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Appropriate technology – A comprehensive approach for water and sanitation in the developing world

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A B S T R A C T

Appropriate technologies (AT) are only a fraction of the solution in achieving sustainable and safe access to water and sanitation worldwide. The challenges of rapid population increases, urbanization, climate change, poverty, and widespread diseases will affect what are deemed "appropriate" solutions in addressing needs in the water and sanitation sector. Traditional engineering approaches need to be augmented with more flexible trial and error techniques, user participation, and multi-disciplinary collaborative learning in order to create innovative solutions and empower impoverished communities to achieve their own development goals.

There are countless historical definitions of AT, all of which are accompanied by individual criteria for a technology to be deemed appropriate. This paper presents a comprehensive definition for AT and demonstrates its application and relevance today with regard to the water and sanitation sector in a developing world context. Rather than prescribing strict criteria, considerations for AT will be outlined and examined through three case studies: the Lorena Cookstove-Guatemala, a Women's Outhouse in Nepal, and Innovation Rice Practices in Bangladesh.

1. Introduction

Engineers are problem-solvers and today they have more problems to solve than ever before. As the developed world flourishes unsustainably and the developing world struggles to extricate itself from poverty, engineers are being tasked to create technologies that meet the needs of both worlds. For many decades, technology was seen as the primary solution to alleviate poverty worldwide. This mentality originated from the large number of engineers working in the development sector [1]. Although engineers have strong educational backgrounds in thinking systematically and are well-equipped to solve problems, on many occasions they have failed to understand the social dimensions around technology transfer and implementation. Today, engineers are beginning to understand that the problems of poverty alleviation are much more complex in nature and there are no straightforward answers in technology development.

In the past, the term "Appropriate Technology" (AT) generally referred to technologies used in developing nations. The definition of AT has been a matter of significant debate since its emergence more than 50 years ago. Initial definitions of AT stemmed from failed development projects in the 1960s. As tractors and water pumps were abandoned and as other technologies failed to perform effectively in a third world setting, people began to question technology choice and how technology selection should be approached from a development perspective [2].

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There are countless historical definitions of AT, all accompanied by their own set of criteria for a technology to be deemed appropriate. The objectives of this paper are to provide a brief review of these definitions, to present a comprehensive definition for AT, and to demonstrate its application and relevance today with regard to the water and sanitation sector in a developing world context. Rather than prescribing strict criteria, considerations for AT are outlined and examined through three case studies: the Lorena Cookstove-Guatemala, a Women's Outhouse in Nepal and Innovation Rice Practices in Bangladesh.

2. Appropriate technology: history and definition

The concept of AT was initially coined by E.F. Schumacher, a British economist [3–5] and was the inspiration for his famous book *Small Is Beautiful*. Schumacher was a British Coal Board Advisor and a government advisor to Burma and subsequently to India [4]. He founded the Intermediate Technology Development Group (ITDG) in 1966. His approach gained attention in the 1960s social movement as well as again during the 1970s energy crisis and environmental movement. ITDG still exists today under the name Practical Action where they aim to "demonstrate and advocate the sustainable use of technology to reduce poverty in developing countries" [6].

According to the Oxford English Dictionary, the combined definition for the terms 'appropriate' and 'technology' is "the application of scientific knowledge for practical purposes so that it is suitable for a particular person, condition, occasion or place" [7]. This definition implies that "appropriateness" can vary and therefore cannot be precisely defined. In general, the term has traditionally been reserved for use in a developing world context.

In its early years, AT was often used interchangeably with "intermediate technology," meaning tools somewhere between traditional village techniques in developing nations and advanced "capital intensive technologies of the Western world" [3,8]. The term is context specific and is sometimes regarded as a technique for development used to address the issues of poverty, social equity, employment, and basic human needs [8]. Past definitions prescribed that AT should be small-scale, labor intensive, low capital investment per worker, energy efficient, environmentally sound, and controlled and maintained by the local community [3,4,9].

Ranis argues that appropriateness as it relates to technology is redundant [10]. He contradicts traditional definitions of AT by insisting that "the appropriate process for a poor labor surplus economy is not always labor intensive and an appropriate good is not always a basic good." He argues that ATs can be "advanced," modern, capital intensive, labor intensive, based on domestic or imported core technology, and may or may not make use of extensive local adaptations. There is no simple or straightforward means for identifying AT; it depends on the available resources, local preferences, time, and place. When Ranis refers to AT, he means "the joint selection of processes and products 'appropriate' to the maximization of a society's objectives given that society's capabilities" [10].

In a later UNESCO publication, Ben Ntim [11] explains that AT has been criticized because the standard AT requirements such as "low investment cost per workplace, low capital investment per unit of output, small-scale operations, use of locally available resources and very low cost of final product" are neither always possible nor easy to achieve and can be contradictory, therefore implying that following such a philosophy "can only lead to ridiculous and disastrous results." Ntim explains that other characteristics of the AT philosophy are more appealing, such as teaching scientifically minded locals practical technical skills relevant to their country's needs. Also, because AT is generally simple in nature, it enables larger portions of uneducated populations to be engaged in the application of the technology and further stimulate countrywide capacity development and increase the knowledgebase of the country. Ntim concludes by describing AT as "a concept that puts emphasis on the development of indigenous technological capabilities and as such it offers an effective and complementary path for truly meaningful development in developing countries" [11].

The term AT has transformed numerous times since its emergence in the 1960s. The term has been criticized heavily and whether or not its philosophy has demonstrated significant impact on the developing world has been debated. Today, the definition is more loosely presented, and has evolved as a concept or philosophy as opposed to a rigid definition that outlines specific requirements for a technology to be deemed "appropriate."

3. Considerations in AT development and implementation

AT not only refers to the tools and techniques used to problem solve in a development setting, it also includes the less tangible aspects such as knowledge transfer mechanisms and social, cultural, and gender issues. AT is always context specific and depends on the local circumstances in which it is applied. For the purpose of this paper, AT will be defined in a developing world context as follows:

AT is a strategy that enables men and women to rise out of poverty and increase their economic situation by meeting their basic needs, through developing their own skills and capabilities while making use of their available resources in an environmentally sustainable manner. The AT concept incorporates both "hard" and "soft" aspects of technology, meaning not only the physical tools, but the knowledge transfer mechanisms, capacity building and communication methods as well as social, cultural, and gender implications of technology implementation.

This section provides some background on AT considerations. One central theme throughout all the considerations is capacity development and how it is crucial to successful technology transfer. AT must build individual, institutional, economic, and/or governance capacity.