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Expert Group Planning Meeting for the project
"Implications of Biotechnology on Asian Agriculture"

27-28 June 1988
APDC, Kuala Lumpur

Organized by
Asian and Pacific Development Centre
Kuala Lumpur, Malaysia

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Provisional Programme of Expert Group Planning Meeting
for the project
"Implications of Biotechnology on Asian Agriculture"

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and Workshop Structuring
by Prof V L Chopra
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Public
Policy

Expert Group Planning Meeting for the project
"Implications of Biotechnology on Asian Agriculture"
27-28 June 1988
APDC, Kuala Lumpur

A. Provisional Programme

Sunday, 26 June

Arrival of participants

Monday, 27 June

0900-0930 hrs

Session I

- o Welcoming remarks by the APDC Director
- o Introductory remarks by Project Co-ordinator
 - Project Background
 - Terms of reference of Planning Meeting
 - Confirmation/adjustment of Agenda
- o Administrative matters

0930-1000 hrs

Coffee break

1000-1230 hrs

Session II

Discussion of critical biotechnology issues for developing countries in Asia

1230-1400 hrs

Lunch break

1400-1500 hrs

Discussion of critical biotechnology issues for developing countries in Asia (con't)

1500-1700 hrs

Session III

Themes/topics on which to focus for Policy Makers' Conference/Workshop

- topics for Conference/Workshop papers that will be invited
- scholars to invite to write on topics selected

Tuesday, 28 June

0900-1230 hrs
(with 30 minutes
coffee break.)

Session IV

Organization of Policy
Makers' Conference/Workshop

o Co-sponsorship with other
regional organizations (FAO,
UNESCO, IRRI, etc.)

o date and venue

o Participation (who should be
invited?)

- Policy makers

- Scholars and Representatives
of regional organizations

- Representatives of regional
development and donor
organizations

o Format and modality

o Role of participants

o Co-ordination, administrative
arrangements, logistics

o Formation of organizing
committee

o Follow up

1230-1400 hrs

Lunch break

1400-1630 hrs

Finalization of plans and
wrap-up

Wednesday, 29 June

Departure

B. Provisional List of Participants

Research Collaborators

1. ✓ Prof V L Chopra
Head, Biotechnology Centre
Indian Agricultural Research Institute
India
2. ✓ Dr M S Swaminathan
B-4/142 Safnarjang Enclave
New Delhi 110029, India
3. ✓ Dr William Padolina
National Institute of Biotechnology
and Applied Microbiology (BIOTECH)
University of the Philippines at Los Banos
Philippines
4. ✓ Prof Zakri A Hamid
Department of Genetics
Universiti Kebangsaan Malaysia
Malaysia
5. ✓ Prof Dr Omar b Abdul Rahman
Science Adviser
Prime Minister's Department, Malaysia
6. ✓ Dr R B Singh
Food and Agricultural Organization
of the United Nations
Regional Plant Production and Protection Officer
FAO Regional Office for Asia and the Pacific
(RAPA)
Thailand
7. ✗ Dr A I M Mohamad
Chairman
Pakistan Council of Agricultural Research
Islamabad
Pakistan

APDC Staff

1. ✓ Dr M A J Shahari
Director
2. ✓ Dr I P Getubig, Jr
Co-ordinator
Agricultural and Rural Development Programme
3. ✓ Ms Helen Ponniah
Programme Assistant

C-1. Agenda for the Planning Meeting for the Project
"Implications of Biotechnology for Asian Agriculture"

1. Fixing dates for the Workshops: The dates fixed should provide a lead time of 8-10 months. This is necessary to confirm availability of the speakers identified for making presentations, preparation and mailing of announcements and circulars, giving time to the speakers to prepare their papers, etc.
2. Deciding the Venue and Duration.
3. Identification of Co-Sponsors: Both for ensuring involvement of relevant agencies and exploring possibility of sharing expenses, if necessary, it may be advisable to identify co-sponsors.
4. Registration Fee: Is this to be levied?
5. Technical Programme: For meeting the Development and Immediate objectives, the technical programme will revolve round four kinds of issues:
 - a) Research Issues: Current development and trends and what should be the determining factors for arriving at research priorities - Immediate gains or capability development for long term advantages or both? In what mix? How is the integration of biotechnology to be achieved with conventional methods of agricultural research.
 - b) Policy Issues: Political will and administrative commitment; Expectations; Funding; Patenting and Intellectual Property Rights.
 - c) Issues of Social and Economic Implications: Ecology, environment and biosafety; Monopolistic control of seed trade; Economic and social disparities etc.
 - d) Issues relating to Technical Co-operation: Identifying areas of regional/sub-regional co-operation in biotechnology R & D; application and technology transfer in Asian Agriculture.

5.1 Workshop Structuring:
Model for discussion to arrive at a decision

Day 1

9.00 - 10.30	Inaugural Ceremonies
10.30 - 11.00	Tea
	<u>Theme I - Research Issues</u>
11.00 - 11.35	Speaker I
11.35 - 11.45	Discussion
11.45 - 12.20	Speaker II
12.20 - 12.30	Discussion
12.30 - 2.00	Lunch
2.00 - 2.35	Speaker III
2.35 - 2.45	Discussion
2.45 - 3.20	Speaker IV
3.20 - 3.30	Discussion
3.30 - 3.45	Tea
3.45 - 5.00	Panel Discussion and Drafting recommendations by Group I

Day 2

Theme II - Policy Issues

9.00 - 9.35	Speaker I
9.35 - 9.45	Discussion
9.45 - 10.20	Speaker II
10.20 - 10.30	Discussion
10.30 - 11.05	Speaker III
11.05 - 11.15	Discussion
11.15 - 11.30	Tea
11.30 - 12.05	Speaker IV
12.05 - 12.15	Discussion
12.15 - 1.00	Panel Discussion
1.00 - 2.00	Lunch

Theme III - Issues of Social and
Economic Implications

2.00 - 2.35	Speaker I
2.35 - 2.45	Discussion
2.45 - 3.20	Speaker II
3.20 - 3.40	Tea
3.40 - 4.15	Speaker III
4.15 - 4.25	Discussion
4.25 - 5.00	Speaker IV
5.00 - 5.10	Discussion

Day 3

9.00 - 10.00	Panel Discussion on Theme III
	<u>Theme IV - Technical Co-operation</u>
10.00 - 10.35	Speaker I
10.35 - 10.45	Discussion
10.45 - 11.20	Speaker II
11.20 - 11.30	Discussion
11.30 - 11.45	Tea
11.45 - 12.45	Panel Discussion
12.45 - 1.00	Lunch
2.00 - 3.15	Drafting of recommendations by Groups II, III & IV
3.15 - 3.30	Tea
3.30 - 5.00	Plenary Session

5.2 Deciding the presentation topics and Identification of speakers

This will be done on the basis of discussion in the Planning Meeting. Members to kindly to prepare outlines based on their own perceptions. It will be very helpful if they could transmit it to Dr Getubig in advance.

C-2 Draft (22 June, 1987)
Project No. A-5

UNITED NATIONS DEVELOPMENT PROGRAMME
(UNDP)

PHASE IV

PROGRAMME SUPPORT TO THE
ASIAN AND PACIFIC DEVELOPMENT CENTRE
(APDC)

1987-1989
(RAS/86/151)

Project Title: Implications of Biotechnology
for Asian Agriculture

UNDP Contribution: US\$93,689

Estimated Starting Date: January 1988

A. Development Objectives

The development objectives to which this project relate are:

1. To strengthen policy-making capacity of national institutions in Asia in charge of Research and Development in biotechnology in agriculture by providing them with research-based policy alternatives and implications, and through a programme of dialogue and exchange of experiences among policy-makers;
2. To promote regional co-operation in R&D in biotechnology in agriculture among countries in the region.

B. Immediate Objective

1. to review current developments and trends in the application of biotechnology in Asian agriculture;
2. to assess their short- and long-term prospects and implications on agriculture (technological and economic), trade in agricultural products, and technological self-reliance/dependency on technologically advanced countries;
3. to identify areas of regional/sub-regional co-operation in biotechnology R&D, application and technology transfer in Asian agriculture; and
4. to bring to the attention of agricultural policy-makers in Asia the need to address the issues of rapid technological developments in biotechnology and their likely impact on Asian agriculture and related areas.

C. Special Considerations

Promotion of technical co-operation among developing countries in Asia in the area of biotechnology R&D and technical exchange in the field of agriculture.

D. Background and Justification

One of the most significant technological developments in recent years has occurred in the field of biotechnology - the application of scientific and engineering principles to the processing of materials by biological agents such as micro-organisms and enzymes. Although a relatively new field (as it is presently known), a number of technological breakthroughs have already taken place with far-reaching implications in the field of agriculture, medicine and industry. These developments are bound to influence in a

major way man's technological and economic environment and, more significantly for LDC countries, his capacity to tackle problems of development.

Biotechnology is now increasingly being viewed to usher in a new era of industrial revolution based on micro-organisms which are, unlike the energy base of the old industrial revolution, renewable, cheaper and less polluting.

In agriculture, "biorevolution" is rapidly gaining momentum in the form of increasing productivity of crops and livestock, increasing land resource base by making marginal lands productive and by developing plants resistant to salinity, water-logging and drought, decreasing dependence on some types of non-renewable commercial fertilizers through nitrogen-fixing microbes, increasing food supply by converting inedible biomass into foodstuff, and other unconventional developments. Biotechnology products like bacterial pesticides, pest-resistant crops, increased plant responsiveness to low levels of fertilizer and growth regulators may be more suited to Third World countries than the Green Revolution packages. Indeed, biorevolution is widely believed to have the potential of making a far greater impact than the Green Revolution technologies in the near future, partly because it will apply to all living organisms, both plants and animals, whereas the latter is restricted to only a few crops.

The growth of biotechnology-related industries has been phenomenal. One reliable source estimates a market of US\$50-100 billion per annum for biotechnology-based agricultural inputs in the next two decades.

While biotechnology is potentially very valuable to the developing countries, there is increasing concern that the process of commercialization of biotechnology currently occurring may lead to serious negative impacts. The development of more efficient varieties of plants/animals which are reproductively unstable or require imported inputs may lead to increased technological dependency. The domination of TNCs in the R&D and the scaling-up stages of biotechnological application, the patenting and privatization of techniques and even genes, and access to biotechnology, are some of the issues. Developing countries, especially those with a major agricultural component in their economies, would find it in their interest to respond quickly to the rapid developments in biotechnology. What are the possible points of intervention (if intervention is desirable) available to developing countries in Asia and the Pacific given their limited resources? What kind of policies toward biotechnology R&D, application, and transfer should LDCs in Asia adopt to reap much of the benefits of biotechnology while avoiding their potentially harmful effects?

The recent setting up of the two components of the International Centre for Genetic Engineering and Biotechnology (ICGEB) of UNIDO in New Delhi and Trieste (Italy) is an important step in enhancing biotechnology awareness and capacity, especially among developing countries. While this is a major step in the right direction, much still needs to be done, especially to bring accurate and policy-relevant information on biotechnology to the attention of policy-makers in developing countries. This project will provide a forum for dialogue between experts on the implications of biotechnology on agriculture and policy-makers from developing countries with a major agricultural component in their economies. In this endeavour, APDC will liaise closely with ICGEB - New Delhi whose focus is more on the agricultural, animal health and human health aspects of biotechnology.

E. Outputs

1. Proceedings of the conference.
2. Summaries of conference papers.
3. Areas of possible regional co-operation in biotechnology will be identified.
4. Policy-makers in participating countries who are aware of the implications of biotechnology on agriculture and some policy options available.
5. The APDC Project Co-ordinator's final report on the project.
6. An evaluation report on the project by an independent consultant.

F. Success Criteria

1. Participation of high-level representatives from agricultural policy-making bodies of governments in the region.
2. Clarification of issues relating to the potential impact of biotechnology in Asian agriculture and identification of areas of co-operation and policy options.
3. Increased collaboration between national research institutions in Asia and the Pacific engaged in biotechnology work in agriculture.

4. Increased awareness of policy-makers on the potential implications of biotechnological development on agriculture and policy options available to exploit their positive contributions.

G. Activities

	<u>Tentative Dates</u>
1. Preparatory project planning with the Lead Scholar	Jan. 1988
2. Preparatory consultative visits of Lead Scholar to biotechnology-related organizations in South-east Asia, South Asia and Europe	Jan. 1988
3. Project planning meeting to plan conference and select paper writers and participants. Also to set terms of reference for an external evaluation of the project's performance by an independent consultant	Mar. 1988 <i>June, 1988</i>
4. Invitation to paper writers and conference participants	April <i>July</i> 1988
5. Preparation of papers for the conference (thematic papers addressing issues that transcend national boundaries, and country papers detailing the situation and issues relevant to each particular country)	May-Sept. 1988 <i>July-December 1988</i>
6. Conference	October 1988 <i>March 89</i>
7. Writing up, editing, publication and dissemination of conference proceedings, conference papers and summary papers, especially to policy-makers	<i>April</i> Oct. 1988 <i>May</i> -Feb. 1989
8. Submission of the APDC Project Co-ordinator's final report on the project to the Director of APDC and to UNDP	Feb. 1989
9. Submission of the external evaluator's report on the project to APDC	April 1989

H. Inputs

H.1 APDC Inputs

The Centre will provide the following inputs for this project:

- a. One professional staff to assist in project formulation and assume primary responsibility for planning, organizing and co-ordinating the project
- b. Administrative and support staff
- c. Office space and facilities for (a) and (b) above.

I. Preparation of Workplan

A detailed Workplan for the implementation of the project will be prepared by the project co-ordinator assigned to the project in consultation with project network participants. This will be done at the start of the project and brought forward periodically.

The tentative schedule of the main activities of this project is given in Section G (Activities).

J. Institutional Framework

The Centre would look for a suitable international organization (e.g., the ICGEB of UNIDO at New Delhi, FAO, the International Rice Research Institute (IRRI), the International Centre for Co-operative Research and Training in Microbial Engineering in Osaka, or the Regional Microbial Network for South-East Asia) to co-sponsor the conference. While initial enquiries indicate that the ICGEB at New Delhi may be the most active agency in this field (and with which the Centre will be liaising closely on this project), additional discussions will be conducted with other international agencies, particularly the FAO.

Participants of the conference will comprise directors of research centres engaged in biotechnology work in Asia, policy-makers representing government bodies that determine biotechnology-related policies, scholars and representatives from the business community. Tentatively, representatives from the following countries will be invited: Bangladesh, Pakistan, Sri Lanka, Nepal, India, Japan, Korea, Malaysia, Indonesia, Philippines, Singapore, Thailand, Fiji, Australia, the United Kingdom and U.S.A. In addition, representatives from the Technical Advisory Division of the UNDP Bureau of Policy, Planning and Evaluation will be invited to the conference.

3

OUR COMMON FUTURE
FIRST NGO CONFERENCE ON SUSTAINABLE AGRICULTURE
23 JULY 1989

GANDHIGRAM RURAL INSTITUTE, GANDHIGRAM

SUSTAINABLE FOOD & NUTRITION SECURITY:
CHALLENGES AHEAD

by

M.S. SWAMINATHAN

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL
DEVELOPMENT, MADRAS

It is easy to use the prefix ~~the term~~ "sustainable" before the terms "growth" and "development" but it is difficult to make the prefix really meaningful by getting its implications institutionalised in the development protocol, whether in agriculture or industry. We observe three major positions among those concerned with growth and development. At one extreme is the eco-preservationist position of a zero growth ethic. At the other extreme is the market and technology driven view point of growth at any cost, without consideration of the long term implications of such exploitative growth processes. In between these two extremes, we find a growing school of thought which is convinced that natural and renewable resources can be managed in a sustainable manner for improving the economic well being of the people. For adopting this middle path way, we need tools for measuring sustainability and for integrating the concept of sustainability in ~~the design of~~ research and developmental strategies.

Sustainable agricultural development implies that the environmental capital stocks should be held constant over time. Maintaining the natural capital stocks leads to the protection of both environmental functions useful to humans and the habitats and ecosystems essential for biological diversity. What we now need urgently are simple and reliable tools of measuring sustainability. For example, an appropriate form of measuring agricultural productivity will be :

$$\text{Productivity : } \frac{\text{Output value}}{\text{Input value}} + \text{changes in environmental capital stocks (i.e., soil, water etc.)}$$

SUSTAINABLE FOOD & NUTRITION SECURITY

Food Security implies physical and economic access to food to all people at all times. Modern technology has made physical access to food possible but for achieving economic access we will need a re-orientation of research and developmental priorities and strategies towards the generation of diversified opportunities for skilled employment in rural areas. Nutrition security which implies physical and economic access to balanced diet and safe drinking water to all people at all times is still a far cry in most parts of our country. Nutrition security particularly at the pre-school age is vital for providing children with opportunities for the full expression of their innate genetic potential for physical and mental development.

Sustainable food and nutrition security involves meeting current needs in agricultural production without sacrificing the prospects for meeting the needs of future generations. Sustainability has to be a dynamic concept, since human needs will change continuously both in quantitative and qualitative terms. For promoting sustainable food security concurrent attention to ecological, equity and economic factors is essential.

We face many challenges in our quest to achieve sustainable food security. First, land is a shrinking resource for agriculture and we have to produce more and more from less and less land. Secondly, as agriculture becomes intensive, soil toxicities and deficiencies of various kinds threaten sustainable production. Third, pest and post-harvest problems as well as energy requirements multiply when cropping intensity increases. Maximum yields start declining in high production areas and the cost of production goes up, if sustainability concepts are not integrated in both technology development and transfer.

The average size of a farm has been declining and over 80 million out of 90 million operational holdings in India in 1980-81 were below the size of 2 hectares. Compounding the problems arising from the growing pressure of human and animal population on the sustainable carrying capacity of land, are ecological problems of various kinds such as the increase in carbon dioxide in the atmosphere, ozone layer depletion, tropical forest denudation, unscientific land use, pest resistance to pesticides, water and air pollution, problems of salinity, alkalinity and waterlogging, and many others. A nuclear autumn or winter without a nuclear war appears to be a distinct possibility if current trends in life styles and environmental pollution are not altered and reversed.

What can scientists do under such adverse circumstances to promote sustainable food and nutrition security?

Some of the priority areas requiring attention are the following :

First, scientists should help in designing land and water use strategies for each agro-ecological area which can help to optimise production and profit from cubic volumes of soil and water. This will involve designing farming systems which can help to derive maximum benefit from the available water, land, labour, credit and sun light resources. Agro-forestry and integrated systems of crop and animal husbandry and agriculture and aquaculture need attention.

Second, scientists should help in improving small farm efficiency both at the production and post-harvest phases by developing low cost input technologies and by improving the efficiency of the plant in utilizing water, sunlight and nutrients. Integrated pest management and integrated nutrient supply systems are necessary for achieving reduction in the cost of production without correspondingly lowering yields.

Third, there is a need for more research on all aspects of tolerance to climatic and soil stresses. We need higher and more stable yields both under conditions of moisture stress and moisture excess. By incorporating insensitivity to photo-period, a greater resilience can be developed in crop plants to sowing dates. This will be an important component of our strategy to minimize the adverse impact of unfavourable weather. Scientific monsoon management strategies are yet to receive the attention they need.

Fourth, there is a need for more work on tolerance to temperatures - both cold and heat. For example, in Assam and several part of eastern India where there is good potential for ground water use, the incorporation of cold tolerance in rice will help in the cultivation of good rice crops during winter months.

Fifth, we need to intensify research on raising the ceiling to yield in the already available high yielding varieties of crop plants and link high yields with multiple resistance to biotic and abiotic stresses. This will help in promoting land, water and energy saving agriculture.

Sixth; we need urgent steps to increase biomass production and utilise it efficiently. Biomass Refineries which can help to produce value-added products from every part of a plant or animal, will have to be developed. Our animal husbandry programmes will have to be based predominantly on the use of enriched cellulosic residues rather than on grains or pastures.

Finally, we need in every district of the country an intensive Forestry programme based on the careful use of the land available for tree cultivation for the following three purposes:

(a) Conservation ~~of~~ Forestry - e.g. Biosphere Reserves, National Parks, Reserve Forests etc.

(b) Commercial Forestry: Particularly in degraded lands by adopting the latest tools of restoration ecology and

(c) Social Forestry to meet the needs of the people.

The nineties will be a critical decade in many areas of our national life, particularly in the area of ecological security. Our life support systems are under stress, the loss of the biological potential of land is persisting and the biological impoverishment of the country is increasing. Good land for crop husbandry is shrinking, while biotic and abiotic threats to food security are expanding. Some of the topics which will attract increasing attention at the political, professional and public fora during the VIII Plan period are

Sustainable Development
Biological Diversity
Hazardous Waste Disposal,
Air and Water Pollution and
Global Climate Change &
rise in sea levels

The report of the World Commission on Environment and Development chaired by Mrs. Brundtland is titled "Our Common Future". I would like to pose two questions in the context of the Brundtland report.

First, can we visualise a better common future without working for a better common present for the bottom billion of human kind?

Second, can development be sustainable if it is not equitable? When intra - generational equity does not exist, will the concept of inter-generational equity make any sense to a large segment of our population ?

It is clear that a new administrative and developmental ethos which fosters symbiotic interaction between the state and the citizen is a must for making the concept of peoples' participation in the protection of environment a reality. Local communities should have an economic stake in the conservation and sustainable use of common lands and forests. The desired degree of afforestation will not be possible without the active participation of the rural communities. Foresters and forest dwellers should jointly protect and upgrade our forests on the basis of shared perceptions and goals. The mass media will have to play a significant role both in awareness generation and in serving as an early warning system of impending ecological disasters.

Thus for making agricultural advance ecologically sustainable, we need first, a set of reliable measurement tools for monitoring the long term sustainability of the gains achieved in different farming systems. In particular, we need simple but reliable tools of measuring the biological potential of

soil, water quality and availability and genetic vulnerability to biotic and abiotic stresses. We need also measurement tools for studying the impact on biological productivity of changes in temperature, precipitation, ultra-violet radiation and atmospheric carbon-dioxide concentration.

Second, we need a symphonic or mutually supportive packages of technology, services and public policies. For this purpose we can construct a symphonic agricultural matrix which will enable us to examine whether these packages satisfy the basic ecological, economic and equity criteria essential for harmony and sustainability (Table 1).

Third, we should design farming systems which promote better growth linkages among the primary, secondary and tertiary sectors of economic activity. Farming systems with a greater downstream employment potential should be preferred in areas where there is heavy pressure on the farm sector for employment opportunities. Unless we can achieve diversification of labour use, far too many people will depend upon the primary operations of farming for their livelihood security.

Four, we should use the public distribution system not only to insulate the poor from price rises but also to promote ecologically sound land and water use practices. For example, in areas where annual crops are not ecologically desirable, still people grow cereals because the first call on land is meeting the home needs of the farming family. An intelligent deployment of staple grain stocks would be a prerequisite for achieving ecologically desirable trends in land and water use.

Finally, we must harness the best in modern science and technology for promoting land, water, energy and cost saving agriculture and grain saving animal husbandry. Some aspects of biotechnology including bioprocessing, Space technology, information technology and management technology will, if incorporated carefully in traditional farming systems, help to increase the productivity, profitability, stability and sustainability of our major farming systems.

An Advisory panel on food security, Agriculture, Forestry and Environment of the World Commission on Environment Development which I chaired, recommended the following 7- Point Action Plan for making agricultural progress ecologically sustainable ~~See~~
(Food 2000; Global Policies for Sustainable Agriculture, Zed Books Limited, London, New Jersey, 1987, 131 pp).

1. An international code for the sustainable and equitable use of life - support systems.
2. Sustainable livelihood security for the poor.
3. A symphonic agricultural system.
4. Science and technology options for sustainable livelihood security.
5. Education and training.
6. New Orientation to international action and assistance and the use of technical, financial and commodity resources for promoting self reliance.
7. Achieving political commitment and accountability.

I would like to conclude by quoting a few sentences from my Presidential Address to the Agricultural Sciences Section of the Indian Science Congress Session held at Varanasi in January, 1968 since I feel they are even more relevant today.

"We are now entering an age of exploitative agriculture. Exploitative agriculture offers great possibilities if carried out in a scientific way but poses great dangers if carried out with only an immediate profit or production motive. Intensive cultivation of land without conservation of soil fertility and soil structure would lead ultimately to the springing up of deserts. Irrigation without arrangements for drainage could result in soils getting saline or alkaline. Unscientific tapping of ground water could lead to the rapid exhaustion of this wonderful resource. The rapid replacement of numerous locally adapted varieties with one or two high yielding strains in large contiguous areas could result in the spread of serious diseases capable of wiping out entire crops. Indiscriminate use of pesticides could cause adverse effects on biological balance and lead to the presence of toxic residues in food. Scientific multiple cropping could become a great blessing for small farmers, while unscientific multiple cropping could become an unmitigated disaster.

"Therefore, the initiation of exploitative agriculture without a proper understanding of ~~the~~ various consequences of every one of the changes introduced into a traditional agriculture system and without first building up a proper scientific and training base to sustain it, may lead us into an era of agricultural disaster in the long run, rather than to an era of agricultural prosperity"

TABLE 1 SYMPHONIC AGRICULTURE MATRIX

Basic Consideration	ACTION LEVEL		
	Science & Technology	Services	Public Policies
<u>ECOLOGY</u>	Improvement of biological productivity based on the conservation and enrichment of environmental assets.	Village level Associations for sustainable development.	Ecologically sound land and water use policies; promotion of developmental ecology and ecological economics; support to NGOs; Awareness generation, education and training
<u>ECONOMICS</u>	Cost reduction without yield reduction; biomass utilisation; diversification of labour use and promotion of off-farm income. Agricultural technology development as a joint sector activity with farmers and fishermen.	Timely and adequate supply of inputs; key centralised services to support decentralised production .	Input and output pricing policies, incentives for group endeavour such as group insurance and extension, promotion of home and international trade.
<u>EQUITY</u>			
a) Intragenerational	Focus on resource for poor farmers; women; and families belonging to socially and ecologically handicapped sections.	Reaching the unreach- ed in the sharing of new skills and know- how; tailoring delivery system to reach the target groups and areas.	Political will and action for ensuring the livelihood security of the poor.
b) Intergenerational	Conservation of biological diversity, soil and water; prevention of atmospheric pollution and preventing adverse change in climate and ozone layer.	Education; early warning and other monitoring systems.	Political commitment to protecting the interest of the generations yet to be born

NAO Statement on Sustainable Development for
our Common Future

① Concept of Sustainable Development - harmony, non-violence
Buddha to Gandhi - 3 different approaches

② World War II - Nuclear Winter or autumn

③ Brundtland :
 Common Present
 Equity

④ 7 components of an Action Plan

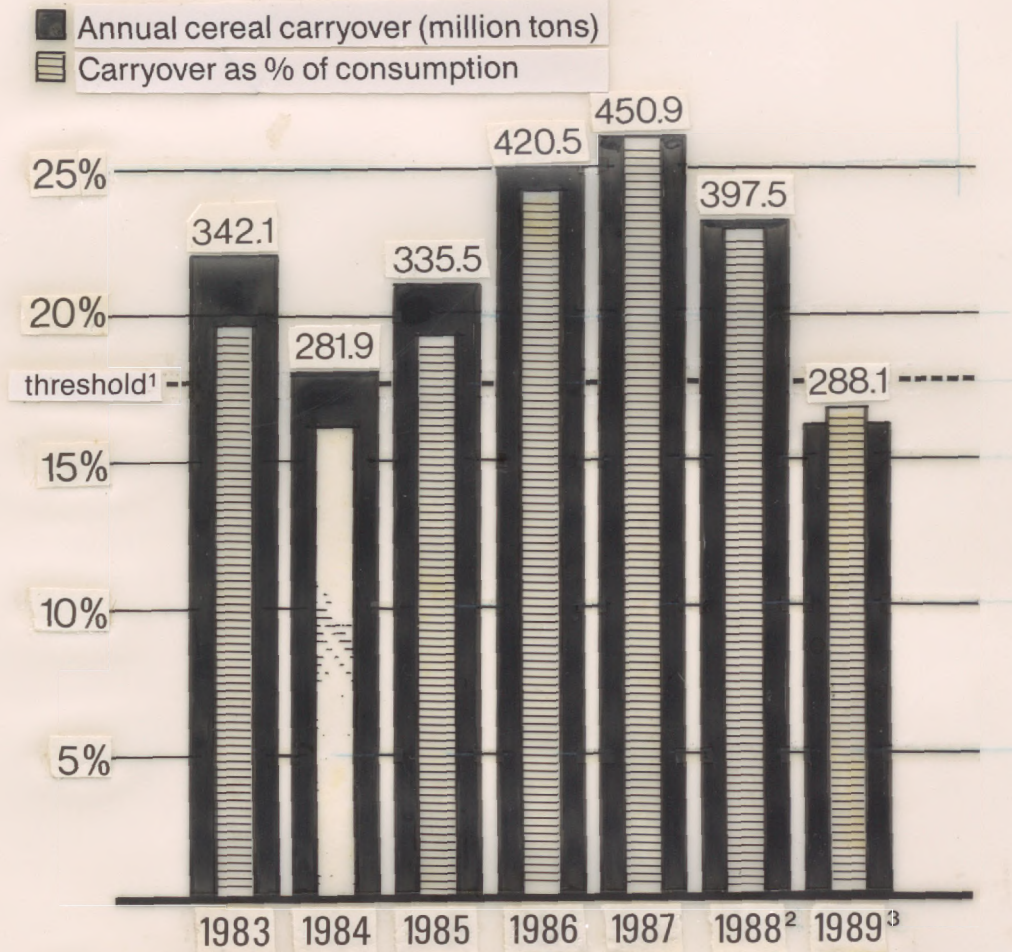
- Economic Stake in conservation
- (a) Village level Association for sustainable & equitable use of life support systems
 - (b) Livelihood security of the poor
 - (c) Symbiotic Agriculture Nature
 - (d) Education & Training
 - (e) Science & Technology options
 - (f) Resource - professional, financial & commodity
 - (g) Political will and action

⑤ Nineties - critical decade - NAO Network

- (a) Biological diversity
- (b) Biological Productivity
- (c) climate ^{and} Radiation Regulation
- (d) Toxic & Hazardous waste disposal
- (e) Air and Water Pollution

World food stocks plunge to dangerously low levels

World carryover cereal stocks, 1983-1989
(million tons)



¹17-18% (minimum level for world food security)

²forecast

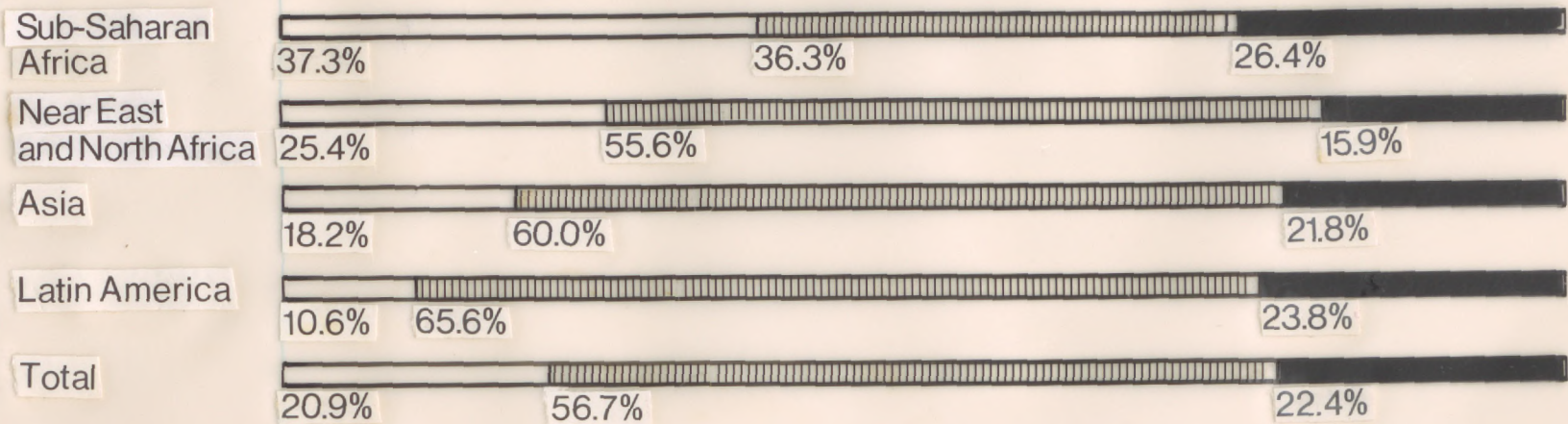
³preliminary

source: FAO

Poor crops in the major grain-producing countries in 1988 undermine food security in 1989. When reserves fall, prices rise and food aid for the poor countries gets scarcer.

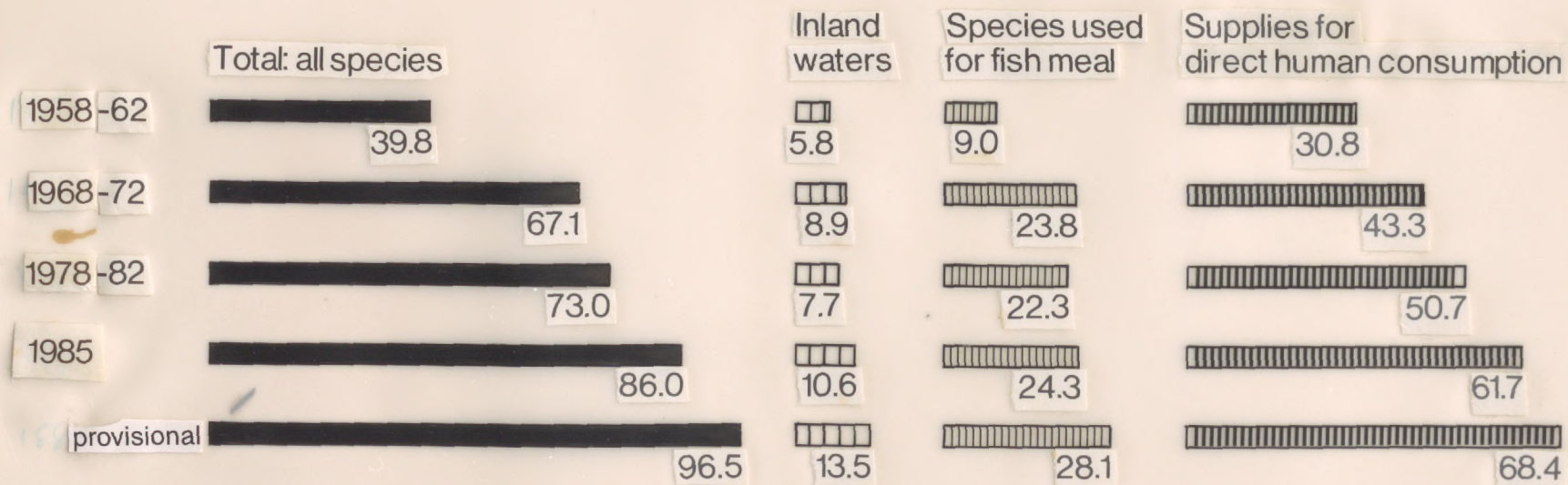
Shares of total harvested land of different potentials, 1982-1984 (93 developing countries)

- Low potential land (low and uncertain rainfall, rainfed land)
- High potential land (good rainfall, rainfed, naturally flooded)
- Problem land (situation mostly in humid tropics)



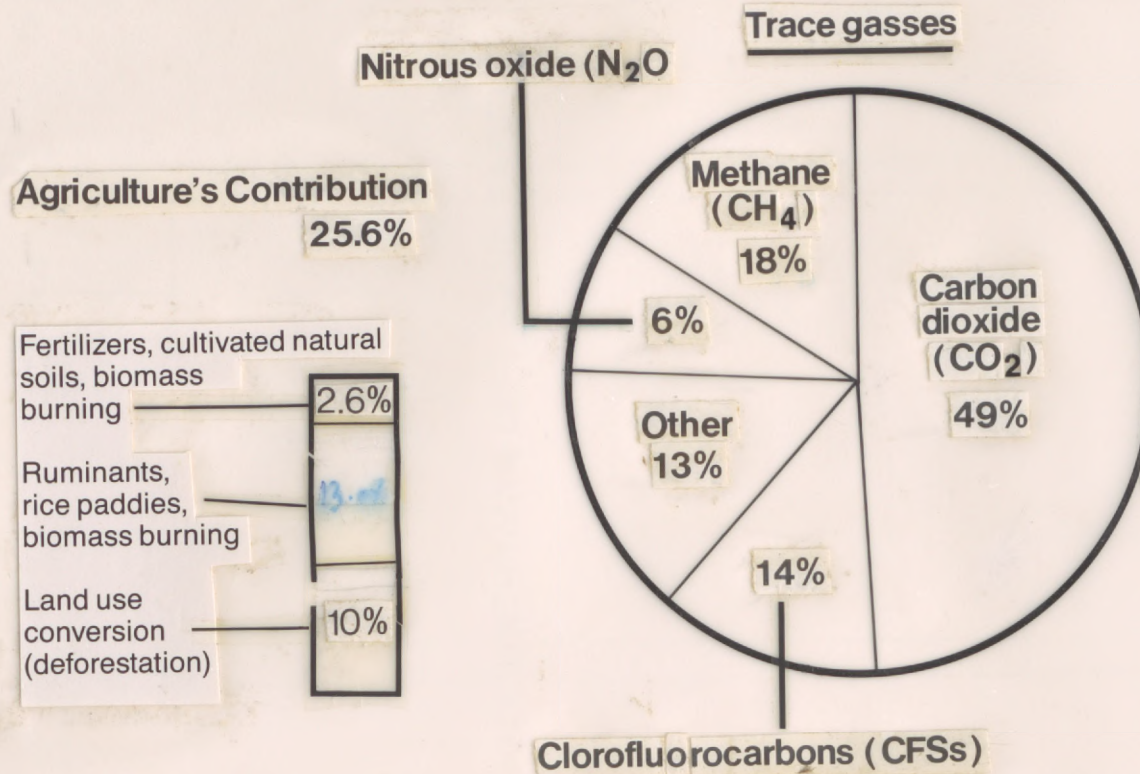
Source: FAO, World Agriculture: Toward 2000

Annual landings of aquatic resources (excluding mammals and seaweeds) (million tons)



Source: FAO, Yearbooks of Fishery Statistics

Contributions to increases in radiative forcing in the 1990s



Source: J. Reilly and R. Bucklin. 1989. Climate change and agriculture. World Agriculture Situation and Outlook Report. Washington, DC: USDA/ERS, WAS-55.

Figure 2. Contributions to increases in radiative forcing in the 1990s.

Population experiencing a fuelwood deficit, 1980 and 2000
(millions)

	Latin America	Africa	Near East and North Africa	Asia and the Pacific	Total	
1980						
Total population	26	55		31	112	Acute Scarcity
Rural population	18	49		29	96	
Total population	201	146	104	832	1283	Deficit
Rural population	143	131	69	710	1052	
2000						
Total population	512	535	268	1 671	2986	Acute scarcity or deficit
Rural population	342	464	158	1434	2398	

Source: FAO, Fuelwood Supplies in Developing Countries, 1983