report of
the tac quinquennial review mission
to the
west african rice development association
(warda)
THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH
TECHNICAL ADVISORY COMMITTEE
Twenty-First Meeting, Washington, 13-20 February 1979

REPORT OF THE TAC QUINQUENNIAL REVIEW MISSION
TO THE
WEST AFRICAN RICE DEVELOPMENT ASSOCIATION

TAC SECRETARIAT
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1979
REPORT OF THE TAC QUINQUENNIAL REVIEW MISSION
TO THE
WEST AFRICAN RICE DEVELOPMENT ASSOCIATION

1 - 18 September 1978

Dr. Hussein Idris (Chairman)

Messrs.: R. Chabrolin
         V. Ruttan
         S. Risopoulus (Secretary)
         J. Coulter (Observer)
Dear Dr. Cummings,

I am pleased to submit to you the report of the Panel of the TAC Quinquennial Review of the West African Rice Development Association (WARDA) and thank you and TAC for offering us, members of the Panel, the opportunity to learn and humbly contribute towards improvement of rice research in West Africa.

This review has benefitted from the experiences of past reviews (IRRI, CIMMYT, CIP, CIAT and IITA) and has followed the new terms of reference and guidelines for conductance of TAC quinquennial reviews. This report, also, contrary to previous procedures is being submitted to you and TAC for the first time in a final form within three months from conductance of the review. This is a new practice which may prove beneficial to the Centres, TAC and the CGIAR.

WARDA is unique amongst the activities supported by the Consultative Group. It embraces research and development activities. It is controlled by a Governing Council of the fifteen West African member states and financed partly by them and by several bilateral donors and the CGIAR. WARDA research activities are conducted in the centres and experimental farms of member nations by predominantly African scientists from the same countries.

Though the Panel focused its attention mainly on those aspects related to research and especially those which are financed by the CGIAR, it had the opportunity to have a general overview of all WARDA programmes and comment on them. The Panel, accompanied by the Executive Secretary of WARDA and the Senior staff visited all WARDA facilities and the Ministries of Agriculture in Liberia, Sierra Leone, Senegal, Mali and the Ivory Coast.
The Panel observed that justifications for the establishment of WARDA in 1970 still hold today as the rate of rice consumption in the region has been rising more rapidly than the population growth and more rapidly than production. The Panel is satisfied that WARDA has achieved highly commendable progress in implementation of its mandate and realisation of the goals set for it and recommends strongly continued CGIAR support to its research programmes. The report describes in some detail the research components financed by the CGIAR and gives a general account on the other programmes and arrives at recommendations for consolidation and strengthening of various activities.

It is noteworthy that the CGIAR supports in the WARDA's research programme the coordinated trials (W1) which correspond to the outreach activities of other IARCs and which are normally supported by extra-budgetary funds (i.e. bilateral donors). In WARDA, the bilateral donors participate in financing the Special Research Projects or the sub-regional centres at Fako (Sierra Leone), Richard-Toll (Senegal), Mopti (Mali) and Bouaké (Ivory Coast). The Special Research Projects are formed of multi-disciplinary teams engaged in research in variety improvement, agronomy, soil fertility and management and plant protection.

Out of the four components,

1. Coordinated trials
2. Variety improvement
3. Soil fertility and management
4. Plant protection

of the research programme submitted by WARDA to TAC and the CGIAR, TAC endorsed in 1973 the W1 (Coordinated trials) project as worthy of CGIAR support. It was then believed that improved strains of rice from the IARCs (IRRI, CIAT and IITA) and Asian countries would be tried in the WARDA countries and high yielding and widely adapted strains and varieties would be identified and adopted. Moreover, the project was particularly appealing in view of promoting cooperative ties in rice research between the member states and as a vehicle for strengthening national research capabilities through training. Though separate funding by bilateral donors and WARDA member states was then sought for the W2-W4 programmes, advantages of integration of W1 with W2-W4 programmes were duly realised.

The results of the coordinated variety trials soon revealed that, generally, introduced strains and varieties of rice proved inferior in yield to local varieties particularly in the countries which had long history of rice improvement programmes, e.g. Liberia, Sierra Leone and the Ivory Coast. Exceptions were superiority of IRRI's strains under irrigation at Richard-Toll and some deep water and floating rices from Bangladesh at Mopti. The necessity of undertaking vigorous rice improvement programmes in situ under different ecological conditions became compelling and the relative importance of rice improvement and multidisciplinary research conducted at the sub-regional centres or Special Research Projects progressively increased.
The Panel heavily underlined the importance of research in the Special Research Projects or sub-regional centres and recommended their strengthening and inclusion of at least the Team Leader of each centre in the core budget. The Panel also recommended the consolidation of the number of the coordinated trials at their present level with the view of gradual devolution of full implementation responsibilities to the national systems. It is foreseen that the CGIAR support in future will gradually shift towards strengthening the sub-regional research centres. This will meet a greatly felt need and will also conform more closely to CGIAR practice with regard to other IARCs.

The Panel noted the new proposals of the Governing Council of WARDA for research in upland rice, control of grain-eating birds, farming systems, mechanisation and nitrogen fixation. The Panel recommended that in view of present commitments in hand and scarcity of resources, WARDA should concentrate efforts on ongoing programmes and approach with caution new ventures. Nevertheless in view of the importance of upland rice in West Africa (occupying about 60% of the rice area) the Panel shares the concern of the Governing Council and endorses the plan of the management for holding a seminar involving all concerned rice research institutions to discuss the issue in depth.

The WARDA management has to be commended for excellent forward preparations for the Panel's visit. Voluminous documentation on WARDA's activities were provided but in the area of forward planning more work and financial quantification would be needed.

The Panel was constantly aware throughout its examination of WARDA's activities of the deficiencies and complexity of the funding procedures. The Panel recommended collaboration of the African Development Bank, the CGIAR Secretariat and others with WARDA for holding a Consortium of WARDA donors to arrange for a more assured and regular funding.

The Panel has greatly appreciated meetings with H.E. Mr. J. Baker, Deputy Minister of Agriculture, Liberia; H.E. Mr. A.F. Joe Jackson, Minister of Agriculture and Forestry, Sierra Leone; H.E. Mr. J. Diouf, Delegate General for Scientific Research and Technology, Senegal; Dr. Boubacar S. Sy, Directeur de Cabinet, Ministry of Rural Development, Mali; Dr. Dessongoi Kone, Adviser/Ag. Directeur de Cabinet, Ministry of Agriculture, and Mr. H. Leroux, Directeur de Cabinet, Ministry of Scientific Research, Ivory Coast. The Panel could feel the enormous political backing and goodwill enjoyed by WARDA in these countries.

I wish to record my thanks to all members of the Panel for their valuable contribution, understanding and pleasant disposition throughout the tour. Special thanks are due to Mr. S.A. Risopoulos, Member/Secretary and Dr. J. Coulter, Observer for their considerable contribution in various stages of the preparation of the report.
On behalf of all the Panel members I wish to register our gratitude to Mr. S. Coulibaly, Executive Secretary of WARDA and his colleagues for excellent arrangements and hospitality and for accompanying the Panel in all its visits to the WARDA countries. Thanks are also due to H.E. Mr. P. Akpo, Chairman of the WARDA Governing Council and Minister of Rural Development, Benin, for presiding over the final joint meeting with WARDA management and receiving the Panel's comments, major findings and recommendations.

Finally, I wish to thank you Dr. Cummings and Mr. Mahler for assistance in launching the Panel's tour and for most helpful comments in the preliminary draft of the report. I hope that the Panel's report which I humbly submit to you will contribute towards helping TAC, the CGIAR and WARDA in their endeavour for attaining self-sufficiency in rice production and social welfare in West Africa.

Yours sincerely,

Hussein Idris
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I. INTRODUCTION

1. At its fifth meeting, in July 1973, the Consultative Group on International Agricultural Research (CGIAR) saw the need to assess the overall scientific quality and effectiveness of the work being carried out by the International Agricultural Research Centres (IARCs) which it was financing.

2. The Technical Advisory Committee (TAC) to the CGIAR accepted the mandate to carry out review missions every five years, on terms which were agreed upon by the Directors of the IARCs and the CGIAR, and defined by TAC as follows:

"on behalf of the Consultative Group, to assess the content, quality, impact and value of the overall programme of the centres, and to examine whether the operations being funded are being carried out in line with declared policies and to acceptable standards of excellence".

It was hoped that the review will inter alia assist the International Centres themselves in planning their programmes and ensuring the validity of the research priorities recognized by the Boards of Trustees.

3. After the review of IRRI, CIMMYT, CIP, CIAT and IITA, the TAC decided, at its 16th Meeting (May 1977) to carry out the evaluation of WARDA. The terms of reference and list of special questions were discussed at subsequent TAC meetings and with the WARDA Executive Secretariat, members of the Consultative Group and Co-sponsors. They were finalized at the 19th TAC Meeting (June 1978).

4. It was stressed that, in reviewing WARDA's activities, and programmes, the Review Panel would concentrate mainly on those aspects which are related to research and especially those which are financed or to be financed through the CGIAR. The Review Panel would however examine these activities and programmes keeping in mind the overall perspective of the whole WARDA Programme and to this end be fully apprised of other aspects which are not directly related to research.

Terms of Reference

5. In pursuance of the main objective, defined above, the Panel was requested to give particular attention to the following aspects:

The CGIAR is an informal group of donors, which in 1978 totalled 27. Created in 1972, the CGIAR has disbursed about $350 million from that date until 1978. The estimated contributions to eleven international agricultural research centres amount to $86 million in 1978, and will reach $103 million in 1979.
(i) The Mandate of the Association, its appropriateness and the interpretation thereof with respect to:
   a) the immediate and long-term needs for improved rice supply and human welfare in developing countries in West Africa;
   b) present and possible future areas of work.

(ii) The relevance, scope and objectives of the present programme of work and budget of WARDA and of its forward plans for the next five years in relation to:
   a) its mandate and the criteria for the allocation of resources as defined by TAC;
   b) the ongoing activities of other international institutes and organizations, and of relevant national institutes in cooperating countries and in others where the work of the institute has bearing;
   c) the policy, strategy and procedures adopted by the Association in carrying out its mandate, and the mechanisms for their formulation;
   d) the Association's rationale for its present allocation of resources, its present and future overall size, and field of research, training, documentation, information exchange and related cooperation activities.

(iii) The content and quality of the scientific and related work of WARDA with particular reference to:
   a) the results of past research;
   b) the current and planned research and the role of the scientific disciplines therein;
   c) the information exchange and training programmes, their methodologies and the participation of the research staff therein;
   d) the adequacy of the research support and other facilities;
   e) the management of the scientific and financial resources of the Association and the coordination of its activities.

(iv) The impact and usefulness of WARDA's activities in relation to:
   a) the present and potential impact of the research conducted by the Association;
   b) its information exchange and training programme;
   c) cooperation with national research and development programmes;
   d) cooperation with other international institutes and organizations.

(v) Constraints on WARDA's activities which may be hindering the achievement of its objectives and the implementation of its programmes, and possible means of reducing or eliminating such constraints.

(vi) Any specific questions which concerned members of the CGIAR cooperating institutions, the Executive Secretary or Governing Council may request TAC to examine.
Specific Questions

6. Further to the above, the Panel was given the following list of specific questions to consider:

(i) Examination of WARDA's forward planning process in general and the planning of its W-1 research programme on a five-year basis.

(ii) Relationships between WARDA's W-1 and W-2 - W-4 programmes.

(iii) The research/extension nature of WARDA's research programmes; dividing lines and responsibilities of WARDA vis-à-vis national programmes.

(iv) Programme balance both within and between W-1 varietal trials and the W-2 - W-4 programmes, and between research programmes and the remainder of WARDA's activities, e.g. what relative emphasis is given to the adaptation to and selection for specific environments versus wide adaptability; what is the rationale for the present programme balance between rainfed, irrigated, mangrove and floating rices?

(v) Training levels and appropriateness of the training at the WARDA training centre with respect to management of WARDA's trials and its country programme.

(vi) Relations of the WARDA research department with other IARCs and agencies, especially:
- a) IITA and IRRI - on rice work in West Africa;
- b) ICIPE - no provision is made for collaborative work;
- c) FAO/UNDP - development programmes at WARDA.

(vii) Relationships with national programmes, donors and other non-IARCs especially with respect to WARDA's role in variety testing vis-à-vis that carried out by national programmes.

(viii) Linkages between headquarters and off-campus programmes. Feedback mechanisms and comparative staffing levels of these programmes and headquarters.

(ix) Quarantine needs. WARDA's approach and needs.

(x) Management, especially of the multi-location trials.

The Review

7. The Review Panel, assembled in Monrovia on 30 and 31 August 1978, visited from 1 to 9 September different field activities of the Association or related to it in Liberia, Sierra Leone, Senegal, and Mali with the help of a chartered twin-engine aircraft. It visited three special research projects (Rokupr, Richard-Toll and Mopti) and had time to visit research stations, coordinated trials, as well as some rice development activities in the region. Talks at Ministerial level were held in Monrovia, Freetown and Dakar.

8. From 10 to 16 September, the Review Panel had in Monrovia detailed discussions with the WARDA Secretariat and staff on the different components of the WARDA programme, and worked on the conclusions which would seem to appear from the review exercise. During the last day, the Review Panel discussed the salient points of its draft report with the Chairman of WARDA Governing Council
(His Excellency Mr. P. Akpo, Minister of Rural Development in Benin), with the
Executive and Deputy Executive Secretary of WARDA and their staff and with the
Deputy Minister of Agriculture of Liberia.

9. On 17 September, part of the Panel* visited the special Research Project and
National Research Programme at Bouaké, Ivory Coast. On 18 September, accompanied
by the Executive Secretary of WARDA, it had discussions with the Ministries of Agri-
culture and Scientific Research of the Ivory Coast in Abidjan.

10. The composition of the Panel, and details of the itinerary and work schedule
figure in Annex I.

The Report

11. The Panel, when preparing its report, has taken into consideration the fact that
WARDA is unique among International Agricultural Research Centres. As WARDA is
less known than other IARCs, and in order to give due recognition of the considerable
work which WARDA has accomplished during the last years, the Panel has thought fit
to give in its report adequate technical details regarding WARDA's structure and
activities.

12. The report contains also a certain number of maps, annexes, and tables which
give information on WARDA's research sites, programme budgeting and rice economics
and which should help in putting WARDA's role in perspective.

13. Chapter II which follows the present introduction, will give the reader, who
wants to peruse the report quickly, a summary of the observations made and
recommendations proposed by the Panel.

* Mr. R. Chabrolin and S. Risopoulos.
II. SUMMARY OF OBSERVATIONS AND RECOMMENDATIONS

The Review Panel underlines the validity of the mandate of WARDA and is satisfied with the progress made to date. It recommends the consolidation of the coordinated trials and supports the reorganization of these trials on an ecological basis. It recommends the phased inclusion of the present special projects in the core programme of WARDA. It recommends the preparation of a five-year plan of work indicating allocation of resources and redefining the core programme.

The Panel further recommends that this plan be presented to a consortium of donors for coordinating and regulating funding arrangements.

14. WARDA is strikingly different from other International Agricultural Research Centres in many ways: it is governed by fifteen member states which elect the top management and provide a cash subscription to the total budget of WARDA. The WARDA activities encompass both research and development; only part of the WARDA research programme is directly supported by the CGIAR. Nevertheless, as will be seen later, this contribution, which amounts now to about a third of WARDA total budget has played, together with the initial and long term assistance of UNDP/FAO, a significant role in ensuring the success of the initial phase of the Association's development, and in securing WARDA's credibility against a quite difficult mandate.

15. WARDA has been entrusted with the attainment of regional self-sufficiency in rice, through the improvement of the quality and quantity of rice production in a region covering more than 600 million ha, where rice is cultivated in about nine different major types of conditions. The countries concerned, totalling more than 120 million people, have a variety of cultural background, administrative heritage and agricultural traditions. Rice development is but one of the problems faced by WARDA countries, which are among the least favoured ones, in terms of financial resources and trained manpower.

16. In this context, it is evident that the objectives of WARDA's mandate are long term ones and that achievements cannot be measured in immediate gains in production, as, for some time to come, technical advances will be overshadowed by climatic variabilities and development constraints.

17. The Panel has noted that the rice consumption in the region has been rising more rapidly than the population growth rate, and local rice production. The deficit, made up by imports, represents a significant drain on the foreign exchange earnings of WARDA countries. If imports continue to rise, they will put increasing pressure on a narrow international rice market which is subject to wide fluctuations of prices.

* See Annex 3 (page 73) "Classification of Rice Cultivation in WARDA Countries" and Figure 3 (page 63).
18. The Panel supports the view that the mandate of the Association - five years after the beginning of the field activities - still addresses itself to important problems and meets, in particular, the priorities for research, as underlined in the CGIAR Report of the Review Committee* as regards "the needs of low income countries where large food shortfalls threaten over the next decade and beyond".

19. Due to the ambitious nature of the mandate, the search for additional funding has been a major preoccupation of the WARDA management since the inception of the Association. Besides UNDP/FAO and the CGIAR (and the member states own resources), WARDA receives the assistance of fourteen bilateral donors, each with its own concepts of assistance, time span, financial and review procedures.

20. The Panel underlines that WARDA should be commended for its successful efforts in securing the above assistance, and, in spite of financial and political constraints more severe than in the case of other IARCs, for developing an operational structure.** Quite understandably, the growth and achievements rate of the different segments of the WARDA programme have been influenced by the timing of external assistance, and this has presented the WARDA management with additional problems of harmonization and linkages.

21. The Panel feels however, that WARDA has demonstrated the validity of a regional approach to a commodity problem in which the wide diversity of ecological conditions and cultural practices figure significantly.

22. The Panel also feels that the decision making process is well-balanced and able to reflect the needs of the region as a whole, and of the member countries.

23. The CGIAR/TAC decided to become involved in 1973, after the identification by leading international centres and agencies of four priority research programmes, viz. W-1 coordinated trials, W-2 varietal improvement, W-3 soil fertility and management and W-4 plants protection.

24. It was thought at that time that the chief role of WARDA would be to facilitate the transfer of technology from IARCs such as IRRI to country level: the W-1 programme was therefore selected for CGIAR support as most appropriate to this function; varietal improvement (W-2) was thought less important as the concept of wide varietal adaptability was prevalent at that time among IARCs. The W-3 and W-4 programmes were thought to be more location specific.

25. The major thrust of the CGIAR-supported research has therefore been the coordinated trials, and these have been divided into the Initial Evaluation Test (IET) and the coordinated trials proper (variety trials and plant protection trials).

26. The Panel supports the view that the coordinated trials have enabled countries to save time by supplying them with seeds of strains and varieties for testing under a wide range of ecological conditions throughout the region and under uniform and standard procedures. This has been particularly valuable for smaller countries with limited research capability. The trials have also contributed to the development of a greater awareness and knowledge of rice problems among participating countries.

27. The Panel has also noted that the coordinated trials have given WARDA the opportunity to train 150 national technicians, thereby increasing their research capability. This has been clearly reflected in the improvement in the quality of the

* January 1977.
** See Charts 1 and 2, pages 64 and 65.
coordinated trials and the Panel hopes that the trend will be reinforced by the closer involvement of the national services.

28. Member states are pressing for an increase in the number of coordinated trials (apart from the requirements of newly admitted members) which, in the Panel's view, would not mean a corresponding increase in the usefulness of the trials; therefore the Panel recommends the consolidation of this programme. The Panel also anticipates the gradual transfer of full responsibilities for implementation of the trials to the member states as is the case between other IARCs and collaborating countries.

29. It further endorses the reorganization of the coordinated trials on an ecological zone basis and the devolution of new insecticide and herbicide trials at Special Project level.

30. The coordinated trials are monitored by a central coordinating team and backed by technical support services.

31. The Panel endorses in principle the plan of WARDA for strengthening the technical support services, which will include the additional recruitment of an assistant plant breeder, assistant plant pathologist and a fully-fledged entomologist.

32. The Panel recommends, however, that those additions be conditional to a closer involvement of the senior staff of the technical support services in the monitoring of the coordinated trials and in the backstopping of the young scientists of the Special Research Projects, through consultancies of adequate duration on the site of the trials and projects.

33. The Panel therefore suggests that the above addition to Headquarters-based staff be re-examined after an adequate period of time.

34. A recent addition to the research structure of WARDA has been the appointment of sub-regional coordinators which signals a decentralization of the supervision of some activities. Each sub-regional coordinator located in one of the member countries will supervise WARDA trials in a group of 2-4 neighbouring countries.

35. The Panel underlines the growing responsibilities of the sub-regional coordinators and recommends that they be fully briefed and assisted by Headquarters services.

36. In addition to the coordinated trials, a restricted* number of on-farm trials will be conducted. The Panel recommends that these trials be part of the sub-regional coordinators responsibilities with a view to testing and demonstrating improved technologies to national services before a wider extension of these technologies to the farmer communities by these services.

37. WARDA has had to tap diverse sources of financing to establish multi-disciplinary research projects, which would concentrate on the research elements not covered by the CGIAR contribution. Four special projects are now in existence and dealing with broad categories of rice cultivation.**

38. Due to the above financial constraints, the oldest special research project has been in existence for barely two years.

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* Ten per country.
** See Chart 2, WARDA Research structure, page 65.
39. The Panel is of the opinion that these projects play an important role, in the
definition of a package of improved plant material and cropping practices. The Panel
is satisfied with the multi-disciplinary approach followed by the WARDA teams, and
hopes that the special projects will be able to promote major advances in rice
production in the areas concerned.

40. To this end, the Panel recommends that the Special Project teams be brought to
full strength, and that the post of team leader be at least included in the core budget of
WARDA and funded by either the CGIAR, or the member states or by a suitable
mixture of both.

41. The Panel was impressed by the seriousness of the young African scientists
who were met on the site of the Special Projects, and by the quality of the work carried
out by them.

42. The Panel recommends that the regional character of the Special Projects be
enhanced through more frequent contacts between the scientists of the different projects
and by inter-change or mutual secondment of personnel.

43. The Panel has noted that among the additional research elements proposed by the
governance of WARDA for inclusion in the Special Projects programmes, would figure
upland rice, control of grain-eating birds, farming systems, mechanization and
nitrogen-fixation.

44. The Panel recognizes the importance of these factors for rice production in West
Africa, but advocates caution before undertaking major programme expansion.

45. The Panel supports the intention of WARDA to convene a seminar of interested
parties on upland rice, with a view to assessing the need for an appropriate research
project.

46. As OCLALAV* has in the region a strong interest in the control of grain-eating
birds, the Panel suggests that WARDA seeks the way to cooperate with OCLALAV as
regards bird control in rice growing areas.

47. The Panel further suggests that WARDA select and test the parts of on-going,
N-fixation research programmes carried out by other institutions and which would be
best applicable to the region.

48. As regards mechanization, the Panel feels that WARDA should, at Special
Project level, follow, assess and utilize the results of the mechanization projects in
the region.

49. Farming systems research was thought to be the primary responsibility of the
national services. The Panel thinks however that WARDA's experience could become
useful in this field; it is suggested that cooperative arrangements be secured with
appropriate research institutions (such as IITA, the Institut du Sahel, etc.) working
on farming systems in the region.

50. In addition to the above, the Panel recommends the inclusion of a production
economist in each Special Project, capable of working on issues such as the
implication of technical resources and institutional constraints on rice production and
factors affecting the acceptance of new technology at farm level. The economist could

* OCLALAV - Organisation Commune de lutte anti-acridienne et de lutte anti-
aviaire. (Common organization for locust and bird control).
also assist in assessing the need for or in specifying the substance of possible farming systems research, together with other team members.

51. The research programme of WARDA (the network of activities grouped around the coordinated trials and the special projects) represents half of the WARDA's total budget. Quite understandably it has drawn on the assistance of the other units of the Association and the Panel has noted that in particular the Development, Training, Documentation and Communication Units have assisted considerably in the Research Programme of WARDA.

52. The Panel would like to draw the attention of the funding institutions to the essential linkages and complementarity between research and the other parts of the WARDA programme.

53. The Development Department has in fact conducted some economic research besides providing analysis at the planning and policy levels and to project preparation. In recommending the appointment of economists at the Special Project level, the Panel has in mind to strengthen this capacity for economic work.

54. The Panel recommends also that WARDA seek ways to establish a more viable structure for its seed production project, and assist member countries in the development of seed multiplication and distribution activities.

55. As regards the relationship of WARDA with the outside world, the Panel has noted that the Association has developed a useful relationship with IITA and IRRI and other scientific institutions in Asia. The Panel supports the appointment of a breeder from IITA to WARDA and hopes that full complementarity and unity of purposes between the three institutions will be ensured. The Panel wishes that the permanent role of WARDA in rice research and development in West Africa be kept always in proper perspective.

56. The Panel further endorses the extension of WARDA cooperative arrangements to include more African-based institutions (e.g. ICIPE, OCLALAV, Institut du Sahel, regional authorities, etc.).

57. The Panel is of the opinion that the Association's objectives and achievements are not well known by the public at large and by interested institutions; the Panel urges the Documentation/Communication Divisions to produce, with the assistance of the technical units, more public information material on rice research and development problems in West Africa and WARDA activities, including a periodic newsletter and research highlights.

58. The Panel also recommends the translation of the documents in the two languages of the Association and completion of staffing of the documentation and communications units.

59. In assessing the impact and usefulness of WARDA, the Panel was impressed by the degree of political support enjoyed by the Association: WARDA's role as a decentralized research and development organization has involved national institutions and services together with WARDA personnel and inputs. It has enabled WARDA to achieve a degree of effective mutual complementarity, reinforcement and rapport with national research programmes, that has been difficult to achieve by many other institutions supported by the CGIAR system.

60. Due credit should be given to the training programme which has produced for the region a flow of trained research scientists and technicians, eventually available for other crops improvement as well.

A total of 299 rice workers were trained from 1973 to 1978 (see Table 10).
61. The Panel is satisfied that WARDA has played a major role in maintaining an awareness of rice development problems among countries concerned, in developing cooperation between member states and in maintaining a satisfactory level of commitment towards regional problems.

62. The Panel considers that the continuation of a WARDA research programme which is able to organize a critical mass of research scientists to develop and conduct a meaningful research programme, is fully justified and deserves the continuous support of the CGIAR.

63. Looking at the future of WARDA, the Panel wants to underline that the Association has had so far the good fortune to elect or recruit, since its inception, Executive Secretaries and Heads of Departments of a high calibre. The Panel would therefore urge the member states to continue to second to WARDA high level scientists and civil servants.

64. Although the Panel does not see the need for any major change in the present programme, it would feel that the time is now propitious to newly appraise the substance and direction of WARDA future research programmes, the resources needed to carry them out, and the ways to remove the major constraints to programme implementation.

65. The Panel would like to emphasize again the difficulties which are caused to programming by the different timing of bilateral assistance. This situation, together with arrears in contribution of member states, is generating cash flow difficulties to the management.

66. At the same time, the Panel recommends that WARDA should utilize its accumulated knowledge to define a core programme, an issue which has never been properly tackled.

67. Since the inception of the Association, the concept of wide varietal adaptability, on which the CGIAR initial assistance was based, has been newly appraised in different IARCs. In the WARDA region, the diversity of ecological conditions have frequently made locally bred or improved varieties difficult to replace by introduced ones.

68. The differing ecological conditions in the region will make, in the future, the strengthening of the Special Projects imperative and increasingly important to rice production in West Africa and would constitute the most important part of the core programme of WARDA.

69. It could be envisaged for instance, that in the future, a growing number of varieties bred and other plant protection measures tested by what is now called the Special Projects, will find its way into the coordinated trials.

70. Obviously, the definition of a core programme with its financial implications will necessitate adequate preparation and a certain number of interim measures.

71. The Panel strongly feels, however, that a core programme should be assured of a stable financing and recommends that WARDA organize for this purpose a meeting of its donors with the assistance of the African Development Bank, E.C.A. and other suitable African regional bodies, with a view to establishing a consortium of donors to facilitate coordination and regulation of the funding.

72. For this occasion, WARDA should prepare a five-year plan of work detailing interim the substance of its core research programme and proposed special or cooperative projects, with their financial implications.

73. The Panel would request FAO as well as the CGIAR and TAC Secretariats, to lend their assistance to WARDA for this purpose.
III. THE MANDATE AND ITS IMPLEMENTATION

(i) The Establishment of WARDA

74. At the end of the 1960s, West African countries were importing annually about 400,000 tons of rice at a cost of US$ 80 million. Local production, which was reaching 1.2 million/ton per year had been growing at an annual rate of 1.6%, whereas population was increasing at a rate of 2.8%. Without a marked improvement in the rate of increase in local production, it was projected that foreign exchange expenditures in rice import could rise to US$ 180 million by 1980 and US$ 540 million by 1990.

75. The countries concerned met in Monrovia in September 1968 and decided to establish an association to foster rice production. A draft constitution and an interim advisory committee were set up with the assistance of FAO. The West Africa Rice Development Association was formally established in Dakar, Senegal, in September 1970 by a Conference of Plenipotentiaries, with Headquarters in Monrovia, Liberia.

76. In the Final Act, (or Constitution), it was stated that:

"The Association shall assist the Governments of Member States to achieve operational cooperation in the pursuit of the following aims:

a) promotion of rice production within the countries of West Africa;

b) increase of the quantity of rice produced;

c) improvement of the quality of rice produced in West Africa;

d) encouragement of production and use of varieties suited to the conditions of the countries in West Africa and to existing and prospective demand;

e) exploration, introduction and extension of rational production methods adapted to the conditions prevailing in the countries of West Africa;

f) promotion and implementation of measures for effective phyto-sanitary controls in relation to rice;

g) promotion of storage and processing, as well as marketing of rice both within countries in West Africa and with respect to external trade in rice."

77. It was also stated:

"With a view to achieving the aims specified in paragraph 2, the Association shall adopt or promote the adoption of the following measures:

a) encouraging, coordinating and undertaking as necessary, basic and applied research programmes in the scientific, technical, economic and sociological fields;

b) collecting, analyzing and disseminating information on methods applied, experience gained, and results obtained both within and outside West Africa;"
c) organizing or arranging for conferences, seminars and training facilities, securing of fellowships and establishing, or assisting in the establishment of, advisory services and training and extension facilities;

d) elaborating requests for special financial and technical assistance and receiving and administering separately such financial and technical assistance (including movable and immovable property, services and loans), as may be made available under the appropriate programmes of the United Nations, the Specialized Agencies, other organizations or governments desirous to support the aims of the Association;

e) providing, as appropriate, regional rice research and development facilities;

f) carrying out or promoting any other measures or activities at the regional as well as the national level, as determined by the Governing Council, for the purpose of developing rice production and marketing in West Africa.

78. The original signatories were eleven, a number which grew quickly to thirteen and in 1977, to fourteen with the addition of Guinea Bissau. Guinea has just joined, thus bringing the total strength of WARDA constituency to fifteen Member States.

(ii) The Implementation of the Mandate

(a) The governance and the policy-making process

79. The three major organs of WARDA are still the same as defined by the original Constitution and are composed of the Governing Council, the Scientific and Technical Committee and the Executive Secretariat.

80. The Governing Council is made up of representatives of all Member States, each Member appointing one representative. It meets once a year and elects a Chairman, two Vice-Chairmen and, generally, a rapporteur, who serve for one year, until the next meeting of the Governing Council. These functions are normally rotated between Member States representatives, although the incumbents are eligible for reappointment. The Executive Secretary serves as secretary of the Governing Council. Among its functions, the Governing Council appoints Members of the Scientific and Technical Committee, elects the Executive Secretary and Deputy Executive Secretary and appoints the External Auditor. It determines the general policies of the Association and its relationship with cooperating states and organizations, considers and approves the Programme and Budget, and the reports submitted by the Executive Secretary and other bodies of the Association.

81. The Scientific and Technical Committee is composed of three to seven persons particularly well qualified in the scientific and other fields of major interest to WARDA. They are appointed for three years and are eligible for reappointment. The membership now includes: Benin, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta; i.e. nine French-speaking countries, five English-speaking, and one Portuguese-speaking country. WARDA constituency is thus identical to that of ECOWAS (Economic Commission of West African States) except for Cape Verde whose climatic conditions prevent growing rice.
Committee meets once a year, and elects a Chairman, Vice-Chairman, and normally a rapporteur. The Committee pays special attention to problems and reports of scientific or technical nature submitted to it by different organs of the Association. The Executive Secretary acts as a secretary to the Committee or may delegate one of his subordinates to act in his stead. He reports the findings and recommendations of the Committee to the Governing Council.

82. The Executive Secretary and Deputy Executive Secretary are elected for a term of three years, renewable once. They must be nationals of WARDA countries. The Executive Secretary appoints the other members of the Secretariat. The salary scales follow those of the UN system.

83. An Advisory Committee was set up at the beginning of WARDA in order to include donors, cooperating institutions, countries and member states representatives. However, the same representatives of interested bodies were frequently attending the Advisory Committee, and, as observers, the Scientific and Technical Committee. Similarly, a Steering Committee proposed by the CGIAR/TAC (see paras 98 and 99 below) was short-lived. The governance of WARDA is therefore basically the same as it was decided by the original conference of plenipotentiaries in 1970.

84. It is to be noted, however, that the forthcoming meeting of the Governing Council, at the end of 1978, will consider a certain number of legal matters which will include the election procedures and duration of the Executive Secretary and Deputy Executive Secretary posts, the enlargement of the Scientific and Technical Committee and the inclusion therein of personalities from outside the region.

85. The policy making and implementation process has evolved over time: a Special Fund has been created in 1976, and is funded together with the administration budget by the member states. It has so far been used for urgent expenditures required by the research and development programmes and not covered by outside sources of financing.

86. The decisions affecting the WARDA programme result from a process which involves at the primary level the departmental units of WARDA and the national services through meetings, seminars and studies. In research there is an annual review meeting which gets together WARDA and national scientists in order to review the progress made and choose varieties for evaluation and trials. Proposals for action at different levels are discussed in in-house reviews, screened by the Executive Committee of WARDA (composed of the senior officers), examined by the Scientific and Technical Committee and put forward to the Governing Council by the Executive Secretary in his annual activity report.

87. The programming and decision-making process of WARDA, therefore, enables the needs of the countries concerned to be taken into account, along with the advice of competent scientific authorities.

(b) The Structure

88. The substantive units of WARDA are Research, Development, Communication, Documentation and Training. Administration and Finance have been grouped into one department with an Administration, a Finance Division; a Planning and Internal Audit Unit will be established at the Executive Secretariat level. An external auditor reviews the accounts twice a year; a Financial Comptroller is being recruited with the World Bank.

* The first Executive Secretary elected has served for the full six-year period.
** See Charts 1 and 2 on pages 64-65, regarding the structure of WARDA and of its research department.
89. The Research Department* is the largest unit as research absorbs about half of the total WARDA budget. It is composed of a research coordinating unit (Headquarters senior staff), of technical support services (Headquarters senior staff, seed laboratory and nursery in Liberia, and a plant quarantine station in Nigeria), of sub-regional coordinators and of special research projects (in Sierra Leone, Senegal, Mali and Ivory Coast). Research seminars, workshops and annual research reviews have generated the inter-change of ideas, materials and results between WARDA and the scientific community within and outside the region.

90. The Development Department** has activities in agronomy and extension, economics and finance, rural engineering, storage and processing, statistics and data processing. It became operational in 1973 and has conducted general and sectoral studies, case studies, organized group visits and seminars, assisted countries and financing institutions in the preparations and appraisal of rice projects. It also runs the seed multiplication farm at Richard-Toll (Senegal) and publishes statistical yearbooks.

91. The Documentation Centre** became operational around 1971 and produces bibliographies and indexes, records and stores documents and publications, and provides the scientific staff with microfilms and information services. The Communications Division** serves the publication, translation, language training and public relations needs of WARDA.

92. The Training Centre** supports both the Research and Development Departments of WARDA, through training courses for Field Assistants, specialized training courses, and rice production courses.

(c) The CGIAR Involvement

93. The very first TAC Meeting (June 1971) was made aware of WARDA scope and objectives, even before the first meeting of the Association's Governing Council. However, it was only at the 6th TAC Meeting (July 1973) that TAC endorsed the support of the CGIAR to part of the WARDA research programme.

94. One evident reason for the time lag was the originality of WARDA scope and governance as compared to the IARC pattern existing at that time; others were due: to the hesitancy of the Committee to be drawn into a regional undertaking based on the strengthening of certain national efforts; to the uncertain relationship between WARDA mandate and those of IITA and IRRI; and finally to the high cost of WARDA's first submission to TAC.

95. The Committee recognized however the validity of WARDA objectives and undertaking and took note of WARDA intent to develop, in collaboration with IITA/IRRI and IRAT, the selective strengthening of the overall rice research effort undertaken in the region, through a network of experimental stations. At the request of the Committee a mission composed of representatives of IITA, IRRI, IRAT met in December 1972 with the Executive and Deputy Executive Secretaries of WARDA to discuss research priorities.

96. At the onset, the Scientific and Technical Committee of WARDA had identified ten integrated projects as particularly deserving of WARDA early attention: variety improvement and multi-location cooperative variety trials; training; coordination of...
research and development; seed multiplication; fertilizer trials; agrometeorology; weed control; plant protection; mechanization of rice cropping; water management. During the above WARDA/IITA/IRRI/IRAT meeting, four research activities were identified as priority ones and selected for a submission from WARDA to TAC:

- W-1 Coordinated Trials
- W-2 Varietal Improvement
- W-3 Soil Fertility and Management
- W-4 Plant Protection

The total cost of WARDA submission was then to be reduced from more than US$ 10 million to US$ 4.5 million spread over four to five years.

97. During subsequent discussions at TAC meetings, it was agreed that the W-1, Coordinated Trials project, would be worthy of CG support, as providing smaller states in the region with the opportunity to participate in cooperative efforts aimed at the solution of a broader than national problem. The need to keep a close interaction between the four priority projects mentioned above was stressed; the possibility to use WARDA as a vehicle for quicker technology transfer from the IARCs to the country level and for adequate feedback was underlined.

98. With this in mind, the Committee, at its 6th Meeting, passed a resolution on WARDA with the following provisions as conditional to support from the Consultative Group:

- a) the expansion of project W-1 must be phased closely in line with the improvement of the scientific capabilities of the member countries of WARDA to supervise the trials. The rate of expansion proposed in the WARDA submission may well be too ambitious;

- b) a corollary of this is that training must be given very high priority in the overall programme, courses must be arranged for field trials officers, as well as for more senior research staff;

- c) although TAC did not address itself in detail to items W-2 to W-4 of the WARDA research programme, for which separate funding is being sought by WARDA, it considers that these are essentially complementary to item W-1 and should be implemented in an integrated manner;

- d) the active cooperation and not just the tacit approval of the main international research organizations working on rice must be assured. This applies particularly to IITA and IRAT;

- e) responsibility for the oversight of the coordinated trials and related training element as well as for ensuring the active involvement of the appropriate international research institutions in the programme should be clearly and unequivocally placed in the hands of a Steering Committee. WARDA has already proposed such a committee in the report submitted to TAC (page 20); we believe this to be an essential pre-requisite for the success of the research programmes, and this resolution sets out the TAC's ideas on how it can best be made effective. The TAC recommends that authority for design and direction (execution) of the progress, and the phasing of the expansion of the coordinated trials be vested in this Committee. It is suggested that it should be small, and should be comprised of representatives of the WARDA Secretariat, IITA, IRRI, IRAT, FAO, two WARDA member countries, and one independent scientist. The Committee would no doubt wish to appoint, in
consultation with the Executive Secretary of WARDA, a
Scientific Director who would report to it, while it, in turn,
could report to WARDA;

f) Progress in the WARDA programme should be reviewed
annually by TAC, on the basis of reports from the WARDA
Consultative Committee, supplemented as necessary by
independent review as in the case of the International Centres
programmes."

99. During the eighth TAC Meeting (July 1974) it was noted that the members of the
Steering Committee, as recommended by TAC, had found their terms of reference
unacceptable, and had preferred to work in an advisory capacity. It was mentioned
that a Scientific Director, as requested by TAC, had been appointed to manage the
W-1 programme. The Committee expressed concern at the lack of support from IITA
and IRRI and stressed the need for adequate scientific backstopping of the CG-supported
programme. It decided to send a mission to WARDA to assess the progress made.

100. The mission, composed of representatives from the CG and TAC Secretariats
visited selected WARDA countries and had discussions with the Secretariat in
September 1974. It recommended a reinforcement of training activities and the
appointment of a research manager to work with the research coordinator in order to
improve the coordinated trials; also a better presentation of budget and financial
requirements as well as better research planning with a view to integrating the W-1 to
W-4 projects. The mission was also in favour of the elimination of the Steering
Committee with the addition of two scientists to the Scientific and Technical
Committee. The report drew attention to the diversity of conditions under which rice
was grown in West Africa and concluded that at least five adequately staffed research
stations were needed to carry out adaptive research.

101. From the 9th to the 16th TAC Meeting, the Committee recorded the nomination
of a research advisor, the report of which led to the decision to add sub-regional co-
ordinators to the supervisory staff of WARDA; other questions which were raised at
one time or the other, concerned: the WARDA/IITA/IRRI relationship; the relative
weight of the research and development parts of WARDA; the effectiveness of the
efforts to strengthen national research units; the validity of sub-regionalization of
research and the financing of coordinated trials. On the whole, TAC expressed a
growing satisfaction in front of the progress made by WARDA and unanimous support
to the continuation of the CG assistance to the Association. After the 16th TAC Meeting,
discussions centered mostly on the details of the forthcoming Quinquennial Review.

(d) Financing

102. Source of Funding: WARDA has a complex funding arrangement because of its
multiplicity of donors; basically there are six sources:

a) the administrative budget, provided by the member countries;
b) the special fund also provided by member countries;
c) contributions in kind from member countries;
d) the UNDP;
e) ten bilateral donors;
f) CGIAR.
103. The WARDA budgets for 1977-79 are as follows (US$ million):

<table>
<thead>
<tr>
<th></th>
<th>1977</th>
<th>1978</th>
<th>1979</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel services</td>
<td>2.330</td>
<td>2.359</td>
<td>2.558</td>
</tr>
<tr>
<td>Operational</td>
<td>2.875</td>
<td>2.680</td>
<td>2.880</td>
</tr>
<tr>
<td>Capital</td>
<td>1.551</td>
<td>0.347</td>
<td>0.480</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6.756</td>
<td>5.386</td>
<td>5.918</td>
</tr>
</tbody>
</table>

104. The administrative budget is assessed by a formula whereby 30% of the total is divided equally amongst all member countries and the remainder according to their UN assessments. The special fund, started in 1976 is assessed at $1/5000 of the national budget of member states with a minimum of US$ 10 000 and a maximum of US$ 500 000 per annum.

105. The UNDP/FAO programme has provided support from the beginning of WARDA, financial support dating from 1971 mainly in the form of experts. WARDA's bilateral donors are nearly all members of the CGIAR; some have contributed on a one-time basis, others have given continuous support. Eight members of the CGIAR are contributing to the research programme in 1978.

106. The annual assessments for the administrative budget have increased from US$ 395 000 in 1971 to US$ 844 000 in 1978. The special fund started in 1976 with an assessment of US$ 1 020 000 and US$ 1 180 000 in 1977. Both funds are in arrears and at the time of the review panel's visit, the arrears of the administrative budget was US$ 1.987 million out of a total assessment of US$ 3.95 million and the special fund had collected US$ 696 000 out of a total assessment of US$ 2.2 million for the years 1976-77.

107. The contributions in kind from member states are mostly in the form of land, buildings, payments for skilled labour for construction, etc. The contributions are quite significant in total.

108. UNDP funding, due to end in 1981, will have contributed US$ 2.76 million over the period 1971-81.

109. Bilateral donors' funds have varied over the years being in both cash and kind. Most of the present projects are due to end in 1979 or 1980, but a number are being considered for renewal. The total cash contributions by bilateral donors up to the end of 1978 will have amounted to approximately US$ 6.7 million.

110. The CGIAR's initial contributions to the research programme, started in 1974. Its contribution up to, and including 1978, will be US$ 4.85 million.

111. Application of funds: Table 1 indicates the major financial support for WARDA programme elements. Table 2 indicates the breakdown of funds between the research budget lines; Tables 3 and 4 refer to the application of CGIAR funding, Table 5 to expenditure, by country of WARDA research activities. The multiplicity of funding sources, the unpredictable time span of some of them, present WARDA with some unique problems of cash flow and financial management which are discussed under Chapter VI, (iv) "Administration and Finance", page 53.

(e) Relationship with International Centres and Organizations

112. The major international linkage would evidently be with institutions working on rice research and development. The International Institute of Tropical Agriculture
(IITA), funded by the CGIAR and located at Ibadan (Nigeria), has the mandate to improve the quantity and quality of food crops in the African humid tropics, including rice. IITA facilities were used by WARDA for its first training course on rice production, but proved inadequate when it became evident that WARDA had to develop and accelerate its training programme. WARDA then established its own training centre in which IITA specialists collaborated.

113. The International Rice Research Institute (IRRI) has a global mandate from the CGIAR for research on the rice plant. Plant material from IRRI and IITA are used in WARDA coordinated trials, and there is an exchange of rice material between the three institutions, as well as mutual attendance to some meetings and seminars.

114. In 1976, IITA, IRRI and WARDA signed a memorandum of understanding whereby the three parties agreed to close planning of programme implementation in order to facilitate the complementarity of the inputs of each organization. It was foreseen that a joint standing coordinating committee would meet once a year for this purpose, and that IRRI would locate a senior scientist to work on a rice programme in West Africa. Material facilities have however prevented the establishment of this officer at WARDA Headquarters. In the meantime, it had been agreed that IITA would second a rice specialist to WARDA Headquarters.

115. This specialist has now taken up his functions as special assistant to the Research Coordinator and IITA Liaison Breeder.

116. WARDA has also signed a memorandum of agreement with the Bangladesh Rice Research Institute (BRRI) and with the Indian Council for Agricultural Research (ICAR) in order to facilitate the exchange of plant material, information and consultancies.

117. WARDA does not have an agreement with the "Institut pour la Recherche en Agronomie Tropicale" (IRAT) which is a leading institution as regards rice research in West, Equatorial Africa and Madagascar, although informal contacts and collaboration have been close since WARDA inception.

118. WARDA and the International Centre of Insect Physiology and Ecology (ICIPE) based in Nairobi, Kenya, are negotiating an agreement in order to develop closer working relationship on problems of mutual interest.

119. Among the UN family, FAO and UNDP have been instrumental in the establishment of the Association and has given it continuous support since its inception. WARDA has also developed a working relationship with the African Development Bank as regards short-term exchange of personnel services.

120. Contacts are being made with OCLALAV and OICMA* as regards joint efforts in the control of losses due to birds and locusts, and with the "Institut du Sahel" on possible common research in farming systems.

(iii) Importance of Rice in West Africa**

121. In the 15 WARDA countries of West Africa, about 2.5 million hectares are devoted to rice production. The average yield is approximately 1.3 metric tons paddy/ha.

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* OCLALAV = Organisation commune de lutte anti-acridienne et de lutte anti-aviaire (Common Organization for Locust and Bird Control)

OICMA = Organisation international pour le criquet migrateur africain (International Organization for the African Migratory Locust)

** See Tables 11 to 24 for further details.
hectare and total production is just slightly over 2.3 million metric tons. Net imports, which ranged in the neighbourhood of 500 thousand metric tons from 1970 through 1976 apparently rose to over 1.1 million metric tons in 1977, and are expected to be even higher in 1978. Average per capita consumption was approximately 18 kg/capita in 1977.

122. There are great variations in the importance of rice production, imports and consumption among countries. In Sierra Leone and Guinea, more than four hundred thousand hectares are devoted to rice. In four other countries, Ivory Coast, Liberia, Mali and Nigeria, over 200 thousand hectares are devoted to rice. In several countries less than 50 thousand hectares are planted with rice (Benin, Guinea Bissau, Mauritania, Niger, Togo and Upper Volta). Yields range from less than 1.0 metric ton/hectare (Ghana, Togo, Upper Volta) to close to 2.0 metric tons per hectare (Benin, Nigeria) and above (Mauritania). Net imports are particularly large in Nigeria, Senegal and Ivory Coast, while Mali is an occasional exporter of rice. Per capita consumption ranges from Asian standards of over 100 kg/capita in Liberia and Sierra Leone to less than 10 kg/capita in Benin, Ghana, Niger, Nigeria, Togo and Upper Volta.

123. During the 1970s, rice consumption in the region has been rising more rapidly than the population growth rate (2.8% per year) and more rapidly than production. The deficit, made up by imports, is of considerable concern to the governments of the region, since imports represent a significant drain on foreign exchange earnings - running about 7.5 percent in Senegal. If imports continue to rise, it will put increasing pressure on a relatively thin international market for rice. At present only about 10.0 million metric tons of rice are traded internationally. Indonesia alone accounts for approximately 30 percent and the WARDA countries for another 10 percent of the world market.

124. Prices in the world market are very sensitive to small variations in either export or imports. In the early 1970s for example, the unit value of rice traded on the world market was less than US$ 150.00/metric ton. In 1974 it was over US$ 450.00. The price had declined to approximately US$ 260.00 in 1976 and is again in the neighbourhood of US$ 350.00 in 1978.

125. The reasons for the rapid growth of rice consumption in West Africa are quite diverse. Mr. Jacques Diouf, Chairman of the National Council for Scientific and Technological Research in Senegal and former WARDA Executive Secretary, emphasized to the Panel the role of population growth, income growth, urbanization and substitution of other cereals by rice.

126. The relative importance of these factors has varied among countries. Since per capita income growth has been relatively modest throughout the region, population growth and substitution, associated both with urbanization and with consumer price policies designed to offset the effects of inflation, have apparently accounted for much of the growth in consumption. Production incentives have also varied. Policies in some countries have not always taken adequate account of the fact that farmers produce rice primarily to meet their subsistence needs and to earn the income needed to improve the level of living of their families rather than to achieve national self-sufficiency goals.

127. In some other countries which appear to assure their producer relatively high prices, an over-valued foreign exchange rate reduces the real value of the apparently favourable prices. Mali, one of the lowest cost rice producers in the region has maintained a price structure which has provided very little encouragement to producers. The Ivory Coast has followed a policy of high prices to producers and relatively low prices to consumers. Ghana and Mauritania have, at times, adopted consumer price policies which were apparently designed to discourage rice consumption. Ghana and Nigeria's relatively high prices provide less incentive to production and more encouragement to consumption than might appear obvious because of the badly over-valued exchange rate which discriminates against domestic food production.
128. The WARDA has jointly conducted a study with the Food Research Institute of Stanford University (funded by USAID), in order to explore the implications of a set of national rice production, import and consumption policies on the structure of the West African rice economy under the conditions likely to prevail in 1980 and 1990.

129. World market prices, corrected for inflation, were projected at US$ 350/metric ton. Consumer and production prices were assumed to be adjusted (allowing for differences due to location, transportation, processing and marketing) to this level. The results indicated that the WARDA region will come closer to achieving self-sufficiency in terms of the percentage of demand met by local supplies, but that the absolute tonnage of imports will increase. Mali and Sierra Leone are expected to be consistent exporters, account for about one-fourth of the imports required by other members. The Ivory Coast, which is a relatively high cost producer, is expected to shift back from an occasional exporter to a consistent import position.

130. The Stanford/WARDA projections are, of course, not predictions. A combination of high rates of investment in rice development programmes and high rate of productivity growth could lead to a slower growth, or even elimination of imports (an average yield of 1.5 metric tons per hectare on 2.5 million hectares could result in something close to self-sufficiency). On the other hand, a combination of lagging investment in rice development programme, lack of effective rice research programmes, price regimes which encourage substitution of rice consumption for other cereals and root crops or which provide inadequate production incentives, could result in rather dramatic decreases in the self-sufficiency ratio and an increase in the absolute level of imports. It should be noted that 1977 imports apparently exceed by substantial amounts, levels projected for 1980 and 1990 in the Stanford study.

131. Most of the difference is due to a sharp rise in imports in Nigeria in 1977. Countries which the Stanford study analyzed in greatest detail were Ivory Coast, Liberia, Mali, Senegal and Sierra Leone; analyses in greater detail of the Nigeria and Ghana situations were considered important but were not effected.

132. WARDA projects have been the subject of three reviews during the last year - by the International Development Research Centre (IDRC - June 1978) by the United States Agency for International Development (USAID - March 1978) and by a joint United Nations Development Programme (UNDP) /Food and Agriculture Organization (FAO) Mission (July 1978). An additional review by the UK Ministry of Overseas Development is scheduled later this year. The IDRC evaluation report is not yet available.

133. The USAID review focussed primarily on the special research projects at the Rokupr and Mopti stations and the Training Centre programme. The report was generally supportive of very substantial progress of the two research programmes and training programme. It did express strong concern with the difficulty that WARDA had confronted in recruiting leadership for the research programme at Mopti. It also urged closer integration of the Training Centre programme and the work at the Rokupr station and to strengthening the extension component of the Training Centre programme. It also recommended strengthening the economic content of the Research and Development Programmes.

134. The UNDP/FAO report focussed primarily on the work of the Development Department, the Communications Division and of the Divisions of Administration and Finance. The report commended and urged further strengthening of the capacity of the Development Department to work on problems of rice planning and development in the region. WARDA was viewed by the team as a useful prototype of Technical Co-
operation among Developing Countries (TCDC). The report noted that the strong support provided to WARDA by the UNDP/FAO since its inception would be phased out by the end of 1981.

135. Both the USAID and the UNDP/FAO reports were useful to the CGIAR/TAC Review Panel. The Panel is concerned, however, about the burden that has been placed on WARDA staff resources and the substantial financial costs of these reviews (including the CGIAR/TAC Review).

136. The Panel notes that it was hoped at the time that the CGIAR initiated its schedule of quinquennial reviews, that one result would be to relieve some of the review burdens on the international agricultural research system. More effective synchronization of reviews would be a more efficient use of donors and WARDA resources.

(v) **Assessment of the Implementation of the Mandate**

137. The Panel was able to witness the great diversity of conditions under which rice was grown in West Africa. It noted the interest shown by government at all levels in the WARDA programme, and the good team spirit evidenced by scientists and technicians coming from different countries and associated with or working in the Association. The Panel was satisfied that WARDA had increased the awareness to a serious rice deficit problem in West Africa and was playing a catalytic role in trying to solve it. The cooperation between Anglophone and Francophone countries, at working and decision-making levels, was worthy of praise. The Panel was of the opinion that the mandate of WARDA had passed the test of time, and was still valid and of high priority due to factors detailed previously. It considered that a good start had been made by WARDA in the implementation of the mandate in spite of the difficulties of the enterprise. The management structure of the Association had been responsive to changing circumstances and opportunities for improvement.

138. Comments on the achievements made by WARDA, on the major constraints faced by the Association in fulfilling its mandate are detailed below, as well as the Panel recommendations for further improvement.
IV. THE CGIAR-SUPPORTED RESEARCH

(i) Background Information

139. Several agencies including the WARDA Secretariat, scientists from the WARDA countries, IITA, IRAT, IRRI, USAID, TAC/CGIAR participated in evolving the WARDA research programmes during 1972-1974 towards better integration. The W series were evolved into multi-disciplinary teams in the framework of special projects. The coordinated trials continued to be labelled W-1 mainly for budgetary considerations.

140. The following research guidelines were crystallized in 1974 during the visit of a CGIAR/TAC Mission:

- strengthening the management capacity of the research team;
- integrating the special research projects with the coordinated trials;
- establishing multi-disciplinary research teams at the special research projects;
- strengthening support to national research activities;
- developing closer ties between WARDA research activities and activities at the international centres; and
- strengthening the initial evaluation and preliminary variety trials.

The above guidelines are the basis of the present structure of the WARDA Research Department (Chart 2).

141. The Research Department has the following objectives and priorities:

- evaluation and utilization of germplasm and their inclusion in coordinated trials. This depends mainly, at present, on international linkages;
- strengthening of national research capabilities to benefit from results of coordinated trials;
- special research projects based on multidisciplinary teams located at Rokupr, Mopti, Richard-Toll and Bouake. It is hoped in the near future that the Special Projects will contribute material and information to the coordinated trials.

142. Further examination of the WARDA research programmes, particularly the recommendations by Dr. Chandler, led in 1976 to the adoption of a policy of sub-regionalization. Justifications for sub-regionalization included ecological and geographical considerations, language problems, better support to national research, efficient trials supervision, better feedback to WARDA and International Centres and participation in on-farm trials. Five sub-regions were created.*

* Sub-region 1 - The Gambia, Guinea-Bissau, Senegal, Mauritania - coordinator located in Gambia.
2 - Liberia, Sierra Leone and Guinea - coordinator located in Guinea.
3 - Upper Volta, Mali, Ivory Coast - coordinator located in Upper Volta.
4 - Ghana, Nigeria - coordinator to be located in Ghana.
5 - Niger, Benin, Togo - coordinator located in Niger.
143. The CGIAR supports research coordination at Headquarters level, the Technical Services Division made up of a Seed Processing and Storage Centre, the Initial Screening of accessions, the Training of Field and Research Assistants, and the sub-regionalization programme.

(ii) Supervisory and Supporting Services

144. The Research Coordinator manages the Research Department and is directly responsible to the Executive Secretary. An Assistant Research Coordinator has responsibility for the special research projects and deputizes for the Research Coordinator in his absence. Five sub-regional Coordinators supervise field activities at national levels and they are directly responsible to the Research Coordinator. An Agro-statistician assists in the design, analysis and evaluation of the coordinated trials. Research coordination and management without regional sub-coordination is run by about 10% of the total professional research staff.

145. In order to strengthen the process of introduction of germplasm into the region and increase the efficiency of the coordinated trials the following facilities were established:

The Seed Nursery Farm at Suakoko (Liberia)
The Seed Laboratory and Processing Centre at Fendall (Liberia)
The West African Germplasm Conservation (presently at each Special Project site)
The capacity at the Plant Quarantine Centre at Ibadan (Nigeria) has been increased by three glasshouses to deal with WARDA plant material.

146. Until 1977 the administration of the above technical supporting services was not distinguished from the research coordination. The activities of the Technical Supporting Services Division inside the research programme include:

- Introduction of varieties and breeding lines from IRRI, Bangladesh, India, Indonesia, Malaysia, Sri Lanka, Thailand, CIAT, IITA and other national and international programmes including the West African Region.
- Dispatch of a sub-sample of each seed consignment coming outside West Africa to the Plant Quarantine Centre at Ibadan for "dangerous diseases" detection.
- Screening of introduced materials at the Seed Nursery Farm for desirable plant type, disease and pest resistance, and general adaptability.
- Selection of promising lines for IET, coordinated variety trials, special research projects.
- Seed increase, maintenance, processing and testing, hot water treatment, packing and dispatch.
- Monitoring of diseases and pests in the region.
- Rice germplasm collection, evaluation, preservation and utilization.
- Training.
- Supervising WARDA IET Programmes.
(a) **Seed Nursery Farm**

147. It is located at Suakoko in Liberia (190 km from Monrovia) within the Central Agricultural Experimental Station. It was started in 1976 and now has an area of 5 ha, 4 hectares of lowland and one of upland. It has a tractor and appropriate irrigation facilities throughout the year. Cropping is continuous.

(b) **Seed Laboratory and Processing Centre**

148. They are located at the University of Liberia College of Agriculture campus at Fendall (30 km from Monrovia). They have equipment and facilities for seed cleaning, sample drying, seed treatments, seed counting, sample dividing, purity and germination tests, moisture tests, dehumidifying and short-term seed storage.

149. Certain other facilities, like panicle threshing, dehulling, milling, bulk drying, parboiling etc. are shared with the WARDA Training Centre.

(c) **Plant Quarantine Centre**

150. WARDA contributed to the expansion of the Regional Plant Quarantine Centre at Ibadan (Nigeria). Three glasshouses were built and some laboratory equipment was provided. The Centre is run by the Nigerian Government. Further expansion of the Centre to include three more glasshouses is planned by WARDA during the next five years.

(d) **Rice Germplasm Conservation Centre**

151. WARDA plans to start intensive collection of germplasm in the region from 1979 to fill geographical gaps left by IITA and IRAT–ORSTOM collections. It also plans to construct a medium-term cold storage facility in 1980 for germplasm conservation.

(e) **Staffing**

152. Up to 1975 the supporting technical services were administered together with the supervision of the coordinated trials by a Variety Improvement Coordinator, a Soil Fertility Coordinator, and a Seed Superintendent. The present staffing is as follows:

- Rice Breeder from 1976
- Senior Plant Pathologist from May 1978
- Seed Superintendent from 1974
- Assistant Seed Superintendent from 1977

Three technicians help in the Nursery Farm and the Seed Laboratory.

(f) **Funding**

153. The entire fund for the capital and operation costs of the Division after 1974 came from the CGIAR budget. The Seed Laboratory was constructed and initially equipped from funds from USAID.
(g) Results obtained 1973-78

154. Seed Nursery Farm: The annual new lines tested increased from 1361 (1975-76) to 2500 (1977-78). Number of varieties nominated for IET increased from 65 (1975-76) to 270 (1977-78) and those nominated for variety trials increased from 12 (1975-76) to 22 (1977-78). Number of varieties selected for the Special Research Projects were 418 in 1976-77 and 219 in 1977-78.

155. The percentage of lines carrying dangerous diseases in 1977 varied from 0.0% to 8.0%. The lines found carrying dangerous diseases are quickly destroyed. The Plant Quarantine Centre also recommended from time to time cleaning and treatment of seed with special chemicals before planting. The number of seed package dispatched from 1973-78 amounts to 19,536.

156. Rice Germplasm Collection: Some time in the past Oryza glaberrima, which is indigenous of West Africa was the dominant cultivated variety in the lowlands of the Savannah, deep-waters of the Niger and other river basins and in the forest zones and swamps in the West Coast. The wild annual O. barthii is frequently found as well as O. longistaminata.

157. Oryza sativa is rapidly spreading in the rainfed lowlands and it is the only species grown in the irrigated areas. Other wild species found rarely in West Africa are O. eichingeri, and O. punctata.

158. Collections of rice germplasm, both O. glaberrima and O. sativa and the wild species have been haphazard in the past. During the last two years joint activities of WARDA, IITA, IRAT-ORSTOM, IRRI and national scientists were undertaken for collections in the region. So far more than 5000 strains were collected.

(iii) Coordinated Trials

159. The coordinated trials form two main categories:
- The Initial Evaluation Test (IET)
- The Coordinated Trials proper (varieties, insecticides and herbicides).

(a) The Initial Evaluation Test (IET)

160. IETs were started in 1974 for screening a wide range of breeding material which were essentially fixed. They are conducted at present at 14 locations representing different ecological conditions of the region (Table 6). They are unreplicated trials. Promising materials selected by the breeder in consultation with WARDA research staff are advanced into the coordinated variety trials.

161. Entries for IET are nominated by IITA, IRAT, national scientists and by WARDA Headquarters staff on the basis of their potential performance. Relevant specialized nurseries of IRRI are conducted at selected places.

162. Results: From the hundreds of strains which passed through the IET during 1974-77 several were selected for the coordinated trials, many found suitable for certain areas and some are already being recommended.
(b) The Coordinated Variety Trials

163. The variety trials are classed according to the rice ecosystems of the region - upland, irrigated, mangrove swamp, deep-flooded and floating rice. Trials are classified into short, medium and long duration according to the needs of the member countries.

164. Entries are nominated by research centres of the region, scientists of member countries and WARDA Headquarters staff. In 1973 forty-nine coordinated variety trials were conducted at 27 locations in the member countries whereas in 1977 eighty-five trials were conducted in 38 locations (Tables 7 and 8).

165. The number of trials has stabilized as from 1974 (see Table 7). Training of manpower and provision of equipment contributed much towards the improvement of the quality of the trials.

166. In the beginning the number of entries per trial used to vary from seven to eighteen. As from 1976 the number of entries per trial has been fixed at 15 including the local check variety. After technical consultation between all research workers, it has been agreed that 50% of the entries be replaced annually. WARDA subsidizes the countries for the implementation of these trials at a rate of $700 per trial. There has been of late a strong demand by countries for increasing the number of trial sites.

167. Upland Trials: The identification of well adapted high yielding upland varieties remains a problem. The Asian and other regions varieties were found not well adapted to West African conditions. The yields obtained in trials ranged however in the area of 3.5 t/ha for short duration varieties to 3 t/ha for medium-term varieties, best adapted to wetter areas.

168. Irrigated Short Duration Trials: During the period 1973/77 about 22 varieties were tried and gave yields of 3.49-6.05 tons/ha. Some gave more than 9 tons/ha and one performed well under iron toxicity conditions.

169. Irrigated Dry Season Trials: In 1976-77 short duration off-season trials were conducted at eight locations in as many countries. The top three varieties gave yields from 5 to 6 t/ha.

170. Irrigated Medium Duration Trial: Out of 25 varieties tried during 1973/77 seven varieties gave average yields in the range of 5.05-6.77 tons/ha. Varieties IR790-28-6 and IR1529-680-3 proved to have the widest adaptability, and are likely to replace Jaya, Vijaya, IR5, DJ 684 D, FARO 8, FARO 12, BD2 and 2526 already recommended for commercial production in certain countries.

171. Mangrove Swamp/Deep-Flooded - Medium Duration Trial: From 1973 to 1976 popular varieties of the region were compared. As from 1977 several high yielding varieties with semi-tall habit and adaptability under swamp or flooded conditions were included. Entries for the trials are required to be semi-tall to stand tidal water or flood water level, moderately sensitive to photoperiod or of medium duration and salinity tolerant for mangrove swamp. The best five varieties gave between 4.8 and 4 t/ha. MANGE 2, semi-dwarf, did very well when the tidal water level was not too high. BD2, ROK5 and D52-37 which are extensively grown in the region proved their superiority over the other varieties tested.

172. Mangrove Swamp/Deep-Flooded - Long Duration Trials: high yielding varieties to suit such conditions are scarce. The trial was started in 1973 with seven varieties of the region. Entries from Mali and Nigeria were added in 1975 and 1976. In 1977 some high yielding semi-tall varieties with medium to long duration and having some tolerance to salinity were included in the trial. Performance of the top varieties is in
the range of 3.5 to 4 t/ha. They are IM16, AA8A and Phar Corn En and have been
grown for a long time by farmers in the region.

varieties from Mali and Nigeria. As from 1974 additional varieties were added.
Yields in the first two years were encouraging. In 1975 and 1977 delayed initial
rainfall caused serious drought. The trial was tested in three to five locations in
each year and conditions were so variable from place to place and year to year that no
adaptable variety could be identified. The performance of the best six varieties from
1973/77 fluctuated between 1.2 to 4.9 t/ha.

(c) The Coordinated Herbicide Trials

174. They started in 1973/74 and continued for five years in upland and irrigated rice.
Forty-one trials with 22 herbicides individually or in combination were conducted at
17 locations; eighteen trials were under rainfed, 6 during off-season and 17 under
irrigated/mangrove conditions.

175. Results: Out of the 18 trials under rainfed and 17 under irrigated conditions, no
worthwhile information could be derived from 8 trials under each condition. Weeds
were found limiting yields in rainfed rice. Losses were substantial but redeemable by
resorting to the use of herbicides or hand-weeding. About 12 herbicides were identified
as promising for rainfed rice. Though the irrigated rice benefits from good land
preparation and suppression of weeds by water, yet significant increases in grain yield
of 37-42% and 7-13% at Richard-Toll and Djibelo respectively indicated usefulness of
herbicides. Under mangrove rice at Rokupr in 1976 and 1977 only one herbicide viz.
Basagran KV gave significant grain yield increase (25%) in 1977.

(d) The Coordinated Insecticide Trials

176. They were started in 1974 and continued during the following years under off-
season irrigated, main season rainfed and irrigated and mangrove conditions. The
main objective was to study the extent of grain yield losses due to common insect pests
which could be avoided by the use of insecticides. In all, 32 trials were conducted at
17 locations.

177. Results: In rainfed rice application of insecticides, including the systematic
Furadan 3G did not give significant grain yield increase except in one trial out of five.
The trials indicated that in rainfed rice insect incidence was low particularly in the
early stages. Trials on irrigated rice showed on the whole that irrigated rice (main
season) in comparison to rainfed rice, was more highly infested by pests. Grain yield,
recoverable by insecticide ranges from 30 to 50%.

(iv) Assessment

178. The Panel confirms that much progress has been attained in strengthening the
technical support services. It endorses the WARDA plan for further strengthening of
the services by the recruitment of an Assistant Plant Breeder and an Assistant Plant
Pathologist, but it recommends the recruitment of a highly experienced Entomologist
also, because of the serious problem of insects, including termites, in the region.
179. **Coordinated Trials**: The standard showed a great improvement over the last years. Most of the coordinated trials examined by the Mission in Suakoko (Liberia), Rokupr (Sierra Leone), Richard-Toll (Senegal) were well conducted and of an acceptable standard. The trials at Mopti suffered from gaps in crop stand and obviously experienced difficulties of establishment due to untimely onset of rains, and uneveness of land. The deep-water trials have to be established on rains, to be inundated later by the flood.

180. Lack of standard seed treatment with insecticide/fungicide contributed to loss of stand of upland and rainfed trials due to the damage of soil born insects. The Panel recommends attention in this respect.

181. Studies of the WARDA Agronomist/Statistician in the quality of the field trials revealed that precision and acceptability, based on CV's below 20-30%, improved from 53% acceptability in 1975 to 75% in 1977. Trials on floating and deep-water have been erratic due to variability in the flooding process. Standard of reporting of trials has improved over the years due to expansion of training and supervision.

182. The Agronomist/Statistician also reported that there was evidence that some supervisors of trials from the national staff tended to give more attention to their own national trials and neglect the coordinated trials. The Panel recommends that efforts should be made to convince member countries of the value of the trials to them.

183. The coordinated variety trials which were started in 1973 cover 14 WARDA countries (Guinea however joined in June 1978). During 1974/78 the total number of trials was stabilized at about 80 trials executed in about 35 locations. Number of locations per country varied from 2-5.

184. In addition to the coordinated variety trials plant protection trials (about 22) were also conducted. The Panel endorses WARDA's decision to transfer the plant protection trials to the Special Research Projects for screening and more detailed investigations, and to conduct trials on herbicide and insecticide of proven value on farmers' fields.

185. Most countries of the region including Gambia, Guinea Bissau, Senegal, Upper Volta, Mali, Benin, Ghana, Niger and Togo identified several outstanding varieties from the coordinated trials and adopted them for farmers' use in their countries. A few countries which have strong national breeding programmes have had minimum gains from the coordinated variety trials.

186. Member countries are free to select promising varieties from the coordinated trials from WARDA reports and deliberations of the Annual Research Review meetings. WARDA plans to help individual countries to organize variety selection and seed multiplication systems as some countries like Mali, Nigeria and Sierra Leone have excessive number of varieties recommended to farmers and this is a tendency which is quite likely to worsen in the future in view of the continuous flow of new varieties from the coordinated trials.

187. The Panel finds that the main advantages of the coordinated variety trials is to enable multi-location testing under different environments which lead to selection of highly adaptable varieties. The procedure of testing at several locations in one year sometimes has the equivalent value of testing at one location for several years, therefore shortening the exploration of the potential of varieties. Other advantages are furnishing member countries with possibilities of selecting outstanding varieties with high plasticity. Training of Field Assistants to conduct the trials is one of the indirect benefits accorded to the member countries.
188. Member states have shown great interest in the coordinated variety trials and several of them have asked for an increase in the number of locations for testing. The Panel feels that CGIAR funds should not be used for expansion of the trials and either national or other outside resources should be sought. The trials have so far a demonstrational effect and further expansion should be undertaken by the member countries.

189. The Panel endorses the planned reorganization of the coordinated trials to meet the specialized requirements of the different environmental conditions of the region.

(v) Plans for the Next Five Years, 1978-82

(a) Technical Supporting Services

190. Further strengthening of the Technical Supporting Services Division will continue for screening more than 3000 strains a year and providing the coordinated trials, the Special Projects and the member countries with clean seeds of promising lines with a wide spectrum of disease and insect resistance and adaptability.

191. It is planned to add an Assistant Plant Breeder and an Assistant Plant Pathologist to the present team of Plant Breeder and Senior Plant Pathologist. Two more field assistants will also be added to the Seed Nursery Farm.

(b) Coordinated Variety Trials

192. There is ample evidence that the coordinated variety trials had an impact on the rice research and development of many countries. Several varieties were adopted by the countries for commercial production or scientific breeding.

193. Difficulties were faced in the early years of trials in the intermediate height varieties responsive to fertilizers as most of the high yielding varieties were semi-dwarf and were not found suitable in West Africa outside the irrigated areas.

194. Some Asian countries like Bangladesh, Indonesia, Malaysia and India were faced with similar problems and were able to generate some good strains of appropriate height. Some of the materials were procured and some are included in 1978 trials. In the next few years medium height varieties will continue to get preference over semi-dwarf and tall varieties.

195. Upland Trials: No outstanding varieties are forthcoming from within or outside the region. The upland rice breeding programme has to be strengthened and the limiting factors better identified.

196. Irrigated Trials: It is intended to regroup the trials for cold-tolerance, heat tolerance, salt tolerance, irrigated Sahelian areas, coastal area, main season, etc. Careful review of environmental and ecological conditions of existing sites and other new sites will be made.

* As said in para 178, the Panel recommends the addition of a fully-fledged Entomologist to the supporting services.
197. **Mangrove Swamp Trials:** Some progress has been made but more entries will be expected from the Special Research Project at Rokupr Station by 1980. It is planned to have two groups of mangrove trials one for the non-sensitive or moderately sensitive varieties and another for the fully photosensitive varieties. Most of the present entries are moderate to non-sensitive. At the moment photosensitive high yielding varieties are lacking in the region and elsewhere. So this group of trials has to wait until adapted photosensitive varieties are identified.

198. **Deep-flooded and Floating Trials:** Though varieties with desirable characters associated with the growing conditions, such as drought tolerance at seedling stage, submerge tolerance, elongation ability, aerial branching, etc., have been identified and varietal suitability to different water depth has been established, yet higher yields cannot be expected every year because of numerous constraints as uncertainty of rain and incoming flood. More efforts will be made to increase the number of test locations for the floating rice trial, in shallow (0.3-0.8 m), medium (0.8-1.60 m) and deep-water situation.

(c) **Initial Evaluation Test (IET)**

199. As from 1978, two sets of IETs, one for upland and one for irrigated rices, will be started. In 1979 an IET for deep-flooded conditions will be started. The number of sites will be increased from 19 in 1978 to 30 by 1982. Promising materials selected from the IETs will continue to flow in the coordinated trials. It is expected that by 1980 breeding material will be available from the Special Research Projects. By that time, specialized IETs (for mangrove swamp, cold tolerance, etc.) will be started.

(d) **Herbicides Trials**

200. The main objective of the coordinated herbicide trials has been fulfilled; several promising herbicides have been identified.

201. Having identified promising herbicides from trials conducted at experimental stations, simpler trials will be designed to be conducted at farmers' fields where weed composition varies. Emphasis will be laid on the cost benefit ratio. The trials would serve the dual purpose of confirming the experimental results in farmers' fields and of demonstrating to the farmers the benefits of weed control operations. The WARDA Special Research projects will undertake the screening and evaluation of new herbicides.

(e) **Insecticide Trials**

202. The following studies have been proposed for conductance in the Special Projects in the future:

- Monitoring the insect pest status in various rice ecologies;
- Pest identification;
- Biological control of major pests;
- Studies in ecology, population dynamics and seasonal fluctuation of major pests;
- Pest control through insect growth regulators, attractants, repellants, etc.;
- Host resistance;
- Medium and long-term pest forecasting.
203. A seminar on Rice Insect Pest and Disease Management planned by WARDA in 1979 will form the basis of the future programme. Depending on the availability of funds, the four Special Research Projects will be strengthened to carry out the task.

(f) Sub-regionalization and On-Farm Trials

204. As mentioned earlier, sub-regionalization was meant to decentralize some of the headquarters activities and the strengthening of the field programmes. The sub-regional coordinators will help to organize training of national personnel, delivery of equipment, conduct on-farm trials, and advise on research policies and programme formulation.

205. One of the important tasks which will be conducted by the sub-regional coordinators will be to induce national programmes to expand on-farm trials which could demonstrate a package of practices to the farmers. WARDA plans to conduct in 1979 ten on-farm trials per country financed at US$ 400 per trial as examples for the national programmes.

206. The Panel views the subject of on-farm trials as having either the purpose of feedback to research and validation of research results or having a demonstration effect for education of the farmer. WARDA should be directly concerned with the first purpose as part of its research activities. This will be small in scale and involve only a few trials. The national programmes should be induced to undertake the demonstration of proven practices to the farmers by conducting on-farm trials which might run to hundreds.

207. The Panel feels that WARDA should study in detail the objectives and procedures for drawing maximum benefits from the trials. The sub-regional coordinators have to be assisted and well briefed by the Headquarters research management.
V. THE SPECIAL RESEARCH PROJECTS

(i) **Rokupr (Sierra Leone)**

(a) **The Station Programme**

208. Rokupr station, Sierra Leone's main national agricultural research institution, is located in the northern part of the country along the great Scarcies river. Established in 1934, as a national rice research station, it became the West Africa Rice Research Station in 1952 and returned back to national status in 1964. Throughout this period it concentrated its activities exclusively on mangrove swamp rice problems. Since 1971 it has been working on improving all types of rice cultivation in the country (boli lands, inland swamps, upland and riverine grassland rice), and more recently it has taken responsibility for other food crops as well as for cropping systems' improvement.

209. The station is funded by the national budget, but an important part of its activities is financed by UNDP/FAO and carried out in cooperation with IITA, as subcontractors to the above two agencies. This report will limit itself to the station's main programme which comprises four main themes.

210. **Variety improvement:** The first phase, completed in 1974, led to the adoption of the varieties ROK 1, 2 and 3 for upland rice (yields of 2 000-2 500 kg/ha) and ROK 4 to 7 for lowland rice (yields of 4 500-5 500 kg/ha). Since then, new objectives have been set for the programme, namely disease and pest resistance, reduction of culm height, good fertilizer response, and good cooking quality. The station's participation in the WARDA coordinated trials augurs well for the continuation of the programme.

211. **Plant physiology:** The programme is centred on mineral fertilization (research deals with major and trace elements, doses, and methods of application) chemical weeding, the study of double cropping and mangrove areas which seem possible under certain conditions (early transplanting, use of short duration varieties, etc.).

212. **Phytopathology:** The programme started in 1974 with the arrival of an IITA specialist (UNDP/FAO project). It deals with the control of diseases which affect the country's economy, the emphasis being put on the identification of resistant varieties, collection screening, the creation of resistant lines in connection with the variety improvement programme, the assessment of the economic importance of diseases, and the study of their epidemiology. The most important disease is leaf and neck blast. Leaf scald is spreading, and a virus disease (the pale yellow mottle) has been discovered. Its economic importance in the region remains to be determined.

213. **Agronomy:** The programme's main themes are cultural practices and fertilization. The programme is conducted around Rokupr by way of minikit trials which compare, on farmers' fields, the value of improved techniques and recommended fertilization against traditional practices. Cultivation on soil with a high iron toxicity has been thoroughly studied and some results have been obtained in that field.

214. **Pre-extension:** The UNDP/IITA project includes an important aspect, the pre-extension of improved techniques. The programme is implemented by ASLCAT (All Sierra Leone Coordinated Agronomic Trials) through trials on farmers' fields. A handbook for carrying out the trials has been published (Manual for Farmers' Field Trials - 1978). It describes the objectives and procedures while suggesting various
means to overcome the constraints. These were numerous at the inception of the pro-
gramme and during the first year of the project, but have been gradually reduced
thanks mainly to the increase of financing from the national budget. The method adopted
is considered as being the only way of ensuring an effective transfer of technology.

215. Significant results have been obtained on nitrogen fertilization, in the form of
sulphur-coated urea (SCU), and on potassium and phosphate fertilization. Thus, the
station was able to recommend to the Ministry of Agriculture and Forestry the
modification of the composition of the fertilizers imported by Sierra Leone, suggesting
that NPK 20-20-0 be replaced by NPK 30-15-15.

(b) WARDA Special Project

216. Infrastructure: The project is located in the national station and covers an area
of 3 ha in the station itself and has, in addition, two trial points of 0.25 ha each,
downstream of the station where the saline conditions are most serious and similar to
those of Guinea Bissau and the Gambia. In addition, 40-50 simple trials along the
river on farmers' fields make it possible to test mineral fertilization, herbicides and
insecticides.

217. The project shares some basic infrastructure with the station such as electricity
and running water, neither facilities being adequate yet: the importance of rapidly
improving this situation cannot be over-emphasized. Since 1977, houses, laboratories,
screen houses, warehouses, etc. have been built. A guest house is also being built.

218. Financing: Funds come from four different sources: USAID, Ministry of
Overseas Development of the UK, Government of Sierra Leone, and the WARDA
Special Fund. The budget will total US$ 753 000 by the end of 1978, as far as invest-
ments are concerned.

219. Staff: The project is presently composed of eight research scientists (of whom
six are Africans) paid either by USAID or by the UK Government, and five field
assistants. There is also an administrative officer. The field staff and labour are also
paid by the UK and USAID.

220. Research Programme: The objective of this programme is to increase the
productivity of mangrove rice. It comprises five themes: variety improvement,
agronomy, entomology, phytopathology and weed control.

221. Variety Improvement: The objective is twofold: to select varieties for mangrove
cultivation during the rainy season (i.e. in a normally desalinized soil) and to select
other varieties for the more saline areas: these will have to be of short duration
(140-150 days) and salt tolerant. By and large, the approach is to breed varieties that
are similar to those used in traditional rice cultivation: tall, semi-erect plant type of
long duration (160-180 days) photoperiod sensitive with large panicles, resistance to
shattering, and adaptability to low fertility conditions. Previous experience has shown
that these requirements are fundamental since varieties that do not meet them often
fail.

222. The breeder is collecting a number of local varieties and others imported from
WARDA member countries. This collection is being screened for pest and disease
resistance, and resistance to physiological disorders resulting from soil toxic
conditions which makes it possible to select a number of varieties to be used either for
extension or as breeder seeds for the hybridation programme currently being carried
out. Varieties and lines thus obtained have been screened since 1977 in pre-extension
trials. As from 1979, it is planned to test them outside Sierra Leone, in the WARDA
mangrove areas as well.

At the same time, the optimum value of such
parameters as date of sowing, age of seedlings at time of transplanting, and field density is being experimentally determined.

223. **Entomology:** The programme started in 1977, with the collection and conservation of the main mangrove rice pests. The paddies of Sierra Leone, the Gambia, and Guinea Bissau have been investigated. The pest population in these paddies turned out to be far more important than anticipated.

224. The study of losses resulting from pests has shown that these can be as high as 1 000 kg/ha, that farming practices play an important role, and that emphasis should be put on the manipulation of these practices (dates of sowing, fertilizers, post-harvest burning of the culms combined with the use of reduced doses of chemical insecticides) in order to be able to define a method for integrated control.

225. The varietal resistance is being studied in connection with the breeding programme. The control of crabs which seriously damage the seedlings after transplanting - especially *Sesarma huzardi* - started on two aspects which can be linked in practice: farming practices (age of seedlings), and chemical control. The latter should take into account the need to limit pollution in view of the importance of the quality of river water for human and animal life in the region. For example, an interesting solution with no risk to the environment appears to be the soaking of young seedlings to be transplanted in a mixture of furadan or carbamate-based mixture.

226. These various studies will be carried on, and gradually extended to other WARDA member countries where mangrove rice cultivation exists.

227. **Phytopathology:** The programme started in 1977 with the identification of the mangrove rice diseases and the screening (in cooperation with the breeder) of the collection in order to determine the varieties' field resistance to the main disease, blast. The programme will gradually cover the other countries in the region.

228. As from 1979, it is planned to tackle the evaluation of losses due to pathogenic organisms and to start in particular the study of "udbatta", a disease caused by *Ephelis pallida* which often seems to be found in the mangrove paddies.

229. **Weed Control:** The programme started in 1977 with the identification of the main weeds in Sierra Leone mangrove paddies. In 1978, visits were organized to mangrove areas in other WARDA member countries.

230. The study of losses in yield due to the competition from weeds has shown that these could reach 57%. *Paspalum vaginatum* is the most troublesome for the farmers but can be effectively controlled through the combination of appropriate farming practices and the use of chemical herbicides.

231. **Soil Science and Agronomy:** The programme started by monitoring salt content of soil and water in relation to the period of the year and of the geographical situation along the river. Practical conclusions have been drawn concerning the cropping calendar. Nitrogen response has been studied in detail, and an original method based on the injection of urea solution into the soil has given results similar to those obtained with the application of sulphur-coated urea (SCU), a product which is difficult to obtain commercially. Screening of the collection for salt resistance (in collaboration with the breeder) has been carefully studied, and an appropriate methodology is being defined.

232. Techniques for using a power tiller for the soil preparation in mangrove conditions before transplanting will hopefully compensate for the shortage of manpower which is an important limiting factor; these techniques have been demonstrated both on the station
and on the farmers' fields along the Great Scarcies river. All these activities will be pursued during the years to come, and increasing emphasis will be put on the regional role of the project through travel outside Sierra Leone and the implementation of trials by local rice specialists.

(c) Major Problems of Mangrove Rice Cultivation in the Region

233. There is an estimated area of 100,000 ha of mangrove rice in the WARDA region, of which approximately 25,000 ha are in Sierra Leone. Large areas have yet to be developed. Of the other WARDA member countries, mangrove rice cultivation plays an important role in Senegal, the Gambia, Guinea Bissau, Guinea, and Nigeria. It has been assessed that there are 5,000,000 ha in the world on which this type of rice cultivation could be effected.

234. Most soils in areas subject to tides are made of clay. In the dry season, they are subject to salinization which has to be corrected at the beginning of the rainy season before any cultivation can take place. This is why transplanting is often delayed, to the detriment of the yield. The high number of crabs that attack the young rice plants rather than the older ones makes it necessary for the farmers to delay transplanting, resulting in the same adverse effects on yields. These are further compounded by the proliferation on the paddies of the grass weed *Paspalum vaginatum*, which is salt resistant and whose compact rhizomes preclude any transplanting unless the plant is dug out and left to rot one or two months in advance.

235. Mineral fertilization is not widely used in traditional mangrove rice cultivation, a fact which is easily understandable, given the considerable risks of leaching resulting from twice daily tides. For the farmers, this mangrove rice farming is time-consuming since the paddies are generally very far from the villages (up to 20 km) and, for security reasons, the nurseries are situated on the uplands near the houses. The distance problem is further accentuated by that of transportation, 10-15 tons per ha of young plants being required for planting. The distance also makes harvesting and crop transportation difficult. Moreover, in view of the fact that most farmers grow other upland crops during the rainy season, the paddies are abandoned and are no longer visited from the end of transplanting to the beginning of harvesting. Due to these conditions, even if the soil salinity during the dry season limits their proliferation, weeds nonetheless constitute a potential danger which must be recognized. The same is true of grain-eating birds against which there is no protection to date.

(d) Relationships with National and Outreach Programmes

236. The WARDA Special Project has taken over most of the mangrove rice research. The Rokupr national station is still the main centre for agricultural research in Sierra Leone, it receives valuable assistance from an important FAO/UNDP/IITA project. The co-existence of the three teams, which live close to each other and have to share poor working facilities, has strengthened the human and professional links between them. The relationships between the special project research workers, and WARDA Headquarters, IITA, IRRI, other interested institutions and WARDA countries with mangrove rice cultivation, have been developing since 1976.

237. The Rokupr team members have participated in a number of WARDA seminars and workshops, and in October 1977, convened a one-week workshop on rice in which twenty-two rice specialists in the region took part. It can therefore be said that relations between the WARDA special project and related activities are excellent. They are expected to develop further in the future.
(e) Assessment

238. The choice of Rokupr to represent mangrove rice cultivation cannot be questioned, even if in other countries like the Gambia, this type of rice cultivation is relatively more important than in Sierra Leone. The fact that it is an old research station and that results have been collected there for over forty years is also an additional qualification. The WARDA team is well balanced, and should be able to deal effectively with the factors limiting mangrove rice cultivation.

239. The multidisciplinary approach is excellent, and only satisfaction can be expressed with the research policy which has been adopted: the assumptions made, and the tentative solutions to the problems identified, are tested in the very environment in which they will be put into practice through an increasing number of trial points in field conditions. Although for obvious reasons, the project activities are presently concentrated in the immediate surroundings of the station, the contacts already made and the opinions already expressed by the various research workers, indicate that the project will play a fully regional role within two or three years. The practical difficulties facing the special projects are still considerable, but could be alleviated if the donors maintain their assistance.

(ii) Richard-Toll (Senegal)

(a) The Station's Programme

240. Senegal's first rice research programme dates back to 1945 and was aimed at supporting a 6 000 ha mechanized rice cultivation project in Richard-Toll. The station was manned by IRAT from 1961-75, and then by the Senegalese Institute for Agricultural Research (ISRA). A great deal of work has been done during this period on variety improvement, the definition of agricultural practices including weed control, and on finding the most appropriate mineral fertilization.

241. The results obtained during this period have made it possible to extend, with some success, annual double cropping of irrigated rice in the Senegal River Basin with yield of up to 5 t/ha per crop. It is probably due to these results that SAED (Company for the Development of the Senegal Delta) was set up to develop rice cultivation alongside the River Basin. The irrigable areas of this basin could extend to 250 000 ha once the hydro-agricultural infrastructure has been completed (the Diama dam near St. Louis is intended to prevent salt water flowing upstream; the Manantali dam will be situated in the upper part of the river basin; the project preparation of both dams are in advanced stages).

242. Research on irrigated rice in Northern Senegal has been almost entirely transferred to the WARDA Special Project; the national programme deals only with the coordinated trials and with irrigated crops other than rice. In Southern Senegal (Casamance), there are two important rice research stations: Sefa for upland rice, and Djibelor for wetland and mangrove rice cultivation. These stations presently have four scientists.

243. In 1972, the Richard Toll rice scheme, which was controlled by SDRS (Company for Rice Development in the Senegal) was almost entirely converted to sugar cane cultivation. Agricultural research could only keep a small area with high salt content and difficult to irrigate since it is located at the end of the irrigation network.
244. Another station was then created in 1972 at Fanaye, approximately 60 km upstream from Richard Toll, and its main development was completed in 1977. The soils at this new station are representative of the Senegal Valley, ranging from very heavy clay in the lower parts (hollalde) to sandy upland (djeri) to silt deposits (fonté), with all the intermediate types. It is theoretically possible to irrigate the soils by pumping the year round; (exceptionally, in July 1978, salt water reached Fanaye, thus preventing irrigation). ISRA has 25 ha on this new site devoted mainly to alternate crops and irrigated cropping systems. Two scientists work on this programme.

(b) The WARDA Special Project

245. It is centred on the improvement of irrigated rice cultivation in the Sahel, the emphasis being put on annual double cropping. It started in July 1976.

246. **Infrastructures:** At Fanaye, the project covers an area of 70 ha for which a 1/2000-scale soil map has been prepared. Thirty hectares have been selected for their texture characteristics and their representativity. They include hollalde-related soils and fondé. A total of 15 ha will be developed (6 ha have already been developed in plots of 750-2500 sq metres, surrounded by dykes and levelled, each being equipped with water intake and drainage outlet. One pump has been installed, and a second one is planned). A number of plots are reserved in each soil type for the study of irrigation parameters which will be carried out as soon as funds are available (bilateral assistance is being contemplated for this). Presently, the main activities of the special projects are still based in the former Richard-Toll station (Canal D) where the offices, laboratories and housing for scientists, donated by the Senegalese Government are located. In Fanaye itself, there are four houses for technicians.

247. **Financing:** The project is financed by IDRC, CIDA, Abou Dhabi, Belgium and the WARDA special fund. The whole financing will total US$ 782 500 by the end of 1978.

248. **Staff:** The project comprises four scientists (of whom three are African) and three Senegalese research assistants. The post of Weed Control Specialist is presently vacant.

249. **Research Programme - Variety Improvement:** There are three cropping seasons in the Senegal Basin: hot and humid from July to November; dry and cool from November to April; hot and dry from February to June.

250. The aim of the breeding programme is to identify, for each of these seasons, high yielding varieties that are resistant to pests and diseases, sensitive to photo-periodism, of short duration, and with good cooking quality. One of the main aspects of the study is cold tolerance. Towards this end, varieties already collected by IRRI in this field are widely used. Thus, in 1976 and 1977 the International Cold Tolerance Nursery (ICTN), including 157 varieties, was assembled, a screening method was defined, and 14 varieties were selected for further testing. Another aspect of the programme is the study, in collaboration with ISRA, of the post-harvest ratoon crop and of the influence on its yield of various parameters such as cutting height and nitrogen fertilization. Various systems of annual double cropping are being studied: they involve direct sowing, transplanting or making best use of a ratoon crop.

251. **Entomology:** Research started in February 1977 by the identification of various insects and the study of the seasonal variations in the number of the most important species. The collection (340 varieties) was screened on the basis of pest resistance, particularly as regards the most common varieties. Forty-five of them showed some resistance to borers. The insect population turned out to be very large, with more than 90 species belonging to 52 different families but competition among them as well as hyperparasitism result in a very effective natural limitation to their aggressiveness.
especially in the rainy season. Furadan and Diazinon applied at a rate of 0.5-2 kg/ha once every 20 days have given yield increases of 26-38%. This programme will be continued and should lead to the determination of control methods combining insecticide treatments with suitable fertilization and irrigation in order to minimize losses due to pests. These methods will then be tested in coordinated trials both on farmers' fields in the Senegal River Basin and in the WARDA member countries.

252. Agronomy: The present programme is a follow-up to studies already initiated by IRAT and ISRA on mineral fertilization, especially nitrogen, rates and dates of application, and water supply. The best method is to split the nitrogen application as follows: 50% at sowing, 25% at tillering, 25% during the panicle initiation period. During the hot and humid season, the most effective nitrogen rate can be as high as 160 kg/ha but losses in the soil can reach, in this case, 50% of the amount used. These results will be quickly tested in the farmers' fields in SAED areas. Also under study is the role of ploughing-in straw, either as organic matter or in the form of ashes, to correct the depletion of the potassium content of the soil.

253. Preliminary studies on the role of trace elements have shown yield increases of 18-20% resulting from the use of manganese and copper.

254. The role of phosphorus which in the past has given erratic results at Richard-Toll should be studied more thoroughly. More reliable data might be obtained at Fanaye.

(c) Major Problems of Irrigated Rice Cultivation in the Region

255. In the Sahelian ecology, irrigated rice cultivation is likely to attain high yield. The Richard-Toll station has already proved that it is possible to have yields much higher than 6 t/ha twice a year, with double cropping. Similar results have been obtained in Kogoni, Mali.

256. This type of rice cultivation which requires very high investments (in the vicinity of US$ 5 000 to 8 000/ha) is not yet common in the WARDA region where it covered, in 1976, only 2% of the rice growing areas. However, due to its high productivity and its reliability for farmers, it is definitely going to play a greater role in the future. To optimize the investments connected with hydroagricultural developments, it will be necessary to intensify cropping methods so as to achieve the highest productivity. For this purpose, there should be two crops per year, a system which entails the use of short-duration, non-photosensitive varieties. The use of inputs (fertilizers, insecticides) should be planned and optimized, a fact which involves a good research programme and careful collaboration between agronomists and economists.

257. Some factors such as the low temperature of December-January-February prolong the cycle of most varieties and jeopardize the success of double cropping. Grain-eating birds constitute a serious threat to rice cultivation in the Sahel. Their depredations increase exponentially with the concentration of cultivated areas where cropping is intensified. Agricultural solutions (adaptation of the cropping calendar, development of resistant lines, etc.) and group farming with collective control measures could become economically feasible and environmentally acceptable in preference to large-scale destruction of the birds. WARDA keeps in touch with the OCLALAV (Joint Organization for Locust and Bird Control) which comprises most of the region's French-speaking countries and Gambia.

258. The Panel is of the view that efforts towards that aim should be intensified and that matters related to the economy of bird control and to the financing of large-scale implementation of adequate control methods should be dealt with as soon as possible by all parties concerned.
(d) Relationship with National Programmes and Outreach Programmes

259. The WARDA special research project at Richard-Toll operates in connection with the national ISRA programme on various irrigated crops in the Senegal river basin. At present, rice is only a minor component of this programme. However, cooperation between the two parties will certainly develop in the years to come within the framework of the study of farming systems that involve several crops. The special project is also in touch with the WARDA seed multiplication centre attached to WARDA Development Department. It is desirable that the Special Project specialists increase their technical assistance to the centre thus enabling it to increase its productivity and efficiency which are still inadequate.

260. Contacts between the Special Project staff and other operations based on irrigated cultivation in the region are still latent. Problems should be quickly identified and the search for solutions investigated, in these areas as well as in the Senegal River Basin proper. For this purpose, important operations like the Office du Niger in Mali, the Kou Valley project in Upper Volta, the Libore project in Niger, and Northern Ivory Coast and the Cameroon, should be visited as soon as possible by the project staff.

(e) Assessment

261. The WARDA Special Project at Richard-Toll has only just started. It has had the opportunity to draw upon the important experience acquired for more than 30 years by rice research in the region. It is regrettable that part of its activities is devoted simply confirming these results. However, new promising research areas are being covered, especially in the field of entomology. The search for cold tolerant varieties should be intensified because the dry and cold season cropping is likely to develop considerably in the region. In this respect, the location of the project at the Fanaye site seems particularly favourable.

262. The research team should be rapidly strengthened by the appointment of a weed control expert, as this post has been vacant for some time. Weed control is essential for cropping intensification.

263. Similarly, an administrative officer should be appointed to the project, because this duty is presently assumed by the team leader.

(iii) Mopti (Mali)

(a) The Station Programme

264. The Ibetemi station was created in the early 1950's for the improvement of floating rice varieties. Since 1961, it had been managed by IRAT, on behalf of Mali, and was replaced, in 1975, by the Mopti station, situated in the North Mopti polder on the opposite bank of the river, which has been assigned to WARDA since October 1976. The Ibetemi station no longer engages in research activities and now devotes itself exclusively to multiplication (registered seeds) of foundation seeds provided by the Mopti station. In the past, more than 250 Oryza sativa varieties were introduced and screened at Ibetemi station. In 1961 and 1962, 230 floating rice varieties were received from Bangladesh and South Vietnam. There was also a large collection of O. glaberrima undoubtedly native of the Niger delta. Varieties like Mali Sawm, Khao Gaew, Nang Kiew, HKG 98 and Giambiaka, presently recommended for extension, were identified during this period. At best, their yielding potential is estimated at 3 t/ha.
265. The Mopti rice development project (Operation Riz Mopti - ORM) responsible for rice extension and ensuring a minimal irrigation security to rice growers has also devoted itself, at least during a given period, to an adaptive research programme based mainly on land preparation techniques with particular emphasis on the control of annual wild rice, *O. barthii* ex *breviligulata* and the use of animal traction.

(b) WARDA Special Project

266. The Mopti project devotes itself exclusively to the improvement of deep-flooded and floating rice cultivation.

267. Infrastructure: The station has at its disposal 46 ha of bunded land whose water supply is ensured by gravity during river floods, as well as a supplementary pump irrigation system. However, the growth of the crop depends on rainfall only for about the first month, as is the case of all floating rice in the WARDA region (with the rain deficit in August this year, the situation in Mopti appears very critical).

268. These 46 ha of land are divided into four plots where levelling is in progress, and are situated in various topographic zones.

269. One plot (5 ha) will permit cultivation in a water depth of 0.3 to 0.8 m (deep water rice). Another (14 ha) will permit cultivation in a water depth of 0.8 to 1.3 m (floating rice). Another (11 ha) will be submerged under 1.8 to 2 m of water (deep floating rice). A 16 ha plot will be devoted to the multiplication of foundation seeds (Elite I) as requested by Mali in exchange for its contribution in land and other facilities.

170. Presently under construction are a screenhouse, offices, laboratories, six staff houses and guesthouse (situated at Sevare, about 12 km from Mopti, as in Mopti it is difficult to find suitable land and building is expensive). In addition to these are a certain number of buildings (sheds, workshops, a warehouse) donated by the Malian authorities.

271. While awaiting the completion of these buildings, the station staff occupies, temporarily, the former offices of IRAT, owned by the Malian Government.

272. The station has a tractor, a reversible double furrow plough and a sprayer. It will shortly avail itself of a generator and running water.

273. Financing: The project is financed by USAID, Saudi Arabia and WARDA and has a budget provision of US$ 1 653 000 for the 1976-78 period.

274. Personnel: There are, at present, five young research assistants from Mali, two of whom were trained in Russia, one in the Federal Republic of Germany, and two at the Malian Polytechnical Institute of Katibougou. To complete their training, they undertook intensive long-term training especially at IRRI, IITA and in Bangladesh.

275. A USAID administrative officer in charge of procurement was recruited for a year. His contract expires on 1 October 1978. To date, there have been fruitless attempts to recruit a US national (a condition established by USAID) as project Director, despite assistance from IIE* and the Near East Foundation. One of the research assistants at the station is at the moment acting as the Director of the station.

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*International Institute for Education, based in the U.S.A.*
276. **Work Programme:** Four of the five research assistants devote themselves, respectively, to selection of varieties, weed and pest control, entomology, and cultural techniques. The fifth acts as a liaison officer between research and development activities. The programme is designed to define a package of techniques for the environmental testing and supervised extension of floating rice, new technology in the area of the Mopti rice operation and subsequently to adapt these techniques as will be necessary, in other areas of the WARDA sub-region where floating rice cultivation is practiced (Niger, Nigeria, Gambia).

277. **Variety Improvement:** The aim is to identify floating rice varieties with the following characteristics: high yield, rapid elongation, white grain, good cooking quality, long duration, strong dormancy to resist germination before harvest, disease and pest resistance, drought tolerance since drought is to be feared before the floods. In addition, those varieties should have a good milling output.

278. What has been done so far is to study the varieties coming from the previous station (215 cultivars of O. glaberrima and 134 of O. sativa) and to collect data from farmers on the behaviour of cultivated rice and the problems encountered. New varieties have been introduced from Bangladesh (28 cultivars) and three crosses have been carried out.

279. Several comparative trials, among which WARDA's coordinated trials, have been carried out but they have failed to give any significant result so far due to drought and to attacks by grain-eating birds. It is planned to continue this programme. All possible sources of floating rice varieties in Asia and Africa (these are relatively few in number), will be investigated and all these varieties will be screened at various levels of flooding under natural or artificial conditions.

280. Non-floating varieties which however possess characteristics that meet the agreed selection criteria will also be introduced in the collection, and used as parent material on a permanent basis. Between three and five crosses will be carried out each year and will be subject to genealogical selection.

281. A study will be carried out to determine local preferences as far as grain quality is concerned.

282. **Weed Control:** The first stage of the programme was to collect weeds that seriously affect crops, to identify them and to start studying their biology. In addition to the annual wild rice (O. barthii and brevilligulata) and perennial wild rice with rhizomes (O. longistaminata) which are the most dangerous ones, weeds include mainly grasses, Brachiaria spp., Echinochloa leleynre, and Sacciolepis cymbiandra.

283. Information has been collected on control measures presently used on their constraints, mainly due to the amount of working time they require. Later on, it is planned to improve those methods according to the various water depths and to the various soil types, to assess the impact of weeds on yields, to use cautiously chemical control with emphasis being put mainly on biological control and to adapt the results to the whole region.

284. **Pest Control:** As a first step, the entomologist started collecting and identifying rice pests present in the Niger basin, to study their biological cycle, to determine the resistance of rice varieties presently collected, and to test some chemical insecticides, the emphasis being put on the economical aspect of the control measures. The most dangerous pests are two stemborers Chilo zacchonius and Maliarpha separatella, one leaf-eating caterpillar Marasnia and one beetle Heteronychus oryzae which attacks young seedlings at the level of the neck. Two microhymenopters, parasites of larvae and eggs of stemborers have been identified.
285. Among the varieties that resist borers are nine O. sativa and ninety O. glaberrima. The latter could therefore effectively be promising as far as pest control is concerned.

286. **Agronomy:** The programme comprises the study of mineral fertilization - mainly nitrogen rates, and dressing dates, according to the water depth (so far the results have not been significant) and the study of the importance of sowing date and sowing density.

287. In the long-term, mechanized and animal draft cultivation will be dealt with and cropping systems adapted to new varieties identified by the breeder will be developed.

288. **Relations between Research and Extension Departments:** The assistant in charge of this programme took office in October 1977. He has identified a number of limiting factors to the production of floating rice among which the most important are:

- the uncertainty of rainfall during the period before the floods* and the difficulty of forecasting the level of the floods;
- the competition from weeds, among which wild rices, that are presently difficult to control in view of the cultural practices;
- losses resulting from bird, insects and rodent attacks.

289. In the future it is planned to undertake trials on farmers' fields in order to test the new techniques that will be developed to assess how efficient they are; this will be done first in the "Operation Riz Mopti", then outside Mali. These trials should in turn give new research themes to the special project team. The economy of farmers' fields will be studied in order to underline the role of the various factors of production. In the long run, it is planned to organize training sessions for extension workers and for the farmers themselves and to produce and disseminate the relevant teaching material (handbooks, audio visual aids, etc.).

(c) **Major Problems of Deep Flooded and Floating Rice Cultivation in the Region**

290. In the central delta of Niger, the floating rice is sown in July at the beginning of the rains and the plant grows during approximately one month like a dry season crop. At the time of the floods the water level increases quickly by two to ten cm in the non-developed areas which are the majority. The speed can be reduced in the bunded polders. The water level varies according to the topographic situation of the field and the size of the annual flood. Its duration also varies according to the same parameters. According to the growth duration of the varieties used, harvesting can either be done under dry conditions, the plants being then completely lodged and the losses (through shattering and rodents) being very high or under wet conditions with the help of canoes. The latter system is time-consuming and birds eat a high percentage of the grains. In non-developed plots and chiefly in deep water areas, some plant-eating fish (Diostochodus spp.) are likely to deplete the paddies.

291. As was shown earlier, weeds compete with cultivated rice for space, light, and water during the so-called dry phase of the crop and for soil nutrients. One of the most dangerous weeds is the annual wild rice (O. barthii). This weed shatters naturally right from its maturity, ensuring a rapid infestation of the paddy. In this respect, the situation has become serious in Mopti over the last few years due to the lack of effective control methods. One of these methods, experimented within the framework of ORM, was to plough up the field after the harvest and to till the soil once or twice

* The average rainfall in Mopti is only 500 mm/year.
following the first rains and after the emergence of the wild rice, in order to destroy
the weed at the seedling stage before sowing the crop.

292. The time-table involved by this method is so tight that it is unlikely to be applied
by the average farmer who is confronted with serious manpower problems as well as
lack of equipment; the method therefore was not widely extended.

293. Over the past two years, rainfall has been particularly low during the month of
August. Emergence was poor and field density was too low to yield good results. The
fact that at the Mopti station the hand sown trials have a field density noticeably
superior to that of the mechanically sown multiplication plot is an indication of the
importance of the sowing techniques (land preparation, sowing depth, compacting of the
soil following sowing, etc.); it also indicates that there should be an in-depth study
of this problem by the Mopti project.

294. It appears difficult, however, to improve the productivity of floating rice
cultivation in the region so long as there is a threat from drought, and this could only
be eliminated by hydro-agricultural development the cost of which in view of the flat
topography and the vast areas concerned, would be so high that they would not likely
be implemented in the near future. Pending the adoption of improved methods of
irrigation, one could contemplate resorting to individual or collective buffer stocks to
be used during deficit years. This requires however, a detailed economic study.

(d) Relationship with National and Outreach Programmes

295. In Mali national research has entirely entrusted the WARDA special project with
the rice floating programme. Some links have, however, been established at the
extension level with the "Operation Riz Mopti" and these links would be strengthened
in the years to come in order to become more functional.

296. As the project started only recently, there is no external activity yet. This is
provided for in the programme and it is planned to extend the result of floating rice
areas in Niger, Nigeria and the Gambia. The project team is to visit those countries
very soon.

(e) Assessment

297. Floating rice and deep flooded rice cover 10% of the world's rice cultivated
areas and approximately 22% of those of the WARDA region which cover:

132 000 ha in Mali
30 000 ha in Niger
5 000 ha in Nigeria

Yet the potential is even higher: 500 000-700 000 ha in Mali alone.

298. The location of the Mopti special project right in the middle of the inland Niger
River delta is a very good choice.

299. The composition of the research team as well as their areas of specialization
are beyond any criticism. One can, however, regret that due to USAID requirements,
it has been impossible so far to provide the team with a strong scientific leadership
thus preventing it from dealing with research themes that have already been fully
investigated (sowing date, spacing, mineral fertilization, etc.), and the results of which
are already being extended. Thus nitrogenous fertilization which has failed to give
any significant result during the trials carried out by the special project is nonetheless
extended by the Mopti Rice Operation at the rate of 70 kg per hectare in two
applications, at sowing time and just before the flood. Similarly, it has been ascertained in the past that phosphate fertilizer has no effect during the first two-three years of cropping, but becomes effective thereafter.

300. Closer attention should be given by the project agronomist to techniques likely to ensure the emergence of the crops and the survival of seedlings during short drought periods: ploughing methods, sowing depths, soil compaction.

301. The weed control expert and the entomologist are to be commended for making it a rule to keep as low as possible the use of chemicals for weed and insect control. The assistance of a specialized institution should be requested for weed control studies.

302. Any assessment of the project has to be qualified in view of the fact that the team is made up of junior scientists who will definitely improve as they gain more experience, and also in view of the fact that the project started only recently, and has not yet grown one crop under normal conditions.

(iv) Bouaké (Ivory Coast)

(a) The Station Programme

303. The Bouaké agronomic research station, located in the savannah zone of the Ivory Coast with a bimodal rainfall pattern, was established during the thirties. It was given primarily responsibility for carrying out research on various crops in the area, rice being considered, at that time, as only a minor one.

304. After independence, the management of the station was entrusted by the Government to IRAT in 1965. At about the same time, the Ivory Coast embarked on a large scale project for the development of rice production. As upland rice was, and remains by far, the most important type of rice cultivation in this country, IRAT was specifically given the task of its improvement; this part of the programme was considered of high priority by the decision-making authorities.

305. Since that time, IRAT, in collaboration with ORSTOM, has successfully built a strong multidisciplinary research team in order to cope with all relevant aspects of upland rice improvement. In the meantime, it has also run research programmes, at a less ambitious level, on such crops as irrigated and rainfed rice, maize, cassava, yam, and on farming systems. In liaison with the extension agencies, IRAT is also in charge of producing breeders and foundation seed, and inspecting and certifying the bulk of the rice seed produced and distributed to farmers by the Seed Industry.

306. Since last year, the Bouaké Station has become a part of IDESSA (Institut des Savanes) which, in collaboration with GERDAT (Groupement Economique de Recherches, de Développement et d'Agronomie Tropicale) of which IRAT is a member, has been entrusted with the whole of agronomic research in the area: Food Crops, Fibre Crops and Livestock Husbandry.

307. The IDESSA research actually engaged on upland rice research at Bouaké comprises:

- 4 breeders
- 1 physiologist
- 1 phytopathologist
- 1 weed specialist
- 3 extension specialists*
- 1 seed specialist*
- 2 agronomists*
- 1 economist*
- 1 entomologist

* Also working on the other crops mentioned above.
308. It is backstopped by the necessary mount of field assistants. Among them are Ivorians as well as expatriates. It has been agreed by Ivorian authorities that Bouaké has a regional role to play, and a regional as well as limited international network has been established to test the new accessions. Permanent or tentative trial locations have been located in countries such as Senegal, Mali, Upper Volta, Benin, Togo, Cameroon, Brasil, Guyana, Indonesia, Sabah, etc. The national network is based on three locations, in different ecological areas.

309. The main line of the programme is the selection of varieties with high yield potential in strict upland conditions (different from rainfed as there is neither stagnant water on the field nor water table at a significant depth).

310. To attain this target, the breeders work in close cooperation with the different specialists on plant material introduced from abroad or derived from crosses or induced mutations made at Bouaké. The characteristics which are deemed desirable are:

- drought resistance (deep rooting and moisture stress);
- adapted plant type (about 1.20 m tall, semi-erect habit);
- resistance to disease - horizontal resistance to leaf and neck blast has been an important topic. Leaf scald is now becoming of increasing concern to the pathologist;
- acceptable grain type and eating quality;
- short to medium duration according to the expected rainfall pattern in the extension area;
- shattering resistance.

311. In addition, the flora of weeds (grasses and sedges) in upland rice fields is surveyed, new herbicides screened and tested as they appear on the market, and recommendations issued to extension services.

312. Mineral nutrition of the plant and fertility status of the rice soils are being monitored on a permanent basis; losses of mineral nutrients are assessed. Farming systems are being analyzed and new ones will be tentatively designed and tested.

313. Two breeders have embarked on a programme of evaluating O. glaberrima species and selecting suitable varieties.

(b) WARDA Special Project

314. The WARDA variety improvement project for upland rice, which involved the assignment of a research assistant to the IRAT team, started in 1974 and has since concentrated on testing newly developed or introduced plant material. A second specialist, an agro-statistician, is now part of the WARDA team.

315. Infrastructure: The project benefits from all facilities of the IDESSA Bouaké research station. The building of a rice breeding laboratory, on a joint funding basis, is the subject of negotiations between WARDA and the Ivory Coast Government.

316. Funding: It is funded by the French Government and WARDA Special Fund.

317. Staffing: 1 Research Assistant (Breeder)
    1 Research Assistant (Agro-statistician)
These are in fact considered as part of the IDESSA team, and perform the tasks which are assigned to them within the programme of the Institute.
318. Programme of research and achievements: A screening method for shattering resistance has been developed by the WARDA breeder. To this end, an apparatus has been designed and has undergone several improvements since 1976.

319. Variety improvement: The selection work led to the naming of 18 varieties which have been proposed to various experiment networks for further testing.

320. International trials carried out included WARDA coordinated trials and IET, the International Upland Rice Observation Nursery (IURON), and the Upland Rice Trial of IRRI. WARDA coordinated variety trials are generally considered less useful than in other countries because of the rather high susceptibility of their varieties to leaf and neck blast.

(c) Major Problems of Upland Rice Cultivation in the Region

321. Upland rice in tropical countries is usually a high risk crop due to the uncertainty of rainfall amounts and distribution. That is the reason why IRAT in accordance with Ivorian research from the beginning, decided to put a strong emphasis on drought resistance in its breeding programme. Besides, under the very low management level which still often prevails in West Africa upland rice growing, the yield potential of the varieties is not always a limiting factor.

322. It has been recently argued, among WARDA officers, that this approach was only valid for the so-called "Dry zone" of upland rice cultivation in the region, and that it was not adequate for the more humid areas of countries such as Liberia, Sierra Leone, etc., where the drought resistance is not important, and would be related to unwanted characteristics such as poor tillering, susceptibility to diseases not prevalent in the dry zones etc., IRAT's as well as national research workers at Bouaké have somewhat different views.

323. Whether the issue is a real one remains to be seen and the Panel strongly commends the proposal, put forward by WARDA, to convene a Seminar in the near future in order to fully assess the matter, taking into account the views of the research and extension specialists from the interested member countries, as well as scientists from IITA and IRRI, invited to attend the Seminar, and the global review of the results achieved so far in the coordinated trials.

324. Should it be decided that the Bouaké location is not well suited to varietal improvement in upland rice for a wet environment, it would then become advisable for WARDA to set up a new programme to this effect. On the other hand, should the point be deemed wrong, Ivory Coast seems fully prepared to develop, in cooperation with WARDA, the necessary facilities in Bouaké to strengthen the regional aspect of the project.

(d) Relationship with National Programme and Outreach Activities and Assessment

325. As stated above the WARDA research programme in Bouaké represents now only a minor aspect of the national programme. This national programme itself is strongly related, through IRAT, ORSTOM, WARDA, and on its own, to national and international research-oriented agencies, among which IITA, IRRI, CIAT, IAEA (labelled phosphorus for root systems studies), CEA (Commissariat à l'Energie Atomique, France), Université de Paris-Sud, EMBRAPA (Brasil), Cornell University (USA), a.s.o. It is assumed by the Panel that the situation is excellent in this respect.
326. On the other hand, the Panel regrets that, resulting from the ongoing changes in Department responsibilities, the implementation of coordinated trials by Ivorian extension agencies has come temporarily to a stop, thereby greatly reducing the total number of trials in the country.

(v) General Assessment and Future Programmes

327. In view of the major role the special projects could play for the fulfilment of WARDA's mandate and in view of the member countries expectations, the Panel strongly feels that the special projects have to be honed to maximum efficiency. They are the best hope to achieve important technological progress in the specific ecological areas where they are implemented, particularly as the national research systems have generally given way to WARDA special projects in their particular field of competence.

328. Certain new avenues seem so far to deserve consideration:

- Closer cooperation should be encouraged between scientists from different special projects who have the same specialization. That could take the form of joint field visits, communication of progress reports, and informal correspondence, exchange of ideas, etc. For each of the different subject matters dealt with by WARDA special projects, the senior scientist among the relevant specialists of the WARDA teams could play the role of leader in his field of specialization.

- The regional role of the projects could be stressed as far as and as soon as possible by organizing, in the very premises of each project, formal meetings of selected people in charge of rice research or development within the area covered by the project.

329. The purpose of these meetings would be twofold:

- Advertise the project among those potentially interested;
- Enlarge the vision of research workers and keep them informed of rice development problems outside the immediate scope of their work.

330. These meetings could take place where specific visits could be arranged, outreach programmes planned, etc. It is suggested that WARDA regional sub-coordinators be deeply involved in such meetings.

331. It is further suggested, as an improvement on the regional role of WARDA, that research scientists engaged in special project activities be switched progressively from their own countries to special projects situated in other countries.

332. The circulation among donors and member countries agencies of papers, designed to appeal to an educated public rather than to scientists, profusely illustrated with good pictures, and describing the status of rice production in the area, defining the problems and suggesting ways of improvement, would greatly enhance the general acceptance of the projects and their backstopping by everyone concerned. The preparation of these papers would better be left to WARDA Communications Division.

333. Has WARDA itself to embark on farming systems themselves? This will not be an issue as long as the projects have not put together enough facts and information. Nevertheless, the Panel is of the opinion that if WARDA has to take such a step, the inclusion of an economist in the special project teams will be essential besides the
general need for research in economics.* The role to be devoted, in each special project, to the extension specialists will also be decisive in delineating and testing farming systems and it is accordingly suggested that they be trained in that direction. The Panel generally believes that farming systems research is the responsibility of the national research programmes. However, WARDA could help as occasions arise, in specific matters, depending on its experience.

* See para 342 et sqq.
VI. OTHER WARDA COMPONENTS

(i) The Development Department

334. The Development Department was established with the objective of having a direct impact on rice policy, planning and production in the WARDA region. The work by the Department is not funded by the CGIAR and the Panel is not in a position to assess its accomplishments in as definitive a manner as some of the other parts of the WARDA programme. The Department is unique among CGIAR member institutions in that it attempts to assist in developing an institutional environment in the region which will facilitate the achievement of the objective of contributing to the growth of rice production in the WARDA region.

335. When it was established in 1973, the Development Department mandate was far from clear. How the Association was to have a direct impact on rice development was not clearly defined. It was explicitly recognized that international organizations have a limited role to play in national policy. The first quinquennial programme approved in Bamako in May 1972 envisaged a rather modest level of activity including only two projects: a multidisciplinary team consisting of five experts to conduct or supervise studies and help member countries in project preparation; a regional seed multiplication farm.

336. During 1973-77 a major objective of the Development Department was to achieve a better understanding of the West Africa rice economy. This involved the collection of statistical materials, an inventory and case studies of rice development projects, a series of rice sector studies dealing with rice cultivation, post-harvest technology and the political economy of rice production, market and trade policies.

337. Seminars were held on the socio-economic aspects of rice cultivation in West Africa and on rice project management. During the period the Department also assisted member countries in rice development planning and in the preparation and appraisal of rice development projects. The Department feels that it can take at least partial credit for the increased attention which international financial institutions have given to the financing of rice development projects in West Africa.

338. The Training Centre was initially organized within the Development Department, but provides now for Research and Development needs. The Department has continued to manage the Seed Multiplication Centre at Richard-Toll.

339. During the next five years, the Development Department will give somewhat less attention to activities designed to improve the understanding of the regional economy. It will focus more directly on planning and policy studies and consultation designed to have a more direct impact on the rice trade, market and production policies and plans in the region and on technical assistance to member governments.

340. At present the Department consists of five divisions: Agronomy and Extension; Economics and Finance; Rural Engineering; Rice Processing and Storage; and Statistics. Early support for the leadership and the programme of the Department was primarily from UNDP/FAO. At present the support for the programme is highly diversified.

341. The Panel is concerned about the difficulties which uncoordinated support, reflecting the interest and capacities of individual bilateral donors impose on long-term planning and staffing of the Division’s programme. In the Panel judgement the
effectiveness of the programme is hampered by the diversity of sources of assistance, high staff turnover and low proportion of nationals from member countries.

342. The Panel is also concerned about the limited capacity for economic research on the constraints on rice production, at the farm, project and national level possessed by WARDA. During the last two years, WARDA has substantially strengthened its capacity to provide analysis at the planning and policy levels. It has not yet established any capacity for economic research on the technical or institutional constraints which limit rice production at the farm level.

343. It is the judgement of the Panel that economics research capacity is needed at each location at which WARDA is conducting a major research programme. There is a French agricultural economist stationed at Bouaké, but he works on crops other than rice too. There is no economics capacity at Rokur, Richard-Toll or Mopti.

344. The Panel recommends that economics positions be established as part of the research teams at these three locations. The production economists should be recruited by the Economics and Finance Division of the Development Department and seconded to the special research projects. Immediate supervision would be provided by the project leader and general programme leadership and coordination by the Economics and Finance Division.

345. The Seed Multiplication Centre at Richard-Toll is administered by the Development Department. When the Centre was established, its goal was to provide 75 tons of foundation seed annually. It is expected that this target will be realized in 1979.

346. Some of the technical problems of seed multiplication have been solved. Others, such as large losses due to bird damage and low yields, remain. These problems must be solved if the unit cost of seed multiplication is to be reduced. The project has been useful, particularly to some of the smaller countries with limited capacity to manage seed multiplication activities.

347. The Seed Multiplication Centre is presently supported by the French Government. The French support is scheduled to terminate in 1979. The Centre presently makes foundation seed available to member governments at no cost and in some cases even pays for the transportation of the seed to member countries.

348. The Panel is concerned that WARDA establish a more viable economic structure for its own seed production activities and that it assist member countries in the development of seed multiplication and distribution activities. Foundation seed production, further multiplication and distribution to farmers are activities which can reasonably be expected to become economically viable activities. WARDA may find it useful to consult with the FAO seed industry programme and with IRAT in the Ivory Coast as it works on this problem.

349. Finally, the review team is concerned that WARDA locate an effective replacement for the present programme leader who will be leaving the project in 1978. The programme has had strong leadership from its inception. Both a high level of professional capacity and skill in interpersonal relationship and administration will be required if the Development Department is to continue to play an effective role in its influencing rice policy, planning and production in the WARDA region.

(ii) The Training Programme

350. The training programme represents one of WARDA's major contributions to agricultural development in its region. When the Governing Council of WARDA met at
its First Extraordinary Session in Bamako, Mali in 1972, to plan the Association's research and to apply new technology developed from research, training was identified as a major constraint to increasing rice production in member countries.

351. Part of WARDA's training activities is carried out within the framework of the Research Programme. Approximately 10% of the total cost of WARDA research activities over the period 1973-78 was devoted to professional training. Table 9 shows the types of training that have been offered to WARDA research staff. Training for research, largely financed by USAID, involved a language course, a six months rice production course followed by six months on-the-job training at the Bangladesh Rice Research Institute (BRRI), the International Rice Research Institute (IRRI), and the International Institute of Tropical Agriculture (IITA), in their respective disciplines.

352. One indication of the success of this staff training programme was that most of the young men who are now staffing the breeding, entomology, soils, agronomy and other professional positions at Rokupr, Richard-Toll and Mopti, have been trained since the WARDA programme began. The team was impressed by the professional approach to their work that these young men displayed, and with the progress of their research programmes, particularly when working under good leadership.

353. In order to serve the broader training needs of the region, WARDA has operated -since 1976- the James T. Phillips Jr. Regional Training Centre located at the campus of the University of Agriculture and Forestry at Fendall in Liberia. WARDA came to the decision to operate its own training centre reluctantly. The first rice production specialists course (RPSC) was held at IITA in 1973. Although WARDA was pleased with the programme at IITA, other arrangements had to be made because IITA was not able to host the RPSC every year. Initial funds for the construction and running of the Centre were contributed by the USAID while about 14 acres of land for the project were donated by the Government of Liberia.

354. The Centre became operational in 1976. Three non-degree training courses are offered each year. The Field Assistance Course (FAC), the Rice Production Specialists Course (RPSC) and specialized courses such as Post-Harvest Technology, Seed Multiplication, Water Management and others. Since 1973 WARDA has trained 299 West Africans (Table 10).

355. The Panel had an opportunity to visit the Phillips Centre during a field day conducted by the rice production trainees as part of their training course. The team was impressed by the ability of the trainees to explain the significance of the experiments that they were conducting as part of their training programme and to answer questions dealing with technical and scientific aspects of their experiments. It was also impressed by the capacity and personality of the Head of the Training Centre and with the procedures that he had worked out for a trainee operated training centre.

356. Some of the limitations in the social and recreational aspects of the Centre programme noted in the USAID review had been corrected. Food service resources continue to be somewhat limited. The Centre continues to operate with a minimum permanent staff. Somewhat more adequate permanent staff could contribute to programme continuity.

357. The Centre Director will be leaving in October. The Panel hopes that it will be possible to replace him with another strong Director. The team noted that WARDA is also planning to appoint a Director of the Training Department.

358. The Review Team was concerned that the association between the Training Programme and the Research Programme be strengthened and noted with approval the plans to familiarize the trainees with the work at the research project sites as part of future training programmes.
359. One of the most positive aspects of the WARDA training programme is that it is creating a corps of West African rice professionals who are able to bridge the language barrier that has previously separated the Francophone and Anglophone culture areas. The Panel sensed both in the Special Research Projects and at the training centre a very positive morale factor in being part of a scientific and technical enterprise that was larger than an individual research station or nation.

(iii) The Communications and Documentation Division

360. WARDA has developed an effective communications programme in spite of the difficulties with communications services and in staffing. The objectives of the Communications Division are: to assume the timely production and distribution of all the Association's publications and documents; to carry out the information activities to sustain political and financial interest in the programme in the region; to remove the language barrier among the scientists and the research and development workers in the member countries.

361. To achieve these objectives, the Division conducts the following activities: translation and editing; public relations; scientific and technical communication. It also operates a printing shop and a language laboratory.

362. The publication programme includes a service of regular publications - including quarterly review of activities, annual report, annual research report and world rice reference and bibliographical materials for West Africa; special publications - including mission reports, case studies, sectoral studies and the reports and documents of WARDA sponsored scientific meetings and seminars; internal documents - including documents presented at the meeting of the governing bodies of the Association, documents dealing with administrative matters; and documents for submission to financing institution.

363. The Division is now well equipped and adequately housed. Major difficulties remain in the area of staffing. It has been difficult to recruit and retain competent translators and bilingual staff capable of using the more sophisticated equipment such as the IBM electronic composer. The position of scientific editor has remained unfilled because of the difficulty of identifying a qualified individual who can work in both French and English.

364. The objectives of Documentation Centre are: to provide information services on all aspects of rice production in West Africa to the governmental departments, research institutes, universities, and other organizations concerned with rice in the member nations; to provide the WARDA staff and collaborators with the relevant world literature on rice, and to operate a library to serve the needs of the WARDA staff.

365. The activities of the Centre to achieve these activities include preparation of a Current Bibliography and Retrospective Index, operation of the library, production and distribution of microfiche, copies of Centre materials, collaboration with FAO and other information programmes, consultation with information centres and libraries in member countries, and the conduct of documentation training courses for member countries. A special effort is made to collect literature from West Africa which is not otherwise readily available.

366. As in the case of the communications programme, staffing is a difficult problem. Staff includes one indexer, one photographer, two documentalists and one bilingual clerk/typist. A permanent librarian has not yet been identified.

367. In spite of the staffing difficulties encountered by the Communications Division and the Documentation Centre, WARDA staff appear pleased with the service they receive.
Research staff at the several project locations feel that they are kept well informed and that their literature requests are handled promptly and effectively. The Review Panel was pleased with the ability of the Communications Division to provide it with the necessary documentation to conduct its activities effectively.

368. The Panel urges that steps be taken to complete the staffing of the above two Divisions which are essential to an efficient research programme. It also urges the Communications Division to prepare well illustrated and attractive pamphlets, periodic newsletter and research highlights similar to those published by IARCs to truly reflect the image of WARDA and its activities.

(iv) Administration and Finance

369. The structure of WARDA is described in Chapter III and the line management responsibilities are illustrated in Charts 1 and 2. The managements of the research, training and development departments have been described under their respective sections, so that the present section is confined mainly to the overall administrative and financial managements.

370. By the very nature of its constitution, WARDA must have strong political contacts in the region so that the Executive Secretary and his Deputy must devote a considerable amount of their time to the maintenance of these. As described in the following section, maintenance of financial support is also a continuing problem on which top management has to spend a lot of time.

371. The Department of Administration and Finance has two divisions: Administration covers personnel, procurement, liaison, inventory, insurance and maintenance, and finance division covers accounts and budget. This section is also responsible for financial control of WARDA projects in the region, including the special projects. Each of these projects has an imprest account and the project managers have to adhere to a standard accounting procedure. The imprest accounts should be replenished monthly against receipts.

372. A new division, planning and audit, is being created this year which is directly responsible to the Executive Secretary and which is responsible for internal checks and controls. This division had not been staffed at the time of the Panel's visit.

373. The Research Department described in Chapter IV covers regional coordination and the coordinated trials. The special research projects form part of the programme of this department, and it is the management and staffing of this department in which the Panel was most interested.

374. The Panel was impressed by the fact that WARDA has been able to recruit a number of well qualified and experienced staff, many from the region itself. However, the Panel is concerned with the problems of continuity in programme direction and management resulting from a need to find replacements for the directors of the research department and the Development Department and the head of the training centre within the next few months.

375. The Panel was impressed by the capacity of the individuals who are in charge of these activities at present, and hopes that WARDA will be able to find equally capable replacements.

376. Although the decentralization of the management of the coordinated trials took place only in 1976, and the appointments to these posts subsequent to this, the general improvement in the quality of the coordinated trials and the increasing interest in WARDA's programmes by member countries have been aided considerably by this arrangement.
As noted in Chapter IV, the Panel considers that some improvements could be made in utilizing the scientific capability at Headquarters especially in helping the special research project. The appointment of an IITA scientist (plant breeder) at WARDA Headquarters should aid this.

The diverse sources of funding described in Chapter III present the management of WARDA with especially difficult problems. The arrears in contributions from member states constitute serious cash flow difficulties.

The CGIAR Secretariat has attempted to have WARDA bring its budget preparation for the CGIAR-funded part of the operation into line with the group practice. The budget does not for example provide for man-years per programme, sources and application of funds and a complete breakdown by the object of expenditure.

Since WARDA's full budget is prepared only in the latter part of the year, it is not possible by April of each year to present the CGIAR budget as part of an overall WARDA budget.

As noted elsewhere, the lack of forward planning also means that budget projections beyond the current year have no detailed programme basis making it impossible to have a really sound future financial plan.

The financial division has suffered staffing problems and has had difficulty in recruiting and retaining experienced staff. Whilst progress has been slow, there has been an improvement in financial management over the years and the Panel fully endorses the attempts that have been made to strengthen this division.
VII. ISSUES AND PERSPECTIVES

(i) Introduction

383. During the course of the Review, a number of issues came to the attention of the Panel. Most of these are discussed under the various chapters, but the more important are set out in this chapter together with the Panel's view on them.

384. At the same time the Panel has given considerable thought on how WARDA, and particularly its research programme, might operate more effectively in the future.

385. Some aspects of this are discussed, including a proposal for better long-term research and financial planning. The balance of the programmes, within WARDA and within the CGIAR system as a whole, also received attention from the Panel.

(ii) WARDA's Mandate

386. The WARDA mandate, discussed in Chapter III gave the Association a very broad basis on which to operate, but, as early attempts at raising finance showed, it covered a range of activities well beyond the financial resources that could be mobilized.

387. The Association, well aware of the financial constraints made commendable attempts to limit its programme whilst at the same time trying to mobilize additional resources both internally in the region and externally. It has undoubtedly had considerable success in both aspects and the Panel commends the Association for its success.

388. It furthermore considers that WARDA did choose high priority areas on which to concentrate and its achievements in a complicated political environment, amongst a group of relatively poor and recently independent states, are certainly praiseworthy.

389. Nevertheless its member states are asking for more help and have requested for example the following additions to the programme of the Research Department: grain-eating birds, nitrogen fixation, mechanization, upland rice, farming systems.

390. Concurrently the other departments are also being requested to undertake more work. In a mature organization, it would, of course, be possible and -in fact- normal, to drop some activities and take up others as priorities change and as some programmes reach a successful conclusion.

391. In WARDA however, the coordinated trials programme is only in its sixth year of operation, and the oldest of the special research projects has been in operation for only two years. In the case of WARDA therefore, suggestions for dropping projects would in most cases be immature. Some of these broader issues are discussed in the section on priorities.

392. The Panel's terms of reference included attention to the present and proposed future research strategy of the Association. Thus it has commented not only on technical aspects, but also on other aspects where the Panel felt that donors, including the CGIAR and member states, might be able to cooperate more effectively in assuring a strong and more certain future for the organization.
(iii) **Allocation of Resources**

393. As discussed in various sections of the report, WARDA has never had a particularly firm, long-term financial foundation. Even if this can be improved, financial resources will remain limited and the Association will need to pay continuous attention to cost effectiveness.

394. The Association is unique within the CGIAR and the original support from the CGIAR was therefore regarded as of an experimental nature. In deciding on the allocation of resources to this activity, the CGIAR has also been conscious of the small proportion that West Africa rice production represents on a world scale.

395. However, the CG recognized that whilst this scale of production must influence the overall allocation of resources, the importance of the crop in West African countries and the weakness of the national research programmes should be taken into account.

396. The evidence discussed in Chapter III (iii) confirms the growing importance of the crop in a region of general cereal deficit and the value of improving research on a regional basis, particularly as several of the countries would have difficulties in developing a self-sustaining national research programme in the next ten years.

397. The Panel thus considers that the continuation of a WARDA research programme which is able to organize a critical mass of research scientists to develop and conduct a meaningful research programme is fully justified.

398. However, it would emphasize that this puts a major responsibility on WARDA to continuously monitor its priorities and to determine the most effective way of doing regional research, a new venture in an area where there are wide variations in national capabilities.

399. The Panel therefore suggests that WARDA should always focus on its comparative advantages in relation to both national and international programmes.

400. The Panel would also like to emphasize that a successful regional approach to rice research would have a considerable spin-off to agricultural research in the region, generally. Not only should it lead to increases in rice production - a 1% per annum increase in production arising from the application of successful research would be worthy probably at least US$ 6 million annually - but it will produce a considerable flow of trained research scientists, available eventually to work on other crops and in agricultural development projects. Even more important it will demonstrate to governments that well conducted and properly financed research can pay off handsomely.

(iv) **Priorities**

401. The Panel does not consider that any major changes in emphasis within the ongoing programmes is necessary.

402. It considers that the regional coordinated trials have and will continue to serve a useful purpose not only in introducing improved varieties into the region, but in training scientific staff to improved standards of agronomic research.

403. There is also an unquantifiable element in that member states have become more conscious of the presence of WARDA and its role in promoting rice production. Nevertheless the Panel suggests that this is an area where there would be rapid fall in pay-off from increased number of trials and has thus suggested that this be an area of consolidation. It has also endorsed the proposals of WARDA to drop some activities from its coordinated trials.
404. The Panel is also concerned that really effective use be made of the comparatively strong scientific team at the Headquarters in Monrovia. It regards the proposals for strengthening this team as a way of making it more effective and whilst it recognizes the administrative load carried by the team and the problems of travelling in West Africa, it considers that ways could be found of using at least some members of the team more effectively.

405. Since WARDA's scientific credibility will only develop as a result of a successful research programme, and since the special research projects are the most likely vehicle for this, the Panel regards support of these as high priority. The Panel has therefore suggested that they be strengthened by having an economist in each project.

406. Furthermore, the Panel would like to see the Headquarters scientific staff play a bigger role in these, particularly in the planning and management of the breeding programme. Because of their importance for the different ecological regions the Panel suggests that these programmes, at least at the research direction level in each station, should have a secure source of long-term funding. This might come from either the CGIAR or the member states or a suitable mixture of both.

407. In para 389 proposals for additional research projects are noted. Upland rice is obviously an important crop in the region, and WARDA Headquarters scientists believe that the work at Bouaké is mainly applicable to the "dry zone" of the region and that a major gap in the "wet zone" - Liberia, Sierra Leone - remains to be filled.

408. Whether this issue was a real one was not clear yet, and the Panel therefore strongly endorsed WARDA's proposal to convene a seminar on this subject with a view to assessing progress so far and defining an appropriate research project for the "wet zone", should this be warranted.

409. Grain eating birds cause tremendous damage, not only in the region, but elsewhere in Africa. OCLALAV has a strong interest in this problem in Africa, and WARDA will undoubtedly wish to cooperate closely with it. Help from outside organizations, specializing in vertebrate pest control will be valuable.

410. In many parts of West Africa, rice production is part of a complex farming system. Thus the economists will play a key role in defining the place of rice in these and in helping WARDA's agronomic research programme develop rice technologies that will fit into these. The Panel does not foresee WARDA's role as that of developing a strong capability in farming system research, but rather of providing the appropriate improved rice technology components for the varied farming systems of the region and of close collaboration with farming systems research at national and international levels.

411. The Review Panel recognized the potential importance of mechanization of rice production operations in the WARDA region. In some areas substantial progress is being made as a result of the introduction of or intensifying the use of draft animal power. In other areas, particularly those characterized by tsé-tsé fly infestation, motorization seems essential to successful mechanization. Many of the rice development projects in the region have included a mechanization component. Successful mechanization efforts have, however, been difficult to achieve. The team believes WARDA should have the capacity to evaluate progress in the technical and institutional aspects of mechanization experience in the region.

412. On the other hand, the Review Panel would, in view of other priorities, find it difficult to endorse any proposal that WARDA plan to become a major centre for research on rice mechanization but rather would encourage attention to this problem within the special research projects.
413. In a region where all fertilizers including nitrogen are expensive, the desirability of improving the nitrogen status of the soils by biological means is obvious. The Panel endorses WARDA's interest in this and suggests that its scientists select those parts of the ongoing programmes at other international centres which seem ready for testing in the region, and follow them up in some of the research projects.

414. In conclusion, the Panel considers that whilst the Association could obviously use a lot of new resources, it can continue to do an excellent job, and fill major gaps in rice research in West Africa, with relatively small increases in present resources. The Panel has not considered the balance in the allocation of resources between the research and other departments of WARDA, as it considers this entirely a matter for the Governing Council. However, the Panel does consider that improved programme and financial planning with the sound budgetary support that should go with such planning would considerably enhance the effectiveness of the Association in all departments.

(v) Forward Planning

415. The Panel can only re-emphasize its recognition of the problems of forward planning in an atmosphere of financial uncertainties, and of individual, and not always, coordinated demands from member states. Nevertheless, it considers that such a plan is essential.

416. Although the WARDA staff gave the Panel a comprehensive review of how they intended to continue or modify their ongoing research activities and also indicated the kinds of new activities which the Government Council had suggested that they add in future, the Association has yet to produce a well thought out forward plan with priorities. Hence it has not been able to develop a corresponding financial plan.

417. The weakness is understandable, to some extent, for the relatively small Headquarters staff have been fully involved in making the existing operations more effective. The Panel does not underestimate the difficulties involved in trying to run such a diverse operation. Nevertheless in a period of consolidation, it will be essential for the research management to develop a long-term research programme, to cost it out realistically and to refrain as much as possible from year to year ad hoc additions. Most important for this is the development of a clear sense of priorities, now that the staff have an adequate and up-to-date knowledge of the problems of rice growing in the region.

418. The Panel recommends that the CGIAR and WARDA's bilateral donors seek ways of helping WARDA develop this programme. One possible method of achieving this objective would be for WARDA to prepare and present the financial implication of a five year research plan at a donor consortium meeting.

(vi) Funding

419. The diverse sources of funding described in Chapter III present the management of WARDA with especially difficult problems. The arrears in contributions from member states constitute serious cash flow difficulties.

420. Each of the special research projects for example depends on more than one donor, but the timing of each donor's support is not synchronized and there are examples of two donors to the same integrated project, one of whose contributions ends in 1979 and the other in 1980. This may also result in each donor holding an independent review, which involves the project staff in extra work.
421. Each donor requires that the budget preparation and the accounting of a project be carried out in conformity with its own particular requirements. The CGIAR Secretariat for example has attempted to have WARDA bring its budget preparation, for the CGIAR-funded part of the operation, into line with the Group's practice, but this has been difficult because of other demands.

422. As noted elsewhere the lack of forward planning also means that budget projections beyond the current year have no detailed programme basis, making it impossible to have a really sound future financial plan.

423. The Panel has therefore given considerable thought to methods of improving the financial situation. Ideally CGIAR funding, because of its normally long term and stable nature, should be used for "core" funding. Similarly the member states contributions by their support of the administrative budget could also be regarded as essentially "core" and long-term funding.

424. Whilst the Panel is not in a position to suggest the optimum blend of these with the very substantial but nevertheless some time uncertain bilateral funding, it considers that this is a very important area for a detailed study.

425. To put funding on a firmer footing, the Panel suggests that WARDA organize a meeting of its donors. Perhaps such a meeting could be sponsored by the African Development Bank which has, of course, a strong commitment to rice development in the region.

426. The Panel also gave some thoughts to the idea of matching funds between member states and donors. At the moment the member states' contribution to the annual budget of WARDA amounts to approximately 16% of the total. Whilst it is fully aware that even this constitutes a substantial contribution, it considers that parallel growth of funds would be an attractive proposition to the donors.

(vii) Relationship with Country Programmes

427. WARDA functions as a decentralized research and development institution. The coordinated trials are conducted by national programme staff. The research activities are conducted at national stations. The pattern has developed in response to the extremely varied conditions under which rice is produced in West Africa (upland, deep-water, floating, rainfed, irrigated). It has enabled WARDA to achieve a degree of effective mutual complementarity, reinforcement and rapport with national research programmes that has been extremely difficult to achieve by many of the other institutions supported by the CGIAR.

428. WARDA represents an important institutional innovation, within the CGIAR system, that is highly relevant to the CGIAR's concern with strengthening national systems. Much of the credit for the innovation must be given to the initial support by the UNDP/FAO and by the USAID. The WARDA model should be instructive if the CGIAR should decide to institutionalize an international service for national agricultural development.

429. The Review Team is concerned however, that the WARDA special research project not become so closely identified with national programmes in the countries in which they are located that they fail to perform their appropriate regional responsibilities.
(viii) Relationships between WARDA and Extension Services

430. As a development agency, WARDA is only too well aware of the need for improved technologies from its research programmes to reach the farmer. However, in many member states extension services are just as weak as the research services. This presents the Association with a dilemma. It does not want to leave its technology at the experiment station nor can it mount an effective extension programme. Obviously it needs a minimum programme of trials in farmers' fields, to identify the major constraints, to keep its young researchers fully aware of farmers' problems and to validate its technology.

431. The Association can be effective only in cooperation with national research and extension programmes, never in substitution for them but the very nature of the Association places it in a unique position to persuade member states to improve their national services in parallel with the progress of WARDA's programmes. When member states are persuaded that WARDA has useful technologies for the farmers, it will be that much easier for them to justify and finance the strengthening of their own programme. Indirectly of course the training programme will help greatly.

432. The Panel therefore considers that WARDA's participation in work on farmers' fields should be on carefully planned, closely monitored sites and should have validation of technology and demonstration to research and extension workers, rather than to farmers, as its objectives.
Fig. 1. ADRAO, PRINCIPALES UNITES DE LA RECHERCHE - WARDA, MAIN RESEARCH UNITS

- SPECIAL RESEARCH PROJECT CENTRES
  CENTRES DES PROJETS SPÉCIAUX DE RECHERCHE
- SEED MULTIPLICATION CENTRE
  CENTRE MULTIPLICATION SEMENCES
- SEED LABORATORY
  LABORATOIRE SEMENCES
- TRAINING CENTRE
  CENTRE FORMATION
- CENTRAL NURSERY
  PEPINIÈRE CENTRALE
- QUARANTINE STATION
  QUARANTAINE
- WARDA H.Q.
  SIÈGE ADRAO

MAURITANIA

MALI

NIGER

SENEGAL

GAMBIA

GUINEA

SERRA LEONE

MONROVIA

LIBERIA

IVORY COAST

GHANA

BENIN

LOGO

IBADAN

300

600

1200
Fig. 2. ADRAO, SITES DES ESSAIS COORDONNES - WARDIA, COORDINATED TRIAL SITES

- COORDINATED TRIAL SITES: 1977
  ESSAIS COORDONNES

- IET TRIAL SITES: 1977
  ESSAIS EVALUATION INITIALE
Fig. 3 CATEGORIES OF RICE CULTIVATION AND AREAS COVERED
CATEGORIES DE CULTURE DE RIZ ET SURFACES COUVERTES

- UPLAND RICE - RIZ PLUVIAL
- IRRIGATED RICE - RIZ IRRIGUE
- MANGROVE RICE - RIZ DE MANGROVE
- DEEP FLOODED AND FLOATING RICE - RIZ IMMERGE ET RIZ FLOTTANT

Map showing cultivation areas of rice in West Africa with countries and cities labeled.
(*) Not yet operational.
ANNEX I

Composition of the Panel

Panel Chairman - Dr. Hussein Idris, TAC Member, Coordinator, Cotton Development International UNDP, New York

Panel Members - Dr. R. Chabrolin, Chief Rice Department IRAT, Paris

- Dr. V. Ruttan, Professor Department of Agriculture & Applied Economics University of Minnesota, USA

Secretary - Mr. S.A. Risopoulos, Senior Officer TAC Secretariat, FAO, Rome

Observer - Dr. J. Coulter, Scientific Advisor CGIAR Secretariat, Washington, D.C.

Itinerary and People Met by the Review Panel

August 30-31

Monrovia - Assembly of the Panel

September 1

Monrovia - Visit to WARDA Headquarters - Introduction of the Panel to the Executive Secretary, Mr. S. Coulibaly and senior staff.

Visit to the Ministry of Agriculture, Liberia.

Discussions with:

H.E. Jenkins Baker - Deputy Minister/Ag. Minister
Mr. Joe Ricks - Assistant Minister - Livestock
Mr. Joshua Cooper - Assistant Minister for Planning and Evaluation
Mr. Edward Findley - Director Rice Development
Mr. Leonard Ballay - Responsible for Rice & Tuber Crops
Mr. Adama Fahnbulleh - Training Officer

Monrovia-Suakoko-Monrovia by air with a Trislander chartered by WARDA from Air Liberia.*

Suakoko - Visit Research Station - under the guidance of the Director, Dr. Hilton Jarrett.

Monrovia - Freetown, by air with a Twin Otter, Chartered by WARDA, from Air Senegal.

* From 1 to 9 September, the Panel was accompanied during its field tour by the following WARDA team: Mr. S. Coulibaly, Executive Secretary; Dr. H. Will, Head of Research Department and Research Coordinator; Mr. D. Aw, Head of Development Department; Dr. B. Enyi, Assistant to Research Coordinator; Mr. G. Boccara, Chief of Communications Division; Mr. E. Neblett, Photographer.
September 2  Freetown-Rokupr by car.

Freetown - dinner with Hon Dr. A. F. Joe Jackson, Sierra Leone Minister of Agriculture and Forestry.

Mr. A. B. S. Bangurah, Deputy Sec. to Ministry of Agriculture and Forestry
Mr. A. R. Siafa, Chief Agricult.
Mr. L. M. Teika, Assistant Chief, Agricult.
Mr. R. Williams, " " "
Mr. B. I. Serry, Senior Assist. Secr. II
Mr. L. Lisk, " " "
Mr. B. D. M. Teika, Chief, Conserv. Forests
Mr. Sho-Sawyer, Chief, Fisheries Officer
Mr. T. P. Amara, Project Co-Manager, Seed Mult.

Rokupr - Visit of Research Station with Director R. A. D. Jones and his staff and WARDA team (E. Jones, leader, Mr. Agyen Sampong, Entomology; J. W. Stenhouse, Breeding; H. M. Bernard, Weeds; M. P. Jones, Breeding; C. A. Dixon, Soils; S. N. Fomba, Pathology; S. J. Fannah, Entomology) and FAO/UNDP team (Raimundo-Mahaptra).

Night at Rokupr.

September 3  Rokupr-Freetown by car

Rokupr - Visit of "Delegation Generale à la Recherche Scientifique et Technique, près du Premier Ministre" meeting with M. J. Diouf, Délégué General (ex WARDA Executive Secretary); L. Saugé, Dir. of Institut Senegalais de la Recherche Agronomique. (ISRA)

Freetown-Kenema-Freetown by air. Visit of Kenema rice development project with:

Messrs. E. S. Lamia, Project Manager
E. A. T. Moody, Deputy Project Manager
F. S. D. Tengbeh, Senior Agr. Officer
G. H. Vandy, Project Manager, Treecrops
L. H. Llymon, Land Develop. Officer
J. P. Amara, Project Co-Manager
M. A. Lewally, Seed Mult. Centre Manager
H. B. Gilbert, Ag. Commercial Services Manager
I. P. Tucker, Training Officer IADP
J. G. James, Project Accountant

Night at Freetown

September 4  Freetown-Dakar by air.

Night in Dakar

September 5  Dakar - Visit of "Délégation Generale à la Recherche Scientifique et Technique, près du Premier Ministre" meeting with M. J. Diouf, Délégué General (ex WARDA Executive Secretary); L. Saugé, Dir. of Institut Senegalais de la Recherche Agronomique. (ISRA)
Annex I - cont'd

Dakar-Richard Toll by air

Visit of Centre Agronomique de Richard-Toll and Fanaye with Mr. Sonko (Dir., ISRA Station), WARDA Special Research Project (leader, H. Van Brandt), WARDA Seed Multiplication Centre (leader, A. Diop).

Evening - dinner - discussions with Mr. Bakary Coly, Director General, Development Agency for the Senegal River (SAED) and his staff.

Night Richard-Toll.

September 6 Richard-Toll - Visit of trials. Round up meeting with:
Messrs. M. Sonko, Director, Agronomic Res. Centre, Richard-Toll, ISRA
M. Courtesolle, Agronomist, " " "
J. Caneil, " " "
H. Van Brandt, Team Leader, WARDA Special Project
A. Coly, Res. Officer, Varietal Improvement/Phys.
T. Diop, " Entomology
I. Camara, " Agro-pedology
A. Diop, Team Leader, WARDA Seed Centre
P. Diouf, Assistant, " "

Richard-Toll - Matam by air

Night at Matam

September 7 Matam-Bamako by air

Interview of Mr. Sidi Coulibaly by Radio Mali

Bamako - Meeting at the Ministry of Rural Development with:
Dr. Boubacar S. Sy, Directeur de Cabinet
Mr. Mbayo Sangantha, Director of the Ministry of Rural Development Agriculture Department
Mamadou F. Traore, Deputy Director, Institut d'Economie Rurale, Director of Agr. Division
Sori Sissoko, Director Genie Rural Department

September 8 Bamako-Mopti by air - Visit of Mopti Rice Research Station and WARDA Offices and buildings. Round up meeting with:
Messrs. Mamadou A. Dembele - ADRAC/Mopti
Almoubarakou Ibrahima TOURE " "
Kalifa Goita " "
Check Bougadary Bathily - Chef du Bureau d'Etudes Genie Rural, Bamako
Aboulaye Dicko - Operation Riz Mopti
Diadié Tembely " " "
Abdallah Quaraba Konde, Directeur Interim ORM
Mamadou Fatogama Traore - D.G.A. et chef D.R.A./IER
Sadio Diallo - ADRAC/Mopti
Kent Salter " " "
Abdoul Karim Diakite - Operation Riz Mopti
Sinenta Mama - Division A.S.E. ORM
Mamadou Daouda Traore - Division Approvisionnement ORM
Fousseyni Diatifaga Diarra - Zone Agricole de Mopti - Nord ORM
Aboulaye Toure - Production ORM
Dougou Keita - Zone Agricole de Mopti-Sud ORM
Visit to Governor of 5th Region of Mali, Amara Danfaga.

Buffet/dinner at Governor's house.
Night at Mopti.

September 9  Mopti-Segou  by road
Segou-Bamako  - by air
Bamako-Monrovia  - by air

September 10  Monrovia  - discussions on substance of report

September 11  Monrovia  - a.m. Fendall - Field day at WARDA Training Centre.
Visit of the Centre and of the experiments conducted by trainees
id. - visit of Seed Laboratory
p.m. exposé of Mr. S. Coulibaly regarding achievements, policy and problems of WARDA - general discussions.

September 12  Monrovia  - exposé of heads of departments and units, and sub-regional coordinators on WARDA activities in research, development, communication and documentation, and in the different sub-regions.

September 13 to September 15

September 15  Monrovia  - p.m. - Exposé by the Panel Chairman, Dr. H. Idris, of the Panel's major findings and recommendations to the:
Chairman of WARDA Governing Council, H.E.P. Akpo
Minister of Rural Development of Benin
Executive Secretary of WARDA and his staff
H.E. Mr. J. Baker, Deputy Minister/Ag. Minister of Agriculture of Liberia

September 16  Monrovia  - Finalization of report

September 17  Monrovia-Abidjan by air
Abidjan-Bouaké-Abidjan by air - Visit by Mr. R. Chabrolin and Mr. S. Risopoulos to the IDESSA Research Station and WARDA Special Research Project Bouaké. Discussions with: Messrs. Chevreau, Reyniers, Koffi, N’Guessan, Thomin.

September 18  Abidjan  - Visit by Mr. Sidi Coulibaly and Mr. Chabrolin and Risopoulos with:
Messrs. Dossongoi Kone, Adviser/Ag. Directeur de Cabinet of Minister of Agriculture, Ivory Coast
N. Guetta Bosso, Director, Division of Agr. Training, Adaptive Research and Pre-extension, Ministry of Agriculture
Annex I – cont'd

J. Barrault, Advisor, Research Development Liaison, id.
P. Bernard-Coffre, Advisor, Pre-Extension, id.
H. Leroux, Directeur de Cabinet, Ministry of Scientific Research.
ANNEX II

Documents Consulted by the Review Panel

A. Mandate
1. Excerpts relating to WARDA taken from reports of TAC meetings
2. WARDA Final Act

B. Governance
3. Reports of the Governing Council
4. Reports of the Sessions Scientific and Technical Committee

C. Research Coordination
7. The Research Programme of WARDA with emphasis on its linkages with the International and National Research Programmes - paper presented by Dr. H. Will
8. Rice Research Review 1977
10. Objectives and Strategy of the WARDA Research Programme
11. WARDA Research Programme - Progress and Future Plans (a quinquennial report, 1973-1978)
12. Contribution of the WARDA Research Programme to Rice Research of Member Countries (1973-78)

D. Special Projects
13. Regional Research Project on Mangrove Swamp Rice, Rokupr
14. Mangrove Swamp Rice - Special Project Rokupr
15. A Brief Review of Progress at the Rice Research Station Rokupr
16. Rice Research Station - Work Programme
17. All Sierra Leone Coordinated Agronomic Trials (Manual for farmers' field trials)
19. Regional Research Project on Irrigated Rice - Richard Toll
20. Le Centre de Recherche Agronomique de Richard-Toll - Structure, programmes de recherches et situation des acquis de recherche au 31.1.78
21. Richard-Toll - Note de présentation du Centre Semencier Régional de l'ADRAO
22. Assistance to the Specialized Research Programme on Deep Water and Floating Rice at Mopti
23. Mopti Special Research Project - research programme for 1978

E. Programming and Evaluation
25. Activity Report 1977
26. C.G. commentaries on 1978 Programme and Budget
27. C.G. Secretariat observations on 1979 Programme and Budget
28. Revised draft W1 Budget - Summary 1979 - Supplementary notes on revised draft W1 Budget-summary-revised detailed W1 draft budget proposals, 1979 (July 1978)
31. UNDP/FAO - Assistance to WARDA on Constitutional and Legal Matters (1978)
32. WARDA - Preliminary Analysis and Working Documents for the Quinquennial Review (TAC Secretariat 1978)

F. International Linkages
33. Meeting between IRRI, IRAT, IITA, FAO and WARDA - 1972
34. Tripartite Agreement IITA/IRRI/WARDA
35. Agreement with BRRI
36. Agreement with ICAR
37. Draft agreement with ICIPE

G. Development
38. Request for an expertise evaluation mission on the future development of agricultural mechanization in West Africa (1978)
40. Renforcement des capacités rizicoles des pays membres (1976)
41. Rice statistics yearbook 1975
42. Rice statistics yearbook 1978 (Abstracts)

H. Miscellaneous
43. Report of the TAC Quinquennial Review Mission to IRRI
44. Report of the TAC Quinquennial Review Mission to IITA
45. CGIAR Report of the Review Committee - January 1977
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<th>Sub-Total</th>
<th>Rice Cultivated on Flood Recession Water Only</th>
<th>Upland Rice with the Use of Ground</th>
<th>Soil Surplus Water in Depression in Rainfall</th>
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<th>Upland Rice without the Use of Ground</th>
<th>With Other Crops Frequently in Association</th>
<th>Classification of Rice Cultivation in Warner Countries (Total Rice Area = 2,300,000 Ha)</th>
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**ANNEX III**
### Annex III - cont’d

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<th>% of total surface cropped</th>
<th>Major Locations</th>
<th>Av. area covered (ha)</th>
<th>Av. yield per ha (t)</th>
<th>Potential yield/ha (t)</th>
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<td>Guinea Bissau, Guinea, Sierra Leone</td>
<td>138 000</td>
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<td>b. With tidal control along coast and low parts of estuaries - use of polders</td>
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<td>a. Without water control; comprises floating rice in land subject to flooding from a river to poorly drained low-lands where water stagnates during parts of the year</td>
<td>Mali, Niger, Nigeria, Sierra Leone, Senegal, Gambia, Guinea Bissau and Guinea</td>
<td>506 000</td>
<td>1-1.5</td>
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<td>b. With partial water control use of dam or pumping but no land levelling, hence no assured water depth</td>
<td>Mali, Senegal, Nigeria</td>
<td>69 000</td>
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<td>c. With complete water control land levelling and complete control of water distribution</td>
<td>Senegal, Ivory Coast, Nigeria, Mauritania, Niger, Upper Volta, Sierra Leone, Benin, Liberia, Gambia</td>
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<td>CG</td>
<td>Seed multiplication</td>
<td>- Bilateral</td>
<td>Identification, formulation, eval.</td>
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<td>Bilateral</td>
<td>Specialized training courses (6-8 weeks)</td>
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**COMMUNICATION**

**DOCUMENTATION**

**ADMINISTRATION**

**FINANCE**

*Special Fund and contribution in kind.
### TABLE 2

**Breakdown of WARDA Research Budget and Sources of Funding**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. BY PROJECT (US$'000)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Coordinated trials &amp; related expenditure (W1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-harvest technology</td>
<td>827</td>
<td>1 182</td>
<td>1 564</td>
<td>2 310</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>827</td>
<td>1 182</td>
<td>1 714</td>
<td>2 460</td>
</tr>
<tr>
<td>% of Total Res. Budget</td>
<td>37.35</td>
<td>50.00</td>
<td>72.13</td>
<td>76.52</td>
</tr>
<tr>
<td><strong>(2) Special Research</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rokupr</td>
<td>213.0</td>
<td>235.0</td>
<td>273.5</td>
<td>225.5</td>
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<tr>
<td>Richard-Toll</td>
<td>615.0</td>
<td>116.2</td>
<td>54.3</td>
<td>200.0</td>
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<tr>
<td>Mopti</td>
<td>531.9</td>
<td>812.6</td>
<td>308.5</td>
<td>330.0</td>
</tr>
<tr>
<td>Bouaké</td>
<td>17.1</td>
<td>17.8</td>
<td>26.0</td>
<td>-</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>1 387.9</td>
<td>1 181.6</td>
<td>662.3</td>
<td>755.5</td>
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<tr>
<td>% of Total Res. Budget</td>
<td>62.65</td>
<td>50.00</td>
<td>27.87</td>
<td>23.48</td>
</tr>
<tr>
<td>Total Res. Budget</td>
<td>2 214.0</td>
<td>2 363.6</td>
<td>2 376.3</td>
<td>3 215.5</td>
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<td><strong>B. BY SOURCE OF FUNDING (US$'000)</strong></td>
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<td></td>
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<tr>
<td>Belgium</td>
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<td>0.0</td>
<td></td>
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<tr>
<td>CGIAR</td>
<td>827.0</td>
<td>1 182.0</td>
<td>1 564.0</td>
<td>2 310.0</td>
</tr>
<tr>
<td>USAID</td>
<td>544.9</td>
<td>747.6</td>
<td>350.0</td>
<td></td>
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<tr>
<td>IDRC</td>
<td>215.0</td>
<td>98.0</td>
<td>0.0</td>
<td></td>
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<tr>
<td>CIDA</td>
<td>350.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>100.0</td>
<td>200.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Kuwait*</td>
<td>7.1</td>
<td>7.8</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>10.0</td>
<td>10.0***</td>
<td>0.0***</td>
<td></td>
</tr>
<tr>
<td>Special Fund (WARDA)</td>
<td>0.0</td>
<td>0.0</td>
<td>212.3</td>
<td></td>
</tr>
<tr>
<td>Abu-Dhabi</td>
<td>50.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Japan (post-harvest technology)</td>
<td>0.0</td>
<td>0.0</td>
<td>150.0</td>
<td>150.0</td>
</tr>
<tr>
<td>Estimated Earned Income</td>
<td>0.0</td>
<td>0.0</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>Estimated Carryover</td>
<td>0.0</td>
<td>92.0</td>
<td>111.4</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2 204.0</td>
<td>2 455.6</td>
<td>2 502.7</td>
<td>2 460.0</td>
</tr>
</tbody>
</table>

* Out of total aid of US$ 150.0
** One Research Assistant
*** Two Research Assistants
### TABLE 3

**Application of CGIAR Funding**

*(CGIAR Secretariat – August 1978)*

<table>
<thead>
<tr>
<th></th>
<th>1977 Actual</th>
<th>1978 Revised Budget</th>
<th>1979 Budget</th>
</tr>
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<tr>
<td>Research coordination</td>
<td>310</td>
<td>227</td>
<td>283</td>
</tr>
<tr>
<td>Training and Seminars</td>
<td>125</td>
<td>88</td>
<td>184</td>
</tr>
<tr>
<td>Variety Introduction, Improvement,</td>
<td>148</td>
<td>236</td>
<td>431</td>
</tr>
<tr>
<td>Protection and Seed Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative support</td>
<td>-</td>
<td>234</td>
<td>350</td>
</tr>
<tr>
<td>Sub-regional Activities, Coordinated</td>
<td>591</td>
<td>739</td>
<td>983</td>
</tr>
<tr>
<td>Trials, Assistance to National</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programmes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidental, W-1</td>
<td>8</td>
<td>-</td>
<td>56</td>
</tr>
<tr>
<td>Post-harvest technology</td>
<td>-</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>1 182</td>
<td>1 674</td>
<td>2 437</td>
</tr>
<tr>
<td>TAC Quinquennial</td>
<td>-</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>IITA Cooperation</td>
<td>-</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1 182</strong></td>
<td><strong>1 714</strong></td>
<td><strong>2 460</strong></td>
</tr>
</tbody>
</table>

*Amount recommended for approval by CGIAR Secretariat:
2 334 000 (=US$ 2 460.00 minus carry over and earned income)
### TABLE 4

**Program Budget Analysis**  
West African Rice Development Association*  
(in US$'000)

<table>
<thead>
<tr>
<th></th>
<th>ACT74</th>
<th>ACT75</th>
<th>ACT76</th>
<th>ACT77</th>
<th>REV78</th>
<th>REV79</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Core Operating Budget Summary</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>475</td>
<td>555</td>
<td>297</td>
<td>593</td>
<td>770</td>
<td>1,158</td>
</tr>
<tr>
<td>Total Res.</td>
<td>475</td>
<td>555</td>
<td>297</td>
<td>593</td>
<td>770</td>
<td>1,158</td>
</tr>
<tr>
<td>TRG &amp; Conf.</td>
<td>-</td>
<td>-</td>
<td>101</td>
<td>126</td>
<td>88</td>
<td>184</td>
</tr>
<tr>
<td>Gen. Admin.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>234</td>
<td>350</td>
</tr>
<tr>
<td>Gen. Oper.</td>
<td>-</td>
<td>-</td>
<td>258</td>
<td>163</td>
<td>252</td>
<td>363</td>
</tr>
<tr>
<td>Othr. + Cont.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>23</td>
</tr>
<tr>
<td>Inflation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>56</td>
</tr>
<tr>
<td><strong>Total Opns.</strong></td>
<td>475</td>
<td>555</td>
<td>656</td>
<td>882</td>
<td>1,384</td>
<td>2,134</td>
</tr>
</tbody>
</table>

| **B. Capital Expenditure Budget** |       |       |       |       |       |       |
| Equipment      | -     | -     | 171   | 393   | 330   | 326   |
| **Total Cap.** |       |       | 171   | 393   | 330   | 326   |
| **Total Core** | 475   | 555   | 827   | 1,275 | 1,714 | 2,460 |

| Center Tot.    | 475   | 555   | 827   | 1,275 | 1,714 | 2,460 |

| **Center Funding** |       |       |       |       |       |       |
| Earned Income   | -     | -     | -     | -     | -     |       |
| FDS B/F         | -     | -     | -     | -     | (132) | (111) |
| Req. of CG      | 475   | 555   | 827   | 1,275 | 1,582 | 2,334 |

| **Core Operating Budget by Major Expense Categories** |       |       |       |       |       |       |
| Pers. Serv.     | -     | -     | -     | 491   | 527   | 1,009 |
| Sup. & MTC      | -     | -     | -     | -     | 81    | 8     |
| Equipment       | -     | -     | -     | 38    | 51    | 39    |
| Travel          | -     | -     | -     | 56    | 83    | 85    |
| Othr./Cont.     | -     | -     | -     | 297   | 642   | 993   |

| **Center Staff Summary** |       |       |       |       |       |       |

---

*CGIAR Secretariat, August 1978*
TABLE 5

Expenditure per Country of the WARDA Research Activities (1973-78)*
(in US$)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Coordinated Trials</th>
<th>Equipment</th>
<th>Training</th>
<th>Infrastructure</th>
<th>Annual Meeting, Seminars, etc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mali</td>
<td>60 804</td>
<td>16 524</td>
<td>104 900</td>
<td>-</td>
<td>13 816</td>
<td>196 044</td>
</tr>
<tr>
<td>Senegal</td>
<td>78 359</td>
<td>20 604</td>
<td>72 800</td>
<td>-</td>
<td>9 953</td>
<td>181 716</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>57 569</td>
<td>15 921</td>
<td>59 000</td>
<td>-</td>
<td>14 418</td>
<td>146 908</td>
</tr>
<tr>
<td>Liberia</td>
<td>42 501</td>
<td>29 748</td>
<td>14 000</td>
<td>119 000</td>
<td>1 558</td>
<td>206 807</td>
</tr>
<tr>
<td>Nigeria</td>
<td>47 200</td>
<td>29 583</td>
<td>41 400</td>
<td>60 000***</td>
<td>18 888</td>
<td>197 071</td>
</tr>
<tr>
<td>Gambia</td>
<td>49 974</td>
<td>10 557</td>
<td>26 000</td>
<td>55 000***</td>
<td>9 161</td>
<td>150 692</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>90 937</td>
<td>24 783</td>
<td>9 000</td>
<td>-</td>
<td>12 256</td>
<td>136 976</td>
</tr>
<tr>
<td>Niger</td>
<td>54 185</td>
<td>22 765</td>
<td>22 800</td>
<td>22 000***</td>
<td>12 694</td>
<td>134 444</td>
</tr>
<tr>
<td>Benin</td>
<td>47 988</td>
<td>22 850</td>
<td>20 500</td>
<td>18 000</td>
<td>9 045</td>
<td>118 383</td>
</tr>
<tr>
<td>Ghana</td>
<td>50 825</td>
<td>11 109</td>
<td>16 400</td>
<td>-</td>
<td>15 322</td>
<td>93 656</td>
</tr>
<tr>
<td>Togo</td>
<td>36 689</td>
<td>19 011</td>
<td>8 000</td>
<td>18 000</td>
<td>9 576</td>
<td>91 276</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>32 933</td>
<td>28 175</td>
<td>11 200</td>
<td>10 000</td>
<td>6 979</td>
<td>89 787</td>
</tr>
<tr>
<td>Mauritania</td>
<td>34 252</td>
<td>21 898</td>
<td>10 000</td>
<td>18 000</td>
<td>5 450</td>
<td>89 600</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>16 825</td>
<td>12 054</td>
<td>6 000</td>
<td>18 000</td>
<td>6 075</td>
<td>58 954</td>
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<tr>
<td><strong>GRAND TOTAL</strong></td>
<td><strong>701 041</strong></td>
<td><strong>285 582</strong></td>
<td><strong>422 500</strong></td>
<td><strong>338 000</strong></td>
<td><strong>145 191</strong></td>
<td><strong>1 892 314</strong></td>
</tr>
</tbody>
</table>

* Guinea not included.
** Not including such costs as Coordination, Staff and Consultancies, etc. and not including special research projects.
***Essentially regional facilities; cost includes all inputs up to the end of 1978.
## TABLE 6

### Recommended Stations for the initial Evaluation Tests

<table>
<thead>
<tr>
<th>Station</th>
<th>Latitude (°N)</th>
<th>Rainfall</th>
<th>Cultivation Type</th>
<th>Soil</th>
<th>Others*</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Sapu</td>
<td>13.28</td>
<td>&quot;</td>
<td>Irrigated</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>5. Libore</td>
<td>13.18</td>
<td>&quot;</td>
<td>Deep flooded</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>6. Farakoba</td>
<td>11.0</td>
<td>Short monomodal</td>
<td>Upland</td>
<td>&quot;</td>
<td>Drought tol.</td>
</tr>
<tr>
<td>7. Nyankpala</td>
<td>9.25</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>8. Rokupr</td>
<td>9.01</td>
<td>Long monomodal</td>
<td>Upland</td>
<td>Fe toxicity</td>
<td>Deep water resistance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mangrove</td>
<td>Al toxicity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Deep water</td>
<td>Salinity</td>
<td></td>
</tr>
<tr>
<td>11. IITA (Ibadan)</td>
<td>7.30</td>
<td>&quot;</td>
<td>Upland irrig.</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>12. Moor Plantation</td>
<td>7.20</td>
<td>&quot;</td>
<td>Upland</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>13. Suakoko</td>
<td>6.58</td>
<td>Long monomodal</td>
<td>Upland irrig.</td>
<td>Fe toxicity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Various def.</td>
<td></td>
</tr>
</tbody>
</table>

* Diseases and insects at all locations.
### TABLE 7

**Number of Variety Trials Conducted in Different Years**

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Upland-Short</td>
<td>7</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Upland-Medium</td>
<td>6</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Irrigated-Short</td>
<td>13</td>
<td>17</td>
<td>16</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Irrigated-Medium</td>
<td>10</td>
<td>15</td>
<td>16</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Mangrove Swamp/Deep-Flooded-Medium</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>Man Swamp Medium 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Long 2</td>
</tr>
<tr>
<td>Mangrove Swamp/Deep-Flooded-Late</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>Deep-Flooded Medium 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Long 3</td>
</tr>
<tr>
<td>Floating</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Off-Season</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>90</td>
<td>87</td>
<td>72</td>
<td>85</td>
</tr>
</tbody>
</table>

### TABLE 8

**Number of Trial Sites in Different Countries**

<table>
<thead>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Gambia</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ghana</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Guine-Bissau</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Liberia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mali</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mauritania</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Niger</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Nigeria</td>
<td>4</td>
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<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Senegal</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Togo</td>
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TABLE 9
WARDA Research Staff Training

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<td>-</td>
<td>6</td>
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<td>24</td>
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<td>6</td>
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<td>-</td>
<td>-</td>
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</table>
TABLE 10

Number of Rice Workers of WARDA Member States Trained in Various Courses.

<table>
<thead>
<tr>
<th>Member States</th>
<th>1973 FAC</th>
<th>1975 FAC</th>
<th>1976 FAC WMC RPSC FAC PHIC RPSC FAC RPSC</th>
<th>GEU (IRRI) Specialized Course</th>
<th>Total</th>
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<tbody>
<tr>
<td>Benin</td>
<td>2 2</td>
<td>2</td>
<td>5 1 2</td>
<td>-</td>
<td>1 2</td>
</tr>
<tr>
<td>Gambia</td>
<td>3 -</td>
<td>2</td>
<td>2 2 2</td>
<td>2 1</td>
<td>2 2</td>
</tr>
<tr>
<td>Ghana</td>
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<td>1</td>
<td>1 2 1</td>
<td>2 3 2</td>
<td>2 3</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>- -</td>
<td>-</td>
<td>2 1 2</td>
<td>2 -</td>
<td>2 1</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>3 1 1</td>
<td>1</td>
<td>3 - -</td>
<td>2 1 1</td>
<td>-</td>
</tr>
<tr>
<td>Liberia</td>
<td>4 2 1</td>
<td>1</td>
<td>1 2 2</td>
<td>4 2 2</td>
<td>4 2</td>
</tr>
<tr>
<td>Mali</td>
<td>5 3 3</td>
<td>3</td>
<td>3 1 1</td>
<td>3 4 -</td>
<td>2 3</td>
</tr>
<tr>
<td>Mauritania</td>
<td>2 2 3</td>
<td>1</td>
<td>1 - 1</td>
<td>2 1 2</td>
<td>2 1</td>
</tr>
<tr>
<td>Niger</td>
<td>2 1 -</td>
<td>1 1 1</td>
<td>1 1 -</td>
<td>2 1 1</td>
<td>2 1</td>
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<tr>
<td>Nigeria</td>
<td>- 3 2</td>
<td>4</td>
<td>1 1 1</td>
<td>- 4 6</td>
<td>2 5</td>
</tr>
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<td>Senegal</td>
<td>6 2 2</td>
<td>3</td>
<td>3 - 1</td>
<td>6 3 5</td>
<td>5 3</td>
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<td>Sierra Leone</td>
<td>4 3 3</td>
<td>3</td>
<td>2 1 4</td>
<td>2 4 3</td>
<td>5 1</td>
</tr>
<tr>
<td>Togo</td>
<td>2 2 -</td>
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<td>2 2 2</td>
<td>2 2 2</td>
<td>2 1</td>
</tr>
<tr>
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<td>2 5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>37 23 20</td>
<td>30 14 21</td>
<td>30 27 24</td>
<td>33 30 5</td>
<td>5 5</td>
</tr>
</tbody>
</table>

FAC: Field Assistant Course  
WMC: Water Management Course  
GEU: Genetic Evaluation and Utilization  
RPSC: Rice Production Specialist Course  
PHTC: Post Harvest Technology Course
### TABLE 11

**WARDA Countries - Population, Land and Cereals**

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Population* (1'000)</th>
<th>Total Area** (1'000 ha)</th>
<th>Arable Land** (1'000 ha)</th>
<th>Irrigated** Land (1'000 ha)</th>
<th>All Cereals Harvested (1'000 ha)</th>
<th>Yield (kg/ha)</th>
<th>Production (1'000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>3 249</td>
<td>11 262</td>
<td>2 940</td>
<td>5</td>
<td>451</td>
<td>745</td>
<td>336</td>
</tr>
<tr>
<td>Gambia</td>
<td>530</td>
<td>1 130</td>
<td>260</td>
<td>25</td>
<td>93</td>
<td>550</td>
<td>51</td>
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<tr>
<td>Ghana</td>
<td>10 461</td>
<td>23 854</td>
<td>1 050</td>
<td>25</td>
<td>823</td>
<td>750</td>
<td>601</td>
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<tr>
<td>Guinea</td>
<td>4 642</td>
<td>24 506</td>
<td>4 100</td>
<td>6</td>
<td>1 061</td>
<td>721</td>
<td>765</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>544</td>
<td>3 162</td>
<td>255</td>
<td>not m.</td>
<td>71</td>
<td>768</td>
<td>55</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>7 062</td>
<td>32 246</td>
<td>8 050</td>
<td>25</td>
<td>749</td>
<td>885</td>
<td>663</td>
</tr>
<tr>
<td>Liberia</td>
<td>1 635</td>
<td>11 137</td>
<td>126</td>
<td>2</td>
<td>200</td>
<td>1 150</td>
<td>230</td>
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<tr>
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<td>9 797</td>
<td>90</td>
<td>1 537</td>
<td>746</td>
<td>1 146</td>
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<td>1 000</td>
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<td>188</td>
<td>286</td>
<td>54</td>
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<tr>
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<td>126 700</td>
<td>15 000</td>
<td>6</td>
<td>2 941</td>
<td>448</td>
<td>1 317</td>
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<td>66 778</td>
<td>92 377</td>
<td>22 800</td>
<td>15</td>
<td>13 429</td>
<td>627</td>
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<td>2 400</td>
<td>127</td>
<td>1 112</td>
<td>485</td>
<td>540</td>
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<tr>
<td>Sierra Leone</td>
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<td>7 174</td>
<td>3 948</td>
<td>4</td>
<td>441</td>
<td>1 441</td>
<td>635</td>
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<tr>
<td>Togo</td>
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<td>5 600</td>
<td>2 220</td>
<td>3</td>
<td>334</td>
<td>865</td>
<td>289</td>
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<td>27 420</td>
<td>5 600</td>
<td>2</td>
<td>2 254</td>
<td>452</td>
<td>1 018</td>
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<td><strong>TOTAL</strong></td>
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<td><strong>613 967</strong></td>
<td><strong>79 596</strong></td>
<td><strong>338</strong></td>
<td><strong>25 684</strong></td>
<td><strong>628</strong></td>
<td><strong>16 126</strong></td>
</tr>
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</table>

* Figures for 1977
** Figures for 1976

Source: FAO Yearbook 1977
TABLE 12

WARDA Countries* - Rice Area, Yield and Total Production

<table>
<thead>
<tr>
<th>Area under Rice</th>
<th>Yield</th>
<th>Total Production</th>
</tr>
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<tbody>
<tr>
<td>('000 ha)</td>
<td>(kg/ha)</td>
<td>('000 t)</td>
</tr>
<tr>
<td>Benin</td>
<td>3.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Gambia</td>
<td>25.8</td>
<td>22.3</td>
</tr>
<tr>
<td>Ghana</td>
<td>55.1</td>
<td>78.5</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>30.0</td>
<td>42.0</td>
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<td>Ivory Coast</td>
<td>289.0</td>
<td>361.0</td>
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<tr>
<td>Liberia</td>
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<td>191.0</td>
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<td>220.0</td>
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<td>1.0</td>
</tr>
<tr>
<td>Niger</td>
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<td>16.2</td>
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<tr>
<td>Nigeria</td>
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<td>Senegal</td>
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<td>87.0</td>
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<td>Sierra Leone</td>
<td>358.4</td>
<td>434.6</td>
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<td>18.7</td>
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<td>TOTAL</td>
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<td>1 781.9</td>
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</table>

Source: WARDA Rice Statistics Yearbook, July 1978; except Guinea-Bissau, for which data are taken from FAO Yearbook 1977.

* Guinea not included
**Estimated
TABLE 13

WARDA Countries – Rice Consumption and Imports

<table>
<thead>
<tr>
<th></th>
<th>Estimated Rice Consumption per capita (kg/head)</th>
<th>Net Imports ('000 t)</th>
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<td>Benin</td>
<td>2.0</td>
<td>2.6</td>
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<tr>
<td>Gambia</td>
<td>78.9</td>
<td>66.8</td>
</tr>
<tr>
<td>Ghana</td>
<td>10.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
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<tr>
<td>Ivory Coast</td>
<td>42.7</td>
<td>30.3</td>
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<td>105.0</td>
<td>109.4</td>
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<td>Mali</td>
<td>19.5</td>
<td>20.2</td>
</tr>
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<td>9.5</td>
<td>6.9</td>
</tr>
<tr>
<td>Niger</td>
<td>4.4</td>
<td>4.1</td>
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<tr>
<td>Nigeria</td>
<td>2.8</td>
<td>4.1</td>
</tr>
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<td>Senegal</td>
<td>37.4</td>
<td>44.6</td>
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<td>Sierra Leone</td>
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<td>117.0</td>
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<td>5.0</td>
</tr>
<tr>
<td>Upper Volta</td>
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<td>6.4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>12.5</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Source: WARDA Rice Statistics, July 1978

1/ Guinea not included
2/ Including food aid
3/ Provisional
4/ Decrease in official consumption due to Government restrictions on rice import
5/ Sharp increase in consumption and import of rice in Nigeria is attributed to liberalization of rice import
TABLE 14

Distribution of World Rice Production Average 1970-1974

<table>
<thead>
<tr>
<th>Region</th>
<th>Quantities ('000 mt paddy)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>290 210</td>
<td>91.8</td>
</tr>
<tr>
<td>South America</td>
<td>9 252</td>
<td>2.9</td>
</tr>
<tr>
<td>North America</td>
<td>5 716</td>
<td>1.8</td>
</tr>
<tr>
<td>WARDA Region</td>
<td>2 453</td>
<td>0.8</td>
</tr>
<tr>
<td>Other Africa</td>
<td>4 744</td>
<td>1.5</td>
</tr>
<tr>
<td>Others</td>
<td>3 703</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>316 078</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Sources: WARDA - Rice Statistics Yearbook Abstracts, 1978 (for WARDA region)
IRRI - World Rice Statistics, 1978 (for others)

TABLE 15

Per Capita Rice Consumption in Selected Countries Compared to WARDA Region
(Average 1970-74 in kg/year)

<table>
<thead>
<tr>
<th>Country</th>
<th>Per Capita Rice Consumption (kg/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARDA Region</td>
<td>12.9</td>
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<tr>
<td>South Vietnam</td>
<td>231.7</td>
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<tr>
<td>Thailand</td>
<td>204.6</td>
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<td>Indonesia</td>
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<td>P.R. of China</td>
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<tr>
<td>India</td>
<td>73.9</td>
</tr>
<tr>
<td>USA</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Sources: WARDA - Rice Statistics Yearbook Abstracts, 1978 (for WARDA)
IRRI - World Rice Statistics, 1978 (for other countries)
TABLE 16
World Rice Trade - Imports (million mt)
and Percentage Distribution - Average 1970-74

<table>
<thead>
<tr>
<th>Countries</th>
<th>Average 1970-74</th>
<th>Percentage 1970-74</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>1.0</td>
<td>13.7</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.6</td>
<td>8.2</td>
</tr>
<tr>
<td>EEC (9 countries)</td>
<td>0.5</td>
<td>6.9</td>
</tr>
<tr>
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<td>0.4</td>
<td>5.5</td>
</tr>
<tr>
<td>Sri Lanka (Ceylon)</td>
<td>0.4</td>
<td>5.5</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.3</td>
<td>4.1</td>
</tr>
<tr>
<td>South Vietnam</td>
<td>0.3</td>
<td>4.1</td>
</tr>
<tr>
<td>India</td>
<td>0.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.3</td>
<td>4.1</td>
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<td>Singapore</td>
<td>0.2</td>
<td>2.7</td>
</tr>
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<td>Cambodia</td>
<td>0.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Africa</td>
<td>0.9</td>
<td>12.3</td>
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<tr>
<td>Others</td>
<td>2.0</td>
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</tr>
<tr>
<td>World</td>
<td>7.3</td>
<td>100.0</td>
</tr>
<tr>
<td>WARDA Sub Reg.</td>
<td>0.5</td>
<td>6.9*</td>
</tr>
</tbody>
</table>

Source: WARDA Rice Statistics Yearbook, 1975

*about 8.0% with Guinea and Guinea-Bissau

TABLE 17
World Rice Prices Index
(Total Index)

100 = Average 1957-59

<table>
<thead>
<tr>
<th>Year</th>
<th>Index</th>
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<tr>
<td>1970</td>
<td>104</td>
</tr>
<tr>
<td>1971</td>
<td>86</td>
</tr>
<tr>
<td>1972</td>
<td>99</td>
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<td>1973</td>
<td>236</td>
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<td>1974</td>
<td>377</td>
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<td>1975</td>
<td>284</td>
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<tr>
<td>1976</td>
<td>193</td>
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<tr>
<td>1977</td>
<td>212</td>
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</table>

Source: FAO
TABLE 18

WARDA Region: Rice Production and Share of World Trade
(Average 1970-74)

<table>
<thead>
<tr>
<th></th>
<th>Quantities ('000 mt paddy)</th>
<th>Percentage of World Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>2,453</td>
<td>0.8</td>
</tr>
<tr>
<td>Imports</td>
<td>544</td>
<td>8.0</td>
</tr>
</tbody>
</table>

TABLE 19

Yield of Paddy (Average 1970-74 in kg/ha) of WARDA Region Compared to World's Total and Selected Countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARDA Region</td>
<td>1,254</td>
</tr>
<tr>
<td>World</td>
<td>2,376</td>
</tr>
<tr>
<td>P.R. of China</td>
<td>3,401</td>
</tr>
<tr>
<td>India</td>
<td>1,666</td>
</tr>
<tr>
<td>Thailand</td>
<td>1,833</td>
</tr>
<tr>
<td>Egypt</td>
<td>5,350</td>
</tr>
<tr>
<td>Malagasy Rep.</td>
<td>1,852</td>
</tr>
<tr>
<td>USA</td>
<td>5,098</td>
</tr>
<tr>
<td>Oceania</td>
<td>6,564</td>
</tr>
</tbody>
</table>

Sources: WARDA - Rice Statistics Yearbook Abstracts, 1978 (for WARDA Region)
IRRI - World Rice Statistics, 1978 (for other countries and world)

TABLE 20

Parts of Gross Rice Area under Irrigated and Upland Types of Rice Cultivation in the WARDA Region Compared to the World Total (Percentage)

<table>
<thead>
<tr>
<th></th>
<th>World</th>
<th>WARDA Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated</td>
<td>44.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Upland</td>
<td>10.5</td>
<td>62.5</td>
</tr>
</tbody>
</table>

Sources: WARDA - Classification of Types of Rice Classification in West Africa, 1978 (for WARDA Region)
IRRI - World Rice Statistics, 1978 (for world)
TABLE 21
Evolution of Rice Production, Imports and Self-Sufficient Ratio in WARDA Region*

<table>
<thead>
<tr>
<th>Year</th>
<th>Production ('000 mt equiv. milled rice)</th>
<th>Imports ('000 mt)</th>
<th>Self-Sufficiency Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 1960-64</td>
<td>816.5</td>
<td>269.1</td>
<td>70.8</td>
</tr>
<tr>
<td>Average 1965-69</td>
<td>1085.1</td>
<td>352.4</td>
<td>71.5</td>
</tr>
<tr>
<td>Average 1970-74</td>
<td>1313.6</td>
<td>492.4</td>
<td>69.4</td>
</tr>
<tr>
<td>1975</td>
<td>1588.5</td>
<td>228.6</td>
<td>85.4</td>
</tr>
<tr>
<td>1976</td>
<td>1601.8</td>
<td>383.7</td>
<td>72.1</td>
</tr>
<tr>
<td>1977</td>
<td>1500.0**</td>
<td>1100.0</td>
<td>54.8**</td>
</tr>
<tr>
<td>1978</td>
<td>1601.8</td>
<td>1250.0***</td>
<td>50.0***</td>
</tr>
</tbody>
</table>

Source: WARDA

* Guinea and Guinea-Bissau excluded
** Estimate
*** Forecast

TABLE 22
Rice Production, Imports, Per Capita Consumption in WARDA Member Countries (Average 1970-74)

<table>
<thead>
<tr>
<th>Country</th>
<th>Production ('000 mt paddy)</th>
<th>Imports ('000 mt rice)</th>
<th>Per Capita Consumption (kg) per yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>6.6</td>
<td>7.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Gambia</td>
<td>33.0</td>
<td>17.6</td>
<td>77.3</td>
</tr>
<tr>
<td>Ghana</td>
<td>61.8</td>
<td>41.0</td>
<td></td>
</tr>
<tr>
<td>Guinea</td>
<td>-</td>
<td>27.4</td>
<td>-</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>-</td>
<td>22.8</td>
<td>-</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>352.0</td>
<td>93.4</td>
<td>44.7</td>
</tr>
<tr>
<td>Liberia</td>
<td>215.0</td>
<td>45.2</td>
<td>109.6</td>
</tr>
<tr>
<td>Mali</td>
<td>156.2</td>
<td>38.7</td>
<td>20.7</td>
</tr>
<tr>
<td>Mauritania</td>
<td>2.6</td>
<td>25.6</td>
<td>18.4</td>
</tr>
<tr>
<td>Niger</td>
<td>29.8</td>
<td>3.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Nigeria</td>
<td>403.6</td>
<td>2.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Senegal</td>
<td>86.0</td>
<td>177.5</td>
<td>45.7</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>580.0</td>
<td>34.3</td>
<td>128.5</td>
</tr>
<tr>
<td>Togo</td>
<td>16.7</td>
<td>3.7</td>
<td>5.9</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>36.6</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1979.9</td>
<td>544.5</td>
<td>12.9*</td>
</tr>
</tbody>
</table>

Source: WARDA Rice Statistics Yearbook Abstracts, 1978 except for Guinea (FAO)

*not available yet; consumption thought to be high.
TABLE 23
Evolution of Rice Imports in WARDA Member Countries
Unit = 1000 mt rice

<table>
<thead>
<tr>
<th>Country</th>
<th>Average 1965-69*</th>
<th>1977*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>6.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Gambia</td>
<td>9.5</td>
<td>31.9</td>
</tr>
<tr>
<td>Ghana</td>
<td>35.9</td>
<td>43.0</td>
</tr>
<tr>
<td>Guinea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>10.7</td>
<td>13.3</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>57.6</td>
<td>159.0</td>
</tr>
<tr>
<td>Liberia</td>
<td>37.3</td>
<td>55.8</td>
</tr>
<tr>
<td>Mali</td>
<td>3.3</td>
<td>-20.0**</td>
</tr>
<tr>
<td>Mauritania</td>
<td>9.0</td>
<td>52.0</td>
</tr>
<tr>
<td>Niger</td>
<td>1.1</td>
<td>7.4</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1.0</td>
<td>427.4</td>
</tr>
<tr>
<td>Senegal</td>
<td>165.0</td>
<td>276.8</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>21.3</td>
<td>16.5</td>
</tr>
<tr>
<td>Togo</td>
<td>2.6</td>
<td>18.2</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>3.5</td>
<td>12.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong>*</td>
<td>363.1</td>
<td>1113.3</td>
</tr>
</tbody>
</table>

* Provisional
** Negative sign represents exports
***Guinea excluded

TABLE 24
Paddy Producer Price in WARDA Member Countries at 1/1/77
(equivalence US$/mt) (Official prices)

<table>
<thead>
<tr>
<th>Countries</th>
<th>Price (US$/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>144</td>
</tr>
<tr>
<td>Gambia</td>
<td>203</td>
</tr>
<tr>
<td>Ghana</td>
<td>310</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>152</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>260</td>
</tr>
<tr>
<td>Liberia</td>
<td>264</td>
</tr>
<tr>
<td>Mali</td>
<td>80</td>
</tr>
<tr>
<td>Mauritania</td>
<td>240</td>
</tr>
<tr>
<td>Niger</td>
<td>140</td>
</tr>
<tr>
<td>Nigeria</td>
<td>480</td>
</tr>
<tr>
<td>Senegal</td>
<td>166</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>150</td>
</tr>
<tr>
<td>Togo</td>
<td>160</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>140</td>
</tr>
</tbody>
</table>

Source: WARDA