with the present arrangement. A regional CG center approach would necessarily involve gradual devolution of all adaptive and most applied commodity research responsibilities from the CGIAR's global

³⁾ For the remainder of the discussion interpret Regional CGIAR Center as agro-ecology institutes regionally defined.

commodity centers to its regional centers. This would also narrow the focus of the global commodity centers and help them spend concentrated effort in further strengthening their germplasm and strategic research capacities.

V. Current CG Structure - Rationale, Strengths and Weaknesses

1. Rationale for the Current Structure

The first two centers established by Ford-Rockefeller Foundation partnership were commodity centers focused on the three most important cereals--rice, wheat and maize. The approach was to use plant breeding to improve productivity by changing characteristics which would have wide adaptability. Of course we all know that adjusting the stature of wheat and rice produced high yielding varieties (HYV) which were potentially adaptable globally as long as sufficient water management was possible. Thus the notion of "global commodity centers" was the first approach.

The next two centers which predated the establishment of the CGIAR were very different in mandate. They were ecological zone, farming systems centers (CIAT, humid tropics of Latin America; and IITA, low altitude humid tropics of Africa). In their initial inception the full spectrum of activities, including livestock and presumably perennial crops, were included. These farming system mandates obviously included the commodities of the so called global centers.

Additions to the CG in the 1970s and early 1980s continued to be a mix of so called global (commodity) centers (CIP, ILRAD), global subject matter centers (IBPGR, IFPRI, ISNAR), regional/ecological centers (ICRISAT, ICARDA, ILCA) and a regional/commodity center (WARDA). ILRAD as it has evolved more closely fits this latter category. As the CGIAR evolved, some of the regional centers assumed "global commodity" responsibilities in addition to ecological/regional mandates--IITA cowpeas, sweet potatoes, etc.--ICRISAT--millet, sorghum, ground nuts, CIAT--beans and cassava, ICARDA--barley. Further, as the regional centers evolved they reduced the focus on "the systems" and focused on regional and/or global commodity programs, e.g. CIAT, IITA, ILCA. Only recently have some partially returned to a resource base focus, e.g. IITA, ILCA and ICRISAT. Few have remained basically regional/ecology centers, perhaps only ICARDA qualifies.

Throughout the evolution all centers have had in their mandates strengthening national programs (including major investments in training and information retrieval, consolidation and dissemination). The result is, when viewed from the country

level, as well as from the donor perspective, an overlapping maze of CG entities attempting to interact with national programs. This problem became more acute in Africa as is documented by the Africa Task Force.

It seems clear that the addition, in whole or in part, of any of the non-associated centers and of agroforestry and forestry without considering existing centers would necessarily further complicate an already complex set of arrangements. Thus it seems appropriate to have a fresh and comprehensive look at the current structure starting with mandates and roles of institutes. Further, as will be recalled, this was an unfinished item of business in the 1986 TAC priority paper.

2. Key Strengths of the CGIAR's Present Organizational Structure

There are certain structural features of the CGIAR which have contributed to its past successes. It would be desirable to preserve or put premium on these when considering alternative organizational arrangements. We list some of the most important of these below.

- Apolitical character. The system should maintain its apolitical character. This means representation of national, institutional or other political entities should be strictly avoided in its governance and staffing. It also means that the legal charters of the institutions supported by the CGIAR should protect these institutions from political interference.
- Decentralized management. The CGIAR derives much of its success from its commitment to decentralized management through independent, autonomous institutions. Centralized management could move decisions too far away from places close to the problems and limit operational flexibility in day-to-day supervision of decentralized activities. A corollary of managerial autonomy is a strong system of external accountability, which should also be preserved.
- Full-fledged centers of excellence. International centers organized as networks have not yet proven their effectiveness. The center of excellence concept, with a minimum critical mass of internationally recruited, multi-disciplinary cadre of scientists, is a model that to date has been most successful.

- Hands-on research capability. Research is the main business of the centers and the system. The centers' success in research-related activities such as training and information dissemination are perceived to be a direct result of their hands-on involvement with research. Also, the centers play a more credible strengthening role vis-a-vis the national programs when they have hands-on research experience themselves.
- Closeness to clients/partners. Many of the present centers have found it necessary to decentralize their operations geographically in order to be close to their clients. Some carry out much of their training in decentralized locations. To the extent frequent contact with the centers' clients/collaborators is necessary, it is more efficient to do this from locations close to them.
- Stable and flexible funding. In order to implement their strategies (which often involves long-term research) effectively the centers need stable funding. The funding also needs to be provide sufficient flexibility for the centers to engage in activities directly relevant to their main mission. Heavy reliance on special project or other restricted funding often constrains a center's capacity to pursue activities in the direction outlined in its strategy.
- Sound experience in commodity research. In the crop research areas the CGIAR has a proven track record in solving problems through research centers organized along commodity lines. Although the number and combination of commodities worked on by each crop center may be debatable, if the centers are to "stick to their knitting" (or continue doing what they do best), a clear commodity focus may need to be maintained in the future.

3. Key Weaknesses of the CGIAR's Present Organizational Structure

Some of the organizational features of the CGIAR listed above represent both its strengths and weaknesses. For example, the part of the centers' funding that is stable and flexible is a distinct strength. But, the part that is inflexible and unstable is a weakness. Certain other features of the CGIAR's organization also present some weaknesses.

- Overlapping commodity mandates. These have been a frequent cause of conflict and misunderstanding within the System. When two or more centers are given

responsibility to work on a single commodity, conflicts are bound to arise even when the responsibilities have been clarified either on a geographic or type of research (i.e., strategic, applied, adaptive) basis or both. Having two or more centers work on a single commodity demands complex inter-center agreements and coordination mechanisms which can lead to inefficiency and become difficult to implement.

- Overlapping resource management mandates. Centers with global commodity mandates carry out some resource management tasks connected with that commodity on a global basis. Centers with regional mandates are concerned with resource management concerns on an agro-ecology basis. Since both types of centers are essentially working on the same resources, some confusion tends to exist on the limits of their respective responsibilities and, of course, major resource issues could fall between the chairs.
- Lack of clear global responsibility for strategic research on resource management concerns. The System is going through the current expansion phase primarily because resource management concerns have been given a back seat position compared to commodity and regional research. This is particularly true for fundamental, strategic research questions on resource management that have inter-country and inter-continental relevance (e.g., soil degradation, crop-physical environment interface, vertisol soils, etc.).
- Uncoordinated decentralization. Each center has decentralized its operations based on its own needs. Research on many of the new activities being considered (such as forestry, fisheries, agro-forestry, water management, etc.) will also have to be carried out in a decentralized fashion because of the location-specificity of the problems that need study. While independent and separate efforts by each center could best serve its own purposes, this may lead to increasing inefficiencies for the System as a whole.
- Lack of intra-system coordination of the centers' capacity building efforts. We alluded to this issue above, in connection with the CGIAR's role in the medium-term. ISNAR plays a role in strengthening entire national agricultural research systems, particularly in the area of their organization and management. Each of the other centers includes the strengthening of national programs as a part of its mission. Although the efforts

of the centers are all directed towards different aspects of a national system, these efforts are disjointed. No mechanism exists to ensure coherence and complementarity of the total CGIAR effort vis-a-vis a given national system. The same is true for the centers' strengthening efforts directed at regional institutions.

- Lack of coordination of the centers' capacity building efforts with technical assistance programs of donors. Donor technical assistance programs geared towards improving the capacity of developing country, national, and regional research systems are not well coordinated with the centers' own efforts in the same area. New mechanisms may need to be created to ensure the complementarity of these efforts.
- Weak accountability to clients/partners. Present accountability mechanisms within the System are geared towards the centers' accountability to the donors. There are no formal and direct means through which the centers' clients/partners can voice their opinions strongly. As there are practically no alternative suppliers of the services the CGIAR centers provide to national institutions, the "market mechanism" does not serve as an accountability reinforcing device. Ownership of the System by the clients/partners may offer a solution to the accountability dilemma in the long-term. Other solutions may be needed in the short-term.
- Need for rationalization of the System's activities. Several centers carry out complementary work in the same or related areas. Restructuring the centers' mandates can lead to gains in efficiency, particularly if this reduces duplication. Complementarities in research on root and tuber crops, for example, may be better exploited if one center had a critical mass of people working on all such crops. The same could be said for research on other commodities and for work on policy and management questions.

VI. Future Structural Possibilities

Mike Arnold's paper ("Activities and Mode of Operation within the CGIAR System: Options for the Future") argues that there are many possible organizing principles for an international research system--disciplines, limiting factors, eco-systems, commodities and geographical regions. In addition one could talk of problem/subject matter areas, e.g. irrigation management, policy, genetic resources. To some extent all of these vectors are

partially used in current structures. While it is not likely appropriate to slavishly adhere to one model, surely there must be some way to rationalize the current and perspective system.

Among the list, TAC (and the CGIAR) have clearly focused on commodities and ecologies as basic organizational principles. Further it has been recognized that research in developing countries is organized in terms of geography which is seldom coterminous with eco-systems. Thus a regional dimension must be included. In our discussion in March there were several recurrent themes that most everybody agreed with.

First: The CGIAR cannot be all things to all people. Therefore it must be selective.

Second: It should concentrate on those things which it can do better than others and which contribute to CGIAR goals.

Third: If the CGIAR really believes in working with and through national programs (to accomplish results on "farmer's fields") it must do so in ways that do not distort national goals and confuse national program management.

Fourth: Two organizing principles were heard frequently:

- (a) commodity thrusts with regional responsibilities clearly defined (could include global);
- (b) eco-systems responsibilities regionally defined.

Using these as basic principles what follows are (1) possible long term visions of the CGIAR; (2) possible medium-term structure; and (3) the short term. They represent possibilities, not recommendations.

1. Possible Long Term Visions

The evolutionary model that emerges from the above discussion appears to be the following. Starting from the present, with expanded efforts in resource management, forestry and additional commodities--e.g. fish, vegetables--we see a possible evolutionary path emerging. As national programs are strengthened, more adaptive and applied research is transferred to transnational, regional and agroecology/regional CG institutes from global and regional commodity centers. These regional entities assume responsibility for broad ecology based issues including soil, water, crop and tree production and management, and integrated farming systems including livestock. It is in these entities that we embed increased CG emphasis on resource management, sustainability and the environment.

As the indigenous regional entities mature, CG agroecology/regional centers either transfer increasing amounts of research to the regional entities or their "ownership" is gradually transferred to regional organizations. In the very long term the CGIAR could be focused only on strategic global issues. This is long term vision number one and is discussed more fully below. A modified scenario would be for the CG to remain in the ecology/regional business on a strategic basis for the foreseeable future. This is long term vision number two.

A. Long Term Vision #1

In its most extreme version, the CGIAR of 2025 (say) could consist of as few as five or six global institutes.

- a. a plant germplasm and strategic research institute--this could be segregated into annual and perennial crops;
- b. an animal germplasm and strategic research institute--this could include aquatic animals or there could be a separate institute;
- c. an institute for strategic global research on natural resource management;
- d. an institute for strategic research on food, resource and agricultural policy and management;
- e. a global information and research service to collate, evaluate and disseminate research findings and facilitate international exchange of results, ideas and personnel.

All other strategic, applied and adaptive research activities would be undertaken by indigenous regional and/or national programs.

B. Long Term Vision #2

A less radical vision would be Long Term Vision #1 plus a limited set of Ecosystem Institutes, regionally defined, perhaps as follows:

- a. Humid and Sub-humid Tropics--Latin America
- b. Humid and Sub Humid Tropics--Africa
- c. Semi-Arid and Highland Tropics--Africa
- d. Dry Areas--WANA

e. Irrigated Ecosystems--Asia

f. Semi-Arid and Sub-Humid Ecosystems--Asia

These institutes would focus increasingly on strategic and basic transnational and externality oriented research.

2. Medium Term Scenarios

In the medium-term, the CGIAR would need to organize itself in a way that will ensure that it can capitalize on its present strengths, address its present weaknesses, prepare itself best for fulfilling its long-term role, and effectively carry out its medium-term mission.

As noted earlier, the biggest challenge of the CGIAR in the medium-term would be to help strengthen the capacities of national and regional institutions and, over time, fully devolve applied and adaptive research responsibilities to them. The solution suggested earlier was to assign this responsibility to a series of regional CGIAR centers. This approach gains further strength in the light of several of the weaknesses of the CGIAR's present structure noted above. Among others, regional CGIAR centers organized along major eco-systems would:

- help rationalize overlapping commodity mandates;
- help remove overlapping resource management mandates;
- provide clear global responsibilities for strategic research on resource management concerns;
- provide clear focal points for coordinating decentralized activities in many subject areas; and,
- help ensure better coordination of the System's strengthening efforts and the donors' technical assistance programs.

Having a series of eco-system/regional centers would imply a reduction in the size of the present commodity centers as they (the global commodity centers) would devolve a great portion of their research and strengthening responsibilities to the regional centers, leaving them essentially with responsibilities in the germplasm area and in strategic research and research-related activities. When they are each of a smaller size, mergers would become more feasible and necessary. This would help remove overlaps in commodity mandates and rationalize the present distribution of responsibilities among the commodity centers.

Existence of a series of regional centers would also have implications on the CGIAR's work in the policy and management areas. Each regional center would be in a better position to carry out work on policy and management concerns of the countries in that region than global centers working on these questions. Thus, a part of the responsibilities of the policy and management institutes would be transferred to the regional centers. Like in the case of the global commodity centers, it would be possible to rationalize research and related services on policy and management by combining them under one center.

A possible structural configuration in the medium-term might be as follows:

- a series of global plant commodity centers working on:
 - rice,
 - other cereals,
 - roots and tubers,
 - vegetables,
 - legumes,
 - forestry and agroforestry,
- a global livestock center;
- a global fisheries and aquaculture center;
- a global policy and management center;
- a global genetic resource conservation center
- a series of eco-system centers working on:
 - humid and sub-humid tropics (Latin America),
 - humid and sub-humid tropics (Africa),
 - semi-arid and highland tropics (Africa),
 - dry areas (West Asia and North Africa),
 - irrigated and humid ecosystems (Asia)
 - semi-arid and sub-humid (Asia)

There are obviously many alternative combinations within the medium term scenario which we could consider. The above only gives a flavor of one possible arrangement, given the principles that emerged from the earlier parts of the paper.

3. The Short-Term and Possible Transition Scenarios

If we adopt some form of the medium term scenario, with the longer term vision in mind, a crucial question is can we get there from here.

A first step would be to ask what is the minimum restructuring that is necessary to accommodate our decisions to date concerning the non-associated centers and forestry. (We are assuming for discussion purposes that TAC will adopt the panel recommendation on AVRDC and vegetables). That adjustment would be as follows using the non-associated centers as listed alphabetically:

<u>Institute</u>	<u>Adjustment needed</u>
1. AVRDC	admit:--expanded mandate of CG to include vegetables and expanding AVRDCs mandate to be a global research institute -IVRC
2. IBSRAM	reject as institute: recommending expanded soils activities in all biological centers--CIAT, CIP, CIMMYT, ICARDA, ICRISAT, IITA, ILCA, IRRI, WARDA
3. ICLARM	admit after strategic plan, EPR/EMR, would require expansion of CG mandate to include selected parts of fisheries/aquaculture research
4. ICIPE	reject as institute: expanded plant protection work in existing institutes--CIAT, CIP, CIMMYT, ICARDA, ICRISAT, IITA, ILCA, IRRI and WARDA and creation of intercenter network
5. IFDC	reject as institute: plant nutrition efforts emphasized in existing centers
6. IIMI	admit and expand mandate to include other common property management issues
7. ICRAF	admit and expand mandate to include selected topics of forestry, particularly tree selection and breeding. Explicit inclusion of ecosystem oriented forestry

and agroforestry research into existing CG agro-ecology/regional institutes-- CIAT, IITA, ILCA, ICRISAT, ICARDA and possibly IRRI.

- | | |
|---------------|---|
| 8. IUFRO-SPDC | reject as institute: subsumed in forestry/agro-forestry approach |
| 9. ITC | reject as institute: in interim portions integrated into ILCA-ILRAD trypanotolerance network along with portions of CRTA. Longer term outcome awaits the outcome of Global Livestock Study. |
| 10. INIBAP | reject as institute:--integrate into IITA--would need to give IITA global mandate on bananas and plantains. |

The above is in our judgement not what we should recommend but it is a base point from which transition issues can be addressed. There are clearly an almost infinite number of possible ways to get from the above minimal model to our medium term and long term models. One possible constellation would be as follows:

Global Centers

- | | |
|---|---|
| • rice: | IRRI |
| • other cereals: | expand the CIMMYT mission to include wheat, barley, maize, millet, sorghum |
| • roots and tubers: | expand the CIP mission to include potatoes, sweet potatoes, cassava, yams, etc. |
| • vegetables: | AVRDC |
| • legumes: (also possibly resource management) | ICRISAT Center (Hyderabad) |
| • forestry/ agroforestry: | expanded ICRAF |
| • genetic resource | expand the IBPGR mission to include forest conservation: genetic resources |

- livestock: merge ILRAD and parts of ILCA (with parts of ITC already included) to work on livestock production and diseases (initially in Africa only--to be turned gradually into a global center)
- fisheries/aquaculture: ICLARM, as modified
- policy/management: merge IFPRI and ISNAR and global management related work of IIMI, including common property management issues

Eco-System Responsibilities

- LAC humid/sub-humid: modify CIAT or use an existing regional institution
- Africa humid/sub-humid: merge IITA and WARDA (during the short-term IITA could carry global responsibility for bananas)
- Africa semi-arid/highland: merge the ICRISAT Sahelian Center with the crop work of ILCA
- WANA:dry areas: ICARDA
- Asia: irrigated and humid eco-systems: IRRI
- Asia semi-arid/sub-humid: ICRISAT Center

The above configuration would lead to ten global and four eco-system centers. Two of the global centers (IRRI and ICRISAT) would also serve as eco-system centers. One eco-system center (Africa humid/sub-humid) would also carry global responsibility for bananas. Global responsibilities for strategic resource management research among the eco-system centers would be defined as appropriate. You are invited to develop alternatives before our discussion in Ibadan

VII. Some Critical Issues TAC's Recommendations Must Address

1. We are recommending expanded efforts in resource management, including forestry and agroforestry, yet we are recommending against apparently "resource related" institutions: IBSRAM,

IFDC, ICIPE but including: IIMI. We must make the case for strengthening resource related research in agroecology/regional institutions in a sufficiently clear manor to convince donors that there will be expanded and effective efforts in sustainability on long run production systems. How are we to assure that such an approach will work when in fact the existence of factor/resource institutes are donor reactions to the perceived failure of existing (particularly commodity) centers to take a long-run sustainability perspective?

2. A similar case must be made for plant protection, e.g. why is more plant protection research needed but ICIPE rejected?.
3. Looked at cynically, TAC's recommendations on the individual NACs could be interpreted as the old commodity model expanded, to include forestry/agroforestry center (ICRAF), vegetables (AVRDC), and fisheries (ICLARM). Only one non-commodity center, IIMI, is recommended for inclusion and it is mainly a social science effort.
4. The CGIAR started with two kinds of centers, commodity and agroecology/system centers. The latter have evolved to become more like regional commodity centers with limited and reduced mandates (CIAT, IITA, ICARDA, ICRISAT, ILCA). In all cases the pressure for selectivity and focus has come from external reviews and TAC who were critical of the dispersed, unscientific character of systems/ecology research. How can we assure donors and clients that our new model will be more effective than the past? What is different about the proposed approach?
5. We persist in drawing a line between research and research related activities on one hand, and development and technical assistance activities on the other. We say yes to some of the former and no to the latter. Yet donors want results that are measureable in farmers fields and food supplies. These desired results require improved national capacity in applied and adaptive research and extension, and increased infrastructure and input supplies. How do we justify where we draw the line for CG institutions? Are we not implying for the regional CG institutes a greater not lesser role in these latter activities?
6. We are negative about pure networks in developing countries because of uneven quality and capacity of national programs. We couple this with the essentiality of in-house capacity (i.e. the international center model). How well have we justified these criteria? How do we reconcile our current position with this paper's version of the long-term future?

7. The medium and long-term visions suggest a much smaller CGIAR focusing only on those activities where there is clear global advantage, e.g. germplasm manipulation, basic and strategic research. The vision sees devolving agro-ecology/regional adaptive and applied research on a systems/land use basis to first agro-ecological/regional institutes (CGIAR) and then to regional or networking entities owned and operated by regions. This is a monumental institution building task both at the regional and national level. What is to be the CGIAR role in this evolution? Isn't it going to require a substantial amount of development/technical assistance work?
8. In the long term scenario, global centers would interact with national programs only indirectly through regional and/or agroecological/regional CGIAR institutions. This puts an enormous burden on these "regional" institutions and cuts off direct contact of global centers with their ultimate partners. Is this a critical problem? Or can global institutes play a global coordinating and expert role without direct contact?
9. What is new about what we are saying? Has it not been said or implied before, e.g. in 1986 TAC Priority Paper? What basis do we have for recommending a restructuring based on old norms and ideas? As the old saying goes--are we just reorganizing the deck chairs on the Titanic?

We hope this paper provides some meat for discussion. These last questions should not imply that we are negative to any or all of the ideas contained in this paper. Rather we are attempting to alert TAC to questions that are almost certain to be asked. We had better be ready to answer them fully and with conviction.

May 17, 1990

A NOTE ON THE PRESENT AND FUTURE USE OF NETWORKS BY THE IARCS*

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* [A paper prepared for the TAC Standing Committee on Priorities and Strategies for its June 1990 meeting. Many of the concepts presented here have been taken from the forthcoming book, Networking in International Agricultural Research, by D. L. Plucknett, Nigel J. H. Smith and S. Ozgediz, 1990, Cornell University Press (in press).]

Introduction

Networking has increased greatly in agricultural research over the past two decades. Five main benefits of networking have stimulated this expansion: (1) networks have a comparative advantage in tackling problems of broad regional or international scope; (2) networks can increase research efficiency; (3) networks facilitate the development and use of improved methodologies; (4) networks enhance interactions among scientists, helping to identify significant problems and fostering development of new ideas and appropriate technologies; (5) scientific consultation and collaborative research networks upgrade the skills of national program scientists through specialized courses, monitoring tours, and workshops.

The term "network" is often used carelessly, referring to any situation where a group of institutions or individuals interact with each other. In our book that is in print we used the following definition: "A network can be defined as an association of independent individuals or institutions with a shared purpose or goal, whose members contribute resources and participate in two-way exchanges or communication". There are two key operative requirements in this definition, namely; contribution of resources, and participation in two-way exchanges or communication. Under this definition a mailing list is not a network. Nor is a group of donor-led projects that only have the donor in common.

In its broadest sense, networking implies the linking of individuals or institutions with a shared purpose to achieve desired goals. Networking allows scientists to participate where they are, as they are, with benefits to all. Networks can be both active and passive. We are most interested in active networks where participants commit some of their own resources, exchange information and technologies with each other, and participate in setting priorities and planning. In passive networks most of the participants tend to be recipients rather than partners. If collaboration is the eventual aim, persons who remain recipients are unlikely to make much contribution.

This note summarizes our thoughts on networks and networking as they apply to the work of the centers. It is written primarily for stimulating discussion on the subject of networking and the centers' relationships with national institutions.

* [A paper prepared for the TAC Standing Committee on Priorities and Strategies for its June 1990 meeting. Many of the concepts presented here have been taken from the forthcoming book, Networking in International Agricultural Research, by D. L. Plucknett, Nigel J. H. Smith and S. Ozgediz, 1990, Cornell University Press (in press).]

TYPLOGIES

Networks can be classified in a number of ways, by their purpose, major product or service, or operational style. Probably the most useful typology is that prepared by Ralph Cummings Jr. and Calvin Martin for the Special Program for African Agricultural Research (SPAAR), and hence known as the SPAAR typology, which is based on a network's operational style and purpose. In our book we adopted the SPAAR typology but added one category, material exchange networks. Under the system as modified there are four types of networks: information exchange, material exchange, scientific consultation and collaborative research (Table 1). Networks operating as international centers (NIARCs) are a special case and are also discussed below.

1. Information Exchange Networks

Information exchange networks are usually the simplest in organization and operation. Many are essentially mailing lists with some interaction between the network center and the individuals concerned, but with little interaction between individual network members.

2. Material Exchange Networks

Material exchange networks are primarily concerned with testing crop germplasm and agricultural machinery designs at various sites such as through international nurseries. Participants in international nurseries plant mostly the same materials and use the same screening methods. Such networks are not devoid of intellectual or research inputs. Materials are exchanged to further research goals. We identified this network type to point out that the major purpose of such networks is to exchange and test plant materials or machinery prototypes. Material exchange networks can serve a wholesaling or evaluative function for other research programs. They are usually rather simply organized and managed.

3. Scientific Consultation Networks

In scientific consultation networks, researchers in on-going, autonomous projects agree to share information and ideas. Changes in those independent research projects may undergo some changes as a result of interaction with colleagues in the network, but such changes are not required as a condition of membership. Workshops or conferences are often organized on a regular basis to facilitate discussion of research progress and problems. Research plans are still made locally however, and participants may use different methodologies. Such networks are cooperative rather than truly collaborative undertakings. Because such networks often involve conferences and workshops, training, and monitoring tours, management of scientific consultation networks may be more complex than either information exchange or material exchange networks.

Scientific consultation networks are easier to set up than collaborative research networks because research programs are already in place and are linked in the network by exchanging information and ideas.

4. Collaborative Research Networks

The main distinguishing feature of collaborative research networks is that research is jointly planned and carried out. Most such networks are new ventures, even though they use existing facilities and personnel, and are planned by the members. Research methodology is usually more uniform than in scientific consultation networks, and participants are actively involved in establishing research priorities, dividing responsibilities, and following common methodologies.

Collaborative research networks have the greatest potential for upgrading skills of participants and helping developing countries overcome constraints to increased agricultural production.

It is not easy to establish and run a collaborative research network, and only a few--probably less than a dozen-- are in operation today. True, there are more than a dozen networks in operation that aspire to becoming collaborative research networks, but those that are actually conducting research under this operational style are few indeed.

5. Networks as International Agricultural Research Centers (NIARCs)

A new organizational form has emerged that is considered by some as a hybrid between networks and IARCs (Table 2). Networks as international agricultural research centers (NIARCs) combine benefits of networking with the institutional advantages of IARCs. NIARCs have the strength of an independent research institution with an independent board of trustees and a director as a chief executive. A NIARC has an international mandate assigned by its donors, and such a mandate and a program strategy that are arrived at by an independent board can help improve funding prospects.

A NIARC is a more structured and formal organization than a network. Because of its institutional nature, most NIARCs can receive, administer, and disburse funds on their own, rather than through a third party as in most networks (however, such is not the case yet with either INIBAP or IBSRAM, which still depend on third parties to act as legal entities to receive donor funds for projects). A NIARC also employs its own staff and does not have to borrow personnel from other organizations. A NIARC can be a focal point for identifying priority research topics as well as addressing major research needs, making long-range plans and ensuring longer-term training and information services. It may build up its own library, data processing and support services (see Table 3).

In networking, the role of a NIARC is unusual because it organizes its own networks and yet often participates in networks organized by other institutions. Network planning also differs from most networks because the board of trustees plays an important policy role in establishing the long-term direction and strategy of the NIARC and any network it supports. In most

networks a policy committee composed of participants would do the policy planning for the network.

National research goals and aims of a NIARC may at times conflict. The historic tension concerning the flow of funds to international centers, rather than to national programs, also surfaces with NIARCs. Some argue that funds for international agricultural research would be more profitably channeled to national programs than to international centers. Another potential problem for NIARCs is that their network coordinators are their employees. Usually, at least part of the program goals for such networks are set by the NIARC, and when the coordinator is also a NIARC employee, national program scientists may not feel that they own the network.

An inherent weakness of most NIARCs is that they are formed to provide a mechanism to strengthen research in areas where expertise is thin. Thus a NIARC may be seen as a way to unite scattered and often inadequately trained individuals, but here a NIARC has the disadvantage of poor prospects of collaborative research in an already understaffed and underfunded field.

Each NIARC must consider carefully the balance in its involvement in in-house research and in networking. Some NIARCs began their operations believing they would not need any in-house research capacity. It now appears some NIARCs have had second thoughts about this approach after discovering that networks can be thin technically and devoid of new ideas to energize research in the networks.

NETWORKING PRINCIPLES

Successful networks share some common characteristics. Table 4 presents some 25 principles considered important in networking. Not all of these principles apply to all networks. Information exchange networks, for example, are often less complex and fewer principles apply to them. To be successful, we believe scientific consultation and collaborative research networks could benefit from adhering to fourteen principles: (1) the problem is widely shared, (2) participants are motivated by self-interest, (3) participants are involved in planning and management of the network, (4) the problem or focus of the network is clearly defined, (5) a baseline study is undertaken to produce an authoritative founding document, (6) a realistic research agenda is drawn up, (7) research and management are flexible, (8) the network is constantly infused with new ideas and technologies, (9) regular workshops or conferences are held to provide opportunities for assessing progress and discussing problems, (10) collaborators contribute resources, (11) external funding is provided to facilitate travel, training, and meetings, (12) collaborators have sufficient training and expertise to contribute effectively, (13) the network's membership is relatively stable, and (14) leadership is efficient and enlightened.

It should go without saying that to become successful, networks should be well organized and managed. In Plucknett *et. al.* (1990) we present some tenets for effective planning and management of networks (see Table 5). Treating networks as an organizational form, these tenets cover management practices that could enhance the overall effectiveness of a network. The

factors listed in Table 5 relate to the following four aspects of a network's management:

- o effectiveness of the network's relationships with its key clients and other stakeholders;
- o how well a network is guided--through its leadership, strategy and governance structure;
- o how effectively and efficiently a network manages its human, financial, physical and information resources;
- o suitability of the network's organizational structure and effectiveness of its processes for planning and managing its activities.

The governance structure of PRECODEPA, a collaborative research network in Latin America, is shown for illustrative purposes in Table 6.

NETWORK PROBLEMS

Not all networks are successful. Problems encountered can be grouped into three broad categories. The first relates to the conduct and quality of research, particularly methodological issues, inadequate communication between collaborators, uneven feedback of results from collaborators, data management, priorities and scope of the research agenda, planning, and proper characterization of research sites. The second major group of problems involves personnel issues such as rapid turnover of participants, paying of collaborators and language barriers. The third group of problems is mostly institutional and includes disbursing arrangements for funds, accounting difficulties, the potential of networks to distort national program priorities, and inadequate credit and extension services to convey technology to farmers.

RELATIONSHIPS

Networks can stimulate collaboration between scientists, between institutions and, by extension of the relationships, between countries. In many cases networks can also stimulate funding for achieving certain research goals through collaboration. Some networks use such special funding to help support individual scientists who are willing to take on responsibility for part of the network's program but need financial support to do so.

Networks can also be useful in helping national research programs, through specialized training to bridge critical manpower gaps, providing information and communication services, and providing genetic resources and research support. However, network cannot substitute in all cases to meet long-term task of strengthening NARSs. For that, other relationships may be necessary.

Mike Arnold has presented a typology of relationships that IARCs might follow in dealing with national programs; collaborative, contracting and enabling. As we understand it, collaborative relationships with NARSs are those where the centers do not contribute any resources; contracting relationships are those where the IARCs contribute resources in contracting arrangements with NARSs; and enabling relationships are those where IARCs contribute their own resources with the long-term goal of helping to improve the ability of a national program to carry out its own work. Here the purpose would be not necessarily to get a particular research task done, but to strengthen the national program.

We find parts of this typology confusing, especially the implication that contracting and enabling relationships could not be "collaborative", in the dictionary sense of the term. We also worry that the terminology implies that enabling or collaborative relationships may not involve written agreements or contracts, and clearly many do.

As we understand it, the typology is based on the idea of transfer of resources from an IARC to someone else, and where there is no transfer of resources, there is no problem. It seems to us that where there is a transfer of resources, there are three basic modes of intent: (1) primarily for the purposes of the giver, i.e. the IARC; (2) primarily for the purposes of the receiver, i.e. the NARS; and (3) where the purpose of the transfer is to meet the needs of both giver and receiver.

Issues seem to arise when the resource transfer is mainly for the purposes of the receiver (category 2, above). This puts the IARC in a purely technical assistance mode vis a vis a NARS. Should an IARC play such a role? Our view on this is that it should not, because a technical assistance role could easily detract from the main business of an IARC (research) and could blur its accountability. However, the IARCs have a strengthening role to play and the role of technical assistance by the centers should be seen in the context of what is involved in strengthening the NARS.

In strengthening NARSs, the CGIAR should distinguish between the purposes of ISNAR, which aims to strengthen national systems, and the purposes of an individual IARC that wishes to strengthen a component of a national research system, e.g. where IRRI helped to strengthen the national rice program of Indonesia.

In the process of strengthening NARSs, there are several steps and decisions that must be made. The first step is diagnosis of strengths and weaknesses of a NARS, and the first question is, should a given IARC help a NARS to diagnose its strengths and weaknesses? The next question is, should a center design a program of improvement for the component of the system or for the whole system? Next, should a center then help implement that plan for improvement? And if so, should it do it alone or with others?

A dilemma in strengthening NARS is that countries do need help, but if each center works independently to help a NARS on a given commodity or problem, there still remains a need for the country to work with the CGIAR

system as a whole, and not just piecemeal, center by center. ISNAR has a role to play here. So do networks that can help to strengthen national systems.

Options for an IARC in Meeting its Goals and Objectives

An IARC has essentially four approaches to meeting its goals in research and technology development:

- (1) do the research itself,
- (2) contract the research to an outside individual or institution;
- (3) do research collaboratively through bilateral or multilateral relationships with advanced institutions or NARSSs,
- (4) conduct research collaboratively with interested partners through networks.

The international nature of the IARCs requires that they must take on research that is important to many countries, and not likely to be taken on by other research organizations. Many international problems are best handled by joint planning and execution of research and by longer-term research collaboration. Networks can be very effective in meeting such goals. Also, networks can be important in helping IARCs to meet the common needs of a number of countries rather than through a host of bilateral arrangements.

Networking in the IARCs, Present and Future

Networks are used by the IARCs for three main purposes: (1) to further their own research and research-related goals and objectives, (2) to help strengthen national programs, and, in many cases, (3) to accomplish both. Networking can be used to: (1) serve as an alternative to adding permanent staff to a center, (2) solve major pressing problems that need solution, (3) contract out research to others, but in a structured and coordinated way.

In achieving the first purpose, meeting its own needs, an IARC may use any of the network types that were described earlier. In the early days of the CGIAR, information exchange and material exchange networks (especially global nurseries) predominated. In most cases these networks were set up to further the work of the IARC itself. Later on, IARCs began to use networks as a way to strengthen NARSSs, especially by establishing a means whereby former trainees from national programs were able to return to their countries and work within a broader context through linkages established within networks. Today, networks are in operation that mostly meet IARC needs and goals (Type 1), a few that are devoted mostly to strengthening NARSSs (Type 2), and many that are devoted to a mixture of IARC-specific goals and the goal of strengthening NARSSs (Type 3).

It is probable that in the future Type 1 networks will increase mostly in upstream activities where the IARCs need special relationships with advanced laboratories and institutions, e.g. in biotechnology. Type 2 networks are likely to increase in the future, especially in Africa where many small countries need to improve their national research capacity in agriculture and because some IARCs still need to test or validate new ideas or technologies in NARSSs and yet still serve in strengthening NARSSs, Type 3 networks are also

likely to increase in number and scope. NIARCs are likely to evolve more toward building in-house and headquarters research capacity, to ensure a strong scientific base for their networks.

Devolvement

When an IARC may wish to end its direct involvement in a particular activity, for whatever purpose, a network may serve as a bridging mechanism to share responsibilities with others, until full devolvement to another institution or other institutions is completed. In some situations, devolvement may result in a network taking over the responsibilities.

Among others, areas where the centers are likely to wish to devolve responsibilities in the future are training and some more applied aspects of plant breeding. Training networks should be considered as a possible approach for devolving training activities, because more countries could be involved and their inputs would be crucial in planning and carrying out training programs suited to their needs.

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Table 1. Some characteristics of networks that illustrate the operations and levels of complexity of information exchange, material exchange, scientific consultation, and collaborative research

Trait	Information exchange	Material exchange	Scientific consultation	Collaborative research
Coordinator	Yes	Yes	Yes	Yes
Publications	Yes	Yes	Yes	Yes
Advisory board	No	Yes	Yes	Yes
Study tours	No	Yes	Yes	Yes
Training	No	Yes	Yes	Yes
Workshops	No	No	Yes	Yes
Common methodology	No	Yes	No	Yes
Joint planning	No	No	No	Yes

Table 2. Contrasting features of networks, networks as international agricultural research centers (NIARCs), and international agricultural research centers (IARCs)

Feature	Networks	NIARCs	IARCs
Legal identity	Usually not	Yes	Yes
Can receive & administer funds	Usually not	Yes	Yes
Can employ staff directly	Usually not	Yes	Yes
Assigned mandate	No	Yes	Yes
Board of trustees	No	Yes	Yes
Independent governance	Usually not	Yes	Yes
Own its own headquarters	No	Seldom	Yes
Own its own substations	No	Seldom	Usually
Research capability at hq	Sometimes	Sometimes	Usually
Strategic planning	Steering committee/coordinator	Board/Management	Board/Management

Table 3. A comparison of characteristics of some existing networks as international agricultural research centers (NIARCs)

NIARC	Facilities		In-house research	Headquarters research	Library	Thematic networks	Regional networks
	Owens	Rents					
INIBAP	No	Yes	Some	Some	No	No	Yes
IBSRAM	No	Yes	No	No	No	Yes	Yes
ICLARM	No	Yes	Yes	Yes	Small	Yes	No
ICRAF	Yes	Yes	Yes	Yes	Small	No	Yes

Table 4. Principles considered important for networking by eight evaluators*

Principle	Author/Organization							
	1	2	3	4	5	6	7	8
Strong self-interest	X	X	X	X	X	X	X	X
Effective coordinator	X	X	X	X	X	X	X	X
Clearly defined problem	X	X	X	X		X	X	X
Participants commit resources	X	X		X		X	X	X
External funding	X	X	X			X	X	X
Problem widely shared	X	X						X
Scientific capacity to contribute	X	X					X	X
Effective advisory group			X	X			X	
Scope for new ideas/free exchange			X	X				
Sufficient new ideas and technologies			X					X
Participants involved in planning and management		X						X
Regional scope			X					
Linkages to basic research			X					
Clear strategy as well as theme				X				
Training and monitoring				X			X	
Common constraints					X			
Capacity to adapt and diffuse					X			
Access to other networks					X			
Long horizons						X		
Extra funding for national programs			X					
Authoritative founding document								X
Realistic research agenda								X
Regular workshops and meetings								X
Relatively stable membership								X
Flexible research and management								X

* Author/Organization

1. Plucknett and Smith, 1984
2. Greenland et al., 1987
3. Zandstra, 1986
4. SPAAR, 1986
5. ISNAR, 1985
6. FAO, 1985
7. Valverde, 1988
8. Plucknett, Smith, and Ozgediz, this chapter

Table 5. Tenets for effective planning and management of networks

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1. Widely shared values
 2. Effective governance and policy-making structure
 3. Effective coordinator/leader
 4. Clear, well-focused strategy
 5. Decentralized coordination and communication
 6. Sound, pragmatic work plans
 7. Effective review mechanisms
 8. Appropriate work process
 9. Good system for recruiting and keeping network staff
 10. Stable and adequate funding
 11. Adequate physical resources
 12. Effective information management and sharing
 13. Good linkages with clients
 14. Productive dialogue with donors
 15. Healthy relationships with host institutions
 16. Effective ties with other networks and institutions
 17. Skilled research managers at the network nodes
 18. Effective teamwork among participants
-

Table 6. Governance structure of PRECODEPA and the roles of each management and policy entity

Regional Permanent Committee (COPERE—Comité Permanente Regional)	
<i>Functions</i>	
Nominate executive committee (COE)	
Draw up regional projects for potato improvement	
Establish priorities and appoint project leaders	
Seek external funds for individual projects	
Help national programs set their potato research budgets	
Contract an international auditor for reviewing expenditures of external funds	
Set up a technical committee	
<i>Composition</i>	
Two representatives from each participating country and two representatives from CIP	
Executive Committee (COE—Comité Ejecutivo)	
<i>Functions</i>	
Implement COPERE's decisions	
Contract PRECODEPA personnel	
Promote PRECODEPA's linkages with other networks and technology transfer	
Organize annual PRECODEPA meetings and other technical reunions	
Represent PRECODEPA when dealing formally with countries and institutions	
<i>Composition</i>	
President, a technical adviser, and an administrative secretary	
Coordinator	
<i>Functions</i>	
Arrange annual meetings	
Act as liaison between technical and administrative aspects of project implementation	
Coordinate technical reviews	
Manage external funds	
Maintain regular contact with external donors	
Carry out agreements reached by COPERE and COE	

Thoughts on Post-Production Research at the International Agricultural Research Centers*

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Appendix A: Summary, Commentary and Recommendations, J.H. Hulse, 1990
"Crop Utilization and Agro-Industrial Development"

Introduction

Close to a quarter of global crop production is lost each year during or after harvest due to improper handling, numerous pests and diseases, and inefficient processing (CGIAR Ann. Rpt., 1988/89). In developing countries, losses due to spoilage, insects and rodents often exceed one-quarter of the crop yield. Ngugi (1989) estimates that 30 percent of total grain produced by African subsistence farmers is lost to storage pests. Post-production (often referred to as post-harvest) losses in some developing countries are estimated to go as high as 40 percent in cereals and 50 percent in fruits and vegetables (Scrimshaw, 1988). Losses of this magnitude are intolerable, given the fact that so much labor, energy and investment goes into bringing a crop to harvest. However, it should be pointed out that average losses across wide areas and a number of years are much lower.

Because of the serious problems and losses encountered after harvest, it has been argued that the CGIAR should become more involved in post-production research. Indeed, the CGIAR recognizes the importance of post-production problems. The 1986 TAC study on CGIAR Priorities and Future Strategies, for example, identified "enhancing commodity conversion and utilization" as a major objective of the CGIAR system (TAC, 1986:27). Currently, the CGIAR investment in post-production research is modest, about 2 percent or less of total System resources. Whether that figure will increase is a matter for conjecture, but it is possible that post-production concerns may command a somewhat larger investment in the future, from its currently small base.

In its new study of priorities and strategies, the TAC faces again the question of the type and size of investment in post-production research it should recommend to the CGIAR. In its deliberations the TAC may want to consider the following questions: (1) what aspects of post-production problems are suited for international research; (2) of the international problems identified, which ones are best done by the international agricultural research centers; (3) of the international problems, what categories of research in the post-production fields (strategic, applied, adaptive) are best suited for the IARCs; (4) do the CGIAR centers enjoy any comparative advantage in post-production research; (5) are there areas of research now being carried out by the IARCs that have post-production implications (but may not be recognized as such) and that should be identified as post-production research?

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This paper has been prepared at the request of the TAC Standing Committee on Strategies and Priorities. A related paper entitled, "Crop Utilization and Agro-Industrial Development" by Dr. Joseph H. Hulse was also prepared for TAC and should be read in conjunction with this paper.

Purposes for CGIAR Involvement in Post-Production Research

The IARCs may have several reasons for becoming involved in post-production research. These include:

- o cases where the Center's own program responsibilities depend on new knowledge to improve post-production technologies for a given commodity.
- o pressing international problems requiring international initiatives to solve them.
- o pressing continental or regional problems that are international in nature and requiring international initiatives to solve them.

Present CGIAR research

The 1988/89 Annual Report of the CGIAR listed several areas of post-production research in which the centers are currently involved; these are:

1. **Innovations for gathering the harvest** - in particular, development of machines to aid in harvesting and drying, especially for cereal crops.
2. **Protecting the harvest** - reducing susceptibility of crops to lodging, reducing the effects of damage to harvested or stored products from diseases, insects, and rodents. Genetic resistance to pests is a major strategy in protecting products from such post-harvest losses. Centers involved in root crops have conducted research on inexpensive but effective, on-farm storage methods.
3. **Evaluating product quality** - This work is especially important for centers with responsibility for cereals, where grain, milling or product (e.g. bread) quality are essential.
4. **Processing techniques and marketability** - Some of the centers with responsibility for the often-highly-perishable root crops have become involved in processing research. Some centers have also undertaken marketing studies to determine consumption and demand patterns for certain commodities.
5. **Greater use of crop byproducts.**

Lessons Learned from CGIAR Research on Post-Production Problems

There is not unanimity in the CGIAR centers regarding the value of and pay-off to research on harvest and post-harvest technology. Many problems can be handled adequately by applying existing knowledge to the local situation, but this is really not a responsibility of an international center. Also, many post-production problems are location-specific in nature and therefore

not suitable for research by an IARC. The Centers have therefore adopted a selective approach to such work, usually selecting problems that are specific to a particular commodity and that are faced by the producers and consumers of that commodity.

Three main lessons can be learned from present CGIAR research on post-production systems: (1) **genetic resources are essential to combat post-production losses**--without comprehensive and carefully evaluated germplasm collections for use in crop improvement, many post-production losses will be difficult to overcome; (2) **many disciplines are required to develop viable post-harvest technologies**; and (3) **networking can be a valuable mechanism for facilitating research on post-production technologies**. The IARCs have a comparative advantage in genetic resources work, especially conservation, evaluation and utilization of basic germplasm to study major pests and diseases, to identify genetic traits to meet those pest and disease constraints and to make evaluated or enhanced germplasm available to national programs. The centers are also well-placed to work through networks to solve problems. In a few cases the centers may have available a suitable array of disciplines needed for post-production research, but in most cases to be effective the centers may have to ask other institutions to take on the responsibility or at least to share responsibility in that research. A continuing question for the IARCs is whether centers should promote new areas of post production research to stimulate demand for their mandate commodities (e.g. CIAT or IITA for cassava).

Recommendations Contained in the Hulse Paper on "Crop Utilization and Agro-Industrial Development"

Appendix A presents the **Summary, Commentary and Recommendations** of the Hulse paper. In this section the major recommendations made will be reviewed briefly.

The paper concludes that the CGIAR investment in post-production research is small, that related center programs are variable in purpose and scope, that the boards and TAC have not paid much attention to such research, and that donor support for post-production research appears fragmented and uncoordinated. The paper recognizes that there are many problems to be tackled, that there are constraints to technology transfer, and that much can be learned from past successful post-production efforts. The paper recommends that post-production concerns be incorporated into center strategic plans, and that any expanded program in post-production systems should employ existing resources to a better purpose.

The paper makes a series of recommendations that seem to say; post production research is good, to do more. Evidence for priorities among possible research activities is hard to find. Recommendations in the paper are presented in three categories; (1) to TAC and CGIAR, (2) to donors and development agencies, and (3) to IARCs.

Recommendations to TAC include: post-production concerns should be specifically reviewed in the EPRs; specific responsibilities in EPRs should be assigned to one or more members of the panel; **Stripe Reviews** on post-

production matters should be commissioned; TAC should recommend how centers should carry out post-production research (e.g., in-house, in cooperation with other partners, or by inter-center collaboration); TAC and CGIAR should encourage research to elucidate biochemical and biophysical properties of CGIAR crops. The paper suggests that TAC should pay particular attention to routine analyses being carried out at the centers, with particular attention to whether methods are up-to-date and reliable. Also, TAC should consider if and in what manner IFPRI and ISNAR might expand their mandates to take account of post-production concerns and agro-industries.

Recommendations to the IARCs include: matters for inter-center cooperation (developing a CGIAR manual of standard methods of analysis; regional workshops on crop quality and utilization; standardized monitoring of wide crosses for unusual, nutritionally-negative factors); matters for individual centers (quality factors, monitoring of wide-cross genotypes); cooperation with NARSs, and training. Regarding training, the paper suggests that the centers should conduct more training in agro-industrial development and marketing. Further, the paper suggests that centers should give particular attention to quality factors for commodities that are amenable to industrial diversification, and to reduced dependence on imported grains.

The paper also suggests research priorities for the centers in four main categories: (1) properties of crop components, (2) utilization, (3) utilization of by-products, and (4) crop drying.

Questions for TAC to Consider:

- o what should be the level of investment of the CGIAR in post-production research?
- o should the CGIAR be involved in adaptive research in post-production problems?
- o how much applied research on post-production problems should the CGIAR undertake?
- o what strategic post-production research topics should the CGIAR undertake?
- o how far, if at all, should the CGIAR be involved in research to determine the utility of a commodity?
- o how far, if at all, should the CGIAR be involved in product development?
- o should the CGIAR centers be involved in food safety research? If so, in what situations?
- o how much analysis for quality should the CGIAR undertake, considering such analyses could include analysis for potentially toxic or deleterious factors, nutritional quality, product quality, and others.

- o should the CGIAR be a leader in standard methods of analysis or should it be a user of standards established by others? Should the CGIAR publish handbooks and carry out training for developing countries on standard methods of analysis?

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J. H. Hulse, 1990

"Crop Utilization and Agro-Industrial Development"

OVERVIEW

The paper, written for critical review by TAC and CGIAR is predicated on the beliefs that:

- [i] Food has no nutritional value until it is eaten and digested;
- [ii] All food crops are perishable;
- [iii] Most grain and root crops are indigestible in the raw state;
- [iv] Consumers, particularly poor people, choose food that is familiar and from experience can be regarded as safe;
- [v] As nations develop and urban communities expand, dependence upon food processed and distributed by agro-industries increases.

Post-production systems [PPS] and agro-industries that are efficient technically, viable economically and acceptable socially are essential:

- [a] To protect and preserve harvested crops
- [b] To process and transform crops into acceptable, nutritious and wholesome foods and usable co-products (by-products).

Though TAC cites "improvement in post-harvest technologies" as an Objective, CGIAR support for PPS is small indeed compared with its investment in crop improvement. The focus and scope of PPS activities varies markedly among Centres though all IARCs who contributed to the preparation of this paper seem convinced that qualities of utility are as important as agronomic characters. Donor support of PPS and of agro-industrial development appears fragmented and uncoordinated, and there seems to be no consolidated critical analysis of what has been learned from past experience.

The paper is intended to stimulate greater interest and imaginative support for research, development, technical assistance and training to improve PPS; to broaden our understanding of the useful properties of CGIAR mandated crops; and to encourage the rational expansion and diversification of the means of processing the crops and distributing the products. The subjects addressed are listed in the Contents. Several are placed in historical perspective in the belief that "He who knows not his past history can have little hope for his future prosperity".

The point of embarkation is TAC document AGR/TAC/IAR/88/12 May 1988 which states CGIAR Objectives. An overview of PPS [pp4-8] points out constraints to technology transfer and the need to begin by learning from long established PPS. A review of recent growth patterns, economic and social benefits that agro-industries provide [pp9-11], precedes reference to contract farming [p11] and the principles of food product preservation [pp12-13]. Then follows a description of crop processing technologies, dry and wet milling of cereal grains, pulses, oilseeds, roots and tubers [pp13-17], with particular emphasis upon extrusion, breadmaking and composite flour technologies [pp17-19], and to research needed to reduce developing country dependence on imported grains.

Fractionation techniques, by which crop components can be chemically and/or physically separated for analytical or technological purposes, are reviewed [pp19-20] and particular properties of plant proteins, carbohydrates, lipids, cellulose and lignin discussed in relation to known or potential utility [pp20-23]. The diversity of products derived from maize illustrates the opportunities for greater utilization of other CGIAR crops when science unveils their useful properties [p24]. It is repeatedly recommended in the text that research to this end be given high priority in the Centres' in-house and cooperative programs. Alternative approaches to industrial product development are outlined with caution against over-reliance on technology push [p25].

Analysis for utility [p26] relates modern laboratory methods to useful properties, and Analysis for safety [p27] suggests protocols and sources of expertise to monitor for possible anti-nutrients or intoxicants introduced by wide crosses with wild species.

Reports received from IARCs that describe activities related to PPS and crop quality are summarised [pp28-34]. These reveal different approaches and emphases, including prototype technologies demonstrated through pilot projects, product development, market studies, regional reviews of government policies and consumer preferences. Some have started and most expressed the need to cooperate with private sector agro-industries in PPS programs.

Government regulatory, industrial and consumer perspectives on Food Quality are presented with particular reference to food-borne hazards and safety considerations [pp36-37]. Final pages of the narrative address Marketing and Market research, subjects of particular interest to developing country contributors and to several IARCs [pp38-40]. The purpose of, need and opportunities for, and benefits to be derived from Operations research - to make better use of resources available - are surveyed [p41], with the proposition that more is likely to be gained from systematic studies of existing operations than from excessive investment in product and process innovation. The paper ends by urging more investment in the training of managers and resources that might be tapped to this end.

RECOMMENDATIONS

Explicit and implicit recommendations are distributed through the main text. The following are specifically recommended for consideration by (A) TAC and CGIAR; (B) Donors and development agencies; (C) IARCs. At the end is a list of subjects proposed for research priority.

(A) TAC and CGIAR

1. The essential importance of PPS be recognised and in future Strategic Plans PPS be effectively integrated with farming and production systems.
2. The Centres' give equivalent consideration to qualities of utility as to desirable agronomic characters.
3. TAC assign specific responsibility for review of PPS and crop utilization research to one or more of its members.
4. Research and other activities related to PPS and crop utilization be specifically reviewed in future EPRs.
5. TAC commission "Stripe reviews" of IARC activities related to PPS and quality for utility.
6. Based upon the results from 5, TAC recommend the desirable focus and scope of IARCs PPS activities and suggest which be pursued [a] in-house, [b] in cooperation with external partners, [c] by inter-IARC collaboration.
7. Encourage research to elucidate biochemical and biophysical properties of CGIAR crops and their components and how they influence stability and qualities of utility in traditional and processed foods, and in useful co-products [by-products].
8. Centre breeders, analysts and biochemists be encouraged to cooperate in identifying inheritable useful properties and genetic, agronomic and biochemical means of enhancement.
9. PPS and agro-industrial development be on the agenda of a future Centres' Week or mid-year meeting to which donor and development agencies be invited to report on lessons learned from past experience.
10. IFPRI be asked to study policy related to PPS and agroindustries.
11. The Group for Assistance on Systems for Grain After-harvest, of which a sponsor and several CGIAR donors are members, be encouraged to expand its membership and PPS activities.

(B) DONORS AND DEVELOPMENT AGENCIES

1. Donors seek means to coordinate their respective support for PPS and agro-industrial development, and to gain common benefit from each others' earlier experience and difficulties.

2. UNDP and bilateral agencies expand their support for training of managers in agro-industries, giving special attention to women who have particular abilities in food processing and marketing. It is suggested bilateral donors draw upon people with management experience who can be provided by executive service organizations.

3. PPS and agro-industrial development projects rely upon identified user needs, opportunities and resources rather than imposed technology transfers.

4. More encouragement be given to operations studies to improve the efficiencies of existing PPS systems and technologies than to the invention of novel products and processes.

5. People with relevant practical experience be provided to assist developing countries to improve their marketing and market research capabilities.

6. In consultation with IARCs, donors encourage cooperation between their nations' scientists and the Centres in research to gain greater understanding of the properties of food crops and their components.

(C) IARCSResearch and Analysis

Inter-IARC cooperation could include:

1. Composition of a CGIAR Manual of standardized methods of analysis and crop quality assessment;
2. Sponsorship of regional workshops on crop quality and utilization;
3. Standardization of protocols to monitor wide-cross hybrids for nutritionally undesirable substances inherited from wild species;
4. Biennial meetings of Centre analysts and biochemists on PPS and quality assessment activities.

Individual Centres in-house activities should probably include the following:

1. Identification of properties
 - Essential for utility and nutritional quality
 - Desirable in traditional and processed foods and by-products
 - That make for reduced reliance on, and facilitate substitution of locally grown for, imported food crops
 - Amenable to modification by genetic and/or agronomic manipulation.
2. Monitoring of genotypes derived from wide crosses for unpredicted and/or undesirable characters and components.

Cooperation with NARS could include

Regional networks of government and academic laboratories, consumer and agro-industrial associations to assemble useful information on mandated crops, such as:

1. Principal uses in traditional and processed foods;
2. Quality characters desirable for 1 above;
3. Regional and seasonal production and industrial use statistics;
4. Government policies that relate to grading, marketing and pricing; agro-industrial development; import/export of food crops.

Training programs should include:

1. Regional group seminars and individual courses in analytical standards and methods;
2. Cooperative networks to monitor reliability by analysis of reference samples prepared and distributed by Centre chemists.

SUBJECTS SUGGESTED FOR RESEARCH PRIORITYProperties of crop components

1. Biochemical, biophysical and identifiable functional properties of carbohydrate and protein fractionated from legumes, millets and new sorghum cultivars, and of carbohydrates from cassava and sweet potato. Legume flours can be fractionated by air classification.
2. Properties of pentosans in legumes, their role in binding seed coats to cotyledons and biochemical means of loosening them.
3. Structure and properties of lignocellulose in different types of straw, and of the derived cellulose, hemicellulose and lignin fractions.
4. Factors in rice that influence [i] cracking in rough rice; [ii] differences in texture after cooking among varieties similar in starch content; [iv] aroma in raw rice.

Utilization

Because of the continuous growth in demand for yeast leavened bread intensive research on bread from composite flours is warranted, the following being some aspects to be considered:

1. Compatibility of starch and protein from other cereals with bread wheat starch and protein.
2. Effect of added pentosans, polysaccharide gums and hemicelluloses on gas retention in composites low in wheat gluten.
3. Development of yeasts for panary fermentations that function at temperatures above 30C.
4. Simple low-cost energy efficient machines to achieve mechanical dough development.
5. Simple agglomeration and low-pressure extrusion devices to produce homogeneous composites with partially gelatinized starch.

The needs and opportunities for research to improve utilization of by-products, particularly straw and hulls, are too many to be listed. It is suggested that clean separation of cellulose, xylan and lignin is unlikely to be effected by lignocellulytic fungi, and that more attention should be given to isolating fungal enzymes from which one or more that could be synthesized biotechnologically might be found to effect cleaner separation.

Finally, as suggested by several advisers, particular attention is needed to the problems of crop drying, in particular to crops harvested during rainy seasons. Improved dryer design will need the cooperation of crop physiologists, bio-engineers and agricultural economists, and should be pursued where the dryers will be used, and in consultation with those who will use them.