

Table of Contents

	<u>Page</u>
I. INTRODUCTION	1
II. WORKSHOP PROCEEDINGS	2
Technology Options	3
Technology Transfer Systems	4
Working Group Sessions	5
III. RECOMMENDATIONS	6

ANNEXES

I. List of Participants	16
II. Meeting Sub-Saharan Africa's Food and Agricultural Needs in the 1990's and Beyond: Future Policy Issues and Orientations, Lead Paper by G.I.Abalu.	37

I. INTRODUCTION

A workshop sponsored by the Organization of African Unity (OAU), the African Development Bank (ADB) and the Economic Union (EU) was held in Abidjan, Côte d'Ivoire, from April 26 to 28, 1995. The objective of the workshop was to bring together African agricultural policy makers, researchers, and extension and development workers (see Annex I for the list of participants) to examine technology options and transfer systems for sustainable growth in food production in Sub-Saharan Africa and to analyze the future perspectives and lessons that can be learnt for the 21st century.

ECA's Senior Regional Adviser in Food and Agricultural Policy, and Planning, Mr. G.I. Abalu, was requested by the sponsors of the workshop to prepare a lead paper reviewing Sub-Saharan Africa's food and agricultural needs in the 1990's and beyond and making proposals for future orientations of food and agricultural policies in the region. The lead paper prepared and presented at the workshop by the Senior Regional Adviser is attached to this report as Annex II. The Senior Regional Adviser was also requested to chair a number of plenary and working group sessions as well as to lead discussions in the special working group charged with the responsibility of coming up with recommendations on promising technology options for attaining sustainable food and agricultural production in the region.

The mission was in conformity with Programme Element 20.48 of the approved United Nations Regular Programme of Technical Cooperation for the 1994 - 1995 Biennium which calls for the provision of advisory services and training in the formulation and implementation of appropriate policies, plans, and programmes for attaining sustainable increases in food and agricultural production.

II. WORKSHOP PROCEEDINGS

The proceedings of the workshop were predicated on the reality that in the next 30 years, the population in Sub-Saharan Africa (SSA) would reach 1.3 billion. Thus, by the year 2025, there will be nearly 800 million additional people to feed. To cope with this number of people, appropriate farming practices would need to be practised so as to foster the expansion of food production to feed and shelter them in a sustainable manner. The challenge is to, therefore, effectively mobilize the needed resources and expand agricultural production to the required scale. One of the precondition for this is to introduce appropriate technological change. The workshop reviewed the effectiveness of available technologies and the efficiency of current approaches to on-farm research, and technology transfer systems and identified lessons for evolving more efficient food production systems in the 21st century.

The participants also acknowledged the fact that technology transfer systems (i.e., extension services) established during the colonial era and soon after independence in many countries failed to live up to the expectations. Furthermore, agricultural production was so poor that tangible benefits rarely materialized to improve the economic conditions of the poor and resource constrained farmers. Except for a few countries and for selected commodities, the African "Green Revolution" has yet to be realized.

The workshop critically reviewed the current state of knowledge and approaches to on-farm research in Sub-Saharan Africa. Experiences with technology transfer systems based on a number of country-level analytical case studies were exchanged among the participants and technical gaps and "missing links" associated these systems identified. Available technological options and lessons learned in their implementation in the region were synthesized and documented. In this regard, the work of the workshop was centred around two main themes. The first focused on the types of food and

agricultural policies and technology options that would be needed to meet the region's food and agricultural production requirements in the 1990s and beyond. The activities of the mission were directed largely to the realization of the objectives of this theme. The second theme focused on the kinds of technology transfer systems that would be needed. The proceedings of the workshop on these two themes are outlined below.

Technology Options

The workshop noted that rapid population growth has put pressure on the resource base and land use practices in Sub-Saharan Africa. According to several estimates, agricultural production ought to increase by at least 4 percent per year to meet the food requirements of the region's increasing population. It is anticipated that one percent of this increase could be attained by bringing more new land into production and 3 percent from increased output per hectare as a result of technological change. In the past three decades, on-farm research (OFR) has placed heavy emphasis on the diagnosis of production and socio-economic constraints, design, and on verification of technologies, while neglecting the transformation of research results into extension recommendation and production. In the next five years, the thrust of OFR should be directed towards a critical assessment of technologies on offer so as to enable farmers choose sensibly from the available options. Furthermore, technologies should be chosen based on their potential contribution towards enhancing the recycling of renewable resources in a sustainable manner, and with concurrent improvement of the environment. The lead paper presented by the mission addressed these issues as well as others relating to the appropriateness or otherwise of the available technological options, constraints to their adoption and the policy implications pertaining to their widespread adoption.

In order to meet the future challenge of food, shelter and energy requirements of the 1.3 billion people who will be living in the region by 2025, many issues including those relating to resource endowments and the

availability of appropriate technological options were discussed by the participants. The restoration of the productivity of the resource base was considered crucial not only for enhancing the development of sustainable agricultural production systems, but also for putting an end to the degradation of the environment. The participants felt that since most of the expected food production increase would come largely from the input of more productive technologies, the appropriateness of available technologies, including current approaches to technology generation and transfer, should be revisited and critically examined.

Technology Transfer Systems

The participants noted that in the last three decades, different technology transfer models have evolved in Sub-Saharan Africa. These, however, vary considerably with respect to their level of efficiency in delivering technology, cost and the type of technical services provided. In several countries of SSA, national agricultural research systems were established without adequate consideration of the mechanisms for linking them to the target clients. The workshop underlined the importance of strong and effective linkages between research and technology transfer systems for enhancing agricultural production.

The workshop noted that different models of extension systems have been used within and among countries of the region often with unsatisfactory results. Existing arrangements for technology transfer in the region include:

1. Public and parastatal institution's (extension services);
2. Participatory and partnership, arrangements involving farmers and NGOs;
3. Private sector technology delivery systems, such as commercial seed production, fertilizer distribution, etc.

4. Community-based extension systems where groups of farmers are trained in on-farm research and extension to serve village communities; and
5. On-Farm Research (OFR) and extension linkages designed to respond to the needs of small farmers.

The workshop noted the growing emphasis on participatory research involving technology transfer and development in which farmers, as the "main clients" of research, assume greater responsibility for the evaluation and dissemination of new technologies. The workshop focused on the experience of farmers, and NGOs with different types of technology transfer systems. The Workshop noted that in the last decade, private institutions such as NGOs have played an increasingly important role in technology transfer and adoption. The nature of existing linkages between NGOs and national research and extension systems were extensively discussed. Complementarities between the activities of NGOs and those of public institutions in technology transfer and development were also explored.

Finally, the workshop highlighted the socio-cultural and resource constraints that impede the development and/or more effective utilization of women's capacity and the empowerment in the development process. It was generally agreed that women play a crucial role in food and agricultural production in Sub-Saharan Africa yet the great majority of them are not given equal opportunity in training, land ownership, and access to other resources.

Working Group Sessions

Separate but concurrent group sessions were held to identify lessons learned in the following areas:

1. The types of technologies that would be in demand in African agriculture

in the 21st Century;

2. The availability of low-input technologies;
3. The criteria to be used in packaging more productive technologies;
4. Alternatives to improve the efficiency of existing technology delivery systems; and
5. The appropriate regional approach for revitalizing agricultural transfer and extension systems in Africa.

III. RECOMMENDATIONS

Two committees were set up to propose recommendations on the two main themes of the workshop, as outlined above. The reports of the two working groups are presented below.

Working Group on Technology Options

Chair : G.I. Abalu

Secretary : J. Sedego

Members : J.O. Adeosun
B. Apraku
A. Bationo
A. M. Emechebe
J. M. Fajemisin
V. Hien
R. Kenga
K. O. Marfo
N. Muleba

J. M. Sanders

B. Taye

C. Zaongo

The Group felt that, in order to facilitate an appropriate flow of ideas and an orderly discussion of the issues involved, the discussions should be organized along the following lines:

1. Lessons learned (successes and failures);
2. Main issues for intensification of food production;
3. Implications for sustainable agriculture;
4. Future areas of research emphasis.

The following are the highlights pertaining to the discussion/brainstorming exercise by the group.

Lessons Learned

The group first provided an inventory of the lessons learned according to two major areas, namely, successes and failures. With regards to successes, the group noted the following:

1. One major lesson learned is that for chemical fertilizer to produce the best results possible on both crops and soil environments, it must be used in appropriate combinations with organic amendments, crop rotations/mixture of legumes, as well as with varying forms of agro-forestry practices (e.g., alley cropping).
2. In spite of some limitations, a number of proven working agricultural technologies exist in various forms which can be adopted by farmers to boost the production of most major crops in the subregion.

3. Factors which, in most cases, have contributed significantly to the successful adoption agricultural technologies on offer in the subregion include:
- Favourable influence of market-oriented crops (e.g., effect of cotton on maize crop production in Mali);
 - Appropriate institutional arrangements;
 - Adequate input supply (e.g., seed; fertilizers);
 - Availability of infrastructures;
 - Added value to agricultural products, (e.g., processing of maize in Mali and Nigeria);
 - Suitability of the improved technologies with regard to farmers' needs;
 - Improved human resource capacity to tackle major agricultural problems/issues;
 - Increased awareness by the international agricultural research canters of the need for more collaboration not only among themselves, but also with NARS in particular; and
 - Increased awareness of the need for NARS to collaborate and cooperate with one another.

With regards failures, the following were identified:

1. Weak or non-adoption of existing agricultural technologies by the

end-user, i.e. the farmer, for a variety of reasons;

2. Existence of a wide gap between results obtained under on-station and on-farm conditions;
3. Limited number of applied or adapted research relating to integrated resource management systems (e.g., integration of soil, crops, water and other related factors);
4. Failure to incorporate management of natural resources as a key component in the technology development process;
5. Failure of national governments to provide needed support and attention to agricultural development and related goals; and
6. Inconsistent agricultural and food policies, e.g., the case of urban-biased agricultural policies.

Main Issues for Intensification of Food Production

Issues of importance to be addressed if food production is to be successfully intensified were identified as follows:

1. Accelerated degradation of soil fertility and related factors in most of the existing crop systems. Of particular interest here are soil erosion by wind and water and continuous mining of plant nutrients by farmers.
2. Erratic rainfall resulting in unavailability of water in the soil and poor water use efficiency by crops.
3. Inadequate input supply systems including delivery, distribution,

and quality controls.

4. Inadequate/inappropriate marketing, processing, and/or storage of agricultural products.
5. Need to develop an enabling policy environment to better cope with farmers' needs: e.g., credit,
6. Need to develop complementary agricultural technologies in order to enhance intensification of agricultural production.
7. The long-term effects on the soil of long-term and more intensive use of chemical inputs such as fertilizers and pesticides.

Implications for Sustainable Agriculture

In light of the above considerations, the group concluded that for sustainable agricultural production to occur in sub-Saharan Africa, the following set of factors or enabling conditions ought to be met first:

1. There would be need to promote more research projects or programs that focus on integrated production systems, such as crop/livestock, nutrient/water management, and production of agro-forestry systems.
2. There would be need to increase and expand research efforts which deal with soil/water conservation management and improvement measures.
3. Promotion of environmental friendly agricultural resource and policies.

4. Appropriate means and ways should be sought to make agricultural production highly profitable and in-come generating at the farm level. This, for instance, can be done through sensitization, education, and/or training of farmers on issues pertaining, in particular, to natural resource management.
5. National governments should be prepared to grant both the support and resources needed to promote technologies which are compatible with the sustainable use of the natural resource in each country and in the concerned agro-ecosystems in the subregion in general.

Future Areas of Emphasis

In light of the above considerations, the group felt that future research efforts should be focused on:

1. Crop improvement programs which seek to monitor the continually changing biotic environments while responding promptly and ably to the needs of emerging new agricultural systems.
2. Holistic commodity research schemes which take into account on a broader scale most, if not, all the relevant production parameters such as insect, soil fertility, marketing, etc.
3. Need for research scientists, farms, and all other concerned partners to work together to integrate crop production, tree planting, and livestock activities for a better management of existing natural resources and increased output with moderate to low use of modern agricultural inputs.
4. Need for more research directed at removing nutrient imbalances in

the different cropping systems.

5. Need for more research on post-harvest and other agricultural and industrial utilization of agricultural products.
6. Need for more research on seed production technology and effective distribution systems.
7. Need for more research dealing with integrated pest management systems.
8. Need for more research to increase nutrient use efficiency, and related complementary aspects, such as soil microbiology and others.

Working Group on Technology Transfer Systems

The group noted that, in most countries, there has been tremendous improvement in the research-extension-farmer-input systems since independence. There exists in each country an organized extension system that has led to some measure of technology adoption success.

Lessons Learned

It was observed that where success stories have been recorded the following ingredients were usually present:

1. Strong research-extension-farmer-input linkage and collaboration;
2. Strong training component;
3. Strong rural infrastructure;

4. Good mobility for participants; and
5. Deliberate programme to reach women and rural youth farmers as appropriate;

In cases where failures were recorded the following points were observed:

1. During the colonial period farmers were not involved in technology development but technologies were imposed on them. There was not much research conducted and women issues were neglected.
2. After independence there were some inconsistencies in policies concerning research and extension while in others attention to policy issues was weak.
3. Extension and research were placed in different ministries leading to weak collaboration.
4. Generally the rate of adoption was low and technologies were not reaching all the farmers. This was due to inadequate number and quality of technology transfer staff as well as poor incentives.
5. Non-physical availability of technologies and lack of means of acquisition by farmers.
6. Lack of mobility for research and extension staff.
7. The ad-hoc funding of research-extension in the past had produced adverse effects on technology transfer.
8. There has been a negligible number of women workers in research and extension in the region and most of the technologies have been

male-biased.

9. Improved technologies have concentrated on production without adequate attention on processing aspects.
10. The lack of confidence of donors in the national governments gave rise to attention being diverted to some NGOs who may not be able to give long-term and sustainable support.

The Main Issues for Effective Technology Transfer Systems

- Collaboration between research-extension-farmer and input support.
- Training at all levels.
- Mobility.
- Adequate funding.
- Input supply including credit.
- Farmer participation right from the beginning of the technology development process.
- Deliberate attempt to reach women and youth.

Research on Technology Transfer Systems

1. Regional study on technology transfer systems models best suited to African circumstances viz, cost effectiveness, personnel, mobility, terrain, culture etc.

2. Evaluative studies of the existing TTS to determine why technologies are not reaching the farmers.
3. Determination of point of entry of TTS in the technology development and transfer continuum.
4. Study on community-based TTS for cost effectiveness and sustainability.

Future areas of regional collaboration

1. Study of various TTS among countries.
2. Exchange of TTS materials and professional experience.
3. Exchange visits on special programmes, e.g., women in Agriculture, Rural Youth Programmes etc.
4. Facilitating visits among countries on TTS by strengthening existing regional bodies like the West African Farming Systems Research Network (WAFSRN) and SAFGRAD.

Annex I

LIST OF PARTICIPANTS

1. Singh Bir Bahadur
Cowpea Breeder
IITA Kano Station, Sabo Bakin Zmo Road
PMB 3112, Kano,
Nigeria
Tel. 234 64645350/51, Fax 234 64 645352,
Telex TDS KN NG 77330 or 7744 Box 189.

2. Dr. Jean Nyemba Ambela
Ag-Extension
ICRISAT/WCAMRN/ROCAFREMI
ICRISTAT Sahelian Centre
P.O. Box 12404
Niamey
Niger,
Tel. 227 72 25 29
Fax 227 72 43 29

3. Prof. Olusoji Olaolu Olufajo
Agronomist
IAR/ABU
PMB 1044
Zaria,
Nigeria
Tel. 234 069 50571-4
Fax 234 069 50563

4. Hammond Winfred
Entomologist
IITA Plant Health Management Division (PHMD)
IITA-PHMD
BP 08-0932
Cotonou,
Benin
Tel. 229 35 01 88
Fax 229 35 05 56

5. Yapi Atse
Agro-Economist
ICRISAT/WASIP/MALI
BP 320
Bamako,
Mali
Tel. 223 22 33 75
Telex 2681 MJ

6. Williams Timothy Olalekan
Agricultural Economist
ILRI
B.P. 12404
Niamey,
Tel. 227 72 25 29
Fax 227 75 22 08
Telex 5560 NI

7. Kenga Richard
Sorghum Breeder
IRA/Maroua
BP 33 Maroua,
Cameroon
Tel. 237 29 11 78
Fax 237 29 29 76
8. The Charles
Maize Breeder
IRA/Yaoundé,
Cameroon
Tel. 237 22 30 22
Fax 237 22 59 24
Telex 1144 KN
9. Diop Serigne
Raw Materials for Food Industry
AFRIRECO
01 BP 501 Abidjan 01,
Côte d'Ivoire
Tel. 225 41 8159
Fax 225 46 7522
10. Fajemisin Joseph M.
Maize Production Research (Breeding and Pathology)
IITA-CI
s/c ADRAO/WARDA
01 BP 2551 Bouake 01,
Côte d'Ivoire
Tel/ 225 634514/633242/632396

Fax 225 63 47 14

Telex 69138 ADRAO CI

- 11. Koffi Goli**
Plant Breeder
IDESSA
01 BP 633 Bouake 01,
Côte d'Ivoire
Tel. 225 63 31 26/61 31 39
Fax 225 63 20 45

- 12. Diallo Alpha Oumar**
Maize Breeder
CIMMYT,
Côte d'Ivoire
01 BP 2551 Bouake 01
Côte d'Ivoire
Tel. 225 63 29 96
Fax 225 63 47 14
E-Mail-WARDA (CG 1125)

- 13. Adamou Moutari**
Sélectionneur Niébé
INRAN/CERRA/KOLLO
BP 429
Niamey,
Niger
Tel. 72 27 14/73 32 86

14. Professor George I. Abalu
Agricultural Economist
United Nations Economic commission for Africa
UN/ECA
P.O. Box 3001
Addis Ababa,
Ethiopia
Tel. 251 (1) 51 04 89
Fax 251 (1) 51 46 82
Telex 21029 UNECA

15. Sedgo Joseph
Private Consultant
Agronomy, Agroforestry, Soil Fertility and Related Ag-
Development Technologies
c/o OAU/STRC-SAFGRAD
0 BP 1783 Ouagadougou 01
or THRU: BP 3618 Ouagadougou,
Burkina Faso
Tel. c/o 3060 71/31 15 98 or 36 54 27 (Home)
Fax 31 15 86
Telex c/o 5381 BF

16. Baidu-Forson Jojo
Ecconomie Rurale
ICRISAT/NIAMEY
BP 12404
Niamey,
Niger
Tel. 227 72 27 25/72 25 29
Fax 27 73 43 29

Telex 5560 NI

17. **Baffour Badu-Apraku**
Plant Breeder
IITA-CI
IITA Svanna Station
c/o ADRAO/WARDA
B.P. 2551 Bouake,
Côte d'Ivoire
Tel. 225 6332 42
Fax 225 63 47 14
Telex 69138 ADRAO CI

18. **Kehinde Elemo**
Cropping Systems Agronomist
IAR/ABU
Department of Agronomy
PMB 1044 Zaria,
Nigeria
Tel. 234 69 50681
Fax 234 69 50563
Telex AGRISEARCH ZARIA

19. **Bationo André**
Soil Chemistry/Fertility
IFDC/ICRISAT
BP 12404 Niamey,
Niger
Tel. 227 72 25 29
Fax 227 73 43 29
Telex 5560 NI

20. Touré Yaya
Agronome
IDESSA
01 BP 633 Bouaké 01,
Côte d'Ivoire
Tel. 225 63 31 39
Fax 63 20 45

21. Akanvou René K.
Agronome
IDESSA
01 BP 633 Bouaké 01 ou B.P. 121 Ferké,
Côte d'Ivoire
Tel. 225 63 31 39
Fax 225 63 20 45

22. N'Guessan Esoi
Sélectionneur Coton
IDESSA
01 BP 633 Bouaké 01,
Côte d'Ivoire
Tel. 225 63 31 39
Fax 225 63 20 45

23. Ayindé Guillaume
Gestionnaire (ONG)
Groupement des Aides Privées (GAP),
BP 10424 Niamey
Niger
Tel. 227 74 09 07

24. **Zerbo Doro Pierre**
Juriste (ONG)
Secrétariat de Concertation des ONG du Sahel (SECOS),
BP 7126
Ouagadougou,
Burkina Faso
Tel. 226 31 63 98
Fax 226 36 30 32

25. **Ellen Bortei-Doku Aryeetey**
Rural Development Research Gender Studies
Social Policy Studies
Institute of Statistical, Social and Economic Research (ISSER)
University of Ghana, Legon,
Ghana
Tel. 233 21 77 51 82
Fax 233 21 66 58 01

26. **Koudokpon Valentin**
INRAB
BP 884 Cotonou,
Benin
Tel. 229 41 12 06
Fax 229 30 07 36

27. **Bado Jean Badou**
Agro économiste/chargé de formation
Direction de la Vulgarisation Agricole
Ministère de l'Agriculture et des Ressources Animales,
BP 7028 Ouagadougou
Burkina Faso

Tel. 226 38 02 35 (Dom.) 30 70 91 Bureau

28. Mongbo Evelyne
Sociologue
ONG (GEBEDES)
Centre Béninois pour l'Environnement et le Développement
Economique et Social
B.P. 06 2564 PK3 Cotonou,
Bénin
Tel. 229 30 41 39

29. Tenkouano Abdou
Génétique et Amélioration Varietale du Sorgho
ICRISTAT/WCARP
BP 320 Bamako,
Mali
Tel. 223 22 33 75/22 77 07
Fax 223 22 86 83
Telex ICRISAT 2682 MS

30. Toky Payaro Padjawe
Agronome
INCV/SAFGRAD-TOGO
B.P. 218
Kara,
Togo
Tel. 60 62 41
Fax 60 60 03

31. **Sebgo Marie-Thérèse**
Interprète Traducteur
01 BP 2356 Ouaga 01,
Burkina Faso
Tel. 226 30 04 64
32. **Silva Carlos E.P.**
Agronome Responsable Programme Mais
Institut National de Recherche et Développement
Agraire (INIDA)
BP 84 Praia,
CAP VERT
Tel. 238 71 11 47
Fax 238 71 11 33
33. **Tunji Arokoyo**
Agricultural Extention
NAERLS/ABU
PMB,1067
Nigeria
Tel.234 69 50589
Fax 234 69 32198
34. **Amos Taye Tithy**
Naerls/Abu
PMB 1067 Zaria,
Nigeria
Tel. 234 69 50126 ext. 27

35. Osei-Bonsu P.
On-Farm Agronomist
Crops Research Institute
P.O. Box 3785 Kumasi,
Ghana
Telex 3036 BTH10 GH.

36. Asafu-Agyei John Nuamah
Cropping Systems Agronomist
Crops Research Institute
P.O. Box 3785 Kumasi,
Ghana
Telex. 3036 BTH 10 GH.

37. Akim M.Omotayo
Agricultural Extention
NAERLS/ABU
PMB 1067
Nigeria
Tel.234 69 50126
Fax.234 069 32198.

38. James Olasunkanmi Adeosun
Extention Weed Control Specialist
Crop & Forestry pogramme
NAERLS/ABU
Pmb 1067, Zairia,
Nigeria
Tel.234 69 50126
Fax.234 69 32198

39. Benjamin Ahmed
Agricultural Economics
Department of Agricultural Economics
NAERLS/ABU
PMB 1067, Zaria,
Nigeria
Tel.234 69 50126
Fax.234 69 50563

40. Olukosi James otunola
Agric Economics and Farming Systems
IAR/ABU
PMB 1044 Zaria
Nigeria
Tel.234 69 50571
Fax.234 69 50563
Telex 75348 NITEZ NG.

- 41 Joseph Gambo Akpoko
Agricultral Extention
NAERLS/ABU
PMB 1067 Zaria,
Nigeria

42. Sarah Jehu Auta
Rural and Community Development
NAERLS/ABU
PMB 1067 Zaria,
Nigeria
Tel.234 69 50126
Fax.234 69 32198.

43. Awere Anzong Dankyi
Economics
Crops Research Institute
P.O. Box 3785, Kumasi,
Ghana

44. Roger Kanton
Agronomist
Savanna Agricultural Research Institute
SARI
P.O. Box 52, Tamale, Northern Region
Ghana
Tel. 71 2411

45. Marfo Kwadjo Owusu
Food Legumes Breeder
Savanna Agricultural Research Institute
SARI
P.O. Box 52, Nyankpala
Tamale,
Ghana
Tel 712411 Telex. 3046 BTH GH

46. James Mantent Kombiok
Cropping Systems Agronomist
SARI, Nyankpala,
P.O. Box 52
Ghana 71 2411

47. Prof.Emechebe Alphones Mgbanu
Plant Pathologist,IPM
IAR/ABU
PMB 1044 Zaria,
Nigeria
Tel.234 69 50681 (office)/69 50470 (home)
Fax:234 6950563 c/o NAERLS 234 69 32198.

48. N'Toukam Georges
Entomologist
IRA/Maroua
P.O. Box 33 Maroua,
Cameroon
Tel. 237 29 27 21
Fax.237 29 29 76

49. Thiaw Samba
Agronomist
Institut Senegalais de Recherches Agricoles
ISRA/CNRA/BAMBEY
Bp 53
Senegal
Tel.73 60 50
Fax.73 60 52

50. Saliou Dianger
ISRA/CNRA/BAMBEY
Bp 53
Senegal
Tel.73 60 50
Fax 73 60 52

51. Endondo Chevalier
Agronomr
IRA/Cameroun
BP 33 Maroua,
Cameroun
Tel. 237 29 24 58
Fax 237 29 29 76
52. Ouedrago Souleymane
Agro-economist
Institut d'Etudes et de Recherches Agricoles
INERA
Bp 476 Ouagadougou,
Burkina Faso
Tel.226 31 92 2
Fax 226 31 92 06
53. Ouedraogo Souleymane
Zootechnicien
INERA/CRRA du Sud
B.P. 910 Bobo-Dioulasso,
Burkina Faso
Tel. 226 98 23 29
54. Muleba Nyanguila
Agronomist
OAU/STRC-SAFGRAD
01 Bp 1783 ouaga 01,
Burkina Faso
Tel. 226 30 60 71
Fax 226 31 15 86.

Telex 5381 BF.

55. Carsky Robert James
Cropping Systems Agronomist
IITA/Ibadan
PMB 5320 oyo Road
Ibadan,
Nigeria
Tel. 234 2 2412626
Telex.31417 TROPIB NG
E-mail R.
CARSKY AGGNEBT.COM

56. Diallo Samba
Vulgarisateur Agricole
Programme National de Vulgarisation Agricole
PNVA
BP 10428 Dakar,
Senegal
Tel. 27 41 31/27 71 79.

57. Hien Victor
Soil Scientist/Agropedologue
INERA
03 BP 7192 Ouagadougou,
Burkina Faso
Tel.226 34 02 69/70
Fax 226 34 02 71

58. Hema Drissa
Selectionneur de Mais
INERA
01 BP 476 Ouaga 01,
Burkina Faso
Tel.226 3 92 08.Fax 226 31 92 06
59. Kamara Abdoulaye
Agronome
IER/ESPGRN/CRRA/Sikasso
BP 186
Bamako,
Mali
Tel.223 62 03 49
Telex.223 62 03 46.
60. Kebe Demba
Agro-economiste
IER/ESPGRN/Sikasso
BP 186 Sikasso,
Mali
Tel.223 62 00 28/62 03 46
Fax.223 62 03 49.
61. Bengaly M'pie'
Agronome
IER/ESPGRN/Sikasso
BP 186 Sikasso,
Mali
Tel.223 62 00 28/62 03 46
Fax 223 62 03 49.

62. Godet G'ererd
Agropastoraliste
CIRDES/CRTA
BP 454 Bobo-Dioulasso,
Burkina Faso
Tel.226 97 22 87
Fax.226 97 23 20
Telex 8227BF
(BCTR)
63. Coulibaly N'tji
Agronome Mais
IER/Bamako
BP 438 Bamako,
Mali
Tel.223 2260 08
Fax 223 22 37 75
64. Tareke Berhe
Agronomist
Sasakawa Global 2000
SG 2000 Airport PMB Accra,
Ghana
Tel. 233 21 774750
Fax.233 21 773467
Telex.2310 GLOBAL GH.

65. Oheneser Apau Sakyi
Agronomist
Sasakawa Global 2000
14 Ridge Road
PMB KIA, Accra,
Ghana
Tel. 233 21 77 47 50
Fax.233 21 77 34 67
Telex.2310 Global GH.
66. Zaongo Christophe G.L.
Soil Scientist
FEWS/USAID
01 bp 1895 Ouaga 01,
Burkina Faso
Tel. 226 30 67 26
Fax.226 30 82 03.
67. Sedogo Marie C'ecile
Selectionneur
INEAR Kamboinse
01 BP 1895 Ouaga 01,
Burkina Faso
Tel. 226 30 67 26.
Fax 226 30 82 03.
68. Zoundi Sibiri Jean
Zootechnicien
INERA
03 BP 7192 Ouaga 03,
Burkina Faso

Tel. 226 31 92 02/31 92 08
Fax.26 34 02 71

69. Johnson A. Ekpere
Executive Secretary
OAU/STRC
PMB 2359
Lagos,
Nigeria
70. Taye Bezunbeh
International Coordinator
OAU/STRC-SAFGRAD
01 BP 1783 Ouaga 01,
Burkina Faso
Tel. 226 30 60 71/31 15 98
Fax.226 31 15 86
Telex.5381 BF
71. Adanlete Evenunye
Administrative and Finance Officer
OAU/STRC-SAFGRAD
01 BP 1783 Ouaga 01,
Burkina Faso
Tel.226 30 60 71/31 15 98
Fax 226 31 15 86.

ECA/MRAG/95/54/MR

Annex I

Page 36

72. To'e Yvonne
Secre'taire
OAU/CSTR-SAFGARAD
01 BP 1783 Ouag 01,
Burkina Faso
Tel.226 30 60 71/31 15 98
Fax.226 31 15 86.

Annex II**MEETING SUB-SAHARAN AFRICA'S FOOD AND AGRICULTURAL
NEEDS IN THE 1990'S AND BEYOND:
FUTURE POLICY ISSUES AND ORIENTATIONS***

The prognosis for Sub-Saharan Africa's food and agricultural situation for the rest of the 1990's and beyond is bleak. Rapid population growth exceeding 3.0 per cent per annum is expected to lead to declining per-capita food consumption levels. The region is expected to make little progress towards raising its low per capita food supplies. Incomes are not expected to rise fast enough to permit market imports to offset the decline. This paper maintains that this bleak forecast will not materialize only if African governments take the necessary measures now to ensure a sustainable increase of, at least, four per cent per annum in food and agricultural production during the next 10 to 15 years. The paper addresses the critical issues involved and identifies the future policy orientations to guarantee the achievement of this target.

I. INTRODUCTION

Over 250 million people in Sub-Saharan Africa are living in poverty. This figure is expected to rise to over 300 million by the year 2000 if present trends continue. By the end of the decade, it is projected that almost one-third of the developing world's poor will be found in Sub-Saharan Africa, compared to about 19 per cent today (IFPRI, 1994). Most of these people do not have access to enough food to meet their needs for a healthy and productive life, often going hungry and not knowing where their next meal will come from. They often suffer and die from diseases associated with hunger and poverty. In short, over the last two decades Sub-Saharan Africa has been facing a general deterioration in the standard of living manifested in increased levels of poverty and food insecurity.

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Per capita food and agricultural production has been inadequate in the region. Since the early 1980s, per capita production has been declining steadily (Tables 1 and 2). Over three-fourths of the countries in Sub-Saharan Africa produce less food today than in 1980. This stagnation and retrogression is the harbinger of the region's current economic malaise, social decline and marginalization.

Because the food and agricultural sector dominates most Sub-Saharan African economies in terms of contribution to GDP, employment and incomes, its growth and development are essential for the overall process of socio-economic development in the region. The food and agricultural sector must grow enough food and raw materials for its rising population and new industries; produce exports that will earn the foreign exchange needed to purchase essential machinery and equipment and service foreign debts; and, as productivity increases, release labour and capital for the other sectors. The challenge facing African agriculture is, therefore, immense. Not only must it feed a population that is increasing at an annual rate of about three percent and will double in about 20 years, it must also provide employment for a rapidly growing work force - 50 to 80 percent of Africans earn their living from the land.

It has been estimated that, to meet this challenge, Sub-Saharan agriculture must grow at a minimum average annual growth rate of about 4.0 percent during the next 20 to 25 years (ECA, 1989; Cleaver, 1993). Can this challenge be met? Can Sub-Saharan Africa achieve such an ambitious growth rate given its past record and performance? Can the rest of the economy grow at a sufficiently high rate to absorb the increased agricultural production that such a growth rate entails? What would be the implication of such a growth rate on the environment? How should future food and agricultural policies be oriented to meet the target? This paper examines these issues and questions and proposes guidelines on future policy orientation to address them.

II. IS A FOUR PERCENT GROWTH RATE POSSIBLE?

Is a 4.0 percent annual increase in food and agricultural production over the next 20 to 25 years an achievable expectation in Sub-Saharan Africa? In this section we examine the potentials and possibilities that exist for achieving such a target and draw conclusions as to its feasibility and sustainability.

Table: 1 Trends in Per Cap Agric Prod
Index (1979-81=100)

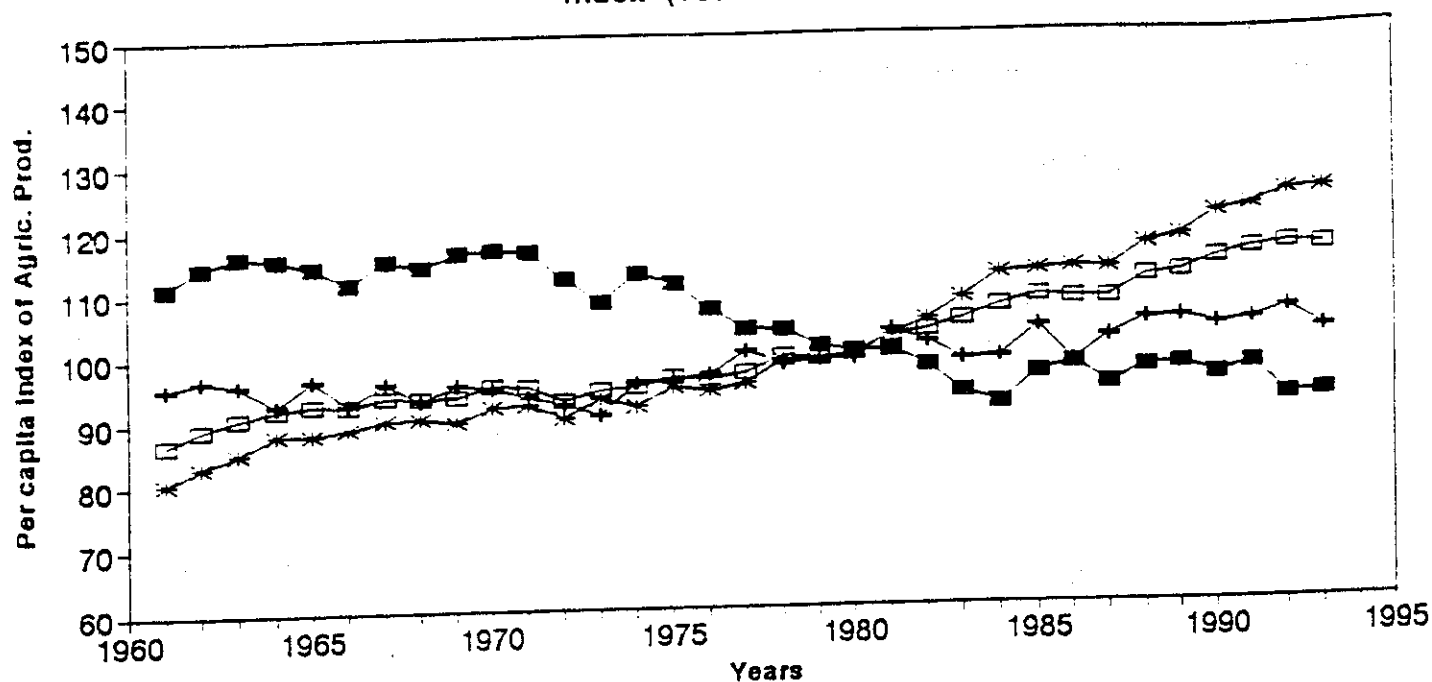
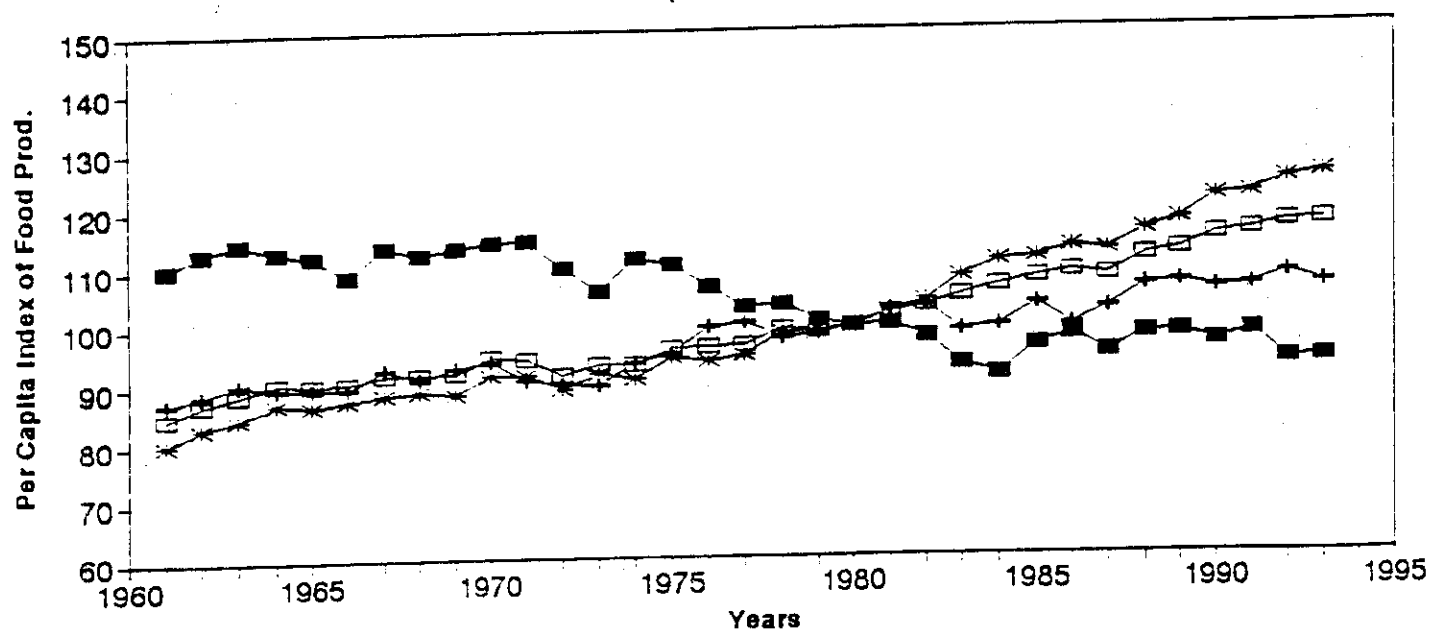


Table: 2 Trends in Per Capita Food Prod
Index (1979/81=100)



—■— Africa —+— South America —*— Asia —□— Dev'g countries

Sub-Saharan African agriculture is mainly rain-fed with irrigated agriculture accounting for only three percent of the total cultivated area. During independence, low population densities characterized most of the region. Today, however, the situation is changing dramatically in most areas. In countries such as Togo, Benin, Rwanda and Burundi, the eastern parts of Nigeria, the industrial mining areas of eastern and southern Africa and a number of Island States such as Mauritius and Cape Verde, it is becoming increasingly difficult to expand local food production horizontally to keep pace with population growth. In these areas, increases in population density has necessitated a shortening of the fallow period resulting in incomplete natural regeneration process of soils previously under cultivation and a consequent decrease in soil fertility. This underlines the need for a "research based" agriculture that uses biological technical change to increase land and labour productivity. What then are the prospects for the future for technological change in Sub-Saharan African agriculture?

Maize is among the few staple crops grown in the sub-region for which there presently exists a dependable improved technology. Research results have been promising and the improved varieties of the crop that made their appearance in the sixties have had the greatest impact on crop yields, particularly in the sub-humid zones (HIID 1993). However, the improved genetic materials available for maize for the humid zone require intensified cropping systems. Unfortunately, intensified cropping systems may not be sustainable here as there are no known land conservation technologies which are well adapted to the ecology of the zone.

The bright prospect for maize in the sub-region is in sharp contrast to those for sorghum and millet. Most of the countries of the region do not yet have improved technologies for both crops that are superior to those presently used by the majority of their farmers. Yet, these two crops are the most dominant staples of the region. While High Yielding Varieties (HYVs) of sorghum are currently available for the sub-humid zone, their superior performance will also be dependent on high input levels which are not sustainable over the long-run. In the semi-arid zone, HYVs of sorghum are currently available although they are appropriate only for large scale commercial farms that are generally oriented to brewing or livestock feed production. Some progress has, however, been made in the development of short-duration sorghum and millet varieties for the zone. Although these shorter duration materials provide some

protection to down side risks caused by poor rainfall distribution, they will not contribute significantly to aggregate production, and can encourage farmers to expand to marginal environment (HIID, 1993).

Rice is the fourth ranking crop in Sub-Saharan Africa in terms of area after maize, millet and sorghum. Prospects for the crop are slightly better than those for millet and sorghum. Although yields of rice have, on average, been about one tonne per hectare throughout the last two decades, improved cultivars have demonstrated high yield potential in the range of 3 to 6 tonnes for upland rice and up to 10 tonnes for paddy. HYVs of rice are now available for irrigated systems and work is proceeding for HYVs for upland and inland valley eco-systems. HYVs of rice are already broadly adapted for main season cultivation under irrigation. Varieties for off-season cultivation that are tolerant of temperature extremes and salinity are still in the pipe-line. If and when available, these could have the effect of increasing rice double cropping from 25 to 75 percent of currently sown areas, and yields by up to 40 percent (HIID 1993).

Wheat has traditionally not been an important crop in terms of area in Sub-Saharan Africa. However, increasing levels of importation of wheat for bread into the region over the last two decades, has forced several countries to seek ways of producing the crop. Satisfactory yields for the crop are being achieved in Kenya, Zambia and Zimbabwe and countries such as Chad, Madagascar, and Uganda have demonstrated that reasonable yields are possible there. Wheat yields are still, however, disappointing in the region as a whole due to many as yet unresolved technical and management problems (CIMMYT 1992).

Starchy roots and tubers are next in importance to cereals in the diets of much of Sub-Saharan Africa particularly in the humid zone. Since they make up an important part of the food basket in the sub-region and are the most competitive source of calories and protein with cereals, their production trends affect cereal requirements, and hence the relative significance of cereals production in countries of the sub-region. There appears to be under-utilized high yielding varieties for cassava, with capabilities for increasing production by as much as 50 percent on 50 percent of currently planted areas in the humid zone. Good prospects also exist for sweet

potatoes in the zone. Improved genetic materials are also available for cassava and sweet potatoes for the sub-humid zone (HID 1993).

Overall, it would appear that there is considerable scope for achieving significant and even dramatic increases in food and agricultural production in Sub-Saharan Africa through increased yields. In the rain-fed farming systems where fallow periods are no longer adequate to maintain soil fertility, the target growth in food and agricultural production will require the provision of adequate soil nutrients, combined with improved seed technologies and complimentary practices to increase weed control, good plant population, and other cultural practices. It has been suggested that, given present knowledge and Africa's severe problem of soil degradation, there will be little choice but to depend heavily on these external sources of nutrients (Desai 1990). Already there is some evidence of rapid uptake of new seeds and fertilizer in a number of countries in response to better economic environments (Seckler, 1993).

Possibilities for meeting the target also exist through the extension of land cultivation. This possibility will obviously be naturally greatest in the least densely populated countries of the continent. The rough estimate is that it would be possible to achieve simple annual rates of increase in food and agricultural production of 1.0 to 1.5 percent simply as a result of developing new land resources in the sub-region (Abalu, 1995). Investments in appropriate irrigated facilities would, of course, have the effect of revolutionizing food production in some of these new lands.

There are several encouraging developments which suggest that the four percent target is, indeed, achievable. In 1989, the World Bank reported that Sub-Saharan agricultural production and exports during the previous two decades were growing at well above the long-term average of the 1970's and early 1980's (World Bank, 1989). Indeed, almost a third of the countries of Sub-Saharan Africa are estimated to have had good to excellent growth rates (3.5 percent and above) during most of the period 1986 to 1991, including an excellent performance by Africa's most populous country, Nigeria (Cleaver 1993). An important question, however, is whether there are critical factors which will either prevent its achievement or mitigate its sustainability. These issues are discussed in the next section.

III. THE CRITICAL ISSUES

Sub-Saharan Africa has considerable untapped resources to assure revolutionary increases in food and agricultural production within the foreseeable future. It, however, takes more than mere potential to get the region's agriculture moving. While the creation of the right policy framework and environment is crucial, and we shall return to this later, there are other critical issues which must first be resolved or, at the very least, not overlooked. These include issues relating to: the region's high population growth rate; whether the non-agricultural sectors of the economies of the region will grow at a rate fast enough to absorb the increased agricultural production, and thus prevent depression in farm prices; whether or not there will be enough peace and stability in the countries of the region to guarantee an appropriate production environment; environmental considerations; and the capacity of the countries to analyze, formulate, implement and manage the policies that are needed not only to achieve the target growth rate but also and, perhaps more importantly,

to sustain and build on it is achieved. These issues are discussed below.

The Population Growth Issue

The 4.0 percent growth target was chosen to reflect a 1.5 percent growth rate in per capita production. This is intended to ensure that production keeps pace with the region's rapidly growing population. The plain fact is that the region will remain enthralled by the sheer demands of sustenance and survival even with a 4.0 percent growth in food and agricultural production, unless its population growth rate is significantly reduced.

The annual world population increase is expected to peak between 1990 and 2020. According to the United Nations Median Projections, 933 million people are expected to be added to the world's population during 1990-2000, 921 million during 2000-2010, and 900 million during 2010-2020. About 93 per cent of the population increase - 86 million persons per year - is projected to occur in developing countries. The highest growth rate of population in the developing regions will be in Sub-Saharan Africa. Absolute increase in population between 1990 and 2025 in Sub-Saharan Africa

will be about 800 million (IFPRI, 1994).

Because of the critical relationship between food production, population growth and food consumption in Sub-Saharan Africa, it is important to have a clear idea of what is happening to the African population? As of now the nature of this relationship is not very clear. A recent review of seventeen countries for which data is available for the period 1985 to 1990 suggests that fertility declined in about half of them in the 1990's (Cleland, Onuoha, and Timaeus 1994). Declines in Kenya, Zimbabwe, Botswana and in the black population of South Africa as a result of rising contraceptive use, were clear cut. Appreciable decline also occurred in Sudan (North) primarily because of rising ages at marriage. Modest decline were recorded for Tanzania, Swaziland, Senegal and Nigeria. In the remaining countries for which data are available - Ethiopia, Uganda, Burundi, Mali, Liberia, Ghana, Togo, and Cameroon - no convincing evidence of fertility decline was reported. What does this very mixed picture of the fertility situation in Sub-Saharan Africa suggests? At the very least it must suggest that the usual scepticism about the prospect for fertility decline in the sub-region must give way to more optimism and commensurate strategic policies. Consequently, efforts to attain dramatic increases in food and agricultural production in Sub-Saharan Africa must be accompanied by effective family planning measures.

The Absorbtion Issue

Given the important role that the agricultural sector plays in almost all the economies of Sub-Saharan Africa (often over 60 percent of the national economy), its growth and the nature of its linkages with the other sectors of the economy is critical not only for the performance of the other sectors but also for its own performance. For example, if agriculture is 60 percent of the economy and is growing at 4 percent, the rest of the economy will need to grow at 9 percent if overall growth is to be 6 percent.

The linkage between the agricultural sector and the other sectors of the economy in Sub-Saharan Africa appears to be becoming increasingly dysfunctional. The share of agriculture in GDP which, under normal circumstances, should go down over time as economic transformation takes place, is instead either stagnant or going

up in Sub-Saharan Africa. For example the World Bank's latest World Development Report (1994) estimates that the agriculture share in the economy in 1970 compared with the share in 1992 for Tanzania increased from 41 to 61 percent, in Zaire from 21 percent to 31 percent, in Zambia from 11 to 16 percent, in Zimbabwe from 15 to 22 percent, in Ghana from 47 to 49 percent. Only in a few countries such as Burundi, Niger, Mali, Senegal and Cameroon did it go down during the period and not by much. When these figures are compared to the annual growth rates in agricultural GDP in the different countries during the period 1970 to 1992, a diverse but disturbing picture emerges. There appears to have been little linkage between agricultural growth and what is happening in the rest of the economy in Sub-Saharan Africa. Sub-Saharan Africa appears to be de-industrializing and de-manufacturing. In this regard, the 1980s appear to have witnessed the birth of a fundamental structural change in Sub-Saharan African economies and the region's agriculture ceased to be a key contributor to the growth process whereas it was hitherto a significant contributor in the 1960s and early 1970s. Following this watershed period, the other sectors of the economies of the region appeared to have become increasingly incapable of synchronizing their activities with those of the agricultural sectors in line with the increases in agricultural growth that was taking place.

This calls into question whether a growth rate of 4 percent, once achieved, can be sustained. It also calls into question the capacity of the other sectors of the economy to stimulate agriculture and give it a chance to continue to grow. All of these suggest inadequacies in the structure of existing macro-economic policies, exchange rates, and commercial policies. They also suggest a failure of local industry and manufacturing to generate the needed demand for agricultural products and the failure of policy and investment in infrastructures to enable that demand to be met through local production than through imports. As everyone very well knows, it is cheaper to import rice or maize from the US or Thailand than it is to bring it from the interior of most Sub-Saharan countries, talk much less of carrying them across national borders. The obvious conclusion from this situation is that existing policies have failed to stimulate agriculture. The lesson here is that it is not just enough to blindly promote the continuation of existing policy reforms. Future policy orientations must first find out where and why these policies have failed before trying corrective measures. Africa's agricultural revolution needs the help of the other sectors of the economy to

bring it about.

Peace and Stability

The end of the "cold war," the discredit of the "command economy", the rediscovery of the "market economy" and the re-emergence of "democracy" in Africa have all combined to set the context for the on-going instability of many countries in Sub-Saharan Africa. The region is presently going through a period of crisis and chaos. There is not a single country that is free from the endless catalogue of ills that make normal economic and agricultural activities possible. Sub-Saharan Africa's traditionally proud and resilient people are today tormented by civil strife, political systems that do not work, refugees, drought, corruption, AIDS, and other untold sufferings. The region is thus in a permanent state of war or other forms of instability.

These are, however, man-made problems. The civil wars, corruption, and bad governance confronting the region may be linked to a search for an African solution to African problems following the continent's colonial past that, to some extent, prevented Africans from thinking through their own problems and forced them to adopt a system of values and cultures that were alien to them. Natural problems such as desertification, draught, poor rains etc. have only compounded and exacerbated an already bad situation. Given this kind of instability and uncertainty, is it realistic to expect the countries of the region to be able to successfully tap the huge potentials that exist in their agricultural sectors? Can dramatic increases in food and agricultural production be achieved and sustained without a clear and unambiguous movement towards lasting peace and stability in the region as a whole?

Environmental Degradation

Sub-sahara Africa possesses a varied environment comprising diverse ecological systems. Tropical forests, cool highlands, humid coastal areas, riverine and marshy zones, extensive savannas, semi-arid regions and vast stretches of desert exist side by side throughout the region. This varied topography super-imposed on highly variable soils and rainfall has resulted in a wide combination of production systems and sub-systems including cultivation, herding, hunting and gathering. The diversity

has given rise, over time, to a wide variety of human activities which seek to exploit local and Sub-regional specificities to achieve food security and sufficiency. As a result, contrasting systems involving shifting cultivation, intensive agriculture, organic fertilizer, intercropping, mixed farming, hill side, wetland and dry plains cultivation, water harvesting and irrigation, soil and forest conservation, and nomadic and transhumance pastoralism, now form part of the traditional production systems of African communities.

It is now, however, clear that environmental degradation caused by soil erosion, desertification, deforestation and unwise agricultural practices is seriously undermining the very resources on which many Sub-Saharan African farmers and their families depend for their survival. It is also becoming increasingly obvious that, to be successful and sustainable, any effort to increase food and agricultural production in Africa to keep pace with the increased demands of the population, must be strongly linked to complementary strategies to sustainably manage the natural resource base.

Available evidence (McNamara, 1990; Anderson and Grove, 1987) suggest that environmental constraints are already posing serious limitations to agricultural production in several Sub-Saharan countries particularly in areas where population densities are increasing rapidly. In many of these countries, high population growth rates are already putting excessive pressure on the land. The consequence has been environmentally damaging levels of deforestation and land degradation. Rangelands are being destroyed as a result of overgrazing and wasteful and inadequate management of available water resources. The problem has been compounded by reduced and uncertain levels of rainfall which are aggravating the already deteriorating status of other natural resources. The worsening situation is also being accelerated by destructive cultural practices leading to severe soil problems and loss of valuable agricultural land. Sub-Saharan Africa's ability to dramatically increase and sustain its food and agricultural production will, therefore, depend heavily on the effectiveness of African efforts in reversing this trend and in managing the natural resource base.

Policy Analysis, Formulation and Management Capacities

In many Sub-Sahara African countries, there are not enough of the highly

trained managers, technical experts and economists needed to understand, plan, implement, monitor and modify food and agricultural policies on a continuing basis. Even where a few such individuals exist, they are often inappropriately utilized. Furthermore, the work ethics, high professionalism and selfless interest that is required to achieve revolutionary increases in agricultural production are virtually non-existent among many of the agricultural civil services and within the private sector in many Sub-Sahara African countries. There are many reasons for this unsatisfactory situation including poor remuneration and compensation and no or inequitable opportunities for promotion and upward mobility. Whatever the reasons for it, the end result is usually low morale, misplaced ideals and misuse of public funds. Is it possible to develop, in many Sub-Saharan countries, a cadre of trusted and respected agricultural administrators at all levels to guarantee the much needed capacity for the analysis, formulation and management of sound policies for the agricultural sector?

External Forces

The external environment has traditionally influenced Sub-Saharan Africa's strategy for food and agricultural production. Most countries of the region depend on an agricultural trade surplus to finance their imports and to service their debts. UNECA (1995) data suggest that there are two major trends in the external arena which should be causes for alarm. First, the total outstanding external debt of Sub-Saharan Africa stood at US\$270 billion in 1990. This debt cost the region US\$23 billion to service in 1991. The share of multilateral debt in the region's aggregate debt stock rose 24 percent in 1993. This compares to 20 percent in 1992 and 19 percent in 1991. The external debt to GNP ratio, the debt to export ratio, and the debt service to export ratio have all been rising since the 1980s. Meanwhile, official development assistance (ODA) flows is on the decline. Second the share of Sub-Saharan African trade has fallen from about 4 percent at independence to only 1.7 percent in 1994. What is worse, intra-African trade amounted to only 5 percent of total African trade in 1994.

The rising debt burden in the face of falling values of the continent's raw materials exports, reductions in market shares, worsening terms of trade, the development and increasing acceptance of synthetic substitutes for many of the

region's products, inadequate international capital flows into the region, breakthroughs in biotechnology and lack of significant progress towards more effective intra-regional cooperation and integration suggest all point to major external bottlenecks over which the countries of the region have little or no control but which will affect their capacity to increase and maintain their agricultural productivity and production. Can an African agricultural revolution take place in the shadow of the region's huge debt overhang? Will Sub-Saharan Africa be able to face the challenges that are being imposed by emerging and more competitive global markets.

IV. REQUIRED ORIENTATIONS OF FUTURE POLICIES

We dwell on the critical issues raised above not to raise doubts about Sub-Saharan Africa's ability to rise out of its present predicament but because we believe that it is our understanding of these critical issues that would shed useful light on the future orientations in policies that must be pursued.

There is presently an absence the kind of coherent national policy frameworks that will usher in and sustain dramatic increases in food and agricultural production in Sub-Sahara Africa. For example, inappropriate pricing, and tax policies often encourage excessive use of inputs, over-exploitation of land as well as environmentally degrading cropping and livestock production patterns. Research results suggests that "good" food and agricultural policies including policies associated with agricultural institutions, infrastructures, and human resources development, influence farmers in deciding which type of production technologies to adopt or adapt as well as the choice of the techniques to use. New and more imaginative orientations in the policy environment in these areas are needed to dramatically broaden the adoption and diffusion of the required production technology to substantially increase output per hectare of virtually all agricultural products produced in the region.

The fact is that the achievement of a Sub-Saharan African agricultural revolution can only come from better domestic policies which result in higher food and agricultural production, higher economic growth, and lower population growth. In the past, the elements of the policy environments on offer to Sub-Saharan African countries have varied depending on the institutional context of the interested parties.

Common elements in most policy prescription packages for Sub-Saharan Africa have, however, included: reform of price, exchange rate, marketing and input supply policies to provide incentives for private sector investment in farming, marketing and processing; improved security of land tenure to induce conservation investments and improve access to credit; increased investment in research and extension, rural infrastructures, and human development including, education, health and nutrition; and improved management, priority setting, and agroclimatic targeting of research and extension efforts (Rosegrant and Agcaoili, 1994).

Indeed most Sub-Saharan African countries have, during the past 10 years, attempted to apply these reform measures with the assistance of the World Bank and the International Monetary Fund. Ten years ago both of these institutions as well as most of Sub-Saharan Africa's other "givers of aid" insisted that the appropriate policies for the region's agriculture was to get the prices right, open up the markets and devalue the exchange rate. They had no doubt about the eventual beneficial outcome of these policies and many Sub-Saharan African countries obliged and implemented them. Today we know better. It must be obvious to any objective observer that this very simplistic policy approach has not worked in Sub-Saharan Africa. New orientations are, therefore needed. Below we outline the main elements that could guide these orientations

Measures to Empower Farmers

Experiences from Africa and elsewhere inform us that in most situations where ordinary farmers have succeeded in raising their productivity and their standard of living, they have first acquired political muscle and influence. In Sub-Saharan Africa, lip service to the plight of the region's farmers abound with very little progress to show for it. However, in the few African countries where farmers have been empowered in the political process, they have been able to develop viable farmer organizations and other political constituencies that have been powerful enough to successfully make the case in the political arena for significant and sustained public investments in agriculture and in the rural communities. Zimbabwe is a good example. This is particularly important given the huge investments that are still needed in many countries of the region to develop the human resources and install the institutions and

infrastructures that are need to allow the agricultural sector to grow rapidly.

The Development and/or Adaptation of New Farm Technologies

Many African farmers are still using low yielding agricultural technologies which contribute not only to low production but also to reduced labour productivity. Why one must ask, despite the billions of dollars that have been spent on national and international research to improve agricultural technologies in Sub-Sahara Africa, the situation is not improving much. Logic would suggest that the stumbling block here may not be agricultural research itself but the linkage between agricultural research and the farm. If this is true, then the International Agricultural Research Centres and the National Agricultural Research Systems have been a big disappointment. Where is the transfer of technology that we all talk about? Where is the training that the Consultative Group on International Agricultural Research (CGIAR) institutions frequently use to justify their budgets? Where is the capacity building in national programmes which is so essential for technology transfer and sustainability? What has happened to the dreams of farming systems research and on-farm adaptive research which, just a few years ago, seem like the panacea for the region's technology generation and adoption problems?

National systems must commit themselves to long-term public and private investments in agricultural research as well as to a systematic effort in introducing improved technologies from the existing global research stock and adapting them to local conditions. There cannot continue to be business as usual for many of the CGIAR international agricultural research centres which service Sub-Sahara African agriculture. They must in future not only be concerned, but more importantly, their strategies and work programmes should be seen to be oriented towards the business of technology transfer and capacity building in the countries of the region. In this regard, the emphasis every where should be on the communication of research results to farmers in a useable form and the establishment of the national and international means to enhance research-extension-farmer linkages and the efficiency and relevance of technology generation and transfer.

Given the limited available financial and, in particular, human resources and thanks to existing experiences of the newly transformed economies of Southeast and South Asia, Sub-Saharan Africa does not have to continue to spend scarce resources on basic research in genetics, plant physiology, biotechnology etc. The future orientation should be towards a concentration of efforts around adaptive agricultural research. The objective should be to develop, in stages, national research services covering all sub-sectors and focused sharply on the needs of each country's different agro-ecological zones and production systems, supported on a broad front by regional and international research arrangements.

Improving the Performance of Critical Institutions

To achieve its food and agriculture goals, national policies and strategies must be supported on a broad front by a set of institutions, both public and private, which provide economic and other services, to directly or indirectly influence the success of the farmers involved. These institutions must make and implement strategic decisions that influence the allocation of resources, regulate and stabilize socio-economic processes, adjudicate between competing interests, and convert public resources into common benefits. Renewed public and private investments geared towards improvements of the performance of institutions involving marketing, credit, research, extension, and land reform are, therefore, essential.

With regards marketing, the future policies should ensure that farmers have easy and ready access to national, regional and international markets. At the national level the orientation should be towards: more efficient rural transport systems; the development of storage facilities; reduction of transaction costs including formal and informal "non-tariff" barriers; improved product quality; support for agro-processing; and better market intelligence. At the regional level the focus should be on: wholehearted and serious implementation of existing regional integration agreements; better market intelligence; and support for increased intra- and inter-regional trade through the elimination of tariff and non-tariff barriers, and a better and faster response to changes in regional demand and consumption preferences. At the international level the orientation should be towards a better understanding of the workings of global markets including the nature of the evolving competition

environment and how to cope and survive in it; and better negotiating African capacities and skills to ensure fairer access to world markets.

With regards extension, the orientation should be towards a pragmatic approach and strategy which experiments with a number of alternative extension approaches as opposed to current World Bank preference and practice of being locked on to one universal model. Such an orientation is not only wise but also prudent in the face of resource constraints imposed by operating structural adjustment programmes in many Sub-Saharan African countries. Many of these countries would benefit more from this flexible approach which experiments with different extension models and extension-farmer ratios and whose major objective is to develop cost effective ways of providing extension services to the majority of each country's farmers.

Future policy orientations should also ensure easier access to credit and agricultural inputs such as seed and fertilizers through the encouragement of alternative group action by farmers such as joint ventures, cooperatives, farmer associations, etc. to improve the bargaining power and position of the farmers.

Effective Capital Investments in Physical Infrastructures

Physical infrastructures or social overhead capital, as they are sometimes called, provide services which are critical for the attainment of national and regional food and agriculture production goals. The contributions of fiscal infrastructures in reducing the cost of marketing food and agricultural products in Africa are obvious and well known. Imperfections in rural labour markets can often be traced back, in most Sub-Saharan Africa countries, to inadequate infrastructures. A network of well maintained rural roads is essential for the timely delivery of the fertilizers and other purchased inputs that are so vital for increased production and for the prompt evacuation of farm produce to minimized post-harvest losses following bumper harvests made possible by the adoption of improved agricultural technologies. Appropriate investments in physical infrastructures such as rural roads and irrigation facilities will, therefore, deliver major benefits in food and agricultural production growth, poverty alleviation, and environmental sustainability, provided these investments respond to the felt needs and constraints of the farmers and of the area.

Development of Human Capital

Many Sub-Saharan African agricultural training, health and other social institutions have just simply broken down. Human resources development in the agricultural sector is fundamental to longer-term sustainable growth in food and agricultural production. This will become even more important in the future with the globalization of production and the increasing importance of human capital. Investments in rural health and education are, therefore, critical not only for sustainable increases in food and agricultural production but also for long-run sustainable reduction in poverty. To be effective, however, these investments must be allocated efficiently across activities, regions and ethnic groups. Furthermore, sensitivity to gender considerations is critical because the building of much neglected female human capital has a significant impact on the welfare of other members of the household, particularly children, including their long-term production and income-earning prospects.

Land Tenure

The present land tenure situation is unsatisfactory in many countries of the region. Sub-Sahara African Governments would need to take action to ensure equity in access to land to provide incentives for their conservation and improvement. In many countries, it will be necessary to establish clear rules on access, ownership and use of land particularly by women. In some cases, this may require individual title deeds while in others there may be need for formalization and effective enforcement of traditional systems of land tenure and use. Under some circumstances, it may be necessary to evolve new property rights regimes and build new institutions to ensure their implementation.

IV. CONCLUSION

Sub-Sahara Africa's economic malaise is first and foremost a malaise of the inability of the region's agriculture to continue to contribute to the overall growth process in the region. The decline in food and agricultural production over the years has become synonymous with the region's stagnation, social decline and

marginalization in the world. Unless renewed measures are taken by the Governments and people of the region to dramatically increase agricultural production, there will be continued deterioration and stagnation throughout the region. Concerted efforts are needed not only from within the region but also from the international community to ensure that the right mixture of policies are put in place to promote and sustain a minimum annual rate of increase of food and agricultural production of at least 4 percent per annum during the rest of the 1990s and beyond.

The potential exists for attaining and sustaining such an ambitious growth rate provided there is peace and stability and the political exists. Furthermore, renewed efforts are needed to slow down the growth in population and to ensure that the environment is protected. It however, takes more than family planning measures, peaceful coexistence, the greening of Africa and empty political rhetoric to feed Africa. These have to supported by the right mix of policies to achieve and sustain the target rate of growth through accelerated investments in agricultural research and technology aimed at yield enhancement and stabilization, the development of rural infrastructure, the strengthening of rural institutions, and adoption of policies that will facilitate access by farmers to land and modern inputs, improve farm management, provide necessary production incentives, and enhance exchange of goods and services between urban and rural areas, between and among the countries of the region and between the countries of the region and the rest of the world.

There is no doubt that if rapid agricultural growth is to be achieved and sustained in Sub-Saharan African countries, concerted action and joint efforts would be required so that the different countries in the region can develop within a common framework that takes cognizance of their peculiar needs. It should now be obvious to everyone that African countries working alone would find it very difficult to revolutionize their agricultural sectors. In this regard, the continent cannot afford to be left out of the general world trend towards regional trading blocks. This is particularly true with respect to the attainment of their food production objectives. Increased trade among African countries, collaborative agricultural research programmes, the implementation of joint food security strategies, and joint natural resource management, particularly river basin development are just a few areas where

regional cooperation would be essential for meeting the future food needs of the sub-region.

Unfortunately, Sub-Saharan Africa has not had a particularly good record with respect to cooperation in this area. Although most of them have long recognized the importance of regional cooperation and indeed have entered into a variety of agreements, old traditions and the absence of long-term political commitment have prevented them from translating the noble objectives of these agreements into concrete action. On the contrary, many Sub-Saharan African countries have become so used to food and other assistance from the developed world that they have become incapable of thinking seriously in inter-African or south-south terms. The fact is that as long as the agricultural and economic relations of Sub-Saharan African countries remain strongly oriented to the developed countries, regional cooperation in Africa will continue to be a programme of wishful thinking and the much needed dramatic and sustainable increases in food and agricultural production a distant dream.

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