Agenda item # 5

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THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

TOWARDS A REVIEW OF CGIAR PRIORITIES AND STRATEGIES

Progress Report

by the

Technical Advisory Committee (TAC/CGIAR)

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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TOWARDS A REVIEW OF CGIAR PRIORITIES AND STRATEGIES [1]

1. Introduction

At the Mid-Term Meeting in Montpellier in 1987, the CGIAR agreed that TAC would produce an updated report on CGIAR priorities and strategies every five years. The last priority paper was approved in 1986 so the next one is due for presentation at ICW in 1991. The Standing Committee for Priorities and Strategies initiated the preparation of this report at TAC 50 and is providing guidance to TAC in this important exercise. This paper presents an overview of the approach TAC is taking and the progress made to date in assessing CGIAR priorities and strategies.

In making recommendations on CGIAR priorities and strategies, TAC operates at two major levels. At the ex ante level, the Committee evaluates and sets CGIAR priorities for the allocation of resources across the System, to enable an appropriate balance among Centres, activities, commodities and regions. It also evaluates proposed new initiatives or activities as to their consistency with these priorities, and their recommended level of funding. At the ex post level, TAC's discussions are guided by considerations related to the actually achieved and anticipated potential impact of centre activities, emerging trends in world agriculture, and capacities of national research systems.

TAC's most recent review of CGIAR priorities and strategies of 1985 identified a number of issues that required further elaboration: sustainability, resource management and environmental degradation, income generation, employment and equity, evolving partnerships with NARS and the sluggish progress in food production in less favoured regions. It identified also vegetables, fish and coconut as new commodities to be considered.

While these strategic changes were in progress the CGIAR decided in 1988 to make the System more broad and inclusive and asked TAC to examine a possible expansion of the CGIAR by considering ways and means to incorporate the so-called non-associated centres or important elements of their programmes into the CGIAR. One year later, the CGIAR also recognized the need to expand research on natural resource management for sustained food production and particularly for the maintenance of land best suited for tropical and sub-tropical forests.

TAC's analyses and recommendations regarding the Non-Associated Centres and the incorporation of a Forestry Initiative are being presented and discussed at ICW 1990. The TAC paper presents regional analyses of problems and research needs, and recommends that the CGIAR System be re-structured along lines which expand the effort on research focussed on agro-ecological zones, regionally defined. Whatever the outcome of the discussions, it is by

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[1] Progress Report prepared by the Technical Advisory Committee (TAC/CGIAR) for presentation at ICW 1990.

now obvious that the CGIAR may have to subject itself to major changes to maintain and enhance active support of the international donor community.

Consequently, the priority and strategy analyses cannot be a simple "business as usual update" of the 1986 analyses, but has to reflect the innovative intentions of the Group in such a way that it may guide important institutional and organizational changes and strategic choices of the Centres.

To serve this purpose, TAC aims at two major outputs of its work:

- the development of a dynamic analytical process, that enables TAC to adapt CGIAR priorities and strategies continuously to changing internal and external circumstances (including impact assessment), while maintaining at the same time sufficient continuity in this process;

- a priority and strategy document that reflects major decisions of the Group regarding its future.

A further complementary and concurrent objective of TAC is the development of a priorities framework in a form that can be used as the basis for resource allocation in the CGIAR System. This will entail an interactive priority setting process which produces a matrix with target values for the relative distribution of resources across activities and agro-ecological zones. Details are given in the report on Resource Allocation in the CGIAR to be presented at ICW 1990.

The purpose of the present progress report is to provide the basis for an initial discussion of the process of priority setting and strategy development. Firstly, a revised CGIAR mission and goals statement is presented and a list of research activities which are considered essential to contribute to these goals is elaborated. It is then shown that the broadened mission and goal statement requires the analysis of problems on an agro-ecological base which expands on the regional approach used in Chapter 3 of the report on "A Possible Expansion of the CGIAR" [1] Based on the pioneering work of FAO, a total of 18 continentally restricted agro-ecological zones are differentiated for this purpose.

Primary and derived demographic, economic and agro-ecological information, aggregated for each continentally restricted agro-ecological zone (CAEZ) are being summarized in an easy to use spreadsheet. Subsequently some commodity-oriented models for assessment of research benefits and a number of other research planning criteria are considered. Finally it is argued that any attempt to develop a comprehensive model to optimize priority setting is bound to fail. This necessitated the development of an interactive spreadsheet approach with the main purpose to enable the use of existing partial models and quantitative databases and to clarify and strengthen the collective judgement of the CGIAR System in general and TAC in particular.

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[1] AGR/TAC:IAR/90/24

2. The Mission and Goals of the CGIAR

The logical starting point for this review of priorities and strategies is a careful assessment of the mission and goals of the CGIAR System. In this important task TAC has already made considerable progress because the issue of the expansion of the CGIAR also required such an assessment. In this section the background to a number of changes to the mission and goals statement is briefly discussed and the revised statement is presented. A more detailed discussion is given in Chapter 7 of the report "A Possible Expansion of the CGIAR".

The last goal statement, adopted in 1986, read as follows:- "Through international agricultural research and related activities to contribute to increasing sustainable food production in developing countries in such a way that the nutritional level and general economic well-being of low income people are improved".

TAC has suggested that the focus on food production should be modified to incorporate the concept of achieving food self-reliance in the developing world. This is an important change from the old concept of self-sufficiency which has major operational implications:

- non-food commodities can be candidates for CGIAR support if they contribute to income generation, especially of low-income people, in ways that enhance their permanent well-being;

- research by the CGIAR ought to reinforce comparative advantage that countries and regions have in the supply of agricultural, forestry and fisheries products and rely on markets and trade to satisfy the basic food and nutritional needs of low-income people.

At the Canberra meeting in 1989, CGIAR members declared their intention to continue to place emphasis on the CGIAR mandate of research on sustainable food production and "to expand this emphasis to include research on the optimal management of tropical and sub-tropical forest lands giving particular stress to the interaction of agriculture and forestry, and the use of forest resources as an important contributor to the rural economies, energy needs and the wealth of partner nations". It is also important to point out that equity, and in particular gender equity, has received increased emphasis from the CGIAR and TAC in recent years.

Taking into account the above issues and developments, and reflecting the consensus that has emerged in recent years among the various partners in the global research system, TAC has developed the following mission statement:

> "Through international research and related activities, and in partnership with national research systems, to contribute to sustainable improvements in the productivity of agriculture, forestry (and fisheries) in developing countries in ways that enhance nutrition and well-being, especially among low-income people".

The above mission statement implies a focus on:

- international research that complements and supports national research efforts;

- complementary activities aimed at strengthening national research capacities such as specialized training and information services, but excluding other development or technical assistance activities;

- satisfying human needs from agriculture, forestry and fisheries, without degrading the environment or the natural resources on which they depend;

- the large numbers of poor people;

- the importance of technological change in generating new income streams for the poor.

The ultimate aims are improved nutrition and economic well-being for low-income people, including women, landless labourers and poor consumers in both the rural and urban communities. Research should contribute to self-reliance by increasing the purchasing power of the poor through lower costs and prices, and greater equity in the distribution of incomes. It should also contribute to the quality of plant and animal products, to sustainability and stability in their supply, and to the prevention of environmental degradation through improved management.

These ultimate aims cannot be achieved solely through research and training. Success depends on many additional factors, such as efficient policies from governments, marketing channels for farm products, input delivery systems, and employment opportunities that bring purchasing power to the poor.

In setting priorities, the relative contributions of different research activities to these ultimate aims must, as far as possible, be explicitly evaluated. TAC considers that priorities can be systematically analyzed and compared using a framework consisting of the following nine goals, to which research activities contribute:

(i) effective management and conservation of natural resources (i.e. land, water, forests and germplasm) for sustainable production;

(ii) improved productivity of important crops and their integration into sustainable production systems;

(iii) improved productivity of important livestock and their integration into sustainable production systems;

(iv) improved productivity of important trees and their integration into sustainable production systems;

(v) (improved productivity of important fish and their integration into sustainable production systems;)

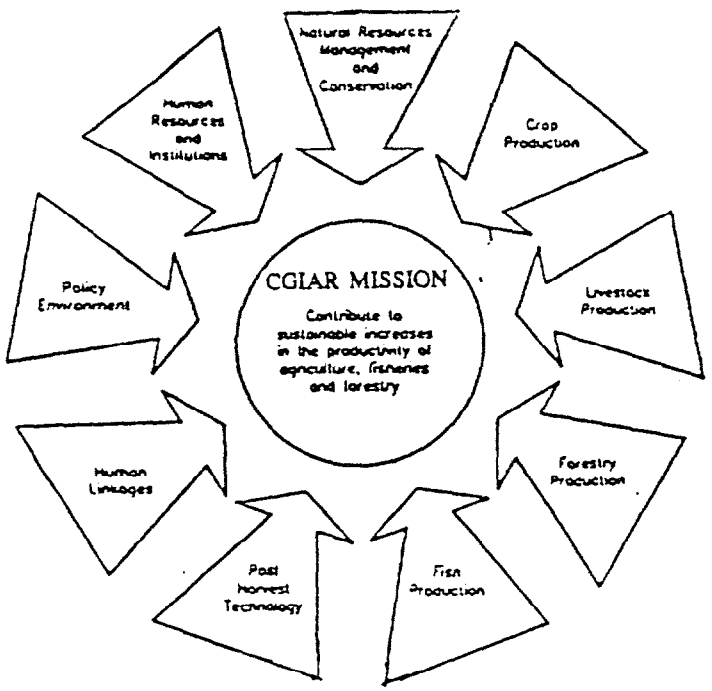
(vi) improved utilization of agricultural, forestry, (and fish) products in both rural and urban areas through improved post-harvest technology;

(vii) improved diets, family welfare and equity (including gender equity), through better understanding of the human linkages between production and consumption;

(ix) strengthened institutions and human resources in national research systems to accelerate the identification, generation, adaptation and utilization of technological innovations.

Figure 1 illustrates the central mission and the nine goals of the CGIAR.

Figure 1 The Mission and Goals of the CGIAR



The level and nature of the CGIAR's future involvement with each of these goals will vary greatly, but all are recognized as essential concerns. The aim is to contribute to the nine goals through research and complementary activities. Through their research, CGIAR centres have to contribute to science but this is not considered a goal in itself.

3. Research Activities of the CGIAR

The CGIAR is engaged in a process which uses inputs such as human resources, physical facilities, land, equipment and supplies to undertake research and research-related activities. These activities in turn form the building blocks of research projects whose objective is to produce outputs that contribute to one or more of the nine CGIAR goals. Within the CGIAR System, support should only be provided to activities that are research and research-related, international in character, consistent with CGIAR priorities and strategies, and which can be more effectively conducted by a CGIAR Centre rather than by another institution.

Projects are of limited duration and may be readily adapted to achieved results and changing circumstances. Their formulation is therefore the prime responsibility of the Centers. Activities, however, require the recruitment of specific skills and facilities that commit the Centres and with this the CGIAR System as a whole for longer periods. Therefore, the spectrum of activities within the whole CGIAR System is an important concern of any priority analyses at the system level. Research projects may be based on several activities and one project may contribute to several goals. Nevertheless, there is a one to one relationship between goals and activities in the sense that a goal can not be properly served, unless the system maintains a cluster of research activities that is especially geared towards the pursuit of this goal.

Table 1 contains some examples of such goal-related research activities that are essential for serving the mission and goals of the CGIAR System. The tentative list which was initially compiled for the development of the new resource allocation process will be further elaborated. It will then be used as an analytical framework for the assessment of research priorities so as to ensure that the mission and goals of the System remain in focus during the process. The list will be based on the strategic plans and medium-term plans of the CGIAR centres, and work done by TAC in evaluating an expansion of the CGIAR. The process of priority setting would remain unnecessarily open-ended without such a list to begin with. Table 1 also presents an estimate for 1989 of the relative allocation of CGIAR resources to activities contributing to the CGIAR goals.

A main output of the analysis will be the relative importance of the nine research activity clusters by agro-ecological zone. Of course, the analysis may suggest that some activities have to be omitted and that others have to be added.

Table 1: Some Examples of Research Activities that Contribute to the CGIAR Goals and an Estimate of the Allocation of CGIAR Core Resources to Activities that Contribute to these Goals (1989, % Core Resources)

		% of 1989 budget
To goal (i)	Natural Resource Management and Conservation Ex: - Agro-ecological characterization - Soil conservation and management - Water conservation and management	10
To goal (ii)	Crop Production Ex: - Germplasm improvement and breeding - Crop systems development - Plant protection - Plant nutrition	51
To goal (iii)	Livestock production Ex: - Germplasm enhancement and breeding - Livestock systems development - Animal nutrition and feed - Animal health	16
To goal (iv)	Forest and tree production Ex: - Germplasm enhancement and breeding - Forest systems development - Tree establishment - Tree nutrition	-
To goal (v)	Fish production Ex: - Germplasm enhancement and breeding - Fish production systems development - Fish nutrition	-
To goal (vi)	Post-harvest technology Ex: - Selected areas of post-harvest technology, tree utilization and fish-processing techniques	n.a.
To goal (vii)	Human linkages Ex: - Nutrition analysis - Gender analysis - Health hazards	n.a.
To goal (viii)	Socio-economic and policy research Ex: - Micro level analysis - Market analysis - Policy analysis - Impact analysis	3
To goal (ix)	Human resources and institutions Ex: - Training - Conferences and seminars - Documentation and dissemination of information - Research on institutional systems - Strengthening of national research systems - Networks	19

Source: TAC/CGIAR. 1989. *A Possible Expansion of the CGIAR - Part I: Interim Report.* TAC Secretariat, FAO, Rome.

4. An Agro-Ecological Zone Characterization for CGIAR Priority Assessment

Ecological conditions determine to a large extent the agricultural production potential and the population supporting capacity of developing countries. Agro-ecological characterization allows for comparison of farming systems and production possibilities between regions and the assessment of research spillovers. It also allows for a quantitative understanding of the biophysical resource base upon which agriculture depends, and is essential for the improvement of resource management and for the development of sustainable farming systems that will meet future demands for food and feed. Agro-ecological characterization puts agricultural and environmental concerns in perspective.

In order to allow for a linkage between the socio-economic data base (which is organized by political units or national boundaries) and the natural resource data base (organized by agro-ecological zones) it has been necessary to reconcile agro-ecological boundaries with political boundaries. For many of the smaller countries with relatively uniform terrain, it has been possible to reconcile agro-ecological zone boundaries with national boundaries. The larger countries or countries with non-uniform terrain have mostly been assigned to more than one agro-ecological zone, and agro-ecological zone boundaries have been reconciled with province or state boundaries. Population data are available at this sub-national level and have provided the basis for the disaggregation of other socio-economic data.

An agro-ecological zone framework provides an appropriate basis for priority setting within the context of the expanding CGIAR goals. TAC has adapted the agro-ecological characterization originally developed by FAO for use in the analysis of CGIAR priorities and strategies. In this classification of FAO, a distinction is made between tropical regions, sub-tropical regions with summer rainfall and with winter rainfall, and temperate regions. These major climatic areas are further subdivided into rainfed moisture zones, using a concept of reference length of the growing period, and their associated thermal regimes.

At the highest level of aggregation, seven basic agro-ecological units can be distinguished. These are:

1. Warm, seasonally dry tropics
   - a - Warm, semi-arid tropics
   - b - Warm, subhumid tropics

2. Warm, humid tropics

3. Cool tropics

4. Warm, seasonally dry subtropics (summer rainfall)
   - a - Warm, semi-arid subtropics (summer rainfall)
   - b - Warm, subhumid subtropics (summer rainfall)

5. Warm/cool, humid subtropics (summer rainfall)

6. Cool subtropics (summer rainfall)

7. Cool subtropics (winter rainfall)

The application of this AEZ classification to the four major developing country regions has lead to the identification of a total of 18 continentally restricted agro-ecological zones (AEZ): three in sub-Saharan Africa, five in Asia, seven in Latin America and three in West Asia/North Africa.

An overview of the definitions used is provided in Annex I. The classification of countries is illustrated in Figure 2.

Although the agro-ecological zone in each continent (CAEZ's) provides the basic unit of analysis and aggregation, the results may be further aggregated on a regional basis, e.g. Sub-Saharan Africa, Asia, Latin America and West Asia/North Africa, and on an AEZ basis across continents. Also, for each of the 18 agro-ecological zones, information on land resources and land productivity potentials is processed at a more detailed level before taking into account socio-economic considerations.

5. Information Needs for Priority Setting

In order to allow for priority setting on the basis of CAEZ's, a data base is being developed in spreadsheet form, that contains primary and derived demographic, economic and agro-ecological information aggregated by CAEZ. The information available mostly originates from FAO and includes time series data on population and its growth rates, income, poverty, nutritional status, demand for major food commodities and for livestock feed, exports of industrial crops, trends in resource utilization and resource productivity (rainfed arable land, irrigated land, livestock, forests, etc), land-use patterns, soil constraints, lengths of growing periods and thermal conditions, vegetative resources and potential population supporting capacities. The CGIAR Secretariat is preparing an analysis of CGIAR resource allocation by agro-ecological zone. In addition, following inputs have been sought from other collaborators:

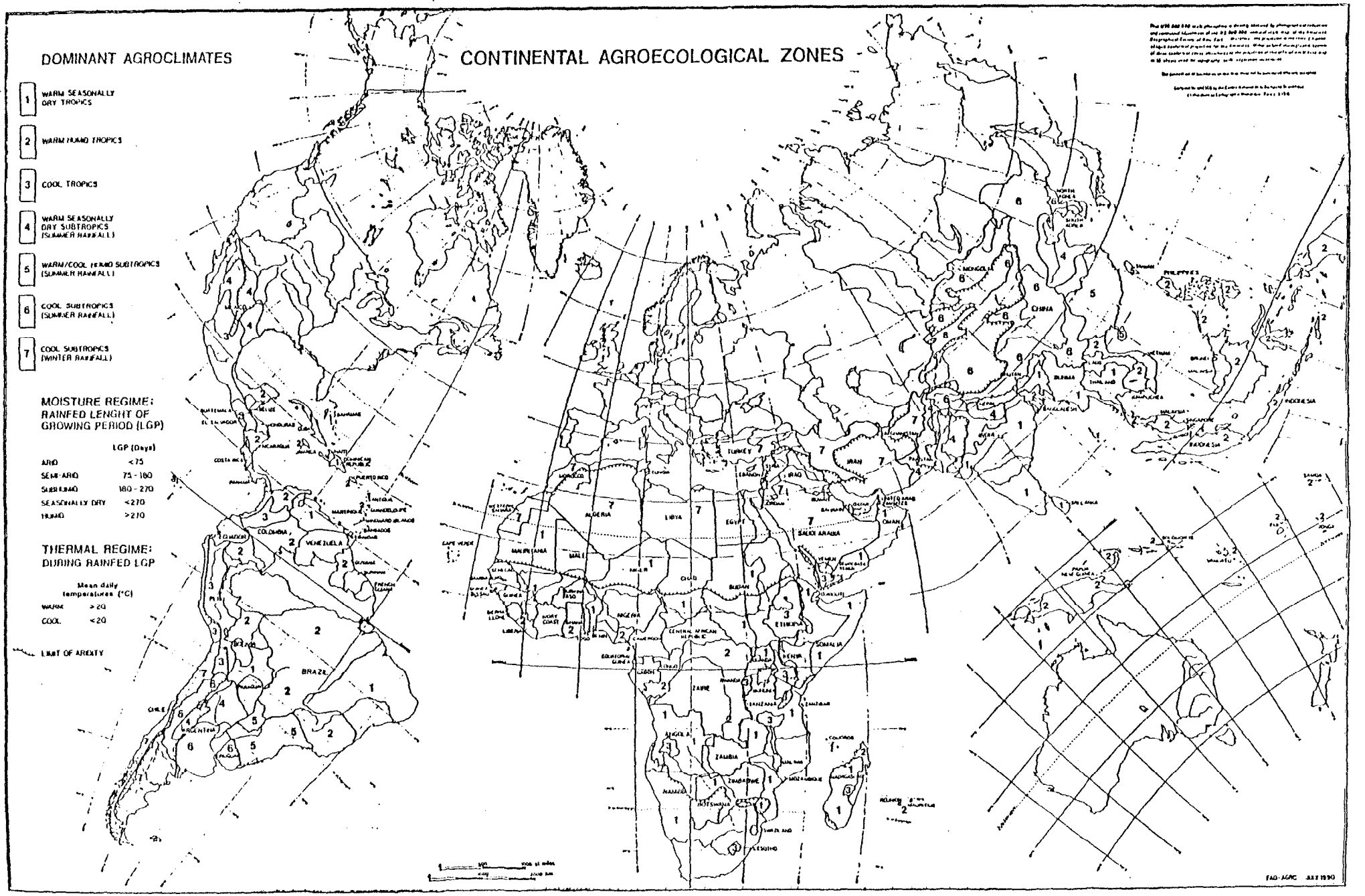
- IFPRI is preparing an analysis of the location of the poor by agro-ecological zone and the use they make of CGIAR commodities.

- ISNAR is providing information on national research expenditures by region and by agro-ecological zone.

- ACIAR has estimated values of production of major agricultural commodities by agro-ecological zone and by region.

- Centre Directors have been requested to comment on the prospects for devolution of research for their respective mandate commodities or zones.

Figure 2.


CONTINENTAL AGROECOLOGICAL ZONES
DOMINANT AGROCLIMATES
1 WARM SEASONALLY DRY TROPICS
2 WARM HUMID TROPICS
3 COOL TROPICS
4 WARM SEASONALLY DRY SUBTROPICS (SUMMER RAINFALL)
5 WARM/COOL HUMID SUBTROPICS (SUMMER RAINFALL)
6 COOL SUBTROPICS (SUMMER RAINFALL)
7 COOL SUBTROPICS (WINTER RAINFALL)
MOISTURE REGIME: RAINFED LENGHT OF GROWING PERIOD (LGP)
LGP (Days)
ARID <75
SEMI-ARID 75 - 180
SUBHUMID 180 - 270
SEASONALLY DRY <270
HUMID >270
THERMAL REGIME: DURING RAINFED LGP
Mean daily temperatures (°C)
WARM >20
COOL <20
LIMIT OF ARIDITY
BRAZIL
CHINA
INDONESIA
ALGERIA
LIBYA
EGYPT
SAUDI ARABIA
ZAIRE
ZAMBIA
ZIMBABWE
AUSTRALIA
FAO-AGRC JULY 1990

- FAO and other sources are providing data on the state of forest and soil resources, rates of deforestation, and demand for fuelwood in different agro-ecological zones.

Table 2 provides an example of a disaggregation of demographic information by CAEZ. The most populous AEZ is the warm seasonally dry tropics which accounts for 26.8% of the population in developing countries. The second most populous zone is the warm humid tropics with 17.8% of the population and the third the warm seasonally dry sub-tropics (summer rainfall) which accounts for 17.2% of the population. The cool tropics are the smallest zone and account for only 5.5% of the population of developing countries.

Table 2: Total Population of Developing Countries by Agro-Ecological Zone by Region (1990, million)

CAEZ	SS Africa	Asia	Latin America	WANA	TOTAL	Share (%)
1. Warm, seasonally dry tropics	273	700	95	6	1,074	26.8
2. Warm, humid tropics	152	469	89	-	711	17.8
3. Cool tropics	76	-	137	8	221	5.5
4. Warm, seasonally dry sub-tropics (SR)	-	670	20	-	689	17.2
5. Warm/cool, humid subtropics (SR)	-	486	62	-	548	13.7
6. Cool subtropics (SR)	-	415	28	-	443	11.1
7. Cool subtropics (WR)	-	-	15	302	316	7.9
TOTAL	501	2,739	446	315	4,002	100.0
SHARE (%)	12.5	68.4	11.2	7.9	100.0	-

SR = summer rainfall; WR = winter rainfall.

The information collected for each of the agro-ecological zones is then further aggregated into global estimates for each of the major developing regions. A brief overview of some of this information is presented in Table 3.

As can be noted from Table 3, the major share of the world's population and number of poor live in Asia. Incomes per capita are four to five times as high in Latin America and West Asia/North Africa as they are in sub-Saharan Africa and Asia. In proportion to the size of its population, Asia has a much smaller area of arable land than other regions, but it accounts for more than two-thirds of the irrigated land. Calorie intake in sub-Saharan Africa is well below that of the other regions. This continent

generates a significant amount of foreign exchange through exports of industrial crops. The rate of deforestation is a source of concern. During the last decade it has amounted to 1.7% in Sub-Saharan Africa, 1.4% in Asia and 0.9% in Latin America.

Table 3: Selected Indicators for Priority Setting by Region (1990)

Indicator	SS Africa	Asia	Latin America	WANA	Absolute Number (million)
Population (% of total)	12.5	68.4	11.2	7.9	4,002
Number of poor (% of total)	16.2	72.1	6.3	5.4	1,110
Incidence of malnutrition (% < 1.4 bmr)	35	22	14	9	n.a.
Income/cap (US$)	416	466	2,099	1,683	n.a.
Arable land (%)	18.3	50.6	20.5	10.6	720 m.ha
Irrigated land (%)	3.0	67.2	13.2	16.6	110.4 m.ha
Calorie intake/CAP	2,093	2,356	2,730	2,999	n.a.
Exports of industrial crops (million $)	928	4,585	534	904	6,951
Demand for staple food crops (million t)	145	927	165	126	1,363
Production of staple food crops (million t)	102	924	177	81	1,284
Deforestation (1981-90, % p.a.)	1,7	1,4	0.9	n.a.	16.8 m.ha
Total wooded area (1980, m.ha) (closed + open + forest fallow)	1,320	640	1,300	40	3,300

Source: FAO and World Bank data files.

Future demand for agricultural products is estimated on the basis of population numbers and demand per caput. The potential supply estimates originate from the FAO work on population supporting capacities and the FAO AT 2000 study both of which take into account possibilities for expanding land under rainfed cultivation and under irrigation. These data allow for the calculation of "production urgency and possibility indicators" for each of the agro-ecological zones. These indicators are based on the following variables:

A - Change in production per year in kg grain equivalent required to meet growth in demand over the period 1990-2010.

B - Present output of agricultural products in kg grain equivalent from rainfed and irrigated land.

C - Agronomic productivity in kg grain equivalent from presently cultivated rainfed and irrigated land under otherwise unconstrained conditions.

D - Agronomic productivity in kg grain equivalent from total cultivable rainfed land and irrigated land in 2010 under otherwise unconstrained conditions.

Immediate urgency to increase production or to meet growth demand can then be calculated as A/B (the present relative increase in demand, in 1/years or expressed as a percentage figure), while growth possibilities on presently cultivated land can be estimated as (C-B)/A (in years). Thus, when A/B is large, the demand for growth is relatively large, and when (C-B)/A is large, the possibilities for growth are relatively large. (C-B)/A quantifies the number of years it would take at the projected change in demand per year, to exhaust the unutilized agronomic potential of the presently cultivated rainfed and irrigated land under otherwise unconstrained production circumstances. Here there would be four combinations of which a large demand for growth combined with a small possibility for growth is the worst situation, and a small demand for growth combined with a large possibility for growth the best.

A third urgency indicator would incorporate the possibilities for reclaiming all potentially cultivable rainfed land and irrigated land in 2010 under otherwise unconstrained conditions, and be estimated as (D-B)/A (in years). This would quantify potential growth possibilities from both vertical as well as horizontal expansion.

Urgency and possibility indicators for fuelwood and other forest products will also be developed. These will be based on data on fuelwood demand, rates of deforestation, and the extent of forest resources. Interpretation of the forestry indicators and the agricultural urgency indicators will have to take into account the need to conserve natural forest ecosystems for the sake of biodiversity and intergenerational equity.

These urgency and possibility indicators allow for the identification of considerable differences in the extent of the nature of the agricultural production problem between different agro-ecological zones. Exports and imports of agricultural commodities do not relieve the problem of demand.

Some preliminary results of this analysis are presented in Table 4. Demand for growth in production is relatively high in sub-Saharan Africa (9.8-13.1% per year). Such high growth rates can only be achieved if a two-pronged approach is followed: increasing the yield per hectare per year and increasing the area of land under cultivation. The production possibility indicators show that there is scope for both. In WANA, there is also a considerable immediate urgency to meet increased demand, but the production possibility indicators are so low, that this demand can be only met by imports in exchange for exports out of non-agricultural sectors. In Asia, the immediate urgency is not large at present, but production possibility indicators show that for the medium-term it is necessary to increase the agronomic production possibilities under unconstrained conditions. The technical situation in Latin America is the least problematic.

Table 4: Production Urgency and Possibility Indicators by Agro-Ecological Zone (preliminary results)

Zone	A (10^6t/yr)	B (10^6 t)	C (10^6 t)	D (10^6 t)	A/B (%/yr)	(C-B)/A (years)	(D-B)/A (years)
SS Africa							
1	7.3	60.4	726	1,974	12.1	92	263
2	3.0	30.7	217	2,120	9.8	62	692
3	1.4	10.9	170	323	13.1	112	220
Asia							
1	5.3	233.9	418	545	2.2	38	65
2	5.0	155.9	282	1,079	3.2	26	189
4	6.2	219.3	335	428	2.8	19	34
5	2.5	168.6	414	999	1.5	97	328
6	2.5	146.1	n.a.	346	1.7	n.a.	80
Latin America							
1	1.0	37.0	n.a.	456	2.7	n.a.	460
2	1.0	31.2	n.a.	2,828	3.1	n.a.	2,884
3	1.9	42.7	n.a.	168	4.4	n.a.	66
4	0.2	10.3	n.a.	236	2.2	n.a.	1,609
5	0.6	24.2	n.a.	1,116	2.3	n.a.	1,984
6	0.2	26.2	n.a.	164	0.7	n.a.	726
7	0.2	5.1	n.a.	42	3.0	n.a.	247
WANA							
1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
7	5.2	81.2	117	196	6.4	18	22

n.a. = not available as yet

Where demand increases approach zero, as in Western Europe and the USA, the immediate urgency also approaches zero and the production possibility shifts to infinite. The production problem then fades away but sustainability issues linger on.

6. Quantitative Methods to Assist in Priority Setting

6.1. Congruence Approach

The general principle of a congruence approach is to allocate resources across research areas in proportion to the commodity's contribution to certain criteria such as value of production, contribution to nutrition or share of physical output. Scoring methods can then be used to specify a set of weights to aggregate across criteria and obtain a final ranking of priorities for resource allocation.

Congruence models are based on the assumption that research budgets are optimally allocated among commodities by making marginal returns the same, that is by ensuring that the increase in production that can be achieved with the last research dollar is the same for each commodity. If it is assumed that the elasticity coefficient of response to research for the commodities concerned is the same, it can be shown that this is achieved when the research budget is divided among commodities in proportion with their production values.

TAC is preparing an initial congruence analysis on the basis of the value of production of commodities under consideration. In general, the economic rewards from research are considered to be proportional to this value of production of the agricultural commodities which are the ultimate target of the research. This provides a rationale for the use of this criteria as a major determinant of priority setting assuming that economic efficiency is the primary consideration.

A comparison is made between the relative importance of a commodity in a particular region and the allocation of CGIAR resources to that commodity in that region.

A congruence analysis would need to be complemented by a study of investments by national programmes and other research institutions. Non-CGIAR commodities will also be included in the analysis. It should be noted that a congruence model which is based on value of production criterion emphasizes economic efficiency as the factor to be maximized. It also assumes that the opportunity for research to generate new knowledge to increase productivity is equal across commodities and regions or agro-ecological zones, and that the value of new knowledge produced by research is proportional to the value of output thereby ignoring the cost of inputs or value added by processing. A congruence analysis will, therefore, have to be complemented by other approaches.

6.2. The ACIAR Framework

The Australian Centre for International Agricultural Research (ACIAR) has developed a decision support system to assist with its research resource allocation decisions. The basic framework consists of a multi-regional international trade model using concepts of economic surplus to derive ex ante measures of the relative economic benefits of alternative commodity and regional research portfolios. The distribution of these benefits among consumers, producers, importers and exporters is also estimated. The model allows for an assessment of the likely extent of spillover effects of research on particular commodities to other environments. It further enables judgments about the relative strength of research and extension systems and rural infrastructures to be factored in the analysis. The ACIAR framework allows for empirical analysis to be conducted at the international level, includes all major production and consumption regions of the world and is based on FAO's agro-ecological zone concepts.

Recently, further work has been undertaken to adapt the basic model and framework for possible application by TAC to assist in priority setting for the CGIAR. The approach has conceptual appeal and could assist TAC in its considerations. Nevertheless, the model is commodity oriented and because of data limitations does not allow for differentiation among research activity clusters associated with the nine CGIAR goals. Additional assumptions would be necessary to enable research allocation estimates to be derived. Furthermore, the approach draws for a considerable part on subjective judgments, particularly with respect to estimates of spillover effects, ceiling levels of adoption, relative strengths of national research systems, or pay-off from research. The results obtained, therefore, would have to be treated with considerable caution and care.

However, this ACIAR model is the only operational approach to research decision support that operates on a global scale. It also provides a transparent assessment of returns to cost-reducing research for commodities (including fuelwood and other forest-based commodities) in the various CAEZ in relation to quantifiable objectives such as total international benefits, benefits to all developing countries, to particular regions or agro-ecological zones, and to producers or consumers. TAC intends therefore to use the ACIAR framework as an additional tool to assist in the process of priority setting among commodities and regions.

7. An Interactive Spreadsheet Approach for Allocating Research Resources

7.1. Background

Both the congruence and the ACIAR framework, as discussed in Section 6, emphasize economic efficiency as the primary basis for allocative decisions on the distribution of research resources. Explicit weight should also be given to equity considerations. A distinction can be made between equity of input and equity of output. Equity of input is frequently accepted as a guiding distributive principle among population groups. Equity of output is a concept that ensures that each individual would derive the same benefit from an allocative investment decision. Both concepts can be illustrated through the example of education. Equity of input would mean that the same amount of money is spent to every pupil irrespective of his/her IQ or social background, but equity of output would mean that more money would be spent, the lower the IQ and the less privileged the socio-economic environment of the student. In the case of research equity of output may be achieved if relatively more resources are allocated to research that benefits AEZs or crops that are only important for a small number of people. Equity of input and of output will only be achieved simultaneously if there are no economies of scale.

The choice between economic efficiency, equity of input and equity of output cannot be optimized because it is to a large extent politically based. TAC will have to formulate the problem of priority choice in such a way that the consequences of political considerations can be made explicit.

Furthermore, both models assume that the opportunities for research to generate knowledge to increase production is equal across commodities, and

also across CAEZ's. The problem faced here is more than that of a simplifying assumption. Past experience of the green revolution has shown that the opportunities for commodity-oriented research are much smaller in less endowed areas than they are in irrigated or other more favourable zones.

7.2. Problems of Research Resource Allocation

Research resource allocation is a typical "black box problem". By financing research activities, people put money into the box to have goals pursued, but a clear idea of the elements and the structure within the box remains missing. In the CGIAR System the goals are ambitious and the box is particularly dark, because so many research activities are involved and the CGIAR is only one of many actors in development-oriented research. However, to proceed, it is not sufficient to formulate goals and to identify problems, but it is also necessary to clarify at least some of their links within the black box. Quantitative models can be helpful in this. Such models analyze and point to specific impacts in the research effort. A good example is the ACIAR model discussed in Section 6.2. which reveals spillover effects of international commodity research which are due to decreases in costs of production and to spread of knowledge by calculating welfare effects for different regions, producers and consumers. Such quantitative models are partial and they suffer from the "what if" problem. They typically analyze what would happen if technological changes would result in a shift of supply curves. Such models could overcome the "what if" restrictions if information would be available on the relationship between alternate research investment and the likely shift in supply curves.

Efforts of regional agro-ecological and socio-economic characterization form a basis to assess the relative importance of the goals for serving the mission of the CGIAR. They also clarify the importance of the related research activities for sustainable cost reducing and production increasing technological developments that meet specified economic and environmental demands. Still, many dark corners remain in the black box as for instance, the outcome of research and the risks involved, the links with NARS, the adaptation of research results and their socio-economic impact, and especially the appreciation of the often conflicting development goals by different stake holders within and without the CGIAR System. This implies that any attempt to come to a comprehensive model to optimize priority setting is bound to fail.

Instead, the development of mechanisms for priority setting requires the development of an interactive approach with the main purpose to enable good use of existing partial models, quantitative data bases and problem descriptions and to clarify and strengthen the collective judgement of the CGIAR System in general and TAC in particular.

7.3. The Framework

If so little is known about means and end of research there is a good reason to start priority setting by the use of a simple and transparent

model for allocating research expenditures to each continental agro-ecological zone (CAEZ), and to the nine goal-related cluster of research activities and commodities. This marks then the starting point for a systematic search process for priorities in which the initial allocation will be modified step by step and in a structured way to integrate relevant information, while reflecting the collective judgement of TAC and of stakeholders on the process. The main advantages of this procedure are that it structures the discussion in such a way that arguments are not confounded, that the contribution of each modifying step to the final outcome is made explicit and that the analysis of the problems is completely separated from the allotment decisions. For this purpose the spreadsheet approach of data handling in Section 5 has been complemented with a spreadsheet in which the 18 CAEZ, the nine research activity clusters and the main commodities within the plant and animal production activities are distinguished. The interactive updating of the spreadsheet is guided in a hierarchical fashion in which first the distribution of the research resources over the 18 CAEZ is considered, keeping the grand total the same, then over the nine clusters of research activities within each CAEZ keeping the sub-total per CAEZ the same and then over commodities keeping the sub-total for the production research activities per CAEZ the same. While changing research allocations, totals and sub-totals are kept the same, by a proportional increase or decrease of all elements of the hierarchical category which is under consideration.

The distribution is done with a grand total of 1,000 units, so that a resource allocation of one indicates one pro mille of the total research resource. Sub-totals are the distribution of research over the AEZ across continents, over continents across AEZ, over goals and over commodities across CAEZ. All modifying steps in the procedure are explicitly related to research priority determinants that are distinguished in previous sections of this paper.

7.3.1. Distribution over CAEZ

A rational initial distribution of research resources over the 18 CAEZ is in congruence with the size of the population. This distribution, based on input equity, could be amended by considering for instance the following modifiers:

- More emphasis on economic efficiency by a distribution that reflects more ACIAR efficiency indicators per CAEZ;
- More emphasis on output equity by a more equal distribution of research resources per CAEZ;
- More emphasis on the poor by taking into account the fraction of poor per CAEZ;
- More emphasis on the urgency of the agricultural production problem by considering the rate of growth in demand relative to present production;

- More emphasis on production possibilities by taking into account the scope for production increase relative to the increase in demand.

The spreadsheet allows for transparency of the rationale for particular recommendations on resource allocations and allows the user to quickly access the implications of a change in emphasis on certain modifiers, to arrive at a distribution which is a satisfactory compromise between different interests. Forms of presentation that allow group interactions are being prepared.

7.3.2. Distribution across research activity clusters within CAEZ

Congruence considerations form a simple rationale for an initial distribution of research resources within each CAEZ over the four research activity clusters: crops, livestock, forest/tree and fish production research. Such initial distribution over these clusters may be modified again by economic efficiency and output equity considerations. Within the activity clusters of crop production and livestock, a further allocation may be made according to commodity, taking again congruence and importance of the commodity for the poor into account. The strength of the NARS may be also considered here although the position may be taken that such strength reflects more in the type of international research that is done than in the amount of research.

The distribution of resources between on the one hand resource management research and policy research and on the other hand commodity research per CAEZ, depends among others on past experience with the so-called "green revolution".

Agricultural development with variety improvement as prime mover has been mainly restricted to irrigated areas or regions with favourable rainfall patterns, because the other main problems to be solved required only improved crop management, like increased use of some main fertilizers and pest control. Furthermore, the infrastructure to enable agricultural development was in place in the favoured areas. This green revolution could not be exported to regions with less favourable rainfall patterns (too much, too little, too irregular) and less favourable soil types. In these areas, there are severe resource management problems to solve before it is possible to profit in a sufficient degree from simple agronomic measures like variety improvement, fertilizer use and pest control. These concern water management, control of soil erosion, cropping systems and soil amelioration (acidity, alkalinity, toxicities, minor elements, etc.). Calculations of FAO and others have shown that once these resource management problems are solved, the potential for production of many of these so called less-endowed regions is considerable. Needed investments are often also considerable, although in many cases far less than in irrigation systems. The task of resource management research is to show the potential of these regions for sustainable agriculture and to develop pathways for incremental improvements that meet increasing demands and are affordable for farmer and country. The latter requires support by policy research. There is as well a green revolution needed in such regions, but now with improved resource management as the prime mover. Consideration could

then be given that in CAEZ where agriculture is dependent on erratic rainfall patterns, more resources should be allotted to water management and conservation research. If soil constraints and soil erosion hazards are relatively severe, more of the research resource could be allotted to plant nutrition and conservation research activities. Also, where socio-economic and policy constraints are relatively severe more of the research resource could be allotted to socio-economic and policy research activities. In CAEZ where forestry problems are more severe more of the production research activities could be allotted to the forests/tree production research activities.

Since the total resources per CAEZ would note be affected, such reallocations would be at the expense of commodity-oriented research activities. The extent to which resources are allocated to post-harvest technology and human linkages activities would depend on whether specific problems are identified within the CAEZ.

7.3.3. Problems of scale

The research is allocated in terms relative to a grand total of 1000 units, so that a resource allotment of one indicates one pro mille of the total research resource. Since the total number of senior person years within the system is at present also approximately 1000, the numbers can also be interpreted in terms of senior person years. The subdivision in 18 CAEZ, nine goal oriented clusters of research activities and about 10 commodities per CAEZ, leads to hundreds of cells in the spreadsheet. This makes the average number of senior person years per cell so small, that there are bound to be a considerable number of cells with less than one person year. If research on an activity within an agro-ecological zone was done in isolation, the demand for critical mass could not be met. However, there may be so much spillover and synergism of research results in different agro-ecological zones that considerable economies of scale may be obtained by joining efforts.

The ACIAR model accounts explicitly for the spillover of research results for commodities between agro-ecological zones. For zones between which there is considerable spillover, the research allocations for the commodity could be aggregated to estimate the research allocation for a global effort in the commodity. At the same time research allocations to the commodity within the CAEZ's that appear outside the main stream could be neglected because of lack of sufficient scale. Even then, it could very well appear that the total research resource allotted to some of the more minor crops does not meet demands of critical mass, whereas compared with the research agenda more than sufficient resources are allotted to some of the major crops. This would justify a redistribution of resources over the commodities within the CAEZ in such a way that the distribution of efforts on the global level is more balanced.

The same approach could be developed for the non-commodity oriented clusters of research activities. In that case it should be recognized that resource management and conservation research especially spillover to the same AEZ in other continents and socio-economic and policy research much more to

other CAEZ's on the same continent. Since it seems the most effective to locate any effort within or close to the CAEZ's where it is relatively the most important, such an analysis could also contribute to discussions on the geographical distribution of research entities.

8. Resource Allocation and Priority Setting

An important output of the proposed approach is a "clean slate" distribution of research priorities, expressed in resource allocation fractions. It is then considered to what extent and at what rate the present distribution should be adapted to this clean slate distribution, and what are the institutional consequences. Target percentages of CGIAR essential core resources would be set for each element of the framework for the period 1992-1997. This would allow for the distribution of shortfalls in the case of funding shortages, and of surplus funds in the case of buoyant financial situation.

9. Participatory Process and Time Schedule

The proposed review of CGIAR priorities and strategies will be a participatory process between TAC, members of the CGIAR, national programme partners, Centre Directors and Centre Board Chairs. Regular consultations on progress made will be held during every TAC and CGIAR meeting between October 1990 and September 1991. TAC recognizes that Centres have unique expertise to contribute in this important exercise, and intends to draw on this large pool of knowledge.

ANNEX I

DEFINITIONS

TROPICS: All months with monthly mean temperature, corrected to sea level, above 18°C.

SUBTROPICS: One or more months with monthly mean temperature, corrected to sea level, below 18°C.

TEMPERATE: One or more months with monthly mean temperature, corrected to sea level, below 5°C.

LENGTH OF GROWING PERIOD (LGP): Period (in days) during the year when rainfed available soil moisture supply is greater than half potential evapotranspiration (PET). It includes the period required to evapotranspire up to 100 mm of available soil moisture stored in the soil profile. It excludes any time interval when daily mean temperature is less than 5°C.

WARM: Daily mean temperature during the growing period greater than 20°C.

COOL: Daily mean temperature during the growing period in the range 5-20°C (includes the moderately cool range 15-20°C).

COLD: Daily mean temperature less than 5°C.

WARM/COOL: Daily mean temperature during part of the growing period greater than 20°C, and during another part less than 20°C.

ARID: LGP less than 75 days.

SEMI-ARID: LGP in the range 75-180 days.

SUBHUMID: LGP in the range 180-270 days.

HUMID: LGP greater than 270 days.

SEASONALLY DRY: LGP in the range 75-270 days.

WARM SEASONALLY DRY TROPICS: Comprises of semi-arid (LGP = 75-180 days) and subhumid (LGP = 180-270 days) moisture zones in the tropics. Arid (LGP = 0-75 days) moisture zone taken into account for the purposes of irrigation and rangeland assessments, and for reconciliation with political boundaries. Daily mean temperature during the growing period greater than 20°C.

WARM HUMID TROPICS: Comprises of humid (LGP = 275-365 days) moisture zone in the tropics. Daily mean temperature during the growing period greater than 20°C.

COOL TROPICS: Comprises of semi-arid (LGP = 75-180 days), subhumid (LGP = 180-270 days) and humid (LGP = 270-365 days) moisture zones in the tropics. Arid (LGP = 0-75 days) moisture zone taken into account for the purposes of irrigation and rangeland assessments, and for reconciliation with political boundaries. Daily mean temperature during the growing period in the range 5-20°C. Includes the moderately cool tropics major climate with daily mean temperature during the growing period in the range 15-20°C. Areas of cold tropics taken into account for reconciliation with political boundaries.

WARM SEASONALLY DRY SUBTROPICS (SUMMER RAINFALL): Comprises of semi-arid (LGP = 75-180 days) and subhumid (LGP = 180-270 days) moisture zones in the subtropics. Arid (LGP = 0-75 days) moisture zone taken into account for the purposes of irrigation and rangeland assessments, and for reconciliation with political boundaries. Daily mean temperature during the growing period greater than 20°C. Includes warm temperate (summer rainfall) major climate in China and Korea.

WARM/COOL HUMID SUBTROPICS (SUMMER RAINFALL): Comprises of humid (LGP = 270-365 days) moisture zone in the subtropics. Daily mean temperature greater than 20°C during one part (warm) of the growing period, and less than 20° during another part (cool) of the growing period. The cool part is moderately cool with daily mean temperature in the range 15-20°C. Includes the warm/moderately cool subtropics major climate.

COOL SUBTROPICS (SUMMER RAINFALL): Comprises of semi-arid (LGP = 75-180 days), subhumid (LGP = 180-270 days) and humid (LGP = 270-365 days) moisture zones in the subtropics. Arid (LGP = 0-75 days) moisture zone taken into account for the purposes of irrigation and rangeland assessments, and for reconciliation with political boundaries. Daily mean temperature during the growing period in the range 5-20°C. Includes the moderately cool subtropics (summer rainfall) and transitional moderately cool subtropics (summer rainfall) major climates with daily mean temperature in the range 15-20°C. Areas of cold subtropics (summer rainfall) taken into account for reconciliation with political boundaries. Includes cool and cold temperate (summer rainfall) major climates in China, Mongolia and Korea.

COOL SUBTROPICS (WINTER RAINFALL): Comprises of semi-arid (LGP = 75-180 days), subhumid (LGP = 180-270 days) and humid (LGP = 270-365 days) moisture zones in the subtropics. Arid (LGP = 0-75 days) moisture zone taken into account for the purposes of irrigation and rangeland assessments, and for reconciliation with political boundaries. Daily mean temperature during the growing period in the range 5-20°C. Areas of cold subtropics (winter rainfall) taken into account for reconsideration with political boundaries. Includes cool and cold temperate (winter rainfall) major climates in Turkey, Argentina and Chile.