Appropriate Technology for Socioeconomic Development in Third World Countries

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Introduction

Persistent socioeconomic problems in Third World countries, despite decades of massive infusion of advanced technology from the industrial world, continue to elicit questions regarding the appropriateness of this technology in the Third World. The concentration of wealth in the hands of the Third World ruling class, bureaucrats, and the elite-the hallmark of a growth-based development strategy-makes life a continuous struggle for a great mass of the people. Problems of poverty, unemployment, inequality, and basic needs fulfillment are common facts of life today in many Third World countries. Worsening socioeconomic conditions in the Third World have underscored the urgency of implementing a development path that de-emphasizes growth and technological monoculture. The technological orientation of this development paradigm has been variously called intermediate, progressive, alternative, light-capital, labor-intensive, indigenous, appropriate, low-cost, community, soft, radical, liberatory, and convivial technology. However, appropriate technology, for reasons to be addressed later, has emerged as the all-embracing rubric representing the viewpoints associated with all the other terms.

The purpose of this article is to discuss appropriate technology as it concerns social and economic development in the Third World. Detractors and advocates of appropriate technology have made claims and counter claims about its strengths and weaknesses. Not surprisingly, some of these claims are often imbued with prejudice, ignorance, or intolerance (Jequier, 1976, Kaplinsky, 1990; Willoughby, 1990). The view espoused in this article is that the national and intranational disparities in the level of development of the Third World are so great that any suggestion of inflexibility in the technological and socioeconomic development strategy employed would be grossly unrealistic. Third World development must not take an either/or stance regarding technology input; it requires both large- and small-scale appropriate technology.

Some Compelling Issues

The conventional development strategy for the Third World is and has been dominated by economic growth. In the process of its implementation, industrialization became equated with development. To this end, industrialization by way of capital accumulation and technology transfer from the industrial nations to the Third World were pursued with immense interest. Decades of massive importation of advanced technology and the implementation of large-scale, capital-intensive production methods in Third World countries have revealed the shortcomings of such an approach. First of all, the strategy entails the employment of capital-intensive technology in countries that are short of capital and endowed with surplus labor. Third World countries, by opting for capital-intensive production technology in spite of their shortage of capital, can only afford to create a few jobs for a small number of people due to a very high capital/labor ratio. This implies that several Third World countries equip only a very small proportion of their labor force with the means of increasing production. In this case, small islands of high productivity emerge in core urban centers at the expense or neglect of the periphery involving the more populous segment of the economy. The result has been the creation of a dual economic structure (consisting of a prosperous modern sector and an impoverished traditional sector), worsening unemployment conditions, and widespread abject poverty in many Third World countries. According to a 1976

U.S. Agency for International Development (USAID) proposal to the U.S. Congress, the effects of capital-intensive technology are not limited to problems of unemployment in the Third World. "The high capital cost of modern technology has also contributed to the development of dual economies-small, relatively well-off enclaves of high productivity and well-paid workers side by side with relative stagnation among the larger community" (Thormann, 1979, p. 282). There are writers who attribute growing poverty in the Third World in part to rapid growth in the modern sector that is sustained with the most advanced imported technology (Singer, 1985). This growth in Third World metropolitan areas is often accompanied with little or no spread effect to the sectors in the periphery. Commenting on this issue, Robinson (1979) observed that "a growth strategy that takes the form of industry-led development, using the technologies that are appropriate for Western societies, leaves almost untouched in the rural areas increasing absolute numbers of impoverished and underemployed workers" (p. xii). It is because this growth has failed to create sufficient employment opportunities and the growing disparity in progress between regions that concerns have been raised about the conventional development strategy. The World Bank even touched on the inevitability of getting priorities right in terms of the pattern of development that best addresses the needs of the Third World:

> The choice to be faced ... is whether to invest heavily in a few workers and in services for a few to increase their production and living standards substantially, leaving the rest unaffected by growth (or at best affected indirectly), or whether to make some gain in the productivity of many people by investments at lower per capita affecting the mass of the people in the country.
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> (Willoughby, 1990, p. 118)

As mentioned earlier, an impact of the pattern of growth in metropolitan areas of the Third World is the development of a dual economy. This has been blamed for causing, among other things, a constant influx of people into the cities from the rural sector. Not only is this rural-urban migration a threat to the economy of the rural sector, but also to the survival of the modern sector as it struggles to cope with an exploding urban population. The modern sector is the creation of mostly advanced, capital-intensive technology imported from the rich industrialized countries. Schumacher (1973) blamed this technology for creating what he called the "process of mutual poisoning" in most of the Third World. This is a condition in which the concentration of industrial development in Third World cities adversely affects the economy of the traditional sector as people abandon their traditional undertakings to move to the cities. This movement in turn affects the cities adversely by overpopulating them and causing problems almost impossible to manage. The relationship in this case becomes one of mutual destruction. This manifests itself today in the Third World in the form of high rates of unemployment, poverty, great income disparity, and declining access to basic needs. This being the case, a major challenge today in the Third World is to articulate an effective approach to ensure that benefits from development are within people's reach regardless of where they live.

Appropriate technology as a development approach is intended to address such socioeconomic problems, especially in the rural and informal sectors. Stewart (1985) perhaps put the need for appropriate technology in perspective in the following statement:

> The argument for appropriate technology is not that jobs should be put before output, but that techniques can be developed which promote both. Appropriate technology is intended to raise productivity and incomes outside the advanced technology sector and so extend the benefits of development throughout the population. (p. 28)

It goes without saying that using appropriate technology to stimulate production and employment in the sectors outside the modern sector is such an important objective that it ought to be seen as a national imperative. It is unreasonable not to promote appropriate technology for development in the traditional and informal sectors in view of the capital and foreign exchange situation in many Third World societies. Development in these regions must start with less complex and expensive techniques and move forward.

Development Path

Communities, societies, or countries have evolved historically with the type of technology that reflects their level of development and factor endowment. For example, the capital stock of the United States late in the 18th century consisted of hand pumps, Franklin stoves, wooden plows, and draft animals (Norwine & Gonzalez, 1988). During the

reign of Mao Tse-tung, communist China turned to appropriate technology for rural development after a major disagreement led to a break up with Russia in 1960. In the succeeding period of Cultural Revolution, China's policies on development centered on the phrase "walking on two legs". This entailed the encouragement of technological dualism for the simultaneous development of large-scale and small-scale undertakings to promote industrialization nationwide in China (Pacey, 1990; Riskin, 1979). While concentration in the urban areas was on building large-scale, capital-intensive factories, the focus in the rural areas was on the development of small-scale industries based on appropriate technology. According to Perkins (1980), "rural small-scale industrialization depended in a fundamental way on the prior and continuing successful development of urban large-scale industry" (p. 187). The rural industries, making use of intermediate technology, were expected to take advantage of the country's abundant local resources, including industrial waste or scrap from the large-scale, city-based factories (Riskin, 1979). But the uniqueness of this new direction was that it emphasized the decentralization of production, the reliance on domestic initiatives, and the pursuit of self-sufficiency. Writers such as Dwight H. Perkins have argued that China's encouragement of small-scale industries making use of appropriate technology in the rural areas created jobs and enabled China "to avoid some of the worst aspects of the urban-rural polarization that characterizes so many developing countries" (Long, 1980, p. 7).

However, before China's "walking on two legs" and "relying on its own forces" (Dunn, 1978, Jequier, 1976) initiative, the concept of appropriate technology had long been an important part of India's village industries even before the 1930s. One of India's early pioneers and practitioners of appropriate technology was its moral leader and advocate of nonviolent resistance Mohandas Karamchand Gandhi. Gandhi's familiarity with the work of Henry David Thoreau of the United Sates exerted great influence in shaping his philosophy of development. In fact, a number of writers on appropriate technology have variously referred to Gandhi as the "father" of appropriate technology and the "first appropriate technologist" (Betz, McGowan, & Wigand, 1984; Rybczynski, 1980), knowing full well that the phrase gained common usage only after Gandhi's time. As Rybczynski (1980) pointed out, "it was Gandhi who, before China's Mao Tse-tung, recognized that the peasants should be the basis for economic development in Asia" (p. 37). Gandhi spoke incessantly of the need for village industries in India, while maintaining that India's survival and future were dependent on the state of the villages where most Indians reside. Underlying Gandhi's notion of village industries was his epigrammatic expression that "the poor of the world cannot be helped by mass production, [but] only production by the masses" (Schumacher, 1973, p. 153). From Gandhi's perspective, any concern with goods requires mass production, but concern with people necessitates production by the masses.

The Charkha (spinning wheel) was Gandhi's ideal appropriate technology device, and he saw in it a symbol of freedom, self-reliance, and a technical means that was right for India. The idea of technology discriminately enriching a minority of people at the expense of the majority or putting masses of people out of work to increase profit was in Gandhi's view counterproductive and unacceptable. However, Gandhi was not uncompromising in his rejection of large-scale, capital-intensive industrial enterprises. Modern-sector industrial development, in Gandhi's view, should supplement and reinforce the development of small-scale industries and agriculture in the hinterland. In a quote credited to Gandhi, he expressed his choice of the development path suited to the Indian sub-continent:

> If I can convert the country to my point of view, the social order of the future will be based predominantly on the Charkha and all it implies. It will include everything that promotes the well-being of the villagers. I do visualize electricity, ship-building, ironworks, machine-making and the like existing side by side with village handicrafts. But the order of dependence will be reversed. Hitherto, the industrialization has been so planned as to destroy the villages and the village crafts. In the State of the future it will subserve the villages and their crafts... (Bhatt, 1980, p. 172)

In his effort to start India in this development path, Gandhi founded organizations such as the All India Spinners Association and the All India Village Industries Association' (Dunn, 1978). A group known as Gandhian economists later founded the Appropriate Technology Association of India, one of the early appropriate technology organizations. Prominent among the non-Indians who shared Gandhi's philosophy was Dr. Ernst Friedrich "Fritz" Schumacher, who later played a key role in popular-

izing appropriate technology worldwide.

From Gandhi to Schumacher

Before becoming a respected leader in the appropriate technology movement, Schumacher was a well-established economist. In fact, Schumacher's work as a top professional economist is believed to have influenced great economists such as John Maynard Keynes. According to Willoughby (1990), Keynes' wish before his death was for his mantle to fall on either of two people– Otto Clarke or Fritz Schumacher: "Otto Clarke can do anything with figures, but Schumacher can make them sing" (p. 57). Both Clarke and Schumacher worked with Keynes for the British Treasury. Later experience convinced Schumacher to become an ardent advocate of a different technological and socioeconomic development path.

Born in Bonn, West Germany, in 1911, Schumacher moved to England in the late 1930s. As a German immigrant in Britain, he endured a period of trial and tribulation during World War II. In the end, Schumacher distinguished himself as a great economist and worked in different capacities for various British establishments, including the position he held for more than 20 years as senior economist and economic advisor to the British National Coal Board (NCB) (Kaplinsky, 1990, Schumacher, 1974; Willoughby, 1990). His experience as an employee of the NCB persuaded Schumacher to reconsider his support of large-scale organizations.

> Schumacher was first sensitized to the problems of scale by the NCB's attitude to the problems of pneumoconiosis [black lung disease], a lethal disease of the lungs associated with coal-mining. Instead of recognizing the self-evident health consequences of coal-mining, the NCB chose to defend itself rigorously and to fight (and subsequently win) the legal argument on technicalities. In saving itself relatively small sums of compensation (2–3 million Pound Sterling), Schumacher believed that the NCB had ceased to concern itself with people. More importantly, he believed that such uncaring attitudes were not exceptional but were an inevitable consequence of the organization's scale. (Kaplinsky, 1990, p. 137)

Schumacher's new philosophy was further shaped from a 1955 trip to Burma, where he served under the auspices of the United Nations as economic adviser to U Nu, the country's prime minister at the time (Crittenden, 1975; Rybczynski, 1980; Schumacher, 1974; Willoughby, 1990). While in Burma he encountered an economic setting quite unlike what he was used to in Germany, Britain, and the United States. With very low income per capita in Burma, which would be tantamount to poverty from a Western view, Schumacher was amazed that the Burmese went about their daily lives apparently quite happy and content. Living in Burma also revealed to him some of the inadequacies of a growth-based conventional development strategy. Such a strategy encouraging the use of capital-intensive technology from the industrialized societies was having some harmful consequences in Burma and other Third World countries. These observations, among others, led Schumacher to the conclusion that the "problems of economics do not have any final solution, because they are human problems, that can be 'solved' only within a particular set of circumstances for a particular time and particular place" (Cornish, 1974, pp. 276-277). Living in Burma also brought Schumacher in contact with Buddhist economics, one of the most influential forces behind his thinking and ideas.

Another major event that occurred while Schumacher was in Burma was his discovery of Gandhi, a man he later called the greatest economist of the 20th century (Crittenden, 1975). According to Crittenden (1975), Schumacher was a self-proclaimed "indiscriminate thief of ideas," who credited much of his ideas about development and preservation of the natural environment to Jesus, the Buddha, and Gandhi. In subsequent years, through contacts and familiarity with Gandhi's work, Schumacher developed the ideas and reputation that earned him an invitation to Hyderabad, India, in the early 1960s. While in India at the invitation of the Indian Planning Commission and his friend Jayaprakash J. Narayan, he gave a seminar on Technologies for Small Industries in Rural Areas (Dunn, 1978). His visit to India was a welcomed opportunity for Schumacher, for he was able to study Gandhi's approach at close range and meet with acclaimed Gandhian economists.

The Birth of Intermediate Technology

Motivated by disillusionment with large-scale organizations and his experience in Burma and India, Schumacher developed the ideas behind the concept of intermediate technology, which became the linchpin of his seminal book *Small Is Beautiful: Economics*

As If People Mattered, published in 1973. Perhaps, more than the others, Gandhi's work exerted the most influence on Schumacher. In using the term intermediate technology, Schumacher envisioned a technology for the Third World that was midway between, for example, a hand hoe and a tractor. As Schumacher (1973) described it, "Such an intermediate technology would be immensely more productive than the indigenous technology...but it would be immensely cheaper than the sophisticated, highly capital-intensive technology of modern industry" (p. 180). In order for the concept of intermediate technology to be considered useful, it must be conducive to meeting the challenges outlined in the following propositions:

- Workplaces have to be created in the areas where the people are living now, and not primarily in metropolitan areas into which they tend to migrate;
- These workplaces must be, on average, cheap enough so that they can be created in large numbers without this calling for an unattainable level of capital formation and imports;
- The production methods employed must be relatively simple, so that the demands for high skills are minimized, not only in the production process itself but also in matters of organization, raw material supply, financing, marketing, and so forth;
- Production should be mainly from local materials and mainly for local use. (Schumacher, 1973, pp. 175-176.)

To tackle these challenges, Schumacher and his colleagues founded the Intermediate Technology Development Group (ITDG) in London in 1965 (Schumacher, 1974). Since its inception, the ITDG has been providing information on existing low-cost, labor-intensive technologies, creating nonexistent technological innovations, and publishing important how-to-do manuals on affordable do-it-yourself work methods. The organization has also been responsible for convening major conferences on simple, low-cost technologies for small-scale industries. For example, in 1968 a trail-blazing conference convened at Oxford University. The aim of this conference was to promote intermediate technology for Third World development and enlist industrial involvement in its development (Rybczynski, 1980). As it happened, one of the issues raised at the conference was the necessity of a name change. Intermediate technology was viewed to be suggestive of a technology that was inferior or second-rate (Kaplinsky, 1990; Willoughby, 1990) and conveyed only the economic and engineering aspects of innovation. The term was further "criticized for implying a technological fix for development problems, separate from the social and political factors involved" (Hollick, 1982, p. 214). The phrase appropriate technology was suggested as a substitute, in part for including the social and cultural dimensions of innovation (Pellegrini, 1979), and, unlike intermediate technology, for not evoking the specter of inferiority. The rationale was that with appropriate technology the chances of its acceptance by those for whom it was intended would be greatly improved. Although intermediate technology is still used, appropriate technology has become the popular and more widely used appellation. The world owes the appropriate technology movement to Gandhi and Schumacher, who are widely acknowledged as its progenitors. Schumacher's role in turning appropriate technology into a household phrase cannot go unacknowledged. So outstanding was this contribution by a single individual that Rybczynski (1980) even opined that "E. F. Schumacher was undoubtedly the motive force behind the appropriate technology movement. It is not an exaggeration to say that without him there would have been no appropriate technology" (p. 6). Individual feelings apart, Schumacher, through his passion and dedication to the cause, established himself as a leading authority on appropriate technology.

What Is Appropriate Technology?

Appropriate technology may have been practiced for many generations in the past, but there is something new about it today; it has evolved into a development approach that is aimed at tackling community development problems. Viewed in this way, appropriate technology cannot be seen simply as some identifiable technical device; rather, it is an approach to community development consisting of a body of knowledge, techniques, and an underlying philosophy. In fact, Dunn (1978) called it a complete systems approach to development that is both self-adaptive and dynamic, because as its users become wealthier and more skilled, they can both afford and also use more expensive technical means. As Hazeltine and Bull (1999) noted, the experience of countries such as the United States "appears to confirm that one of the advantages of appropriate technology is that it can be an effective way to shift to

modern technology" (p. 277). In this case, appropriate technology can only be considered transitional and not static. It follows, then, that as appropriate technology improves the productive capabilities of a community, the community influences and improves the level of technology as well. In this article, appropriate technology is defined as an approach to development that not only emphasizes job creation and optimum use of existing skills and resources, it also builds on the skills and resources to raise the productive capacity of a community. Other definitions by different writers have contributed significantly to a better understanding of appropriate technology.

Other Definitions of Appropriate Technology

The proposal mentioned earlier for the development and dissemination of appropriate technology in the Third World was prepared and submitted to special U.S. Congressional Committees by the USAID in June1976. This proposal featured the following description of appropriate technology.

> In terms of available resources, appropriate technologies are intensive in the use of the abundant factors, labor, economical in the use of scarce fac tors, capital and highly trained personnel, and intensive in the use of domestically produced inputs. In terms of small production units, appropriate technologies are small-scale but efficient, replicable in numerous units, readily operated, maintained and repaired, low-cost and accessible to low-income persons. In terms of the people who use or benefit from them, appropriate technologies seek to be compatible with local cultural and social environments. (Thormann, 1979, 283-284)

Another interesting and enlightening description of appropriate technology is one by Bourrieres (1979), who presented this as:

> one which uses the largest number of people as they are, with the training they have had and with their actual technical and financial aspirations. But while technology must correspond as closely as possible to actual manpower supply, teaching and training methods should endeavor to improve that supply so as to meet the requirements of the most productive technologies. (p. 5)

Pellegrini (1979) suggested that a technology should be considered appropriate "when its introduction into a community creates a self-reinforcing process internal to the same community, which supports the growth of the local activities and the development of indigenous capabilities as decided by the community itself" (p. 2).

Harrison (1980), a freelance journalist specializing in Third World development issues, stated that

> appropriate technology means simply any technology that makes the most economical use of a country's natural resources and its relative proportions of capital, labor and skills, and that furthers national and social goals. Fostering AT means consciously encouraging the right choice of technology, not simply letting businessmen make the decision for you. (p. 140)

Todaro (1997), an economist, defined appropriate technology as:

> technology that is appropriate for existing factor endowments. For example, a technology employing a higher proportion of labor relative to other factors in a labor-abundant economy is usually more appropriate than one that uses smaller labor proportions relative to other factors. (p. 667)

Writing in the *Economic Journal*, Morawetz (1974) defined appropriate technology as the "set of techniques which makes optimum use of available resources in a given environment. For each process and project, it is the technology which maximizes social welfare if factors and products are shadow priced" (p. 517).

> In the definition by Betz *et al.* (1984), appropriate technology equated with providing technical solutions that are appropriate to the economic structure of those influenced: to their ability to finance the activity, to their ability to operate and maintain the facility, to the environmental conditions involved, and to the management capabilities of the population. (p. 3)

Other definitions list specific characteristics of appropriate technology. Take the definition by Jequier and Blanc (1983) for example:

> Appropriate technology (AT) is now recognized as the generic term for a wide range of technologies characterized by any one or several of the following characteristics: low investment cost per workplace, low capital investment per unit of output, organizational simplicity, high adaptability to a peculiar social and cultural environment, sparing use of natural resources, low cost of final product or high potential for employment. (p. 10)

Characteristics of Appropriate Technology

The last definition not only suggests the criteria for technological appropriateness, it also implies that there is such a thing as inappropriate technology. Such characteristics have been well documented by various writers and appropriate technologists (Carley & Christie, 1993; Congdon, 1977; Darrow and Saxenian, 1986; Dunn, 1978; Evans and Alder, 1979; Hazeltine & Bull, 1999; Jequier & Blanc, 1983; Schumacher, 1973;), and as a result will not be treated in depth here. The appropriateness of technology is not limited only to job creation, using local resources, and utilizing renewable energy resources but it is also about being affordable, easy to maintain, compatible with existing infrastructure, efficient in the use of scarce natural resources, environmentally benign, and partial to small-scale.

To many people, appropriate technology is always small, simple, cheap, and labor-intensive. Perhaps Schumacher, more than anybody else, contributed to that general perception. However, Anderson (1985) made the point that "scale, complexity and expense are not always positively correlated. It is possible for a large machine to be both simple and cheap and for a small one to be highly complex and expensive" (p. 68). It is not generally acknowledged that Schumacher expressed a similar idea about the issue of scale. For example, Schumacher stated: "Whether a given industrial activity is appropriate to the conditions of a developing district does not directly depend on 'scale,' but on the technology employed" (p. 179). It is conceivable that Schumacher's commitment to smallness of scale was provisional rather than absolute, and may have had more to do perhaps with the prevailing idolatry of bigness still evident in today's technological society than anything else. "Schumacher once told friends that, had he lived in a world of small organizations, he would have written a book called Big Is Beautiful" (Toffler, 1980, p. 247).

Diversity in the Choice of Technology

The characteristics or criteria of appropriate technology discussed above are not meant to imply that there is a perfect technology or a panacea that can resolve all the socioeconomic problems of the Third World at once. The fact remains that circumstances vary from one Third World society to another, and what is appropriate for one country or social setting may not necessarily be appropriate for the other. As Willoughby (1990) pointed out, "the concept of appropriate technology attempts to discriminate between different technologies according to their relative suitability for specific purposes or situations" (p. 6). Appropriate technology is not about taking a stand against technology, but about technology being a heterogeneous collection of social and technical options rather than a homogeneous phenomenon. From this collection, the best choices are then made based on the objectives to be accomplished and possible human and environmental effects.

The notion of appropriate technology suggests that all alternatives should be researched for "best fit." The impression that advanced technology is invariably inappropriate for the Third World is an exaggerated and misleading interpretation of the intent of appropriate technology. It is not realistic to suggest that the development of the Third World should be based almost entirely on technological monoculture. One must keep in mind that the primary focus of appropriate technology is in rural and informal sectors of the Third World. This is in recognition that economic growth in the past several years has tended to be confined to the urban modern sector in part because of capital and foreign exchange shortage. Interestingly, campaigns against appropriate technology are usually spearheaded not by the poor who stand to benefit the most from its use, but by the rich and powerful elite group. The elite of the Third World are not the "poverty-stricken multitudes who lack any real basis of existence, whether in rural or in urban areas, who have neither the 'best' nor the 'second best' but go short of even the most essential means of subsistence" (Schumacher, 1973, p. 181). This is why the case has to be made for diversity in the pool of technology available for use in the Third World.

Since differences in the level of development and factor endowments do exist between and within countries, the notion that "one size fits all" definitely does not apply. Today's intolerance of pluralism in global technological development is comparable to a situation once in the former Soviet Union about footwear production. According to Ernst F. Schumacher, "we have been like the Soviets who made 500 million pairs of shoes, all the same size, and said, 'take it or leave it-this is the only way we know how to do it'" (as cited in Crittenden, 1975, p. F5). A technological diversity approach to Third World development can satisfy the needs of both the rich and poor of the Third World and promote par-

ticipation for the poor in the development process. Brooks (1980) suggested along the same lines that "appropriate technology and current technology are complementary rather than mutually exclusive, and that the potential benefits of both will be enhanced when they coexist" (p. 54). From the foregoing discussion, it is clear that there is certainly an urgent need to expand the scope of technology and to integrate appropriate technology in the development of the Third World. However, appropriate technology has its critics.

Criticisms of Appropriate Technology

Appropriate technology has been the subject of numerous criticisms despite its obvious advantages. Common among the criticisms is the claim that appropriate technology is inefficient, a technology not congenial to growth and improving the standard of living. Often failed projects based on appropriate technology are cited as evidence in support of this criticism, as if any technology enjoys immunity from failure. Rybczynski (1980) cited cases of biogas digesters in India and South Korea that were abandoned either because they produced insufficient methane or for inadequate supply of cow dung as evidence of inefficient appropriate technology. This account only tells part of the story. A government National Project on Biogas Development in 1981 brought needed relief to many in rural India. For instance, biogas in Pura, a village in south India, has been meeting the water-pumping, electric-lighting, cooking, and fertilizer needs of this village's 485 inhabitants (Sampat, 1995). According to Sampat (1995), about 2 million biogas digesters have been installed in India since 1981, "and although the program has had its share of problems, it has made substantial progress" (p. 21).

Appropriate technology may not be efficient from an engineering standpoint, but it is pedantic and unrealistic to describe any technology that enhances the capacity to satisfy community goals and aspirations as inefficient. A related criticism claims that workplace productivity is compromised with appropriate technology. This argument implicitly suggests that output per worker is unimportant to appropriate technology. The fact is that appropriate technologists understand the important correlation between productivity and standard of living. On the other hand, it must be realized that given the endemic unemployment situation in most Third World societies the maximization of job opportunities is not a matter of subordinate priority either. It is possible that the effort to maximize productivity in the urban areas can be pursued simultaneously with the effort to maximize work opportunities for the unemployed and underemployed in the traditional and informal sectors. The issue is not about opting for either productivity or job creation, but, as mentioned earlier, finding a good mix of techniques to promote both and to ensure a far-reaching distribution of the benefits of development.

Furthermore, critics have made arguments of the kind that if appropriate technology is as effective as some of its advocates claim, it should have no difficulty displacing the dominant, capital-intensive technology. These critics advance the notion that the prevailing technology at any one time is the most efficient possible for that time (Brooks, 1980; Kaplinsky, 1990; Rosenbrock, 1979). This is probably one of those arguments based on the assumption of a "free market" and a qualifying ceteris paribus. It sounds quite presumptuous and too sanguine to completely rule out the possibility that the dominant technology may by chance not be the most efficient or effective. However, it is possible to sustain a wasteful technology through government intervention, institutional inertia, the actions of vested interest groups, years of enormous investment, and established position of the technology, all of which may be prejudicial to the development of alternatives. Given this possibility, Rosenbrock (1979) surmised that "it is quite conceivable that a worse solution could be perpetuated indefinitely this way" (p. 9).

One final criticism of appropriate technology is the claim that it is an inferior technology and a part of a scheme by Western industrialized countries to maintain their position of socioeconomic and technological dominance over the Third World (Kaplinsky, 1990; Thormann, 1980; Willoughby, 1990;). Whether this allegation is believable or not depends on one's perspective. Perhaps it is worth mentioning here that

> there is no evidence that a country which starts with simple technology cannot move into more complex technology, and there is much evidence that for countries starting with a simple technol ogy the transition to industrialization was easier than it was for those that shifted directly to a complicated case. (Hazeltine & Bull, 1999, p. 277)

One must bear in mind that appropriate technology as defined by its proponents is a technology tailored to serve the particular needs of a given region or community. This implies that a painstaking effort is made to secure the "best" alternative there is for the set of circumstances peculiar to that region or community. So, "if one wished to have the best technology for given circumstances it would be absurd to advocate inferior technology and doubly absurd to call it 'appropriate', when, logically, it would not be the best available" (Willoughby, 1990, p. 237). As many commentators have already noted, many of these criticisms are not based on facts and often reflect the prejudices and biases of the critics. Willoughby (1990) put it more succinctly:

> Many criticisms of Appropriate Technology are based upon either ignorance of available empirical evidence, distortion of the claims of leading protagonists, or reliance upon examples from the literature which differ from the consensus of the movement but which suit the biases of the critic. (p. 234)

Concluding Remarks

There is a tendency to condemn appropriate technology for all the wrong reasons and regardless of its true intent and focus. Several writers have pointed out that many of the criticisms of appropriate technology have been made in spite of empirical evidence to the contrary (Kaplinsky, 1990; Willoughby, 1990). That said, it must be stated as well that there is also a tendency on the part of some appropriate technology advocates to overstate its role and effectiveness. Unfortunately, this stance sometimes underlies the attitude that appropriate technology is the only acceptable technological approach to Third World development. This seemingly intolerant attitude toward an integrated approach to development problems in the Third World only works to raise suspicion about the motives of some appropriate technologists. Jequier (1979) did put things in perspective years ago when he wrote:

> Appropriate technology is not, and should not be viewed as a second-best solution. Conversely, neither should its role be over-estimated: appropriate technology is not a universal substitute for the conventional modern technology.
>
> Appropriate and modern technologies are complementary rather than contradictory, and the emphasis given to the former does not and should not rule out the use of the latter in those cases where they are particularly well adapted to local conditions. (p.3)

However, it is interpreted that appropriate technology must be progressive and not retrogressive. Third World countries are advancing in socioeconomic and technological development and must move forward, not backward, with this progress. Appropriate technology is not meant to be static or promote stagnation but to change as a country achieves progress in its level of development. In the end a new and different kind of appropriate technology with emphasis on environmental sustainability must take precedence as success is realized in the eradication of abject poverty and the reduction of unemployment and inequality.

The need for labor-intensive technology in parts of the Third World in order to adapt to existing circumstances is understandable, especially in a situation of scarce capital. However, development must proceed beyond adaptation to concern itself with changing these circumstances. Desirable progress is desperately needed in the Third World and cannot be achieved merely by adapting to present conditions. The determinants of technological appropriateness must include an evolutionary capacity factor. In other words, it is essential "to bring innovators in appropriate technology to think not only in terms of today's needs and resources, but also in terms of building up a system of permanent innovation in appropriate technology" (Jequier, 1979, p. 20). A system of permanent innovation in appropriate technology in the long run should engender domestic capacity to absorb and generate needed capital and technology. Capital, internally or externally derived, is a necessary factor and must be an essential part of any formula for development in the Third World.

Finally, the establishment of several appropriate technology organizations in recent years is a necessary approach toward the adoption and diffusion of appropriate technology, but must not be the only strategy. A commonly cited obstacle to mass diffusion of appropriate technology is the existing power relations that favor advanced capital-intensive technology. Unless the current economic, political, and social structures that promote large-scale technology are overhauled to ensure a level playing field, the generation and diffusion of appropriate technology would remain suboptimal at best. This calls for some policy action to remove current incentives that are mostly in

favor of capital-intensive technology. Dickson (1974) expressed the sentiments of many when he wrote that

> technological change must be viewed as a political process, reinforcing the interests of a dominant class. It also implies that development of non-alienating, non-exploitative technology requires more than just a nominal change in the ownership of the machines we now have. It includes a complete reshaping of our attitudes towards the function of technology in society-a simultaneous change, in other words, of both political and technological consciousness. (p. 95)

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References

Anderson, M. B. (1985). Technology transfer: Implications for women. In C. Overholt, M. B. Anderson, K. Cloud, & J. E. Austin (Eds.), *Gender roles in development projects* (pp. 57-77). West Hartford, CT: Kumarian Press.

Bhatt, V. V. (1980). The development problem, strategy, and technology choice: Sarvodaya and socialist approaches in India. In F. A. Long & A. Oleson (Eds.), *Appropriate technology and social values-A critical appraisal (*pp. 151-175). Cambridge, MA: Ballinger.

Betz, M. J., McGowan, P., & Wigand, R. T. (Eds.). (1984). *Appropriate technology: Choices and development.* Durham, NC: Duke University Press.

Bourrieres, P. (1979). Adaptation of technologies to available resources. In A. Robinson (Ed.), *Appropriate technologies for Third World development* (pp. 1-7). New York: St. Martin's Press.

Brooks, H. (1980). A critique of the concept of appropriate technology. In F. A. Long & A. Oleson (Eds.), *Appropriate technology and social values-A critical appraisal* (pp. 53-78). Cambridge, MA: Ballinger.

Carley, M., & Christie, I. (1993). *Managing sustainable development.* Minneapolis: University of Minnesota Press.

Congdon, R. J. (Ed.). (1977). *Introduction to appropriate technology: Toward a simple life-style.* Emmaus, PA: Rodale Press.

Cornish, E. (1979, December). Think small. *The Futurist,* 8(6), 276-280.

Crittenden, A. (1975, October 26). The economist thinks small. *The New York Times*, p. F5.

Darrow, K., & Saxenian, M. (1986). Appropriate technology sourcebook: *A guide to practical books for village and small community technology.* Stanford, CA: Volunteers in Asia.

Dickson, D. (1974). *The politics of alternative technology*. New York: Universe Books.

Dunn, P. D. (1978). *Appropriate technology-Technology with a human face.* New York: Schoken Books.

Evans, D. D., & Alder, N. (Eds.). (1979). *Appropriate technology for development: A discussion and case histories*. Boulder, CO: Westview Press.

Harrison, P. (1980). *The Third World tomorrow.* Harmondsworth: Penguin Books.

Hazeltine, B., & Bull, C. (1999). *Appropriate technology: Tools, choices, and implications.* San Diego, CA: Academic Press.

Hollick, M. (1982). The appropriate technology movement and its literature: A retrospective. *Technology in Society*, 4(3), 213-229.

Jequier, N. (1976). *Appropriate technology: Problems and promises.* Paris: OECD.

Jequier, N. (1979). Appropriate technology: Some criteria. In A. S. Bhalla (Ed.), *Towards global action for appropriate technology* (pp. 1-22). Elmsford, NY: Pergamon Press.

Jequier, N. & Blanc, G. (1983). *The world of appropriate technology.* Paris: Organization for Economic Cooperation and Development.

Kaplinsky, R. (1990). *The economies of small: Appropriate technology in a changing world*. London: Intermediate Technology Publications.

Long, F. A. (1980). Introduction. In F. A. Long & A. Oleson (Eds.), *Appropriate technology and social values-A critical appraisal* (pp. 1-8). Cambridge, MA: Ballinger.

Morawetz, D. (1974). Employment implications of industrialization in developing countries: A survey. *The Economic Journal,* 84(333), 491-542.

Norwine, J. & Gonzalez, A. (1988). Introduction. In J. Norwine & A. Gonzalez (Eds.), *The Third World: States of mind and being* (pp. 1-5). London: Unwin Hyman.

Pacey, A. (1990). *Technology in world civilization: A thousand-year history*. Cambridge, MA: The MIT Press.

Pellegrini, U. (1979). The problem of appropriate technology. In A. De Giorgio & C. Roveda (Eds.), *Criteria for selecting appropriate tech nologies under different cultural, technical and social conditions* (pp. 1-5). New York: Pergamon Press.

Perkins, D. H. (1980). China's experience with rural small-scale industry. In F. A. Long & A. Oleson (Eds.), *Appropriate technology and*

social values-A critical appraisal (pp. 177-192). Cambridge, MA: Ballinger.

Riskin, C. (1979). Intermediate technology in China's rural development. In A. Robinson (Ed.), *Appropriate technologies for Third World development* (pp. 52-74). New York: St. Martin's Press.

Robinson, A. (1979). Introduction. In A. Robinson (Ed.), *Appropriate technologies for Third World development* (pp. xi-xix). New York: St. Martin's Press.

Rosenbrock, H. H. (1979). The redirection of technology. In A. De Giorgio & C. Roveda (Eds.), *Criteria for selecting appropriate tech nologies under different cultural, technical and social conditions* (pp. 7-3). New York: Pergamon Press.

Sampat, P. (1995). India's low-tech energy success. *World Watch*, 8(6), 21-23.

Schumacher, E. F. (1973). *Small is beautiful: Economics as if people mattered*. New York: Harper & Row.

Schumacher, E. F. (1974, December). Economics should begin with people not goods. *The Futurist*, 8(6), 274-275.

Singer, H. (1985). Appropriate technology and basic-needs strategy. In M. Carr (Ed.), The AT reader: Theory and practice in appropriate tech nology (pp. 27-28). Croton-on-Hudson, NY: Intermediate Technology Development Group of North America.

Stewart, F. (1985). Underdeveloped technology? In M. Carr (Ed.), *The AT reader: Theory and practice in appropriate technology* (pp. 27-28). Croton-on-Hudson, NY: Intermediate Technology Development Group of North America.

Toffler, A. (1980). *The third wave*. New York: Morrow.

Thormann, P. (1979). Proposal for a program in appropriate technology. In A. Robinson (Ed.), *Appropriate technologies for Third World development* (pp. 280-299). New York: St. Martin's Press.

Willoughby, K. W. (1990). *Technology choice: A critique of the appropriate technology movement*. Boulder, CO: Westview Press.