

Appraisal of Effectiveness of Technology in Rural and Underprivileged Area Using some Parametric Indicators

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Abstract : *The measurement of performance of the technology in rural and under-privileged area has become a cumbersome task due to wide divergence in criteria used for the purpose. The useable set of criteria always varies depending on the type of technology and the rural setting for which the technology is intended for. This papers aims at suggesting a set of generalized paranzetric indices which can be used for measuring performance of all rural technologies at all locations in relation to overall rural developnzent objectives. Based on recent field study, the paper traces some fundamental aspects that need to be considered in choosing indicators for performance measurement of rural technologies. It emphasizes the need for appropriate choice of technologies for diffusion in rural areas and suggests criteria to be followed for the purpose. The objective of the paper includes the decision-making approach for diffusion of rural technologies that contribute to rural developnzent. The rationale and indicators of performance measurement of rural technology are discussed emphasizing the need for evolving a limited number of generalized performzance indicator measures and suggesting their use in relation to technology goals emanating from rural development issues. Finally, a set of generalized indicators for measurement a rural technology are summarized.*

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Introduction

The measurement of performance of rural technology is very much essential to ensure sustainable technological development as well as human resource development in the rural context. It sparks debates on the issue of selecting technology performance indicators due to wide variation of the types of criteria to be used for aforementioned objective. The considerable set of criteria is contingent upon technology type and rural setting. Choosing a set of criteria for measuring performance always remains controversial when probed from 'whose point of view' or for 'which goal'. However, in spite of divergent notions in defining, the understanding about performance, it is possible to agree on a single set of generalized indicators. Under a given socio-economic setting and for a given technology (either a product or a process), a chosen set of performance indicators should take into consideration the interrelations between the hierarchy of technology objectives/goals for **predetermined** technology users and/or technologies beneficiaries under a given socioeconomic setting. Due to lack of uniqueness of the rural setting in various countries, it is hardly practicable to have a general and methodologically organized set of performance indicators for rural technologies.

Even within a particular country, such generalization and systemization of indicators has become difficult and thus comprehensive researchers in this field are rare. Rural technology is one of the key factors for rural development. Rural development refers to growth of rural economy as well as change in quality of life of the rural people. A set of generalized indicators has been suggested in this paper, in order to measure performance of all rural technologies at different locations with respect to overall rural development goals. For performance measurement of rural

technology, some basic aspects to be considered. This paper focuses these aspects and proclaims the necessity of proper selection of technologists for diffusion in rural setting. A policy imperative is required for this purpose. The decision-making approach is a key factor for dissemination of rural technologies which in turn contributes to rural development.

The argument for using certain parametric factors for rural technology performance measurement should be probed under specific socio-economic situation considering technological status of the country. It should be emphasized that there is a need for selecting a limited number of generalized indicators for measurement of technology performance and these should be used to achieve technological goals on the way of achieving rural development objectives. All these have been highlighted in the paper

Diffusion of Rural Technologies and Decision-Making Process

Technology is a means for transforming resources to meet desired needs. It is not an independent and autonomous force. Technology is merely an instrument in problem solving. Not all the technologies are considered useful at all times, each must meet the existing socio-economic, cultural and environmental circumstances. The concept of rural technology derives from the fact that it brings into focus a production or service system, which may be called rural in character as it, is linked to the rural development progress. The production or service system involves organization, management, production process, ownership, procurement of input, sale of products, etc. This implies that for a rural location, the chosen technology must produce the goods and services needed to fulfil the basic needs of the people through an indigenous creative process and not to cater the endless

developmental imbalance through an alienating technology selection process. This provides a rationale for the choice of appropriate rural technologies.

There are hardly any acceptable quantitative indicators by which technologies can be divided into rural or non-rural. This is because diffusion of relatively modern technologies also takes place in rural locations. In general, it should be noted that for rural people the technological level should be simple so that rural people can operate them and are compatible to rural economic activities.

It may be noted that rural technologies do not necessarily mean low level technologies and may differ in scale of operation as per end-use. As for example, some rural technologies are transitional in nature and do not require machinery of any kind if operated at the household level. These technologies (poultry rearing, bee-keeping, kitchen gardening, etc.) are intended to contribute to meeting survival needs of rural households but at the same time they may be operated on a commercial basis at a larger scale. Therefore, depending on the intent of purpose, higher level of technologies are also introduced or found in rural areas. Rather, two or more distinctly different hierarchy levels of technologies (manual facilities, powered facilities, general-purpose facilities, etc.) are in existence side by side in many rural economic activities.

Criteria for the Selection of Rural Technology

Through there may be an exhaustive list of criteria for the selection of rural technologies, all of them may be summarized under the following broad headings in a simplified fashion which is shown in Figure 1. It may be noted that capability strengthening invariably includes upgrading both management and technical skill and enhancing level of education of technology operators.

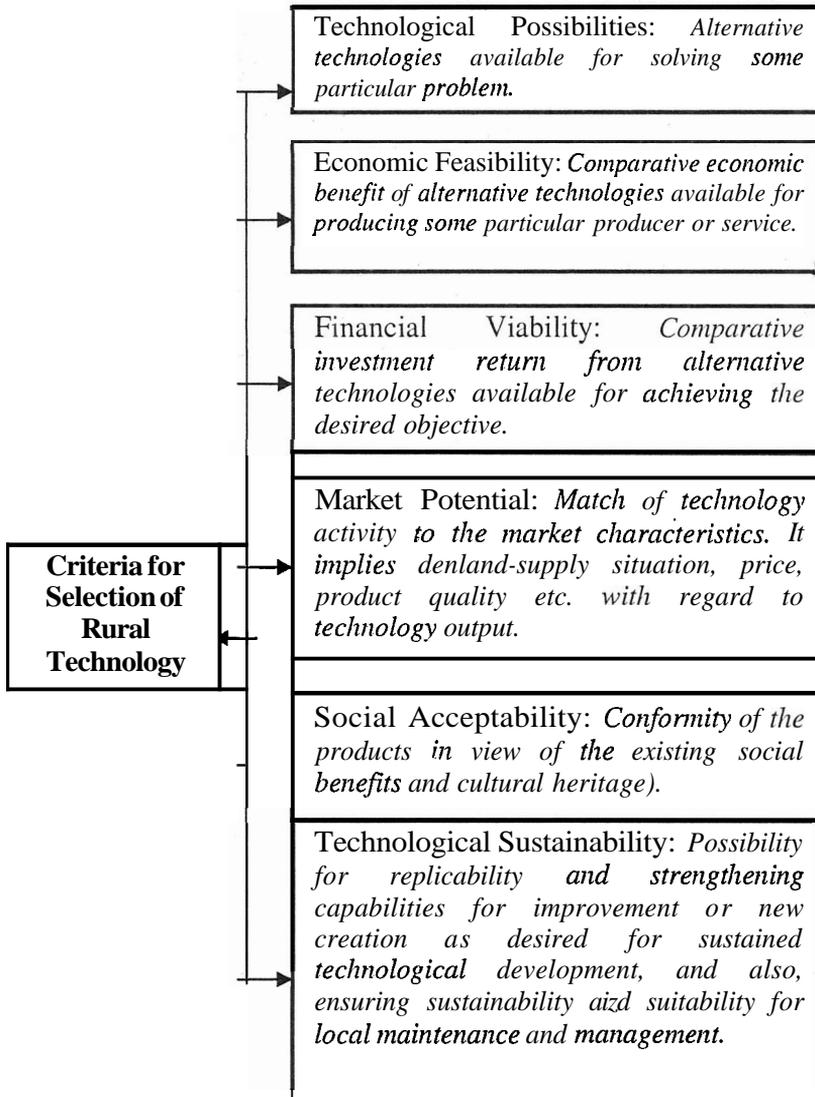


Figure 1: Criteria for Selection of Rural Technology

Technology Diffusion in Rural Areas: Decision-Making

Technological capability refers to gaining more control over resources for overall development. The key decisions for technology diffusion in rural areas should cover what is considered the primary activities of gaining technological capabilities for development. For any technology, the resources should be judged in terms of the following four components which in literature is known as technology components. These components [APCTT-1989] are shown in Figure 2.

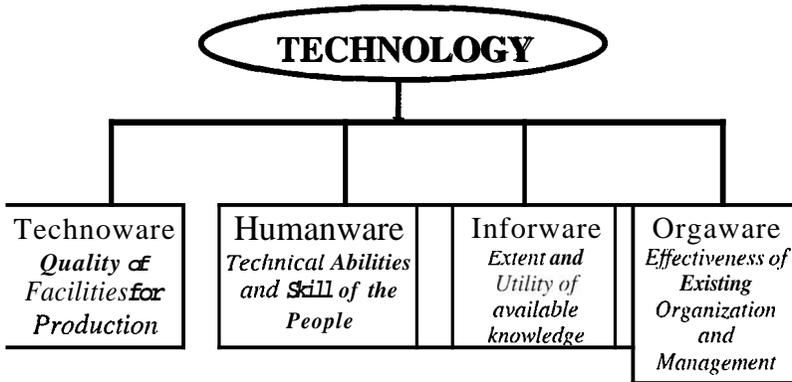


Figure 2: Technology Components

The general approach of technology diffusion to rural areas is either program specific or project based depending on the objective function pursued by various agencies, institutions and organizations (supply side agents). It may be mentioned that technology diffusion process should be viewed from two perspectives; supply side and demand side. The modality of technology transfer and diffusion approaches also vary according to technology-specific function and target beneficiaries in terms of their social status, economic and financial abilities, market norms and market intervention strategies and culture practices (demand side). The technology diffusion in rural area occurs through certain channels as shown in Figure 3.

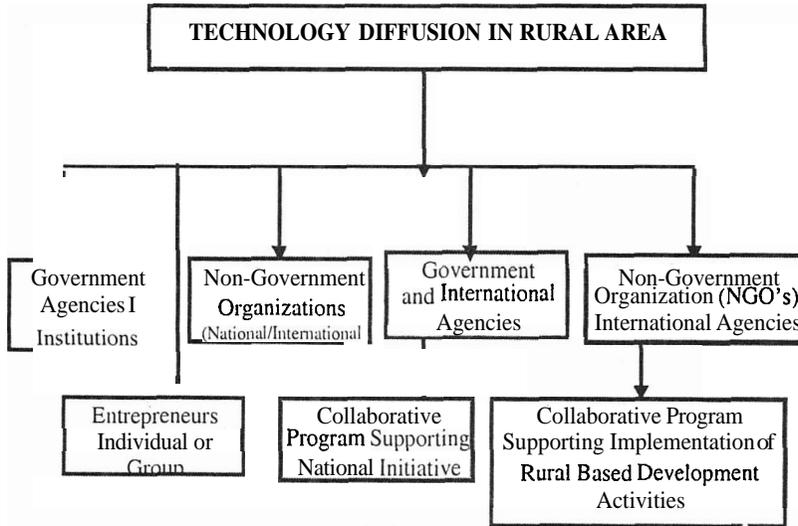


Figure 3: Channels of Technology Diffusion in Rural Areas for Targeted Beneficiaries

Irrespective of technology diffusion channels, the decisions for technology diffusion in rural areas should aim at meeting desired objectives that evolve from the rural development goals of the national government, donors intentions (in case of donor assisted projects), local leadership, and demands from beneficiaries, whether implicitly stated, may be the reduction of human drudgery, increase in scale of production, income generation, employment creation productivity gains, poverty alleviation sustainability of the environment, institution building etc. In developing countries these objectives may vary depending on the extent of integration of rural development programs in the overall national socio-economic development plan.

Matching the desired objectives set for the intended technology investments with available technological resources evolves into the determination of feasible objectives. There may be a trade-off between desired and feasible objectives while considering socio-economic reality in the process of technology

choice for diffusion. For example, weaving technology has demand in many rural areas but modern (automatic) weaving technology may be feasible from an employment point of view. Decisions determining feasible objectives also depend on the availability of functional infrastructure for the operationalization of the technology. The functional infrastructure requirements, *inter alia*, are depicted in Figure 4.

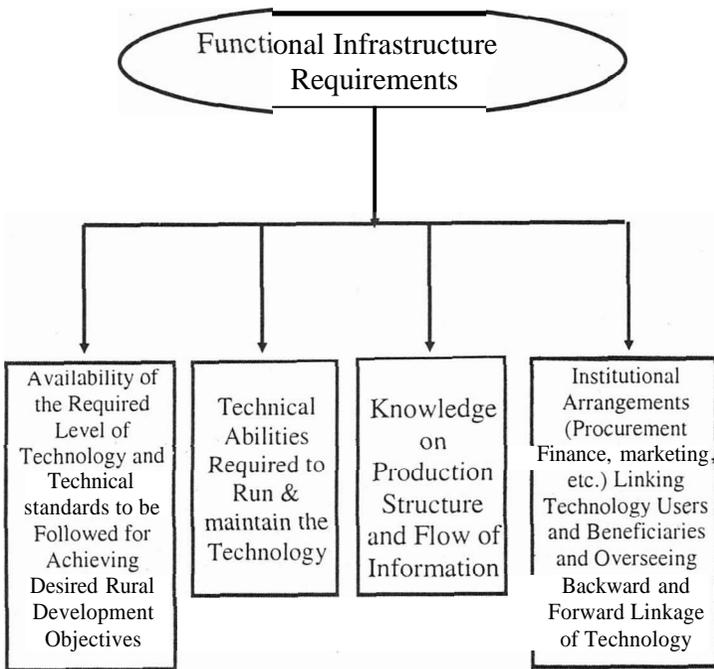


Figure 4: Functional Infrastructure Requirements

Once decision is made for the diffusion of a technology, the expected demand from it in terms of scale and operational performance should serve as the main criterion to justify the demand induced factors for the selection of the technology. Moreover, the opportunities to utilize the demand and for the

technology should always be supported by the supply side factors (technology inputs). It may be noted that if only the technological demands (socio-cultural, economic, financial, market, etc.) are met properly, then only one may expect the desired benefits satisfying the technology adopters. However, the degree of success will depend on the capability of technology users with respect to all the four technology components.

Technology Utilization Plan

Based on technology diffusion objectives (desired and feasible), there is a need to prepare the technology utilization plan. The investment allocation decision for the technology in question would depend on the operational targets to be achieved and the intermediary/final impact for beneficiaries. The technology utilization plan would also have to consider the potential for local resources utilization. Therefore, the technology should be such that demands available local resources as inputs and maximizes optimality in use of resources mix. However, depending on technology type, a blend of local and foreign resources can not be ruled out.

An Example of Rural Technology : Blacksmithy

In Bangladesh, blacksmithy is a rural technology, one of the traditional trades, with about 10,000 units. Some 91 percent of these are located in rural areas, of which 20 percent are in rural trade centers. Blacksmith units in Bangladesh account for 4.8 percent of gross output, 8.7 percent of value added, 22.7 percent of employment and only 1.4 percent of fixed assets in the total metalworking industries in the country. Among cottage-type metalworking industries, blacksmiths play a very significant role, representing 41 percent of all units, 39 percent of employment and 22 percent of sales value. Blacksmithy as a profession has an important bearing on the economy of Bangladesh. Small-scale

manufacturing as a whole contributes 50 percent of the manufacturing share of GDP.

Blacksmithy units are spread widely but unevenly all over the country. They make a wide variety of products, which can be classified according to various uses:

1. Land Preparation (Plough Tip, Spade etc.)
2. Interculture (Hand Hoe, Rake etc.)
3. Harvesting (Sickle, Curved Knife)
4. Household (Knife, Kitchen Knife, Dao Haisha etc.)
5. Housing (Carpentry Tools, Iron Pin, Angle Frame etc.)
6. Non-Household (Rickshaw Body Parts, Trowel, Hullar Clamp etc.)

Blacksmithy has a very important role in rural Bangladesh in view of its linkages with a variety of other economic activities such as agriculture, and housing.

A study was carried out by IAT, BUET in various geological locations of the country on the basis of concentration of blacksmith units and on reputation of good quality blacksmithy products. The study covers 11 out of 64 districts: Bogra, Brahmenbaria, Chittagong, Comilla, Dhaka, Jessore, Kustia, Lalmonirhat, Mymensing, Rangpur & Thakurgaon. Table 1 shows distribution of blacksmithy around the country. The technical analysis of products has been restricted to only two products which are in wide use in Bangladesh: the plough tip (used in land preparation) ('*Fala*') and the kitchen knife ('*Boti*'). Table 2 shows summary of technical findings for the products of different artisans of blacksmithy.

Table-1 Distribution of Blacksmith Units in Bangladesh

District	No. of units	Population	Area (sq km)	No. of units per ten thousand population	No. of units per ten sq km
Dhaka	1 038	10 013 731	7 469	1.0	1.39
Mymensingh	432	6 568 474	9 668	0.7	0.46
Faridpur	692	4 763 737	6 881	1.5	1.00
Tangail	237	2 443 992	3 403	1.0	0.69
Jamalpur	209	2 451 719	3 349	0.9	0.62
Chittagong	598	5 491 330	7 456	1.1	0.81
Noakhali	230	3 816 020	5 459	0.6	0.42
Sylhet	5 593	5 655 543	12 719	1.0	0.46
Comilla	457	6 881 003	6 602	0.7	0.69
Chittagong Hill Tract	104	751 692	13 180	1.4	0.08
Rajshahi	235	5 270 141	9 456	0.4	0.23
Bogra	191	2 727 973	3 887	0.7	0.50
Rangpur	951	6 510 050	9 595	1.5	1.00
Dinajpur	266	3 199 965	6 565	0.8	0.38
Pabna	387	3 423 704	4 732	1.1	0.81
Khulna	569	4 329 320	12 167	1.3	0.46
Jessore	1 038	4 019 993	6 573	2.61	1.58
Barisal	520	4 666 734	7 298	1.1	0.69
Kushtia	584	2 291 997	3 439	2.5	1.70
Pautakhali	257	1 843 001	4 095	1.4	0.62
Total in Bangladesh	9 588	87 120 119	143 993	1.1	0.656

* The old districts have been divided under the present administrative reorganization and presently the number of districts is 64.

Source: Statistical Yearbook, BBS, 1986 and BSCIC, 1983.

Blacksmithy is one of the most important non-farm activities in Bangladesh. It has an important bearing on agriculture, housing, household and non-household sectors of the national economy. Blacksmiths should be recognized as an important social group and as important agents for rural economic development. They have much knowledge and skill to contribute to the generation and development of innovations. Wide product diversification that has taken place in blacksmithy indicates their capability to meet changing demands over time.

Among various production and marketing constraints the study shows that lack of sufficient working capital is the most significant factor putting blacksmith units at a disadvantage. Lack of investment capital and non-availability of raw materials are two other significant factors aggravating the problems. Asked to comment on the order of priority, blacksmiths spoke of the non-availability of raw materials as the second most serious problem after the need for working capital. Investment capital problems were placed in the third position.

All the artisans expressed zeal and enthusiasm for better utilization of their skills. One artisan from Lalmonirhat said 'We know the art of survival and whatever comes our way we try to fabricate'. He continued, 'skill is not given, it has to be acquired and for that we rely most on learning by doing. Whatever we have achieved is by our own efforts and we have never received any formal support.' Such observations of the artisans are quite revealing and demonstrate their latent potential. Their need is to consolidate socially, economically and technologically in order to promote their innovations for the benefit of the economy. They are confident enough to meet future skill requirements in blacksmithy if due attention is given to their problems. They do not want help out of sympathy because skill is their strength. They want support in upgrading their skills, because better application of skills leads to higher productivity.

Formal **R&D** support is needed in the production process, not only to introduce innovations but also to promote the existing innovations of the artisans. This contributes towards skill development and an increase in productivity. Technological innovations in blacksmithy need to be assessed for their potential for large-scale diffusion. The basic approach towards technology assessment in blacksmithy should include:

1. synthesis of experience due to artisan-user interaction;
2. identification of formal R&D support needs for informal R&D system;

3. skill development through appropriate training;
4. assessment of marketing support needs;
5. credit needs.

In order to undertake these tasks, an appropriate stance relating to innovation promotion in blacksmithy has to be formulated. An appropriate institutional framework for development of innovation needs to be developed.

Performance Measurement of Technology in rural and underprivileged area : Parameters and its rationality

Concept of Technology Performance

In a broader sense, the term 'performance' should be used to denote the aggregate results delivered by a technology or a technological system. It represents the outcome of human actions, including management actions, upon some given set of physical facilities. Hence, performance is the outcome of the interactions of the four technology components (Technoware, Humanware, Inforware and Orgaware) at a given time and space. The performance of a technology is the degree to which the technology operates functionally and achieves its declared objectives. In fact such understanding is sometimes confusing since it makes 'performance' a relative, and not an absolute, quantity, and it is inter-temporally relative to targets that are subjective. Hence, the performance of a technology may be represented by its measured levels of achievement in terms of one, or several parameters which are chosen as indicators of the technology goals for a given period of time.

Strategies for Measuring Technology Performance

Strategies for identifying the level of performance of rural technologies are intended to devise a set of measures useful to and useable for many different technologies, although this set of measures in no way answers completely all the requirements of

evaluation. Experience in measuring technology effectiveness suggests that there can not be a universal set of criteria for measuring performance of various technologies in its totality. Performance measurement is specific and particular to the situations and circumstances in which the technology is to be diffused. Although measurement of technology performance has to be situation-specific, it can not be completely devoid of any generality or unable to develop some general but limited set of measures. In fact, there can be a limited number of common measures which may be applicable to number of situations for different technologies. Parameters which are chosen as indicators should serve to clarify the degree of achievement in each of the goal areas that one sets for the technology. For any particular technology, the relative importance of each of these indicators needs to be considered separately, and not all may be found to be appropriate.

Measuring the performance in relation to **technology** goals and rural development, issues must consider the inter-linkages of the chosen technology with the performance indicators and development issues. Development issues (basically for enhancing technological capability to achieve rural development) demand diffusion of technology which in turn should contribute towards achieving certain development goal (may also be delineated to sub-goals). For measuring performance of the technology in question, there could be a number of measures to be followed by technology evaluators such as profitability, return on investment, capital savings ratio, cost to sales, etc. These sets of measures can not tell completely or unequivocally what the impact-benefit of the technology in terms of its contribution to technological capability development or with regard to achieving rural development goals. Hence, there is a need for a broad range of generalized indicators although not technology-specific but common to all technologies for measuring the performance in relation to rural development goals.

It may be noted that methodological questions as to how to measure each of the performance indicators should be dealt with separately for each technology and thus may vary for different locations. Choosing the right methodological approach would depend however on the visions of the technology evaluation team and also on the purpose of evaluation.

A multitude of agents is involved in the diffusion of rural technology. They all do not share the same view as to what constitutes good performance. They may hold different ideas of the technology's goal or of the relative importance of various goals.

In case of most of the rural technologies, the groups of actors include one or (more commonly) several governmental or parastatal entities, and an entrepreneurial community that has relatively little formal organization, although they have many of the innovative ideas for change. There is often a lack of uniformity among these groups. However, in most cases they are more interested on the operational performance and return from the technology. Such indicators are not very useful to measure technology performance in relation to rural development objectives and as such there is a need to adopt first an 'evaluation approach' and then major goals and sub-goals of rural development are to be harmonized (evaluation) for measuring the technology performance concerning the evaluation indicators. Accomplishing these tasks would depend on the visions and expertise of the technology evaluation team. Indicators to be used for each of the goals and sub-goals then can be measured keeping in mind the declared objectives to be achieved from the intended technology.

Determining the Objectives of Measurement

If one measures the performance or effectiveness of the technology, it must be known for what the measuring is being done. Any performance measurement should always be purposive. If the performance of a rural technology diffusion project is measured, the criteria of measurement may center around

technology cost, diffusion period, and the question of quality (in terms of output and impacts). Likewise, if the purpose of measurement is to know the internal efficiency of the technology, cost utilization of manpower, infrastructure requirement, output delivery efficiency etc. could be emphasized. The question may arise, could we not have one composite measure which takes care of all potential demands and requirements, the answer is probably no. As technologies are introduced within the diverse context of an egalitarian rural society of a developing country, it becomes apparent that there can not be single best system of measuring the performance. If one looks for the only set of such measure that will address to the needs of all rural technologies under different rural setting (country specific) then in fact it would just be too ambitious a proposition. This is because the characteristics of all rural technologies are not the same even for a particular rural location and, moreover, the priorities of rural development issues may also vary from country to country. Hence, there will be as many performance measurement models as the number of technologies and locations vary. The selection of indicators for performance measurement will therefore also vary depending on the objective of evaluation. Once the purpose is explicit then it is easier to resolve the methodological question as to how to measure the performance indicators.

Category of Indicators

The choice of specific measures of performance needs to be guided by a clear idea of whether the purpose of the evaluation is to focus on the performance of the technology in terms of its impact on its external environment, its response to its external environment, or in terms of its own internal processes [Brewer 1993]. It may be noted that the suggested generalized performance indicators above are both technology-specific as well as encompassing externalities. These indicators could be used for measuring/evaluating performance of any action (e.g. specific

technology, technology diffusion process, technology utilization system, etc.) and fall broadly under three categories as noted below (Figure 5):

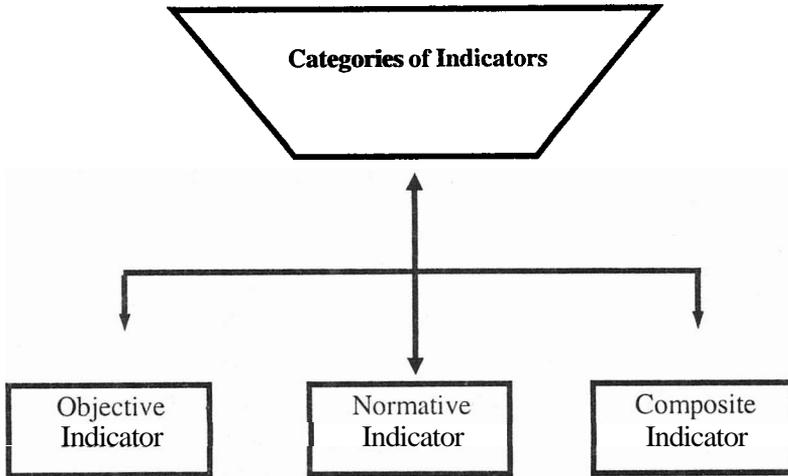


Figure 5 : Three Basic Categories of Indicators

- (i) **Objective Indicators:** Objective performance indicators are derived directly from raw data on the operational characteristics of a technology at a given time. It is derived from the level of technical know-how, information requirement, skill requirement, etc. Availability of alternative technologies over time and space makes it necessary to consider the measured indicators. These data can be used directly to calculate the internal process efficiency of the technology and its operational suitability for a predetermined location (environment). As for example, Pump room represents its efficiency which is objective indicators.
- (ii) **Normative Indicators:** The application of standards to the objective indicators results in a corresponding list of normative indicators. These standards can come from a

variety of sources – original expectation, reformulated expectation, external standards based on such things as composition of raw materials to be used or concepts of equity, or relative standards based on the average levels of performance of comparable technologies. The set of objective indicators discussed earlier is relevant regardless of the purpose of the evaluation; however, because different actors have different goal sets, the selection of appropriate standards to apply to the objective indicators is dependent on the purpose for which the performance evaluation is being undertaken.

- (iii) Composite Indicators: All of the indicator discussed in the previous earlier are outcome measures of performance, involving information directly related to the nature and quality of the technology **output/services**. Composite indicators of performance involve additional information, generally of an economic nature, from the external environment in which the technology exists. Depending on the nature and amount of additional information required, some composite indicators (rural economic growth, import substitution effect etc.) can be considered to be measures of technology **outcome/benefits**. Others however, involve information that goes, so far beyond the immediate results of technology in that they represent measures of technology effects (**e.g.** environmental impact; impact on social change etc.) and their **measurement** to some extent is a subjective process. For example, if income effect of the technology on various socio-economic groups is measured, then a certain degree of subjectivity may creep in because of various sampling techniques and appraisal methodologies that are in use. If one measures the beneficiary's feelings about the effectiveness or usefulness of the technology, it will be purely an evaluation of the beneficiary's subjective opinions. It does not mean that

subjective evaluations or measures with subjective elements are useless or methodologically unsound. It is just, while using them, one have to know their methods and their limitations so that judicious decisions can be made.

With regard to selection of indicators for performance measurement, it appears that the indicators should not only be technology-specific but should also encompass its externalities. Though a single set of technology-specific indicators for all the rural technologies is not feasible for performance evaluation, a limited set of general performance indicators may be applied for all technologies in relation to overall rural **development** issues and desired goals set for the technology under question. Hence, a commonality among the divergent indicators can always be found (though in a broader perspective) as has been **suggested** in the paper for performance evaluation of rural technologies. The relevance and usefulness of such general indicators for measuring technology performance are summarized below.

- (i) **Sustainability:** Technology should be managed in such a way **that** its effective life span is not curtailed, and its productive capacity is sustained. This indeed is not easy to **measure**, since it requires production of the future. To some extent this can be assessed by monitoring rates of change of key variables which in turn is too rigorous an exercise to be carried put and may not be cost effective. Hence, sustainability of a technology could be measured qualitatively if not quantitatively. It may be mentioned that sustainability of technology is also dependent on technology users (both inputs and outputs) and location-specific surroundings. Moreover, sustainability **has** evident time dimension. What is sustainable today may not be sustainable tomorrow even if the same development objective is set for the technology. Therefore, sustainability of technology in the context of rural

development demands not only appropriate choice of technology but also how the technology is maintained, managed and put into operation to affect the changing demand for rural development. Replication could sometimes also be used as an indicator of sustainability. For this purpose, two sorts of sustainability issues need to be addressed. Firstly, there is a need to sustain the physical resource base, and secondly, there is also a need to ensure a sustainable rural institution base and its continuity to pursue strengthening technological capabilities over time.

- (ii) **Profitability:** Some form of financial target is always present. At least investors/entrepreneurs would always look for higher returns from a given amount of investment capital. However, the entrepreneur's reliance should be on the technology and not on cost control devices. This is because cost control devices may be harmful if they operate (if desired) without regard to their effect on output. For example, **excessively** stringent constraints on maintenance budgets may reduce technology productivity and thus affecting economic growth. It should be noted that profit maximization depends on the proportional increase in productivity gains. Hence the level of profit should be judged considering the average operational (functional) capacity of the technology under question
- (iii) **Equity:** Most agencies involved in technology diffusion accept that some concept of fairness should dictate performance measurement of a technology keeping in mind the users' background. For example, the equity of technology benefits in rural and urban areas are not the same because of the difference in consumption demand or even demand for economies of scale. The contribution of the technology towards distributive justice, though not always direct in nature but its significance for long-term impact benefits is not

less important. Rather, from the point of view of rural poverty alleviation or raising the standards of living the question of equity should receive prior consideration. Measuring change in income status of technology beneficiaries is however may be associated with many other factors which are externalities to the technology in question. The extent of technology benefits in terms of equity impact can be firmed up given details data on the socio-economic status of the target group(s).

- (iv) **Productivity:** For a productive rural technology (e.g. rice mill, saw mill, vermicelli making, weaving, pottery, etc.), is it adequate to use volume of output alone to measure the performance or be assessed in aggregate value terms, even though this involves the elements of price distortions due to intervention of government pricing policies. In order to indicate the efficiency of resource utilization, it is better to measure productivity, as total input cost per unit to output, and not only the single factor productivity like labor per unit of output. In general, it is suggested to apply the concept of Total Factor Productivity (TFP) and obviously for better performance good combination of technology components is essential. It may also be useful to look at the 'system productivity' but it may not be possible to express in value terms unless otherwise value weightage is put on the non-quantifiable parameters on the basis of subjective judgements using scale technique. However, cost-effectiveness ratio can also be measured in this case e.g., increase in output per unit of incremental investment on the technology needed to gain system efficiency.

Conclusion

It is very much essential to use a set of indicators which would simplify the process of technological evaluation. Based on

theoretical premise of performance measurement, this paper has stressed the need for an agreement to an overall generalized set of indicators for rural technology performance measurement. Such indicators to a great extent would provide the common platform of understanding among various organizations/enterprises involved in the diffusion process of rural technologies.

REFERENCES

- Abernethy C.I. [1986], *Performance Measurement in Canal Water Management*. OKI/HMI Network Paper 86/2d, Manila.
- Brewer G.D. [1983], 'Assessing Outcomes and Effects' in Cameroon, K.S. and Whetten, D.A. eds., *Organizational Effectiveness: A comparison of Multiple Model*. New York: Academic Press, pp. 205-223.
- Drucker P.F. [1977], *Management*, New York Harper's College Press.
- ILO [1991], *Empowering Women. The technological Change* Annual Report of the ILO/WAD-Bangladesh Project. Dhaka: International Labour Organization.
- Kyi, K.M. [1990], *Measuring the Performance of Irrigation Systems: Social Science Perspective*. Paper presented at the Workshop on Improving the Performance of FCDI Projects through Better management, organized by IFCDR. Dhaka: Bangladesh University of Engineering and Technology.
- UN-ESCAP/APCTT [1989], *An Overview for Framework for Technology-based Development* (Technology Atlas project Output), Asian and Pacific Center for Transfer of Technology, 1.