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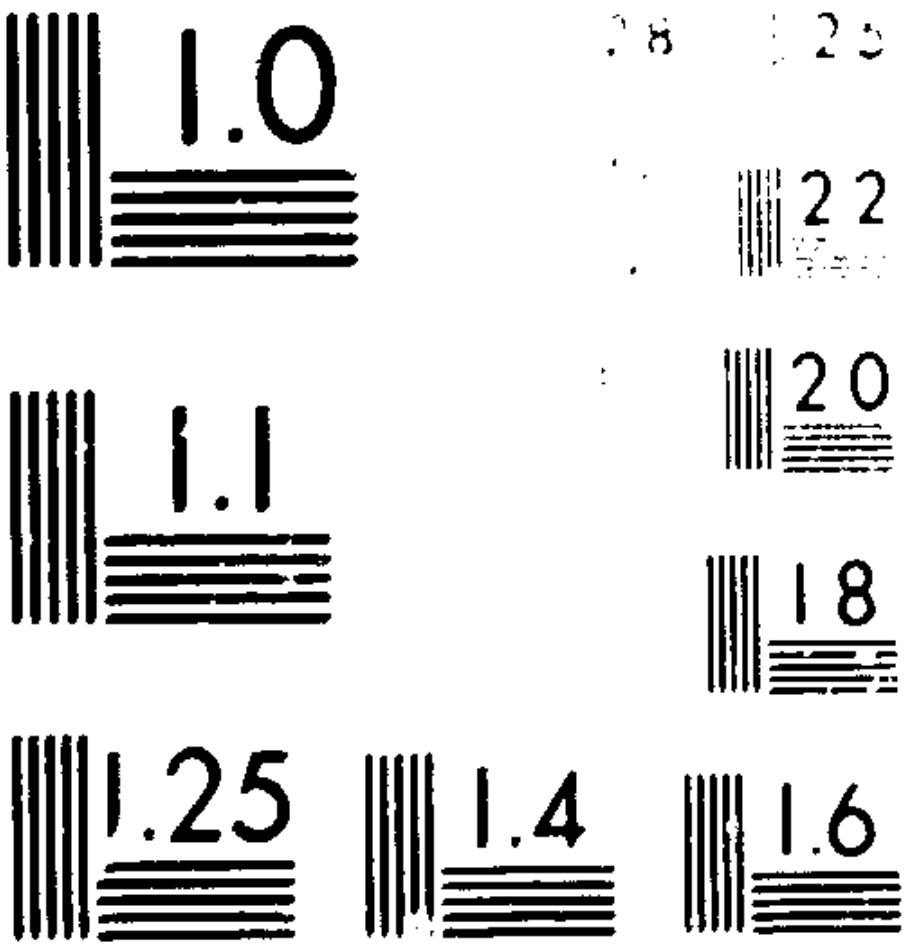
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S.R. Nakodkar, 1982

NOTE PAPER for the 10th Round Table Meeting of Developing Countries.

This brief document is intended to highlight the main issues relating to technology transfer and human resources development in respect of developing countries and to suggest some methodologies and activities for intensifying co-operative activities among the developing countries for achieving greater self-reliance in those areas in the context of the Caracas Programme of Action.

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TECHNOLOGY TRANSFER

2. The key areas identified by the High Level Conference on Economic Co-operation Among Developing Countries (ECDC) held at Caracas in May 1981 relate to the following aspects:

(i) Systematic collection and dissemination of information on technologies and expertise available within developing countries.

(ii) Promotion of co-operative arrangements among technological research and development institutions in specific areas.

(iii) Monitoring, analysis and review of the potentialities and implications of advanced technologies.

(iv) Enhancing negotiating capacity of developing countries vis-a-vis technology suppliers in industrialised countries, through strengthening of Technological Information Exchange System, collection and dissemination of information on terms and conditions of technology acquisition etc.

3. The New Delhi Meeting of Heads of Science and Technology Agencies of Developing Countries held in May 1982 went a step further and identified national focal points to provide for a specific framework for concrete co-operative arrangements among developing countries backed by requisite financial allocations by member states, specifically for ECDC activities. It also defined specific S+T areas and set up action committees to suggest concrete programmes of co-operation. The priority areas identified include energy development, health care and nutrition, agriculture,

industrial technology, technology for rural development, modern technology, resource engineering, chemicals and fertilisers, low cost housing, transportation, etc.

INFORMATION

4. UNIDO realised from the beginning that collection and dissemination of information on alternative technologies already available in the developing countries is the basic prerequisite for ensuring more effective co-operation among them with a view to achieving individual and collective self-reliance. UNIDO has already published two volumes containing information on four hundred different technologies relating to diverse sectors available in the developing countries and a third volume is under preparation. UNIDO also established the Industrial and Technological Information Bank (INTIB) which seeks to provide information on a goal-oriented basis. INTIB has been concentrating on three aspects of information on technology choice, viz. identifying and linking up with sources of information, identifying and meeting end-user requirements and generating information. UNIDO has also prepared a few technology profiles for the pilot operation of INTIB to provide answers to specific technological enquiries.

5. Inadequate awareness of technological capabilities of other developing countries is not the only factor inhibiting greater technological co-operation among developing countries. Another factor responsible for their excessive dependence on industrialised countries is their lack of confidence and credibility in the technologies developed by the developing countries. In order to remedy this situation it is necessary to initiate concrete measures to create keen awareness of the engineering and technological capabilities existing in different developing countries and to generate necessary confidence in the technologies developed by them.

6. For achieving the above objectives the following steps would appear necessary.

1) Devising a suitable mechanism and procedure for systematic identification and collection of information on technological capabilities and

expertise existing in developing countries through a standard questionnaire, the screening of the information for ensuring its authenticity and relevance and for disseminating it to the end-users through appropriate channels.

(ii) Compilation of sectoral directories of technological capabilities - each directory covering a specific area of priority concern and interest to developing countries, such as iron and steel, fertilizers, agricultural machinery, drugs and pharmaceuticals, transport and communications., etc.

(iii) Preparing user-specific information packages in respect of selected industries/projects giving details of nature and availability of alternative technologies, terms of acquisition, magnitude of investment involved, sources of capital goods and equipment, availability of consultancy and engineering services, etc.

(iv) Compilation of rosters of highly qualified and experienced technical and engineering experts available in developing countries in different areas of specialization which are of particular interest to developing countries in the context of their socio-economic objectives.

(v) As part of a confidence building exercise, UNIDO could undertake preparation of a portfolio of case studies analysing the experiences of developing recipient countries in the successful acquisition and absorption of technologies from other developing countries and the extent to which they have contributed to enhancing their own technological capabilities and industrial growth. In order to draw appropriate lessons the studies could also cover cases where technology transfer has not been successful.

CREATING AND STRENGTHENING CONSULTANCY AND ENGINEERING ORGANIZATIONS

7. Consultancy and engineering organizations can play a highly useful role in facilitating technology transfer as well as in strengthening the negotiating power of developing countries vis-a-vis the suppliers of technology and equipment. They can provide a variety of services such as design and engineering services, economic and management services, etc. covering all aspects of the projects' evolution right from pre-investment stage through project implementation to project management stage.

8. The importance of creating or strengthening consultancy and engineering services in developing countries is evident from the fact that they are found to lead to more appropriate technology choice, more efficient technology acquisition, closer linkages between local research and production sectors, better adaption and absorption of foreign technology,as well as to reduction in project cost through disaggregation of technology packages and provision of local technology and raw material inputs to the maximum possible extent.

9. Some of the more industrialised among the developing countries, such as Brazil, Mexico, Republic of Korea and India have relatively well-developed consultancy and engineering services, in certain specialised areas, as well as comprehensive consultancy services. At the same time, most developing countries have little consultancy infrastructure and tend to rely on consultancy firms from industrialized countries for devising industrial projects or improving industrial production and management. The chief drawback of this arrangement is that developed country consultancy organizations are not generally fully aware of conditions and needs of developing countries and tend to transplant solutions found effective in developed countries which may not be quite appropriate or relevant to developing countries. This to a great extent can be avoided through more effective co-operation among the developing countries themselves for strengthening their domestic consultancy capability.

The following could be some of the ways in which developing countries could co-operate among themselves for promoting and strengthening their consultancy and engineering capabilities:

(i) A group of manufacturing enterprises in different countries could jointly promote consultancy services in certain key areas of common interest such as fertilisers, cement, power projects, etc.

(ii) In certain key areas such as generation and transmission of power, power boards of a number of interested developing countries could jointly establish a specialised consultancy and engineering organization for providing the full range of consultancy services.

(iii) Inter-country complementary specialization could be promoted whereby a few selected developing countries which have achieved a high level of competence in consultancy and engineering services in particular areas such as plant design and plant erection could come together in a co-operative network for mutual benefit.

(iv) There could also be consortium arrangements between concerned organizations from two or more developing countries each providing a part of the input to make a total package of technology, consultancy and project design services, as well as equipment and materials.

11. International organizations such as UNIDO could take the following steps for strengthening consultancy capabilities in developing countries.

(i) Organize sectoral workshops on consultancy and engineering services in respect of critical project areas such as power projects, manufacture of essential drugs, fertilizers, etc. with a view to evolving a set of practical measures to strengthen consultancy infrastructure in these areas through networking and complementation arrangements, undertaking joint projects, etc.

(ii) Compile directories of consultancy organizations in developing countries containing relevant information about consultancy and engineering services, both sectoral and comprehensive for dissemination to all interested developing countries.

12. TECHNOLOGY REGULATION

Indiscriminate import of technology from developed countries is one of the factors which had retarded technological research and development effort in developing countries. Only a few developing countries have effective mechanisms for systematically regulating technology imports, for ensuring that they are in their intrinsic interests and that the terms are reasonable.

13. It would be useful to organise an international meeting of experts and policy makers from selected developing countries with practical experience of technology import mechanisms and regulation to compare national experiences and evolve model mechanism and legislation for regulating inflow of technology. The Technology Information and Exchange System (TIES) of UNIDO will also need to be adequately strengthened.

14. COMMERCIALIZATION OF TECHNOLOGY

Often even the technology that is developed by developing countries is not commercialized by them but by developed countries. Unless its technical feasibility and commercial viability are proven through commercialization, a new research finding can be of little more than academic value. Commercialization requires development of capabilities in different areas such as process, product and plant design, manufacturing operations., quality control, etc. Developing countries need to develop capabilities in these areas. Developing countries which have done successful research in specific areas which are of priority concern to other developing countries need to be assisted in establishing pilot plants which could be used as common facility centres by other developing countries.

15. TECHNOLOGY PROFILES

It has been recognised that one of the effective ways in which technology transfer can be facilitated is through preparation and selective dissemination of technology profiles. Technology profiles can provide the prospective user concise information on all relevant technical, as well as economic aspects concerning the establishment of a production enterprise.

Typically, the information would relate to alternative technologies and processes for setting up a unit, the main items of equipment and raw material inputs needed, sources from which they could be obtained, manpower requirement, probable scale of investment, cost of production, etc. UNIDO has already prepared a few profiles in certain sectors such as fertilisers and iron and steel. There is need to prepare a portfolio of such profiles on specific projects and technologies which are urgently needed by developing countries to achieve their socio-economic objectives. They could cover priority areas such as manufacture of low cost building materials, diesel engines, power tillers and harvesters, centrifugal pumps, motorised two-wheeler and three-wheeler transportation vehicles, such as scooterettes, mopeds and rickshaws, cement plants, paper plants, etc.

16. ENHANCING NEGOTIATING POWER

Even as systematic efforts to strengthen technological co-operation among developing countries continue to be made, it would also be necessary for developing countries to take effective step to strengthen their negotiating power vis-a-vis suppliers of technology and equipment from developed countries. Some of the measures necessary would be:

(i) Enlarging TIES network to cover larger number of developing countries to share information and knowledge on terms and conditions of technology transfer from developed country technology suppliers.

(ii) Drawing up model contracts for technology acquisition in priority sectors to serve as bases for negotiating with technology suppliers.

(iii) Undertaking comparative study of technology import regulations and mechanisms in selected developing countries and evolving model guide-lines for assisting other developing countries in framing appropriate legislation and mechanism.

(iv) Strengthening capacity to disaggregate technology and investment packages to enable developing countries to provide components of technology and other inputs from domestic sources to the maximum extent possible.

17. ADVANCED TECHNOLOGIES

A considerable amount of work has been initiated by UNIDO to study the implications of genetic engineering, microbiology and microelectronics for developing countries and a proposal for the establishment of an international centre for genetic engineering and biotechnology (ICGEB) is under active consideration. However, the implications of these technologies for fulfilling the basic needs of the people of the developing countries such as food,, housing, transport, communications, nutrition and health, needs to be studied in depth on a sectoral basis and action plans formulated for implementation. It is also necessary to selectively identify those elements of such technologies which could create maximum impact on problems of common concern to several developing countries and assist them in developing requisite technological capabilities to resolve them. Certain new product ideas such as production of vaccines with the aid of genetic engineering could be pursued in this context. Selected developing countries could also consider establishing joint research programmes in a few areas of common interest.

HUMAN RESOURCES DEVELOPMENT

18. Development of technological capabilities of developing countries crucially hinges upon development of human resources. The base for technological development is provided by qualified and skilled personnel including scientists, engineers, technicians and skilled labour. The S+T education and research system of developing countries must, therefore,

be geared to meet their present and future needs , both qualitative and quantitative, is the context of their socio-economic objectives and aspirations. Human resource development has to be integrated in any programme of technology development for developing countries.

19. The Caracas Programme of Action had stressed the importance of co-operation in the development of human resources for accelerating the pace of industrialization of developing countries. It laid particular emphasis on industrial manpower training, preparation of long-term programmes of co-operation for exchange of experience and skills, to improve and co-ordinate national centres of excellence for industrial training and management, strengthening of existing institutions and establishing new ones in priority areas, encouragement of regional or multinational specialized training and research institutions, organization of training facilities and courses for improving technical and managerial capacity of developing countries, etc.

20. The present system of education, modelled essentially on the developed countries' experiences, is hardly sensitive to the conditions and constraints obtaining in the developing countries. This has resulted in the creation of elitist and privileged groups within a large mass of educational backwardness. The type of education imparted and research done in the educational and research institutions is often foreign inspired and of little relevance to the critical problems facing the developing countries. Intellectual dependence on industrialised countries brought through such North-oriented education is hardly conducive to independent policy formulation and decision making in developing countries.

21. Many of the problems faced by developing countries are specific to their situation and the solution to these problems would be determined, among other things, by their capacity to make best possible use of their human,as well as natural,resources. This would call for strengthening, among other things, of the institutions of teaching and research in basic sciences. These institutions need to be staffed by qualified personnel, of which there is acute shortage in most developing countries. Hence, one of the important tasks that needs to be tackled is to devise schemes for

training such personnel. Training,education and research are, in fact, the key instruments for overcoming the problems which developing countries face in the choice, development and application of technology for bringing about rapid all-round development. Programmes for education, training and research ought to cover the scientific and technological, as well as production personnel right from skilled workers to engineers and managers.

22. In most of the developing countries the educational infrastructure is inadequate. Even in countries where the infrastructure is relatively well-developed, S and T education has not had a marked impact on the economic improvement of the people. Often the gap between the urban elite and the rural population has widened due to mismatch between educational and social objectives and needs. In many cases social stresses have aggravated as employment opportunities have not kept pace with growth in education and skills. This has resulted in large-scale exodus of highly qualified professionals and skilled personnel from developing to industrialised countries. This is also partly due to the fact that the educational system is geared basically to produce seekers of secure jobs rather than risk taking entrepreneurs seeking self-employment.

23. Certain important steps need to be taken to reorient the educational system and research and development infrastructure to better serve the developmental needs and objectives of developing countries :

(i) Promoting better interaction between industry and educational and research institutions. Greater involvement of industry particularly in higher education will help education become more problem-oriented and contribute to greater technological development.

(ii) All developmental projects, including industrial projects, need to be linked with induction of trained technologists and engineers.

(iii) Firm linkages need to be established between research and industry through encouraging establishment of industry sponsored research centres and research projects, exchange of trained personnel, joint development of curricula and educational programmes in manpower planning, etc.

(iv) National educational policies need to be dovetailed to industrial and science and technology policies. They should include introduction of vocational content in school curricula, development-oriented technical education at university level and effective linkages between education and industry or user at every level.

(v) Devise special schemes for creating and strengthening engineering and managerial skills required to transform know-how into process design, development, commercialization and adaptation to actual needs.

(vi) Apart from formal education in educational institutions, it is necessary to provide on-the job training facilities for acquisition skills. UNIDO has already been conducting in-plant training programmes with this objective in mind. It is felt that training of personnel through their participation in actual execution of projects can be far more effective than other forms of training. Growth points for technological capabilities in developing countries reside in certain priority sectors such as agriculture, agro-processing industries, engineering industries, energy related industries, transport, etc. On-the-job training in these areas help to establish the essential skill base for technical progress.

(vii) Programmes need to be taken up for large-scale training of artisans, the improvement of traditional technologies and the adoption by research institutions of programmes concerned with upgradation of traditional technologies and other problem-oriented research activities.

(viii) Steps need to be taken to assess and optimally deploy the existing scientific and technological manpower to serve the developing countries socio-economic objectives more effectively.

(ix) In their central function of providing technical manpower for industrial and economic development, technological training institutions need to develop effective linkages with the national economic planning machinery, industrial enterprises, as well as other technological institutions both within the country and abroad, particularly in other developing countries.

24. As seen earlier, continuing intellectual dependence on developed countries can be detrimental to the developing countries. In the area of human resource development which is the key element in technological development, effective co-operation among developing countries is of paramount importance Among the developing countries there are some which have painstakingly developed sound educational infrastructure, including some educational training and research establishments which have achieved a high degree of excellence in their respective areas. They are in a position to make a significant contribution to development of human resources in other developing countries through effective co-operative arrangements.

25. Institutions are repositories of human resources and skills. Several institutions in developing countries have already done considerable useful work in their respective areas. These institutions provide a valuable basis for the accumulation of experience and know-how in specific sectors and also for quality training of personnel of other developing countries. Measures need to be taken for making selected institutions of this type to function as specialised centres for international technological co-operation.

It would be necessary to promote and strengthen centres of excellence in particular areas of training and research which are of relevance to developing countries such as agriculture, energy, transportation, etc. and develop effective twinning and networking arrangements among them for pooling and sharing of experience and knowledge for mutual benefit.

Also some developing countries which have acquired high level competence in education, training and research systems and methods, could set up educational consultancy organizations to assist other developing countries in establishing or upgrading educational, research and training institutions.