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Environmental technology and regional sustainability – The role of life-based design

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A B S T R A C T

Environmental technology provides useful tools for enhancing regional sustainability. The successful development and adoption of new technologies, however, requires a model which includes social elements. We argue that an optimal technology platform for regional sustainability is constructed by using life-based design, i.e. a design where the requirements of the users, of the local human culture, are taken into account. Our argument is illustrated by means of a case study, where we investigated how Finnish farmers in the Karjaanjoki River catchment area adopted new environmental technologies, and how they adapted these technologies to their specific ways of life. We conclude by proposing that in order to effectively promote regional sustainability, environmental technologies should be construed as elements of social processes, in which their life-based design features are actualized in their adoption.

1. Introduction

Technological advances have had a dual impact on the environment: on the one hand they have intensified the use of natural resources, while on the other hand they have modified, and in some cases, lessened the impact [1]. By developing new technologies, human societies have acquired the capacity to alter natural systems, but for the most part this technological sophistication has been used primarily for the purpose of intensifying the use of natural resources, much less for the purpose of lessening the environmental impact or restoring damage [1].

Many environmental problems are seen as the result of technology choices [2]. Technology can, however, also play a role in solving environmental challenges [3]. It will be particularly important in providing the means for dealing with some of the main threats to the reliable delivery of ecosystem services. New tools and information are needed for the effective management of ecosystems that are vulnerable to these threats and in order to ensure sustainable livelihoods for people living in the areas in question [4]. Advanced technologies offer the possibility of monitoring and understanding the effects of human activities on the natural world [5].

Technology is about designing procedures, plans, processes, or artefacts in order to get certain states of affairs either achieved or avoided [6]. Since all varieties of technology as systems of human activity and artefacts depend on ecosystem services, we may say that technology in general is founded upon the natural environment.

Among the set of different technologies, those that have a causal impact upon the environment can be regarded as technologies with environmental relevance. The impact

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may be value-neutral, positive or negative. For example, the production of automobiles or of agricultural goods is environmentally relevant in various ways. Educational technologies in turn have environmental relevance in that they shape patterns of interaction between human societies and natural resources.

Among the set of environmentally relevant technologies, environmental technology proper (also known as 'green technology' or 'clean technology') can be defined as a branch of technology which applies the environmental sciences in order to conserve the natural environment and constrain the negative impact of human involvement. Its hallmark is the use of the environmental sciences for the purpose of generating a positive impact on natural systems. In a general sense, environmental technologies provide a clear environmental advantage [7].

The concept of environmental technologies is both ambiguous and complex [8]. Environmental technology is a broad category, encompassing all technologies whose use is less environmentally harmful than that of their relevant alternatives, including both low-tech and high-tech applications [9]. Environmental technologies are composed of hardware, such as ecological measurement instrumentation, and operating methods, such as management practices used to conserve and restore nature [10,11]. They include production equipment, methods and procedures, product designs, and product delivery mechanisms that retain energy and natural resources, minimize the environmental load of human activities, and protect the natural environment [10]. Following Mario Bunge [6], we propose that environmental technology deals with the design and redesign, maintenance and repair of artificial systems and processes that can affect environmental values. These systems and processes may be physical, chemical, biological, social or semiotic.

In this article, we argue that an optimal technology platform for regional sustainability is constructed by using life-based design; in other words, design where the requirements of the users, of the local culture, are taken into account. Our research design assumes, on the basis of literature, first, that local actors such as farmers have a central role in regional sustainability, and second, that life-based design provides the model for culturally fit technology.

As a case study for illustrating our general line of argument, we conducted an ethnographic study among farmers in the Karjaanjoki River catchment area. We studied the social-ecological systems and their functioning in generating regional sustainability, for instance in terms of managing the environmental load of agriculture (Rönkä et al., unpublished results). The study addressed the coupled social-ecological system in the Karjaanjoki region, consisting of agricultural ecosystems, local actors and environmental technology. We assessed the sustainable use and management of ecosystem services as part of sustainable development on a regional scale, and the cultural and cognitive resources relating to the use of ecosystem services.

As a whole, our aim is to discuss the assumptions presented above concerning the role of life-based design in promoting regional sustainability, and describe those features of the case of Karjaanjoki farmers that illustrate this argumentation.

2. Life-based environmental technology and regional sustainability

Even today environmental technology is often equated with engineering. This concept is narrow, in that it makes no room for such branches of technology as operations research, knowledge engineering and various socio-technologies, including management science, urban planning and pedagogy [6]. One reason for this narrow view lies in our education system. Literacy and mathematics are taught in schools and universities, but without adequate mechanisms for assigning meaning or value to technology. As a result, students are familiar with civil engineering but give less thought to civilization engineering [12].

Many critical environmental questions, such as the need for a dramatic reduction of carbon emissions, cannot be answered through individual technologies alone. It is important to understand that environmentally sound technologies [2,13] are not just individual technologies but total systems: they include know-how, procedures, goods and services, and equipment, as well as organizational and managerial procedures. In short, they are embedded not only in natural systems but also in cultural ones.

The long-term goals of environmental research, such as preventing pollution or designing inherently safe engineering systems, can best be realized by adopting a systems perspective [14]. Environmental technology is one component of a complex and dynamic system, whose constituents interact and alter one another [15]. Exploring sustainable technologies from a multilevel systems approach is attractive because the diffusion of these technologies is facilitating changes in broader social, economic, and political systems [5]. Following Berkes et al. [16], we use the term 'social-ecological systems' for the contexts in which technology is embedded.

The sustainability of social-ecological systems is dependent on the health and functioning of its ecosystems [17]. A social-ecological system consists of a bio-geo-physical unit and of the social actors and institutions associated with it. Social-ecological systems are complex, adaptive and delimited by the spatial or functional boundaries that surround the ecosystems [16,18,19]. Sustainability also requires equal access to a good quality of life, including physical, material, social and emotional well-being [20]. Well-being is a holistic concept incorporating human connectedness to natural systems [21]. The conceptual relationship of the quality of the environment and its services to human well-being is well-established and accepted [22].

In social-ecological systems, environmental technology is linked not only to the natural systems that are being monitored or manipulated, but also to the cultural systems from which they stem. Saariluoma and Leikas [23] have proposed a concept which allows explication of the link between technology and human ways of life (or cultures): that of 'life-based design'. It rests on the fact that for a designer it is hardly possible to understand technology development without considering culture, consciously or