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APPROPRIATE TECHNOLOGY FOR LIGHT ENGINEERING INDUSTRIES AND RURAL WORKSHOPS

[APPROPRIATE TECHNOLOGY FOR LIGHT ENGINEERING AND RURAL WORKSHOPS

Discussion Paper

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Appropriate Technology for Light Engineering and Rural Workshops*

Issues and Considerations

Note prepared by the secretariat of UNIDO

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INTRODUCTION

1. The pattern of industrialization followed hitherto in most developing countries has generally resulted in a high degree of industrial concentration in metropolitan and urban centres in these countries. Small pockets of industry have grown in several countries, often mainly oriented to the needs of urban consumption. Though significant import substitution, and exports of processed products by certain countries, have taken place, there has been very little impact of industrialization on rural communities which represent, by far, the majority of the population in these developing countries. The 'trickle-down' effect of industrialization has been very limited in terms of the spread of industry and increased unemployment and poverty has tended to perpetuate the low purchasing power in the rural areas. Growing urban migration is not only causing greater pressures in industrial centres but may result in serious imbalance between the large agricultural and rural sector and the small, urban industrial sector in many of these countries. It is necessary, in this context, to ensure that the benefits of industrialization are spread over as wide a strata of the population as possible through a more broad-based industrial strategy specifically directed towards greater dispersal of industry to the rural areas.

2. Such industrial dispersal is complex and difficult. The establishment of a factory in a metropolitan centre possessing necessary infrastructure and other facilities is much easier than to spread industrial planning and operations over a wider geographical area. Apart from basic infrastructure such as energy and transport, the necessary technological infrastructure has to be created in terms of entrepreneurial capability, growth of skills and the like. At the same time, production capacity has too often to be geared to a different set of circumstances in terms of choice of products, nature of investment, scale of production, programmes of training and various related aspects. Despite its complexity, however, greater industrial dispersal may necessarily have to be undertaken in most developing countries if basic socio-economic needs such as that of greater income and employment to the larger rural communities, are to be adequately tackled.

3. With the great variation in factor conditions, levels of growth and socio-economic situations in developing countries, the nature and extent of industrial dispersal and the range of industrial activities to be undertaken in under-industrialized regions of such countries would vary considerably. A fertile agricultural region may principally concentrate on food processing and the production of agricultural equipment and inputs. Pasture areas would present greater possibilities of industries more related to animal husbandry such as dairy products, leather and other such industries. Coastal regions may concentrate on inputs for fishing and exploitation of marine resources. Apart from varying local needs and upgrading of local skills and crafts, the nature and pattern of such industrial activities could also cover a wide range of activities such as :

(i) repairs and servicing of machinery and equipment in local use;

(ii) establishment of 'footloose' industries, such as ready-made clothing etc., that meet local needs;

(iii) setting up of processing units for local produce, both perishable and non-perishable items;

(iv) production of simple agricultural equipment including farm implements, pumps, etc.;

(v) manufacture of products to meet local consumption needs such as building materials, cloth, shoes and other consumer products and

(vi) production of components and products for the 'organized-urban' sector

4. Maintenance and repair, for example, provides considerable potential in most countries. In several developing countries, considerable transport and agricultural equipment is in use which has to be taken to distant urban centres for repairs or servicing. Such functions could be performed locally, which would significantly increase local technological capability. 'Footloose' industries, having low weight and volume but considerable application of labour and relatively simple skills, lead themselves to greater decentralization, either for the whole or part of a production process. A number of local agricultural products could obviously be processed or semi-processed in the areas of production. Various farm implements such as ploughs, sickles, knives, spades, etc., should be able to be produced cheaply and competitively, provided a supply of basic materials can be assured. Certain functions such as welding and casting could also be undertaken in rural areas. Items such as barbed wire,

fencing, poles, wire-mesh etc. could also be locally produced, provided certain simple equipment and a supply of raw materials could be ensured. A number of components and products of various degrees of sophistication could also be manufactured for the 'organized-urban' sector, provided the necessary skills could be developed and certain basic facilities offered.

5. By and large, industrial dispersal presents significant possibilities for the production of a wide range of goods and services, not only directly related to local production and consumption requirements but also interlinked with the overall needs of the 'organized-urban' industrial sector in these economies. It is, however, essential that a proper technological base of environment should be created for the effective growth of the rural industrial sector if the issue of industrial dispersal is to be tackled on a comprehensive basis.

6. Apart from the provision of basic infrastructure in terms of energy and transport which may themselves prove to be significant constraints, it is necessary to consider the technological infrastructure that would need to be created, together with the institutional base that may need to be provided. The concept of Rural Workshops or Industrial Centres[1/] (RWIC) needs to be considered in this context as a nucleus for building the necessary technological base for a programme of rural industrial growth. The detailed content of such Workshops/Centres or similar entities could vary significantly in the light of local conditions and potential, but basically such an institutional unit could provide the necessary base and technological stimulus for initiating and developing industrial activities.

Objectives :

7. The principal objectives of RWICs would be to :

(i) provide a base for the spread of knowledge of industrial operations and the use of modern tools and simple equipment;

(ii) serve as a nucleus for producing a wide range of products for local consumption and use;

(iii) assist rural artisans in upgrading local techniques and relate these to the use of modern tools and techniques;

1/ Rural Workshops/Industrial Centres have been referred to hereafter as RWIC

(iv) provide common equipment and service facilities for maintenance and repair of agricultural and other equipment in local use including transport equipment, diesel engines, pumps, electric motors and the like;

(v) provide training in skills for the production of components and products required by the 'organized-urban' industrial sector;

(vi) initiate adaptation and innovations of existing techniques and processes.

While such Workshops/Centres would basically provide the institutional infrastructure for the growth of local skills, they could also serve as the nucleus for rural industries geared to local requirements of factor endowments.

Location :

8. The location of RWICs would depend on the factor-situation and conditions in each region. This would initially need to be related to the spatial and economic structure of rural regions in a country. Centrally located villages or village market centres could be suitable possible locations. Obviously, the RWIC should cover a cluster of villages, from the viewpoint of demands for service and production functions. The number of such RWICs would depend on the extent of resources channelled for this purpose. Whether a beginning could be made with a few units, which could serve as pilot and demonstration units, would need to be considered in the context of particular countries.

Investment requirements :

9. The establishment of RWICs would need to be related to the specific objectives sought to be achieved in particular cases. Some RWICs could be relatively small units, with investments of less than $ 10,000 and functioning initially as a repair or maintenance unit or as a training facility for upgrading of rural artisan skills. It could also be a fairly large multi-purpose unit, with certain basic machinery and equipment. A model scheme outlined in this regard [2/] is given in Annex I. The nature of machinery and equipment could be adjusted to local production and service requirements. In certain units, it may also be necessary to

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2/ see: Rural Workshops in Developing Countries - ID/WG.282/39; Appropriate Technology for Rural Industries - ID/WG.282/54; Light Engineering Workshops for Rural Areas - ID/WG.282/61

provide a cast-iron foundry, to provide simple, low-weight castings. In other instances, more equipment may be necessary for metal-working and machining or for wood-working. Appropriate combinations would need to be considered, based on local resource factors and endowments.

Pattern of financing :

10. The initial finances for setting up such RWICs would need to be provided by the state. Governmental agencies could either set up such units directly, based on a survey of local potential in different regions or could provide grant-cum-loan-assistance to local agencies/ entrepreneurs in different areas. Since the main objective would be to harness and develop local potential and skills, the management and operations should be entrusted to local agencies, with state organization providing necessary training and technical expertise. The role of state agencies would need to be carefully delineated as there is a likelihood of such a programme becoming unduly government-controlled. At the same time, initial financing and training would need to be provided by government agencies. One alternative could be to entrust management and operations to local co-operatives or other local authorities, with state agencies providing :

(a) initial funds, either as a medium or long-term loan on easy terms or with 50% or more of initial investment in the form of grants;

(b) training facilities for personnel, both in operating skills and in elementary management techniques and

(c) skilled technical personnel in particular trades for varying periods.

11. It is important that RWICs be primarily viewed as essential infrastructure for technological growth in rural areas. While they may prove economically viable over a period of time, these units should not be judged from the viewpoint of commercial profitability and as industrial units yielding high commercial returns. The gestation period for growth of local skills would vary from region to region but may be quite long and a flexible approach may need to be adopted in applying standards of commercial profitability to such units.

12. The size and content of such RWICs would vary from region to region and would need to be related to the factor-situations and potential of each area. The growth of such units could also be suitably phased, so that subsequent expansions could be related to growth of local skills and capability.

Interlinkage with Extension Services :

13. The concept of RWICs is principally intended to provide a nucleus and technological base for developing local skills and capability and to serve as a catalytic agent for the growth of rural industries. Such RWICs would obviously not be a panacea by themselves and would need to be closely integrated with field extension services. An effective extension service constitutes an essential prerequisite for rural industrial growth. Such services should include :

(a) survey of industrial potential in particular regions, in consultation with local agencies and representatives;

(b) assistance in determining viable projects, in terms of potential demand for products, size of investment, etc.;

(c) provision of technological information and expertise regarding technological alternatives as related to local factor-resources and

(d) assistance in securing credit, obtaining machinery and equipment, ensuring regular supplies of processed materials required and in marketing and distribution of products.

Technological assistance provided through extension services would often need to be multi-disciplinary and require close linkage with R&D institutions specialized in particular production branches. The establishment of 'centres of excellence' in particular branches and effective linkage between such centres and field extension services would be especially important. Basic managerial expertise would also need to be provided through managerial extension services, providing guidance in functions such as book-keeping and labour and material costing. Such expertise could also be provided through field institutions and units of banking and credit agencies. The degree of linkage between

the RWICs and industrial extension services would depend on particular situations. In some instances, the RWIC could be wholly integrated with the extension service facilities. In other cases, however, the RWIC would primarily concentrate on training and certain production functions supplemental to extension services.

Rural Workshops/Industrial Centres and Industrial Estates :

14. In several developing countries, industrial estates have been set up to provide certain basic facilities to small-scale enterprises. Such estates range from the provision of basic infrastructure, together with worksheds on nominal rental to various common-service facilities, either for a particular industrial sector or of a multi-purpose nature. The purpose of industrial estates needs to be extended to rural areas to provide basic infrastructure and other facilities to rural entrepreneurs. Rural industrial estates would, however, need to be closely interrelated with RWICs. While the latter would perform principally training together with certain production functions, rural estates would provide the basic physical facilities for rural industrial units which need to be located outside rural households. Thus, rural industrial estates, which could be set up gradually and in nodular form could be established as extensions to RWICs. The production functions of the latter would need to be effectively co-ordinated with activities undertaken in the industrial estates through the industrial extension services.

Policy package for rural industries :

15. Apart from RWICs, supported by an efficient extension service and rural industrial estates, a comprehensive policy package would need to be introduced for effective rural industrial growth. Such a package would need to include :

(a) provision of adequate credit for initial investments and working capital through field units of banking and credit institutions, including arrangements for hire-purchase of machinery and a liberal and sympathetic interpretation of creditworthiness of

rural entrepreneurs;

(b) financial incentives equal, if not greater, than those provided to 'organized-urban' industry, including provision of energy at subsidized rates, liberal tax allowances for specified periods, tariff rebates, direct capital subsidies for industrial units located in underdeveloped and rural areas and the like;

(c) assured supplies of processed materials such as steel or yarn;

(d) preferential purchase of products of rural enterprises by governmental agencies and

(e) possible reservation of additional production capacity in certain sectors for units located in rural areas, for specified periods of time.

16. In several developing countries, the present industrial policy pattern has tended to favour 'organized-urban' industry and basic facilities and fiscal and other incentives have often militated against rural industrial enterprises. This policy pattern needs to be reoriented in favour of industries, particularly small-scale units, located in rural areas. Equal facilities and incentives might themselves not be adequate and preferential fiscal and other incentives would be required. In some sectors, it may also be necessary to 'reserve' additional production capacity for rural-based enterprises for particular periods of time, by way of application of the infant-industry argument in this field. A policy of 'reservation' would need, however, to be carefully designed and related to specified periods, to ensure competitiveness of rural-based units in both domestic and external markets.

Technology selection :

17. Besides institutional facilities and policy measures for rural industrial growth, developing-country institutions would need to carefully select suitable techniques for various production activities in the rural sector and ensure adequate dissemination of information regarding appropriate alternatives. This would necessitate, in some cases, the upgrading of existing techniques and processes, which could be undertaken in the RWICs or national R&D Centres. In other cases,

foreign technology, used in the past and discarded in favour of more capital-intensive techniques because of growing labour costs in these countries, may prove appropriate to the needs of rural-based industries in developing nations. In certain instances, appropriate technology for units in the 'dispersed-rural' sector may be available in other developing countries or can be acquired from medium and small enterprises in developed countries.

18. While the appropriateness of particular technologies would need to be assessed in the context of local factor conditions and circumstances, certain broad criteria which would be generally applicable in the selection of appropriate technology for the 'dispersed-rural' sector would be the following :

(a) The technology should be labour-intensive rather than capital-intensive;

(b) production should usually be undertaken in small-scale units and household units, involving lower unit-investment outlays, though large-scale production using labour-intensive techniques would be fully compatible;

(c) production would be geared to local resources, factor endowments and skills;

(d) products should be related to local needs and related to local purchasing power and

(e) production units should be located principally in rural areas.

19. Technology in developing countries would need to identify and evaluate alternative techniques for the 'dispersed-rural' sector against the above criteria and such other local conditions and circumstance as may be applicable and must thereafter provide an adequate flow of information in respect of :

(a) products, product designs and specifications, etc.;

(a) production techniques and processes, including details regarding such processes and their applicability in particular situations and

(b) adaptations necessary to suit local conditions and circumstances.

Assistance should also be provided by such institutions in the acquisition of such technologies by user rural enterprises. Such technological information would need to flow both to user enterprises and to field institutions such as the RWICs and extension services for dissemination to potential production units. The RWICs should in turn provide information and experience regarding such techniques, together with local adaptations and innovations.

20. It is necessary that a national inventory be made of technologies indigenously available, particularly those applicable to the 'dispersed-rural' sector, together with adaptations and innovations developed in R&D institutions and, over a period of time, in the RWICs. Such an inventory would highlight the requirements of upgrading in particular cases and identify technological gaps which would need to be covered. This task could be undertaken by the national institution dealing with technology and R&D.

Programme of action :

21. The effective growth of rural industry and technological skills and capability in the rural sector would necessitate a comprehensive programme of action, both on the part of developing-country governments and within the framework of international economic co-operation. Such a programme should cover the following aspects at the national level :

(a) Significantly greater resource allocations would be necessary to provide basic infrastructure facilities, viz. energy and transport, for non-urban areas;

(b) To develop technological capability in the use of modern tools, equipment and production techniques in the rural sector, Rural Workshops/Industrial Centres would need to be set up in selected

rural locations. While the detailed nature and structure of such Workshops/Centres (RWICs) would be related to local factor conditions, alternative multi-purpose or sectoral models could be considered for adaptation to local conditions;

(c) The establishment of RWICs on a phased basis should be accompanied by an effective industrial extension service for technological information and guidance and assistance in setting up rural production units, which would also be taken up in a phased programme in each country;

(d) The programme of RWICs should be supplemented by the establishment of rural industrial estates, providing basic infrastructure and physical facilities for rural production units;

(e) A programme for extension of adequate credit facilities to meet fixed and working capital needs of rural industrial units should be through field units of banking and credit institutions. A liberal approach in respect of credit-worthiness of rural entrepreneurs would need to be adopted by such field units;

(f) A comprehensive policy package, providing fiscal and other incentives, together with other essential facilities, would need to be drawn up in the context of particular countries, the objective being to achieve greater dispersal of industry to rural areas;

(g) Institutional facilities would need to be set up for :

(i) identifying and evaluating alternative technologies which can be applied in the 'dispersed-rural' sector;

(ii) disseminating information on such techniques and processes considered most appropriate in particular sectors;

(iii) assisting in the acquisition of such technologies by user RWICs and rural enterprises;

(iv) monitoring the absorption, adaptation and innovations relating to such technologies in RWICs and user rural enterprises.

22. International economic co-operation in this field would need to cover the following aspects:

(a) The resource requirements for the establishment of RWICs, even on a modest scale, would be very significant. Assuming an average cost of $ 25,000 for machinery and equipment alone for each RWIC, the cost of such equipment for even 100 such units in different developing countries, which could barely serve as pilot and demonstration centres, would come to $ 2,5 million. Such machinery and equipment could be supplied from both developed and industrially advanced countries.

(b) Greater inflow of suitable technology should be encouraged between medium and small enterprises in developed and industrially-advanced developing countries on the one hand and rural-based industrial enterprises in other developing countries on the other. This could be channelled through national technology institutions or through international agencies such as UNIDO. A suitable framework of incentives could also be developed to encourage such transfer.

(c) Greater exchange of information and experience could take place, particularly between developing countries regarding :

(i) the application and use of alternative technologies in different branches, with special reference to rural-based industry and

(ii) the experience of industrial extension services and industrial estates in rural areas, including training programmes for rural artisans, etc..

As and when RWICs are set up, exchange of information and experience regarding their functioning would also be very useful.

ANNEX I

Model Rural Workshop / Industrial Centre

Number of trainees: - 100 (machinists, fitters, mechanics) per year

(A) Capital cost estimate:

1)	Cost of land	Nil to $ 3000
2)	Land development and facilities (electric power, water supply, approach roads, etc.)	- $ 2000 to $ 7000
3)	Buildings for Centre (village-type constructions)	- $ 5000 - $ 15000
4)	Equipment and tools	- $ 15000 - $ 75000
		$ 22,000 to $ 100,000

(B) List of equipment:

Type of Equipment	Number of units
Centre lathes, 130/200 mm, 1,000/1,500 mm.	4
Turret lathe, 220 mm, centre height	1
Capstan lathe, bar type, spindle bore, 63 mm. diameter	1
Shaping machine, 500/650 mm. stroke	1
Grinding machine, universal type, 130 x 1,000 mm	1
Tool and cutter grinding machine	1
Kneetype Milling machines, size 2, one vertical, one universal	2
Hacksaw, 500 mm. diameter, bar-cutting capacity	1
Smithy with hammer (drop hammer)	1
Shear, 2,250 mm. length	1
'OBI' presses - 100 T capacity	1

Type of Equipment	Number of units
Welding set	1
Salt bath for heat treatment	1
Annealing furnace (small size)	1
Crucible furnace (oil-fired) for non-ferrous castings	1
Work benches with machine vices, files, cutting tools, milling cutters, drills, reamers, scrapers, etc.	
Other miscellaneous workshop equipment and tools.	

The following background documents on this subject are being circulated:

Creation of Small-scale Industry Development in Southern Sweden - The Gnosjö Case	ID/WG.282/8
Rural Industry	ID/WG.282/9
Swedish Experience in Small-scale Industry: The Role of Government Policies and Institutional Mechanisms	ID/WG.282/24
Some Basic Concepts for Developing Appropriate Technology for Rural Areas	ID/WG.282/31
Starting a Blacksmith and Agricultural Implements Unit in Rural Areas	ID/WG.282/37
Proposal for Starting Carpentry Units in Rural Areas	ID/WG.282/38
Rural Workshops in Developing Countries	ID/WG.282/39
Small-scale Rural Industries: Light Engineering Workshops	ID/WG.282/42
Light Industry Technologies and Rural Development	ID/WG.282/44
Appropriate Technology for Rural Industries	ID/WG.282/54
Light Engineering Workshops for Rural Areas	ID/WG.282/61
Establishment of Small-scale Rural Workshops for Light Engineering Goods in East Africa	ID/WG.282/67

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