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PROGRAMME IMPLEMENTATION

EVALUATION

Evaluation of the global programmeReport of the Administrator

1. The Governing Council at its twenty-sixth session requested the Administrator to prepare an evaluation report on UNDP's global programme for submission to the twenty-seventh session of the Council (decision 79/10, II, para. 6). Pursuant to this request, the Administrator decided to appoint an independent consultant to evaluate the programme. The consultant selected was Dr. Alexander King, Chairman of the Board of the International Federation of Institutes of Advanced Study, and former Director General for Scientific Affairs of the OECD. Dr. King has had a long and distinguished career in the field of science and development and has served as a consultant for many Governments and international organizations. His evaluation report on the global programme is attached. In preparing the report, Dr. King has had full access to all files and documentation relating to the programme as a whole as well as to the individual projects included in it. He has also carried out extensive consultations with Governments, research organizations, and individuals familiar with the programme and global research needs.

2. In the Administrator's view, the consultant's report represents a balanced and objective appraisal of the programme and it has his full endorsement. It demonstrates that UNDP's global programme has indeed provided valuable support for research activities related to important concerns of developing countries, and has served as a major catalyzing force for generating additional resources for research and development work. At the same time it analyses some present weaknesses, and offers constructive and practical suggestions for strengthening the programme in the third IPF cycle. Without attempting to summarize the report,

which speaks for itself, it may be helpful to draw the attention of the members of the Council to several of the more important findings and recommendations:

(a) Until now, the global programme has concentrated primarily on research in two areas, agriculture and health, which have absorbed nearly 90 per cent of the Global IPF during the first and second cycles. While these will remain high priority areas, it is clear that the programme needs to be broadened, and the valuable suggestions contained in Section V of the report (specifically paragraphs 69-83) will receive UNDP's serious attention in connexion with the preparation of the next global programme;

(b) Dr. King's recommendation (paragraph 63) that a small panel be set up to advise the Administrator on the future development of the programme is also fully endorsed;

(c) To facilitate the identification and preparation of projects, it would be very helpful, in view of rising costs, if the delegated authority granted to the Administrator by the Governing Council at its twenty-fifth session could be increased from the present level of \$75,000 to \$125,000 as recommended by the consultant (paragraph 11).

3. Particularly valuable also are the suggestions that have been made for achieving closer articulation between global research and national activities and policies, so that the programme will in future contribute, along with its other objectives, to the strengthening of national research capacities to the maximum extent possible (paragraphs 65-66). This will require, among other measures, close co-ordination of global projects with activities supported from the Interim Fund for Science and Technology which has, as a principal mandate, the building up of national capabilities. Mechanisms for achieving the necessary degree of co-ordination are being worked out.

4. The report contains many other valuable insights and suggestions for strengthening the programme, and the Administrator intends to take them fully into account in the design and implementation of the next global programme.

EVALUATION OF THE GLOBAL PROGRAMME

Report prepared by Dr. Alexander King, Chairman of the Board of the International Federation of Institutes of Advanced Study

I. INTRODUCTION

1. At the twenty-sixth session of the Governing Council, held in June 1970, the Administrator of UNDP was requested to submit to the twenty-seventh session an evaluation of the global programme. This evaluation report was made in relation to the objectives, priorities and activities as approved by the Council at its twenty-third session in January 1977. 1/
2. The programme document (DP/216) for the current IPF cycle approved by the Governing Council, states clearly the need for a global programme, criteria for the selection of projects, initial items identified for action research and fields in which future work might be envisaged. It provides a useful basis against which the present evaluation has been made. The first part of the report (Sections II-IV) is concerned with an evaluation of past and present activities within the programme, their conformity with the criteria of the programme document and their preliminary results.
3. Since the issue of the programme document, however, external events and world trends have had a considerable influence on development needs, relevant to the evolution of the global programme. Part V of the report endeavours to describe some of the new issues and, as a consequence, to suggest how future programmes might develop, both with regard to project selection and of methods to meet the new circumstances.

II. THE NEED FOR GLOBAL PROGRAMMES

4. In its initial paragraphs, the programme document outlined some of the considerations which led to the establishment of the global approach. In view of the developments in thinking and experience, it may be useful to extend this reasoning somewhat, by summarizing types of activity for which the global approach is essential:

1/ See Official Records of the Economic and Social Council, Sixty-third Session, Supplement No. 3 (E/5940), para. 147.

(a) Monitoring of trends in the world situation, both positive and negative, which should be signaled promptly and regularly to all countries, so that their own priorities can take due account of these;

(b) Attack on problems which are inherently global in nature and whose consequences will be felt by all nations; the tendency may well be in many cases, to leave these matters to the industrialized nations, but the universal significance of the truly global problems makes it very important to associate the developing countries from the beginning;

(c) Attack on problems of widespread significance which have little direct dependence on geographical or ecological conditions within national boundaries; the work of the International Maize and Wheat Improvement Center (CIMMYT) and the International Rice Research Institute (IRRI) are outstanding examples of this type of global approach, as Centres primarily directed towards breeding better strains of plant crops, the products being ready to be shipped all over the world for field testing and adaptation;

(d) There are many other types of research which for reasons of economy and effectiveness could best be undertaken globally and regionally. These include many topics of both basic and fundamental research for which national efforts are sub-critical; they range from subjects such as molecular biology and systems science to corrosion and ship design. They may be undertaken centrally or else through a global programme, with elements of the programme and of its constituent projects carried out through a network of national research laboratories; and

(e) The organization of certain services and training activities on a centralized basis with the individual activities carried out nationally. This approach is especially useful as it enables an accumulation of experience and expertise at a global centre on a scale that would not be possible in each country and would therefore be of outstanding value to the participating nations.

5. A number of general considerations must be added in relation to the above. Scientific research is costly in terms of installations and equipment and hence the establishment of international co-operative schemes to permit cost-sharing should be considered. Secondly, if research and application in certain fields is to be successful, it is necessary to have an effort, above a certain critical threshold. The very meagre scientific capacity in most developing countries tends to result in the research effort being spread so thin as to be well below the critical mass in most projects. Yet virtually identical research projects on many subjects are in progress in many countries.

6. A final advantage of the global project should be recognized; its stimulus value. This is essentially an extension of the critical threshold of effort argument. Where a comprehensive global project exists, it permits the creation of a strong scientific team with many disciplines represented, much critical discussion of the issues involved, intimate contact with many advanced scientific

centres throughout the world and, hence, access to new knowledge as it arises. Thus the existence of such Centres provides an important degree of scientific sophistication which individual developing countries would otherwise find it difficult to cultivate.

7. The case of global programmes in science and technology is, thus, very strong. In order to make such a system fully effective, however, there is great need to give more attention than in the past, to the articulation of the global with the national and regional efforts. This need was expressed well in document DP/216, but the new conditions necessitate its reinforcement.

8. Before discussing the existing global programme of UNDP it is necessary to mention a few points inherent in the nature of successful scientific activity which have important policy significance. First, scientific research is inherently uncertain. Experience in the industrialized countries indicates that only a portion of research undertaken at basic research level yields results leading to possible practical applications, while only a portion of these are economically viable. This is one reason why research efforts nationally must be above a certain threshold before there is a statistical probability of a practical outcome. Second, research is inherently a long process; the lead time, from a significant scientific discovery in the laboratory, through the stages of applied research, technological development and the provision of capital for a process to contribute to the economy on a significant scale may be many years. Thus, the tempo of science is greatly different from that of politics; it has to be planned in advance to meet long-term objectives, and the effort has to be sustained if sure gains are to be secured. Therefore, with regard to the UNDP Global Programme which has only been running for a decade, it would be extremely surprising if major results had already appeared. It will take a further decade before a full evaluation can be made. This does not, of course, mean that insufficient evidence has yet accumulated to enable its general significance to be assessed and to foresee some of its successes.

III. THE CATALYTIC NATURE OF THE GLOBAL PROGRAMME: ITS ANALYSIS BY OBJECTIVE

9. The global programme is regarded, very rightly, as being essentially promotional and catalytic. The cost of the major projects and the support needs of the many agricultural research centres are well beyond the means of UNDP. Nevertheless, experience has demonstrated clearly that initiative by UNDP in defining major research needs, in assisting in the precise formulation of projects and through the injection of important pump-priming funds is capable of attracting consortium and collaborative funding of the necessary magnitude for the accomplishment of essential tasks. The success of the current programme in achieving this objective probably justifies the entire effort and finance expended.

10. A second and equally catalytic role has been in institution building. Global research is a very new concept and practice in applied fields, and there

is still very little experience as to how it can best be accomplished. The lessons of the last decade, as in the evolution of the Consultative Group on International Agricultural Research (CGIAR) have been very positive; but much remains to be done, since very different models may be required in different research fields.

11. Third, the global programme can have an essentially catalytic role in undertaking a variety of small preparatory studies on subjects which are as yet insufficiently explored and defined. In this connexion the authorization to the Administrator to incur expenditures up to \$75,000 on preparatory work in a specific field, without waiting for the somewhat infrequent meetings of the Governing Council, is proving to be a very useful mechanism, providing flexibility and making quick action possible. In the light of inflation and of the importance of careful preparatory work for new activities of the type foreseen in part V of the report, it would seem wise to raise this limit to \$125,000.

12. Table 1 below shows the sectoral allocation of the Global IPF during the current programming cycle (1977-81) as a basis for the subsequent discussion on priorities.

IV. GENERAL EVALUATION OF THE GLOBAL PROGRAMME

13. As stated in the programme document, the main priority areas for research to contribute to the solution of the major problems of the developing countries have been recognized for well over a decade and the systematic analysis which resulted in the World Plan of Action for the Application of Science and Technology for Development is still largely valid, although some change of emphasis is necessary owing to changing circumstances.

Priorities

14. The items in the global programme of recent years are essentially those agreed in the programme document, with the exception of the Southern Ocean Programme which was discontinued at the end of the first phase. It has not proved possible to initiate some of the new areas which were regarded as strong candidates for preparatory work in the programme document, such as the interactions between food, nutrition, agriculture and public health, pre- and post-harvest wastage of foods, the development of micro-biological processes or the improvements needed and possible in the fields of education (formal and informal) and training. These matters still remain important and it is hoped that some preparatory work can be started soon.

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25. Not much has yet been said concerning the means for identifying potential new projects as distinct from priority fields of activity and DP/216 is silent on this matter. Most of the specific actions to date were obvious initial choices offered by the existence of the international agricultural research centres and the possibility of increasing their coverage, or on the basis of the knowledge of health needs of the World Health Organization (WHO). The author of this report has had the opportunity of looking through the files of applications and suggestions for the support projects within the global programme and fully concurs with the criteria for their eventual selection or rejection.

26. The task of identifying needs and possibilities in other fields of importance will be much more difficult in the future. DP/216 (para. 3) mentioned how small the proportion is of world research undertaken in the developing countries. It must be realized, in addition, that most of this small effort is in agriculture and health, while most of the rest takes place in a few countries such as India, Mexico and Brazil, which means that there are only marginal research facilities on subjects outside agriculture and health in the great majority of developing countries.

Criteria used in the selection of institutions and agencies
for implementation

27. As already stated, the choice of certain institutions for the implementation of global projects has been, until now, more or less inevitable and it is significant that no criteria for such selection were laid down in DP/216. At the time the global programme was initiated there were, indeed, very few research institutes in the developing countries capable of mounting a critical mass of effort such as is demanded for significant global projects. In the field of insect control, for example, the embryo International Centre of Insect Physiology and Ecology (ICIPE) was coming into existence and was thus the obvious location for any UNDP global project on that subject.

28. In agriculture, the choice of agents was even more obvious. CIMMYT, the outcome of a co-operative programme by the Rockefeller Foundation and the Mexican Government, began work as early as 1943, was formally established as an International Research Centre in 1966 and had already established international renown for the "Green Revolution". IRRI in the Philippines had likewise established a high reputation for similar work on its crop. Both these institutions were already thoroughly international in their activities with research and testing programmes in many nations beyond the host country. Several other Centres for research on other food crops and animal products were formed in the late sixties and early seventies; hence there was a new international network for agricultural research in and for the developing countries. The global programme was thus able to make an immediate and major contribution by speeding up the development of the Centres and using their facilities as a sure base for its own specific projects.

29. A significant new development took place in 1971 with the creation of the Consultative Group on International Agricultural Research (CGIAR). Sponsored by UNDP, the Food and Agriculture Organization of the United Nations (FAO) and the International Bank for Reconstruction and Development (World Bank), CGIAR is an international consortium for the increase of food production in the developing countries by means of research and training. In the first year of funding (1972) there were already five international research centres associated, with a budget of \$15 million; in 1980 the network has increased to include 13 centres with a budget around \$120 million. The global programme of UNDP has played a major role in the creation of this system which constitutes one of the most impressive examples of international scientific co-operation of all times. Not only have the financial injections to major projects within the system been determinative, but the conceptual guidance of the Division for Global and Interregional Projects has contributed greatly to the shaping and innovative character of the Group and is much appreciated by the partner organizations. CGIAR is assisted by a Technical Advisory Committee consisting of 13 eminent scientists, many of whom are from developing countries. This committee has under constant review the agricultural research needs of the developing world, as well as promising new research lines for the solution of problems, and advises on research priorities and specific proposals. The fields covered by CGIAR go far beyond its initial preoccupation with plant breeding and include basic research, farm systems and socio-economic research, mechanization and training. In view of the excellent relations with the CGIAR, UNDP is therefore able to take advantage of the scanning and advisory functions of that body with regard to its own project proposals in agricultural research.

30. The question remains as to whether support from the global programme to Centres within the CGIAR system should be on a strictly project-by-project basis, or whether they should be in the form of non-earmarked grants (it being left to the expertise assembled within the system to determine how best the UNDP contributions should be spent). It is not possible to give a definitive answer at this time, but the question is important and must be answered eventually.

31. In the health field, a somewhat similar situation is arising through the creation of the Special Programme for Research and Training in Tropical Diseases, a body sponsored by WHO, the World Bank and UNDP. This programme, which started from very small beginnings, had a budget of about \$26.8 million in 1979 and concentrates its attack on the six major diseases which affect or threaten more than a thousand million people in tropical areas. It operates under a Joint Co-ordinating Board, representing the three sponsors and donor Governments. It is assisted by a Scientific and Technical Advisory Committee. About half of the Board members are from developing countries. The nature of the tropical disease problem is such that no large, international centres have arisen, as in agriculture. The programme operates, therefore, through a large number of scientific working groups which bring together scientists with widely different backgrounds and experience from many different types of institution in all parts of the world. The work is undertaken in some 71 national institutes to form a series of interlocking functional networks, within which

19. It is necessary, however, to make some remarks as to the criteria themselves and as to whether they can be sharpened. It is certainly essential that activities must concentrate on key development issues of important concern to a broad spectrum of developing countries as indicated in paragraph 3 (a) of DP/216; but a forward looking programme must also pay attention to general world trends and to the promise inherent in new scientific and technological discoveries. In view of the long lead time of research, the research activities must bear in mind the needs a decade ahead, when the results of the global research will be beginning to bear fruit. This stresses the importance of small exploratory probes into longer term possibilities and needs. For example, it now seems probable that the new discoveries of micro-electronics will revolutionize the industrial methods and even the social and service sector operations of the industrialized countries in the next few decades; it would be a tragedy if industrial development in the Third World were to ignore these possibilities and, by sticking to the conventional industrial practices in the advanced countries today, create a network of obsolete and non-competitive industrial enterprises.

20. The criterion that "the global activity must be of important concern to a broad spectrum of developing countries" is not quite sufficient. The problems must, in addition, be of a type inherently appropriate for global attack. There are very many issues of wide and even universal concern which for environmental and other reasons are not appropriate for centralized research and are best considered on a national or regional basis.

21. Great importance is given to the criterion of 31 (d) of DP/216. The programmes should be developed, not as a series of individual, isolated projects, but within a systems perspective within which they are linked together and mutually reinforcing, closely articulated with national and regional programmes into which they will feed new knowledge, experience and opportunity. Recognition of the paramount need to build up a capacity for science and technology in each developing country, greatly increases the importance of this criterion which should be closely adhered to. In much of the existing work, this approach is clearly recognized and in operation. For example, the work of IRRI, CIMMYT and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), while mainly undertaken in the central installations, is subjected to intensive testing and modification in many environments in many countries. The creation of the International Service for National Agricultural Research (ISNAR) is specifically designed to assist the strengthening of national capacities, while the Special Programme for Research and Training in Tropical Diseases is designed to strengthen national institutions. This approach is relatively easy with regard to agricultural and health activities, but will be much more difficult in other fields for which national laboratories and skilled manpower may be virtually non-existent. Thus, in future activities the global programme must continue to regard the building-up of national capabilities as an important element in projects designed and implemented with this end in view. This should be seen as a complement and stimulus to and not as a substitute for national effort. The individual countries must assume their share of the burden through their country IPFs.

22. The arguments of paragraphs 31 (c) and (f) of DP/216 must also be stressed. While activities should give promise of producing useful and tangible results within a reasonable period of time, much depends on the interpretation of the word "reasonable" which may mean one thing to the scientist and quite another to the politician and the manager. Thus research programmes have to be sustained if they are to produce the desired results. On the other hand, the unique value of UNDP in stimulating and initiating new approaches to the solution of the key problems of development would be greatly inhibited if it were to acquire a too heavy fixed financial burden in the form of prolonged, expensive on-going projects. It is for this reason that the attraction of collateral donor support is so important.

23. To sum up on this point, the criteria to be adopted for the selection and formulation of research projects should be, briefly stated, the following:

- Activities should be concerned with key issues of importance to a wide spectrum of developing countries;
- They should be inherently appropriate to global attack;
- They should be conceived in terms of the whole perspective of United Nations and national research systems;
- They should make full use of existing research institutes in the developing countries and of the best scientific skills, wherever these may be;
- They should be of such a nature as to give promise of results in a reasonable time but must be well sustained;
- They should be likely to attract collateral donor support; and
- They should be designed so as to contribute to the building up of national capabilities for science and technology, both by the association of existing national institutions in the work and by the insertion in each project of important training elements.

24. The individual projects generally conform faithfully with the criteria outlined in the programme document and as modified in paragraph 23 above. A few words must be added, however, concerning some of the small, miscellaneous preparatory projects and studies. While there are many examples in the programme of UNDP studies which have initiated important new work or are pointing the way towards significant activities for the future, many of the smaller activities are unimpressive owing to their lack of catalytic potential. For example, the project for a rice bran stabilization unit seems somewhat marginal to the key issues which are the fundamental concern of the global programme, while the support of meetings on technology transfer or science and technology, hardly conform to the criteria. This preparatory mechanism is so important that it must not be used irrelevantly by UNDP for purposes outside the global programme objectives as a sort of rag-bag for activities difficult to finance otherwise.

Table 1. Allocations from the global IPF (1977-81) by sector^{a/}

	1977-1981 (Amount allocated) US\$	Percentage of global IPF
A. <u>Agriculture</u>		
1. Crop improvement	23 671 881	
2. Nitrogen fixation	4 168 511	
3. Insect control (50 per cent)	2 393 575	
4. Animal diseases	2 729 474	
5. Fertilizers	2 182 500	
6. Agricultural economics	1 133 935	
7. Other	<u>124 363</u>	
Total agriculture:	36 404 239	68.8
B. <u>Health</u>		
1. Tropical diseases research	4 213 528	
2. Diarrhoeal diseases control	2 858 700	
3. Insect control (50 per cent)	<u>2 393 575</u>	
Total health:	9 465 803	17.8
C. <u>Water/sanitation</u>	2 184 245	4.1
D. <u>Fisheries</u>	1 753 502	3.4
E. <u>Energy</u>	1 720 000	3.2
F. <u>Institution building</u>	893 267	1.7
G. <u>Miscellaneous projects</u>	527 060	1.0
Total:	<u>52 948 116</u>	<u>100.0</u>

Note: During the first programming cycle 1972-1976, the shares of agriculture and health in the global programme were approximately 82 per cent and 14 per cent respectively.

^{a/} Includes project recommendations submitted for approval to the twenty-seventh session of the Council, June 1980.

15. The action programme has thus conformed faithfully with the priorities agreed by the Governing Council. Nevertheless, as the analysis of the previous section indicates, these priorities were extremely heavily weighted in favour of agriculture and public health and the over-all programme might appear at first sight to be somewhat out of balance. It was undoubtedly wise, however, to give such high priority to agricultural development in view of the fact that rapid population increase in many of the developing countries makes the provision of sufficient food an overwhelming imperative. Furthermore, in most developing countries the largest proportion of scarce scientific manpower is in agriculture and a few of the international agricultural research centres were already in existence, so that a basis existed on which an infrastructure of agriculture might be built and an international research network created to make possible the massive research effort to produce more and better food which global needs dictated.

16. The global projects on health topics which have developed strongly in the last few years have greatly helped to bring about a more balanced programme and they are promising to provide new institutional structures of the greatest importance for future development.

17. Nevertheless, future programmes will have to take account of some other areas of world priority. Energy is a case in point, especially since the provision of sufficient energy at a reasonable cost is a paramount need for agricultural development - for the production of fertilizers and agricultural chemicals, irrigation and in many other ways - while it is equally essential in industrialization, transportation and many other key elements of development. The complete absence of any projects of industrial development in the programme is somewhat surprising in view of the target of the United Nations that 25 per cent of the global industrial production should be in the developing countries by the end of the century. It is recognized, of course, that much of the new industry will have to be based on the transfer of technology from the industrialized countries, and that most of the industrial research activity will be on a national basis. Nevertheless, for reasons of economy there are strong arguments for the sharing of costs by means of co-operative research schemes and many industrial developments are appropriate for this. It is also realized that other agencies of the United Nations, such as the United Nations Industrial Development Organization (UNIDO) and the United Nations Conference on Trade and Development (UNCTAD), have a mandate in this field; but the injection of a comprehensive and strategic approach, such as that which UNDP has been able to give so successfully in the fields of agriculture and health, is badly needed.

18. The detailed criteria for selection of projects are spelled out in DP/216. These are necessarily somewhat general and it is recommended that they be applied flexibly and realistically. This is important in view of the enormous differences in the needs to which the work must respond, the availability or lack of institutions through which the programme must operate and the different nature of the various technologies to be applied.

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200 individual projects are in operation. The system thus penetrates throughout the underdeveloped regions of the world with lines to the major research centres in the scientifically advanced nations. Hence, it contributes in a major sense to the strengthening of research capability throughout. Here again the role of the global programme has been determinative.

32. The new project on Diarrhoeal Diseases Control (GLO/78/005) will probably follow much the same pattern, although one key international institute is involved: the International Centre for Diarrhoeal Diseases Research of Dacca, the successor to the Cholera Research Laboratory of Bangladesh. This group of diseases is among the main causes of sickness and death in the less developed countries and is especially important with regard to infant mortality. There are close biological and socio-economic links with many other issues such as malnutrition, food wastage and human fertility. There is considerable promise in new methods of prevention and treatment and the project will be concerned, among many other approaches, with the development and use of new prophylactic, anti-secretory and anti-emetic drugs, immunological approaches and vaccine development, rehydration techniques and epidemiological studies. As in the case of the Tropical Diseases Programme, the three sponsors will be WHO, the World Bank and UNDP, but it is hoped that the importance and promise of the programme will attract many collateral contributions. Under the sponsors' Steering Committee will be a Technical Advisory Group to provide general scientific guidance, and there will be many scientific working groups on the various elements. Although this project is only just starting, much progress has already been made in identifying research personnel and preparing for meetings of peer groups to advise on priorities in the various areas.

33. It might be asked why, in the fields mentioned above, these major developments should not be left to the functional agencies of the United Nations, or why the role of UNDP is not limited to a strictly financial one. In practice, the influence of UNDP has proved to be crucial. It has certainly provided pump-priming finance and has done so selectively and intelligently; but far beyond this, its influence has assisted in shaping new types of flexible organizations and networks and has enabled a harmonious co-operation to evolve between the multinational financing through the United Nations system and the World Bank, individual Governments, development banks and individual donors, thus providing a level of resources to be assembled to ensure activities on the scale required to attack major world problems. Without such initiative, it is doubtful that the research impact on food and health would have been fully effective. Furthermore, the participation of UNDP has greatly helped to give such schemes a broad and realistic perspective beyond the more narrow professional appreciation of agricultural and medical scientists, taking into account, for example, health and environmental aspects of agricultural development and nutritional, environmental and other aspects of disease control. It was further stressed by several of the Agencies and by the International Development Research Centre (IDRC) of Canada, that the presence of UNDP Representatives in the various countries has had a particularly useful co-ordinating role in the implementation of the various individual studies in these countries and has helped to provide a rare degree of rationality.

34. The choice of agents for the implementation of the residual projects has raised little difficulty. Most of these have been made in co-operation with WHO, the World Bank or other United Nations bodies and the methods for implementation have been straightforward. The problem will become significant in the future, however, since in most fields other than agriculture or health there are few existing major research centres in the developing world and, in many cases, existing efforts are so small as to make the creation of effective networks very difficult. It is doubtful whether it would be possible to establish generally applicable criteria here, at least until a good deal of experience has been accumulated. In any case, the institutional desiderata will vary greatly from case to case and a pragmatic approach will have to be taken. It is probable that UNDP will have to seek much more external advice than in the past for scanning the problems, selecting detailed priorities, identifying precise projects within priority fields and selecting implementing institutions.

35. The evaluation terms of reference also raise the question of taking the maximum advantage of expertise available in developing countries. This is somewhat difficult to estimate. Although many interlocutors agree that it has been seriously respected, many countries would, naturally enough, like to see more of their nationals included, and the Centres should take this need very seriously. The need to include such scientists is very great and is a fundamental part of the long-term training function in the building up of national capacities. The need to attain high levels of quality necessitate the use of a considerable number of experienced research leaders and scientists and these are, unfortunately, for historical reasons, mainly in the industrialized countries. Most of the international agricultural research centres operate through a sensible mixture of scientists from both advanced and developing countries and it has been observed that good use is made of scientists from such countries as India where there is at present a surplus of scientific manpower. In the Tropical Diseases Programme the situation is excellent in this respect, since the networking system adopted includes, among the 1,055 scientists actively involved, many competent people from many developing countries.

36. Before leaving this section, a word must be said about the relations between the UNDP and co-operating Agencies such as WHO and the World Bank. Discussions indicated that contacts were extremely close and very cordial. The role of UNDP is well understood by these Agencies and is regarded as essentially innovative. All this augurs well for a continuation and extension of constructive co-operation in future programmes.

The attraction of collateral funding

37. The existence of genuine possibilities for the attracting of collateral donor support was one of the criteria for the selection of projects laid down in the programme document and this is essential if the global programme is to preserve its catalytic character and not become merely the sole or major financing agency for a limited number of projects, inevitably of long duration. In the dominant agricultural part of the programme, this has indeed been achieved through the CGIAR mechanism. This consortium has now attracted some 31 donors

which include 18 individual countries plus the European Economic Community (EEC), three foundations, the African and Asian Development Banks and the Arab Fund, as well as some development research institutions, the United Nations Environment Programme (UNEP), the World Bank and UNDP. Although the contributions of the global programme are earmarked for specific tasks, carefully formulated, its input must be regarded as having greatly assisted in the attraction of these major funds, within which the UNDP element is modest.

38. The Special Programme for Research and Training in Tropical Diseases has developed in much the same way. This consortium includes a total of 30 donors already, despite the short time since its inception. These include 20 Governments, the African Development Bank and several foundations and charitable institutions. A significant feature of this scheme is that there are seven developing countries among the national donors. Once again, UNDP, its contribution being essentially for the trypanosomiasis project, has helped to catalyse the total operation. The case of ICIPE is somewhat similar, with contributions coming from many countries, although the global programme provides a high proportion of the budget. Most of the other individual projects of the programme are less appropriate for consortium-building than the comprehensive examples above: however, the diarrhoeal diseases project could move in this direction. In most of the remaining individual projects, though, there is joint financing with bodies such as WHO or the World Bank. All in all, therefore, the global programme has met this criterion.

39. The same sub-paragraph of the evaluation directive includes, with the attraction of collateral financial support, that of scientific support generally, while in DP/216 this was made more precise in terms "of enlisting broad co-operation of the international scientific community in the research and development required". In the case of the agricultural part of the programme, the general interest of the agricultural research workers generally has been aroused and it has not been particularly difficult to attract the necessary, specialist expertise to the international centres. The Tropical Diseases Programme, with its network concept involving so many research centres in both the developed and the developing countries, necessarily includes a considerable proportion of the world specialists in this field; and this is true, although to a lesser extent with respect to the entomological activities. The remaining activities have certainly succeeded ad hoc in finding adequate specialist co-operation; but it must be admitted that, with the exception of agriculture, the limited number of health sectors of the programme and insect research, the global programme is little known to the scientific community.

40. One human problem should; perhaps, be raised at this point. Centres of sophisticated research situated in developing countries are inevitably somewhat isolated from the local communities and, especially with regard to the specialized, fundamental research elements of their programmes, they too easily appear to the potential users of their products (farmers, etc.) and even to the local scientists, to be irrelevant and introverted. To some extent this is inevitable in consequence of the variety of expert disciplines involved and the necessary sophistication of the research approach at the frontiers of learning. This is well recognized by some of the Centres which make considerable efforts to explain the nature of their work and the necessity for deep

specialization in the solution of problems of general concern, but it probably demands deliberate cultivation to an even greater extent, especially in cases where a high proportion of the scientists are from advanced research institutes overseas. The relevance of their work to local day-to-day needs must always be demonstrated by such techniques as open days, meetings with local farmers and the use of extension officers. Success in such endeavours also has, of course, the advantage of securing the confidence and co-operation of local farmers, among others, for the undertaking of field trials. Where this is successful, the application of research results can become strikingly effective.

Practical results from the projects of the global programme

41. The inevitably long lead time of scientific research, through the technological development stage to application on a significant scale has already been stressed. This is especially so in the biological fields, where two decades represent a sufficient time to define major problems, assemble and equip teams of well-trained scientists and start serious practical research, but too short to have a demonstrable impact on production in the fields or success of the treatments in tropical hospitals. Thus, it is too early to have any convincing evidence of the practical success of the majority of the projects of the global programme.

42. In the agricultural projects which form such an important proportion of the effort supported by the programme, the immediate and essentially important success has been in the building up of the effective network of institutions under CGIAR. The technology developed for wheat, maize and rice, based on research which was started years before the conception of the CGIAR system, has had such a spectacular impact on production that there is a natural expectation for further dramatic breakthroughs with respect to the various other food crops now receiving intensive research attention within the system. Great improvements can be expected; but it will take many years before they are fully achieved, especially as much less is known than for wheat and rice concerning disease susceptibility, pest resistance and vulnerability toward heat and drought. With regard to the wheat and rice sectors, the main drive must be to extend and improve the use of the new strains and to ensure that high yields and soil fertility can be sustained and the farming systems improved. All in all, not more than gradual but effective progress can be expected.

43. In one instance, a project of the global programme representing earmarked support to the CIMMYT programme has resulted in a spectacular breakthrough in the case of high-lysine maize. This cereal, which provides a major part of the diet of many millions of people, especially in Latin America and Africa is normally somewhat low in its protein content; moreover, the range of the constituent amino acids does not provide a balanced nutritional intake of protein. As long ago as 1963, however, a mutant gene was discovered which gives rise to a modified amino acid composition, with increased amounts of lysine and tryptophan which were deficient in current varieties of maize. Unfortunately, the original mutants were initially found in varieties of maize adapted to temperate climates and not suitable for cultivation in tropical or semi-tropical areas. Furthermore,

the kernels had a dull, lustreless appearance, unlikely to appeal to farmers or consumers; a soft and less dense endosperm, which reduced the yield in comparison with traditional crops by 10 to 15 per cent; and were particularly susceptible to disease and insect attack. By 1969, CIMMYT plant breeding experiments had shown promise of evolving strains of high lysine maize which combined high yield and nutritive value with adaptability to a wide variety of ecological conditions. This encouraged UNDP to provide major support to the continuation of this work on an increased scale. A highly diversified multidisciplinary team was set up to undertake this work which has proved outstandingly successful. CIMMYT now has available several "Opaque 2" maize strains which have high yields, satisfactory nutritional quality, less susceptibility to disease and kernels which are indistinguishable from those of normal, acceptable maize.

44. It can thus be said that this project has proved to be a major success and has the potential of considerable improvement in the diet of millions of people. Much work, however, remains to be done before the new varieties are available to those who can profit by them. More field work in different agro-economic environments is required; but the main problems of application centre on how local farmers can be persuaded to use the new varieties. It seems that the yield of the high-lysine maize, although considerable, is slightly inferior to the best of the normal low-protein varieties. There is thus no immediate increase in profitability to encourage the farmer to make the change, assuming that both grains cost the same. It may be necessary for Governments, convinced of the value of the nutritional gains, to act by persuasion or by the provision of incentives.

45. The rice improvement projects have had considerable success and are even nearer to widespread application. The success of IRRI in breeding a series of strains resistant to drought, insects and disease, with high yields and capable of producing two or three annual crops has led, through the UNDP project, to testing in 45 centres with different agro-economic conditions, which should lead to widespread use on the farms. Plant breeding at ICRISAT with sorghum and millet is also said to have made considerable progress towards the development of high-yield strains; but these are, of course, far from being ready for the farmer.

46. The three projects on nitrogen fixation represent a useful initial contribution to the biological replacement or partial replacement of chemical nitrogenous fertilizers, especially significant in view of high and rising energy costs and the need to retain soil fertility. The project at IRRI is investigating some of the new possibilities presented by recent biological research, but the number and diversity of the new lines of research and the intrinsic importance of the problem suggests that still more comprehensive work is required. (See para. 80 below.)

47. The water and sanitation project, although still at a very early stage, has already persuaded several countries to include some of its non-traditional ideas into their programmes.

48. The case of ICIPE is somewhat exceptional. Here the support of UNDP has been determinative in creating a research institute of first-class quality and practical relevance for entomology in Africa, and has given powerful support to its work on the tsetse fly, mosquitoes, ticks, termites and the African army worm. Such research, while eminently practical, is necessarily of long-term significance, one of its objectives being to evolve biological methods of insect control, both of vectors of tropical disease and of crop pests. The stimulant influence of ICIPE on the scientific community of Kenya has been important and cohesive, with the Director of the Institute, himself an eminent Kenyan scientist, having helped to create a National Academy of Science, of which he is the first President.

49. It thus appears that, despite our warning not to expect too early results from research, the global programme is already beginning to yield substantial results, both capable of immediate practical application and in relation to the building up of research activity and infrastructure in the developing countries.

Procedures for monitoring and evaluating the
global programme projects

50. The monitoring and evaluation of current projects would be a heavy burden, indeed, were it not for the institutional structures which have developed in the course of the work. In the case of the main bulk of agricultural projects, CGIAR provides a general mechanism for this purpose. Under the Consultative Group, the Technical Advisory Committee does a thorough initial screening of each project proposal and an annual assessment of progress based on in-house reviews and evaluations conducted by the Boards of Trustees of the various Centres. In addition, a Policy Advisory Committee is constituted for each project and assesses progress annually, advising on future development. A similar situation exists in the Tropical Diseases Programme and presumably this will also be the case in the Diarrhoeal Diseases work. There are, however, circumstances which demand specific and direct evaluation by UNDP within the global programme. This was the case with the high-lysine maize project which required a careful enquiry before decision could be taken to recommend continued financing, especially because socio-economic and other factors, rather than the essentially technical, were uppermost. A small evaluation group of independent experts was therefore constituted for this task and it was on the basis of its report that the decision was taken to maintain support through the global programme. It is envisaged that terminal evaluations of each project will be carried out by teams of independent experts. The monitoring and evaluation system is thus very thorough and appears to be somewhat heavy.

51. Whether to continue general support to the programme and operation of ICIPE was another situation which required specific attention. This institute has a governing body of highly qualified scientists and generalists of a genuinely international character which was, in any case, considering the future of the Centre. It was therefore decided to use the Board's evaluation, associating a representative of the global programme in the discussions; on

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the basis of its findings it was decided to continue the support. In this particular case, the method of evaluation appears to have been justified, but it is not a precedent to be followed blindly. In many cases, especially where research institutes have been in operation for some years, governing bodies, although internationally and expertly constituted, tend to become so identified with the activity that their judgement of quality ceases to be completely objective and UNDP may need to look at the situation in a broader perspective.

52. Most of the residual projects are carried out in co-operation with other agencies, such as the World Bank, and frequent meetings are held with them to assess the progress made in particular projects, often associating relevant experts. For example, a recent meeting of this type on the water and sanitation project was very useful.

53. It appears, therefore, that the present, somewhat ad hoc procedures for evaluation have worked rather satisfactorily, but it is desirable that systematic attention should be given to monitoring and evaluation needs. An automatic and rigid system would be highly undesirable; but a mechanism might be provided and made visible for the constant scanning of the specific needs for evaluation so that measures could be taken as necessary. This should prove to be reassuring to the donors, especially with the more complex and technical projects. If future work is to extend to fields where no comprehensive supervisory body (of the CGIAR type) has been constituted, special mechanisms will certainly be required to monitor, evaluate and recommend as to follow-up needs.

54. The general conclusion of the first part of this report is, therefore, that the global programme has proved to be exceedingly effective, has shown much imagination and initiative and has provided UNDP with a flexible and innovative mechanism, important for the future development, not only of the programme itself, but of UNDP activities as a whole. These results could not have been achieved on a regional or, still less, on a country-to-country basis.

V. FUTURE NEEDS, PRIORITIES AND METHODS

55. As mentioned above, much has happened of relevance to the evolution of the programme since the approval of DP/216 in 1976. Deeper understanding of the global issues, recognition of their interactions, better appreciation of the trends in human affairs, as well as specific events, necessitate a fresh look at the objectives and methods of the programme with regard to the imperatives of the new decade. In introducing this final section of the report, it may be useful to look at some of the new circumstances, before making suggestions for the future of the programme. We stress only a few:

- Increase in the cost and impending scarcity of petroleum and other forms of energy;

- Sustained, rapid increase in world population with continually mounting requirements for food, amenities and products and pressure on land, water, materials and energy;
- Recognition of the growing importance of a number of problems of inherently global significance which cannot be solved by individual countries in isolation;
- The appearance of new scientific discoveries and technological developments such as the micro-electronics revolution;
- A deepening concern that science and technology must be used more effectively in the development process.

56. The global problems include those of an environmental nature which constitute such threats to the planet as a whole as the increasing amounts of carbon dioxide in the atmosphere from the burning of fossil fuels, augmented by the rapid cutting down of the tropical forests, which could lead to irreversible changes in the world climate. Other examples are the possible destruction of the ozone layer, aspects of the exploitation of the oceans and the operation of the over-all economic system. It must be realized, also, that the interactions between the global problems are of such significance that a particular difficulty may have immediate impact on seemingly distant policy areas; e.g., the carbon dioxide issue has to be taken into consideration in the formulation of national and global energy policies.

57. In preparing for the United Nations Conference on Science and Technology for Development (UNCSTD), Member States of the United Nations were invited to prepare national submissions, assessing their research and development resources and policies and making proposals for presentation at the Conference. This has led to a deepening understanding of both the opportunities offered by the application of existing knowledge and new research, as well as of the conditions necessary to ensure the efficient assimilation of new technology in the pursuance of economic and social objectives.

58. The Conference itself also reflected these changes. It was agreed that there should be a target set for the end of the century with regard to the proportion of the total research of the world which should be carried out in the developing countries, if they were to have the capacity to make good use of their development potentialities. A figure of 20 per cent was proposed, in contrast to the miserably low levels of today. Towards this end, it was decided to create an Interim Fund for Science and Technology within UNDP, while the increased importance given to these subjects was recognized by their being given a more prominent place in the structure of the United Nations.

59. The general approach of the global programme is appropriate in facing up to the new problems although a more strategic edge will probably have to be given to it, while its innovative abilities will be challenged in the diversification and refinement of its methods of implementation. The principles on which the present work is based, or which have evolved as experience grew, are all immediately relevant for the new phase and could prove much more effective

than the traditional approach to filling national research needs; i.e., by building national research institutes, permanent and often isolated, which can easily become rigid and even obsolete. It has to be remembered that scientific and technological activity and policies are not autonomous. If they are to contribute significantly in the complex socio-economic process of development, they must be organically articulated with other areas of national activity and policy. Furthermore, all the problems are interactive and the elements of new knowledge for their solution come from research undertaken in all parts of the world, hence the need for national research activity to work closely with relevant research groups in their various subjects wherever they may be. The concept of working as part of a wide network of expertise is thus the only logical method for dynamic and creative research institutes and their constituent groups.

Strengthening the process

60. In moving into the new phase of activity which presumably will extend priorities beyond the existing topics to other fields such as energy and industry, the basic situation will have to be faced that national research institutes and activities are much fewer and relatively weaker than in agriculture and health. This will stress the twin objectives of contributing to the solution of major problems and, in the process, building up national capabilities for research to the maximum extent. The absence in almost all fields of strong international research centres suggests that such measures as those adopted in the Tropical Diseases project may be appropriate, and that the building of bricks and mortar research institutes may not always be the best approach. There is certainly much room for an imaginative and innovative approach to research structures, especially for developing countries which need not repeat the experience of the industrialized countries in building up national research laboratories, many of which become bureaucratic and uncreative after their initial research objectives have been attained. It is probably only through the creation of networks of research activity, which include elements of all three types, that developing countries will be able to reinforce their national research institutions with inputs of information and experience from outside in order to attain the necessary critical mass of effort which successful scientific activity demands.

61. The question of priorities has already been discussed at length and its conclusions are relevant to future operations. Judgement as to the relative importance of the issues is essentially political and socio-economic; but the delineation within the priority issues of the areas most susceptible to attack, requires, also, a degree of technical judgement and an awareness of significant knowledge already existing or for which the promise of new research findings is high. Until now, this has been done by the Division, assisted with expert advice from outside and latterly helped greatly by the knowledge within the CGIAR and WHO networks.

62. The new needs are extremely diverse and difficult, however, and it would seem that if these are to be reflected in a programme extending beyond

agriculture and health, a more systematic and strategic approach should be taken. It is realized, of course, that present commitments in agriculture, health and entymology will consume major resources of the programme for some years to come and we have stressed the need to sustain major research efforts already launched. Nevertheless, the new needs are great and possibly additional funds will be needed. Several of our interlocutors have suggested that in the future the global programme should merit a slightly increased percentage of the total UNDP budget.

63. Adoption of a more systematic approach to priority and project selection suggests that a more formal consultative mechanism is required. It is doubtful, though, that a traditional science and technology committee would be the best solution; something less weighty and more flexible is required. It is recommended, therefore, that a panel of, say, five individuals should be appointed to be available to advise the Administrator on scientific and technical aspects of the programme. The Panel would meet collectively only very occasionally. Most of the advice invited would be from individual members of the Panel and provided often by correspondence and telephone. Members would be used, therefore, intermittently as need arose, but would be invited to make proposals in the light of their knowledge of the advancing lines of scientific promise. The members of the Panel, perhaps one from each of the five continents, would be selected as scientists of international reputation with broad concern for and familiarity with the problems of applying science and technology to development, rather than for their individual, specialized scientific knowledge. It would, in any case, be impossible to assemble in a small group, the totality of specialized knowledge which the wide range of issues necessarily involves. The main value of the Panel would be, therefore, through its members individually to have as comprehensive a network of contacts with the scientific community of the world, independent as well as official. The terms of reference of the Panel might be:

- (i) To advise generally on the priorities of the global programme;
- (ii) To report on changing world trends, on new discoveries in basic research and on technological developments of potential significance to the global programme (the scanning function);
- (iii) To bear in mind constantly the need for monitoring and evaluation and to suggest where specific action was needed;
- (iv) To advise on matters of scientific and technological policy, organization and the building up of indigenous capacities;
- (v) To help to obtain answers to ad hoc questions and to identify scientists and institutes of research relevant to the needs of the programme; and
- (vi) To maintain contact with the scientific community.

Internal co-ordination

64. This leads to the question of the relations within UNDP between global, interregional, regional and country activities, which have to be recognized in practice as well as on paper as essentially complementary. Mechanism for internal co-ordination exists, but how effectively it works has not been determined in the context of this report. While desirable in the past for administrative tidiness, the need for mutual reinforcement becomes a dominant element in capacity building. The creation of the Interim Fund for Science and Technology for Development and, possibly, an Energy Fund will make effective internal co-ordination still more necessary.

The building up of indigenous capacities for science and technology

65. How can the global programme assist in the building up of indigenous capacities for science and technology? The basic activity has to be at the national level since there can be no general model to be applied to all countries. In each specific case, a country will require a different mix of technologies in accordance with its natural resources, water and soil availability, employment needs, level of skills, cultural considerations, etc. Yet there exists a huge corpus of knowledge on science and technology policy which can be applied in specific cases and it would be most effective if this could be tapped through some global service. It is therefore suggested that the global programme should initiate at an early date, a preliminary study, similar to that on the International Service for National Agricultural Research to design an International Service for National Activities in Science and Technology for Development. The aim would be to create a centre for advice on capacity building, institutional creativity and science and technology policy formation to assist Governments to create infrastructures appropriate to their specific needs, associated with the planning function and articulated with the production and educational systems. Such a body, which could be quite small, would assemble a pool of experts to be available to individual countries for this purpose.

The international scientific community

66. The great majority of active scientists, overwhelmingly located in the industrialized countries, work in universities, industry, independent research institutes and semi-official agencies. These scientists constitute the international scientific community and represent collectively an enormous repository of scientific and technical knowledge, far greater than that in the hands of the individual countries. This major corpus of knowledge, skill and experience has not, hitherto, been exploited effectively. The independent scientists are somewhat frustrated that their offerings are little used and, during the preparations for the Vienna Conference, have expressed great and continuing concern for the problems of development. Scientific research is inherently international and each new project is based on many inputs from all parts of the world. The scientists of all countries are in constant professional contact with colleagues internationally through a large number of international

bodies organized mainly on a discipline-by-discipline basis. Nineteen of the main international organizations for science and technology took the initiative of organizing their own symposium on Science and Technology for Development, which took place at Singapore in January 1979. They reaffirmed their concern and decided to create some sort of continuing body to work with Governments and the United Nations system, and it is extremely important that use be made of this impetus. Not only should it be possible for the Agencies of the United Nations to reduce their in-house work in favour of contract arrangements with the scientific community, but also UNDP, through the global programme and the Interim Special Fund, should take advantage of the new situation, for example, with regard to the considerations of paragraph 65 above. The scientific community offers an extent of objective advice which cannot be ignored.

Institutional innovation

67. The traditional research structures which have evolved in industrialized countries are unlikely to be effective in the developing countries and new methods will have to be sought. The networking approach, adopted in the Tropical Diseases Project may point the way, if certain modifications are made. There are many subjects, both of applied science and of basic research, oriented towards application, in which there is widespread interest in the developing countries but for which, in each case, only submarginal resources are available. For such cases it should be possible to create, either regionally or globally as is appropriate in each specific case, common programmes and inviting (with financial incentives where necessary) national institutes or research groups to take responsibility for elements of the programme, sharing results and experience and constituting in total a critical mass of effort. While the programmes would be essentially for the solution of problems of underdevelopment, some leading groups in the subject in industrialized countries would be included in the network and funds would be made available to enable workers to spend time working in laboratories outside their own countries.

68. Such a system would be suitable for many problem areas, including a comprehensive attack on the many biological methods which might be developed for the fixation of nitrogen fixation, many aspects of bio-resource development or the development of simple solar devices. To take the latter as an example, after a preliminary project design study, the global programme of UNDP, together with other agencies willing to sponsor the approach, would constitute an International Programme for Solar Devices. A Council for the subject would be set up, composed of the donor representatives, national group leaders and independent experts, which would delineate the field, compile information on work in progress, determine priorities within it and construct a programme. In the knowledge of existing work, negotiations would then proceed to ascertain the most appropriate national research group to take responsibility for implementing elements of the agreed programme. The Council would monitor the work and make proposals for strengthening the participating groups as necessary and ensure that there would be a substantial training element. In this way a product might be obtained, many times more important than the totality of

existing efforts which are hopelessly fractionated, with substantial duplication in 50 or more countries. It is suggested, therefore, that the global programme should include an item devoted to exploring new institutional approaches, research organization and management and should undertake one or two pilot experiments on the lines mentioned above.

Industry

69. The huge task of encouraging industrial development in the developing countries is not, in general, one for the global programme. National conditions differ so greatly in terms of need, raw material and energy availability, etc., that the main approach has to be at the country level. Furthermore, industrial property and know-how is mainly in the hands of industry rather than of Governments, as is the great mass of technological research and development. There are, however, some aspects of industrial planning and the promotion of industrial research which Governments in the industrialized countries have assumed and which are all the more relevant to countries at the early stages of development. Not only is it necessary for such Governments to have a strategic approach to industrial development, a capacity for selecting from the vast range of possible manufactures and processes those items of special relevance to their needs, as well as experience in assessing the efficiency and loyalty of foreign firms responsible for the transfer of technology, but there are also a number of background services which they alone can provide: for example, metrology, quality control methods, industrial standardization and the provision of technical information services, efficiency surveys and the like.

70. Such agencies of the United Nations as UNIDO have been engaged mainly in introducing individual techniques and have devoted little effort to the strategic aspects of industrialization. It would be useful, therefore, if UNDP, together with UNIDO and perhaps UNCTAD and the World Bank, would initiate a preliminary study on the strategic aspects of industrial development, with a view to preparing a possible programme. One particular aspect of this problem is the need to create for the developing countries a system of industrial extension officers parallel to the system in agriculture, to assist small firms in improving their efficiency through plant lay-out improvement, more effective fuel efficiency methods, better use of materials, etc., and to assist in the introduction of new processes. The industrialized countries have, in some cases, found it necessary to institute such services for small-scale industry and much experience exists, for example in Canada and the Netherlands, which is immediately applicable. While such work would be undertaken mainly on a national and regional basis, there is need for a global study of the possibilities and constraints and possibly of global initiative. A further aspect of government promotion of industrialization is the Industrial Research Institute mentioned in paragraph 66 above. These can, if well conceived, be important elements of change. They should be considered as part of the proposal for an International Service for National Activities.

The social sciences

71. The social parameters of development have, understandably, been given little attention in the global programme to date. All change, however, involves social consequence and major change demands social preparation. There have been some criticisms of the "green revolution" concept as not having taken sufficient account of the social variables; for instance, influence on land tenure, increasing need for fertilizers and other agricultural chemicals, the consequences of increased farm mechanization and the influence on rural migration to the cities. UNDP has commissioned some studies on these matters, although the criticisms have been of the approach as a whole, rather than of the global programme elements of it. If some of the wider issues are now to be faced, it will be important to give greater weight to the social issues arising from changing life styles. This is particularly important if rapid industrialization is to take place as recent events in various countries have indicated. It will be necessary to take into account not only social aspects but also cultural and religious traditions. It is not proposed that the global programme should initiate special studies in this field at the moment, but only that the social issues be taken seriously. If the recommendation for the creation of a small Panel of Advisers (paragraph 63) is accepted, one of these might well be a social scientist as guardian of the social needs of the programme.

Education and training

72. DP/216 stressed the need for research in the field of education and training, but no action has been taken. Undoubtedly, economic and social progress in the developing nations is directly dependent on the capacity of these countries to provide their own managerial and technical as well as scientific competence in industry, commerce and the public service. Such competence has not resulted from the considerable extension of university education. There remains an immense training gap in most developing countries and little institutional structure to meet it. The basic need is for practical training for each nation's productive sector and the establishment of strong training networks and systems for human resource development.

73. Although there is great need for educational reform in all countries, both developing and industrialized, in order to make possible participatory and anticipatory learning, the subject is essentially so culture-bound that an over-all approach is difficult; the subject of educational research is already the task of many international and national bodies, with, as yet, indifferent success. The global programme should therefore enter this field with caution and only in terms of very precisely formulated proposals.

74. On the other hand, there would seem to be a strong case for the programme to increase its involvement in bridging the training gap. Already there is a strong training element in most of the individual projects; but this, of course, only touches the surface of the immense field, as yet inadequately covered. A number of preliminary studies might be initiated, together with

other concerned Agencies such as the International Labour Organisation (ILO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). One of these might be to assess the over-all need for technicians in the developing countries and of the institutional needs to provide them. A further topic which requires particular attention in relation to scientific capacity building is the training of research managers, a subject of great importance on which much experience of a systematic nature has recently accumulated. In all such work, effort should be concentrated on the provision of facilities for the training of trainers, the provision of training manuals and networking between countries and regions to make the best use of scarce human resources. To this end, co-operation should be sought, not only from other United Nations bodies, but also from independent, non-profit bodies.

75. One special possibility deserves immediate exploration. The main vehicle for the transfer of technology is, and is likely to remain, the transnational corporation. These enterprises have often been criticised, among many other things, for their lack of identification with the real needs of the countries within which they operate; and it is sometimes claimed that they attempt to prevent the spreading to other parts of the economy of skills which they have accumulated. Whether this is true or not, many such firms are anxious to improve their relations with developing countries as a matter of long-term policy. In recent discussions, several of these have expressed a willingness to assist in national training schemes. It is suggested, therefore, that within the global programme, UNDP should explore with a number of these corporations, the possibility of co-operating in a scheme whereby managers and engineers would be made available for a small proportion of their time to participate with nationals of countries in which they operate, in appropriate training courses.

Some priority issues for research

76. While this is not the place for a comprehensive attempt to list the priority items for research attack, it may be useful to give a few examples of fields in which a massive research assault is necessary and promising. It must be recognized that a successful programme relies not only on recognition at the planning and political level of the most important and urgent problems, but also of the new insights on these problems made possible by scientific analysis and by new research findings. Governments, while all too aware of the former, often have insufficient knowledge of the latter. It is here especially that the knowledge of the scientific community can be of help.

A master programme on the biological fixation of nitrogen

77. For many tropical crops, biologically fixed nitrogen, by the bacteria in the nodules of leguminous plants - a mechanism which has long been known, but insufficiently exploited - is the sole source of nitrogen; more recently some capacity for nitrogen fixation has been discovered in some grasses such as sugar cane and sorghum, while IRRI is investigating the role of free-living, nitrogen-fixing bacteria and blue-green algae in flooded rice soils. Many of

the new high-yielding cereal crops, however, depend on the use of considerable amounts of chemical nitrogen which is becoming increasingly expensive as energy costs rise. There is, therefore, a strong case for making a co-ordinated attack on the nitrogen-fixation problem, both for energy saving and for increasing yields of tropical crops.

78. The various international centres for agricultural research are already deeply engaged in the nitrogen-fixation problem, and several of the global programme projects are specifically on this subject. But more needs to be done. The discovery that a much wider range of micro-organisms than was hitherto known, both free-living and in various symbiotic relationships with plants, are capable of fixing nitrogen opens the way to bringing into production great areas at present uncultivated in the tropical savannahs. Still more important, although more distant, prospects are held out by recent basic research: for example, of genetic engineering in the manipulation of nitrogen-fixation elements in various bacteria and plants, resulting from the discovery of mechanisms for the transfer of nitrogenase synthesis genes between bacteria. Possibilities also exist for the production of new nitrogen-fixation plants by tissue culture techniques, protoplast fusion techniques, etc. Such work is widely dispersed in laboratories in different parts of the world.

79. It is proposed therefore that a Master Programme on the Biological Fixation of Nitrogen be created. This would operate through a network of the type suggested in paragraph 69 and would be in two parts: the immediately practical agricultural research activities of the international centres; and the basic, but oriented, research efforts described above, which take place mainly, but not exclusively, in the developed countries.

Solar energy utilization

80. We have already (paragraph 70) exemplified a new institutional approach to research activity by the case of simple solar devices and this seems to offer an a priori case for examination. Satisfying the need for low capital-intensive equipment for use in tropical countries for cooking, refrigeration, distillation, etc., in addition to the solar pump project, seems important. The scheme would operate through a network of existing activities, but might well find the need for some central installation eventually, for the testing of devices.

81. A similar need exists for a comprehensive and comparative approach to the production of bio-solar energy. Some countries such as Brazil have made great progress in the economic production of alcohol from such crops as sugar-cane and cassava and this could be of importance to countries dependent on the mono-crop sugar. Again, much progress has been made recently on the introduction and production of quick growing forest crops, both for tropical and temperate areas, while great potential exists for a better use of forest wastes. A Swedish group, for example, has recently perfected a method of pelleting forest waste to make it transportable economically as a fuel. These matters justify a comprehensive examination.

Third World urban development

82. Recent projections of the growth of cities in the developing regions are alarmingly high, resulting both from the continuing high rates of population growth and from rural migration to the cities. Great problems will undoubtedly arise with regard to how provision can be made in the cities for the new millions with respect to housing, water, sanitation, education, health services and other amenities. Thus, the problems of urban development in some developing countries is extremely urgent. Unless tackled now, there will be a great mushrooming of shanty-towns, favelas and bidonvilles around many of the cities with consequent dangers of disease, malnutrition, alienation and social disruption. This would seem to be an immediate priority for study within the global programme, possibly together with the the United Nations Fund for Population Activities (UNFPA) and the United Nations Centre for Human Settlements (HABITAT).

Health, nutrition, education and population

83. It is becoming increasingly realized that these subjects, usually dealt with in isolation, are intimately interactive, yet experts in each of these fields generally give only marginal attention to the others. This complex of problem areas is at the heart of the development situation and it is important that they should be considered together. It is suggested, therefore, that the global programme should initiate a study on the interactions, through a multidisciplinary team of experts.
