ONTOLOGICAL ASPECTS OF TECHNOLOGY AND TRANSFER METHODS, CASE STUDIES: THE RAINWATER COLLECTOR AND SUSTAINABLE HOUSE FOR INDIGENOUS COMMUNITIES

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SUMMARY

The poverty of the indigenous peoples of Mexico, lack of water and decent housing, and the degradation of their natural environment must be addressed. To support the solution of this problem, the Autonomous University of Chiapas, through the Research Center of the School of Engineering, has designed a community water collector (*colector de agua de lluvia comunitario* or CALLC) and an ecological house with appropriate technologies (*casa ecológica con tecnologías apropiadas* or CETA). The goal is to bring clean water and provide an alternative to decent housing especially for poor indigenous communities, and conserve natural resources and raise the standard of living of these communities. This article briefly presents both technologies as an excuse to analyze the differences between technique and technology, the ontological aspects of the design of such terms, its nature as an object of study, their category and their properties, as well as the basics of technology transfer for its social appropriation taking the CALLC as an example.

Keywords: *Technology, ontology, rainwater collector, sustainable house, indigenous communities*

INTRODUCTION

Mexico's indigenous communities live in precarious conditions regarding education, housing, basic health services, potable water, and sewage. We can add to this the degradation of their natural environment with the problems of the pollution of soil, air and water (Mundo et al, 2015). Two of the most important factors of low living standards and poor health of indigenous communities are: the poor quality of their water and no firm floors in makeshift housing, which demonstrate their poverty.

The housing problem. The indigenous population speaking a native language represents 7% of the population of Mexico, but becomes a little more than 10% if in addition to their language their origin is taken into account. According to data from FONHAPO (2010), 76% of these over 10 million indigenous people are have asset poverty and the proportion that need housing is 80.91%. On the other hand, the houses of indigenous peoples in general are made of flimsy materials, with dirt floors, and lack the conditions necessary to live healthily and with dignity.

The water problem. Mexico continues to suffer, particularly in rural areas, a lack of water and high rates of infectious disease whose transmission is associated with the use of water unfit for human consumption. One of the alternative solutions that the water sector institutions offers for the provision of this vital fluid is the building of rainwater collection basins, which are far from being a good measure but rather become a health problem. The collecting basins are built as "open to the sky" and therefore are easily contaminated by the hauling of garbage and fecal matter that are deposited in the basins by wind or water. Of the 20 projects monitored in the highlands of Chiapas, Mexico by specialists of the Research Center of the School of Engineering of the UNACH, 100% of the collecting basins studied were found to contain fecal coliform bacteria. The "basins" are not only contaminated by human feces, but also by feces from domestic or wild animals, which are carried by storm water runoff .

The problem of the unsustainability of the natural environment. The slash and burn and forest fires are deforesting large areas of ejido land in the country, giving rise to changes in the micro-climate and hydrological cycle. These anthropogenic actions impact not only the ecological balance but also the availability of water for domestic use in areas where the resource in itself is meager. The natural environment changes due to the deforestation of valleys and mountains. If this occurs on mountainsides problem is intensified because the erosion rate increases, the soil is impoverished and the devastated area rapidly experiences desertification over time. In valleys the problem is the same but at a slower rate.

The Eco-Technologies (ET's) or Social Technologies (ST's) as alternative solutions. The ET's or ST's represent alternative solutions to the issues raised previously, for the themes of the conservation of air, soil, natural environment, as well as water. This article only briefly described two technologies related to water. However, presenting them is not the only purpose of this article. In addition, the technical solutions of the problems outlined in relation to the provision of water to small rural communities are described. The relevance of the ST or ET to solve a longstanding problem is also discussed. On the other hand, the relevance of this type of technology is shown and the philosophy behind the technology and its relationship with basic science from which it is nourished are also presented. The article also highlights: i) the technical and scientific value of these technologies (simple or compound), ii) the merit associated to distinguish its correct name according to its subject are and scope, iii) the importance of discerning the technological technique, iv) the significance of its ontology v) the onto-methodological aspects of its transfer and social appropriation.

TECHNICAL OR TECHNOLOGY

The technique is the ability to use procedures and resources to create some kind of tools. According to Liz (1995): "... the technique can be considered as a set of activities and systems of craft, artistic actions, which are socially structured but not integrated into modern productive industrial processes generally organized around an institution or company (public or private) and not linked to scientific activity. " For this reason Liz (1995) states: "... the technique is distinguished from technology, distanced even further from science, approaching an art."

On the other hand, *technology* plans and designs devices that use scientific knowledge to control things, natural or artificial processes, design artifacts or objects to solve specific problems or conceive operations rationally (Bunge, 1985). This is the case regarding CETA and CALLC and succinctly described below. Technology is the product of social organization, and the creative transformation of nature. To encourage and / or develop the economy on a large scale, industry imposes criteria for development (Brocano, 1995). Therefore it was not until the industrial revolution, with the emergence of the modern era of science, when technology began to have a higher demand and a social impact that opened the doors of a new stage of civilization and that today has reached its maximum development. However, despite this enormous influence, and that technology cohabits and is part of the current development of society, there is still no consensus as to its nature, rules of action, values, limits, nor its practical rationality. For these reasons, in this article some ontological aspects are outlined that the little existing literature refers to in order to discuss and if necessary add consensus.

ONTOLOGICAL ASPECTS OF TECHNOLOGY

Technology: A systemic approach. Quintanilla (1989) provides an ontological foundation of technology, trying to structure its action, define its properties and intention and characterize it as an overall system. Thus, he says: A technological realization is an intentional system of actions and technology and is a kind of equivalent of technological achievements. Thus, any physical system composed of interacting parts can be considered as a system of actions between components. For example, a computer is a specific technological system (T), if:

$$T = < C, S, S', A, A', O, R >$$

Where:

C = is a set of specific systems constituting components or materials of T.
S = is a set of human subjects or agents capable of acting intentionally on the elements of C “U” S (“U” denotes union in set theory).
A = it is a set of actions defined in C “U” S.
S’= it is a nonempty subset which is equal to S, or S content of intentional agents.
A’= is a nonempty subset that is equal to A, or content of A, of intentional actions of members of S on members of S with objectives oi i € O.
O = Objectives of the system.
R = Results of the system.

Thus, the “intentional action system” (I), with objectives O, and results R, is:

$$I = <S, S', A, A', O, R>$$

where the "action system" with results R, is:

A = <C "U" S, A, R>

Thus a T technology system and the set of all equivalent systems to T constitutes a technology (Mundo, 2015).

Simple and complex technologies. A technological system (T) is simple if it consists of parts that are in turn (T) technical systems T (simple technologies are those that do not contain other technologies); and it is complex if T is formed by the assembly or integration of other technical systems T (see septuplet 1). That is, a technique T' is integrated to a technique T if some of the results R of T depend on the results of the R of 'T'.

Characterization of a technology. If you want to characterize a technology you have to determine the type of materials that you are going to work with, the characteristics that the subjects have that can develop and / or implement it, the type of actions you have to produce between components and subjects, and the objectives that they are intended to serve and the expected results.

Variants of a technology. A variant of a technological system is another system that has the same properties of structure, but with different values. That is, a variant of a technological system is one which is an embodiment of the same technology, but with duration values or performance of its parts, different from the first. Variations can therefore affect their physical dimensions, physical properties, chemicals, and materials, but not its structure (I), (see sextuple 2).

Modifying a technological system. Modify the structure (I) of the sextuple (2) of a T system, may represent a technological change in a positive generation (when technology changes its structure to respond to a set of different actions (A) of objectives (O) and results (R) , in a positive way), or a negative generation when the opposite occurs. That is, one of the most basic mechanisms of technological change is the introduction of variants in a technological system.

Technology components. A technology consists of “unintentional” actions (3) and “intentional actions” (2). Unintentional actions A = <C “U” S, A, R>, are characterized by unintentional actions between components C and those on the human subject S. While intentional actions I = <S, S’ , a, A’O, R>, are characterized by intentional actions of the subjects S on materials C (materials or raw materials of the technology in question) of (3).

Intentional actions are divided in turn into “production and enforcement actions” and “actions of organization, control and management.” Enforcement actions are the relationships between C and S, where S acts on C, changing S to C in its state, its structure, its behavior, including its assembly, synthesis of new objects, use of tools and machines. The actions of “organization, control or management” are guided by intentional actions aimed organize the technological system as a whole, in other words, the fulfillment of objectives from its planning, design, execution instructions and final fulfillment of objectives .

Applications, uses and technology transfer. These concepts are important not only to understand what is the application and transfer of technology, but also enables the equally important discussion on the evaluative problems of technological application, that is, the objectives of the action and its moral implications. Thus, a T technological system can be applied in different ways by different individuals or group of individuals G, for different purposes; but beforehand T should be available for G, for either development (realization) or use. A T technology is available for a group of individuals G if some members of G possess or have access to their own components C, necessary for realization of T, and some members of G are trained to be part of the set S of agents an embodiment of T. Once developed, T is available for the use of G if T meets the goals that G desires who uses or applies T.

T Is considered transferred if besides that G uses and applies T, G understands its operation and is able to repair T in case of failure, or has advising and / or maintenance of T (this is the case of the transfer system collection of rainwater for indigenous communities, the reader is suggested to visit the following links on the internet about the transfer of T: https://www.youtube.com/watch?v=zeIT2L0bEqQ, https://www.youtube. com/watch?v= bsKjzsSWTpM, https://www.youtube.com/watch?v=dNhkPW2nYOU, https://www.youtube.com/watch?v=CkvB7jI4XcA)

ALTERNATIVE, PROPER AND SOCIAL TECHNOLOGIES

According to Thomas (2009): "... technologies demarcate positions and behavior of the actors, determine structures of social distribution, production costs, access to goods and services, generate social and environmental problems, and facilitate or hinder their resolution. It is not simply a matter of technological determinism, nor a causal relationship dominated by collective relationships. These are social constructs as much as societies are technological constructs. He continues: "... the resolution of the problems of poverty, exclusion and underdevelopment cannot be analyzed without taking into account the technological dimension in food production, housing, transportation, energy, access to knowledge and cultural heritage, environment, and social organization".

For this reason, social technologies are those that respond to problems generated in sectors where poverty exists, and must be analyzed not from an economic perspective of commercial utility, but from the perspective of social utility. In this sense and from a practical and dialectic point of view, it is necessary to know the technology, its relationships, ontological properties, and its evolution. Thus, the history of its genesis becomes relevant to understanding the role they play in the processes of social change.

They cannot be discussed seriously without understanding their nature and evolution. Based on these arguments, some aspects of their origin can be presented. Following this, the ontological properties of technology and social relevance of the methodology of "social technologies" for proper transfer will be discussed.

Since the mid-60's, there began to proliferate the production of "alternative", "intermediate" or "appropriate" technologies, and more recently, "social innovations". The explicit aim of these technologies has been to respond to issues of community development, generation of services and techno-productive alternatives in socio-economic scenarios characterized by extreme poverty in several developing countries of Asia, Africa and Latin America. Archetypal examples of these technologies are biomass reactors, some low - cost energy systems (based on solar and wind power), constructive social housing systems and agro ecological farming techniques.

From these example, Marco Thomas (2009) called them "*social technologies*" "... those aimed at solving social and / or environmental problems that generate social dynamics of social inclusion and sustainable development." However, to this there must be added the following requirements: 1. They are social technologies as long as the community uses them, as a successful methodological effort of their transfer, 2. They are social technologies as far as the social masses, users or recipients have been taken into account for their development, according to their specific needs and culture , 3. They are social technologies as long as the user understands the technology, maintains it and by its utilitarian nature such technology is capable for resolving a specific problem that motivates its incorporation into their way of life and culture and 4. Successful social technologies are those that once transferred are administered and managed by the community independently of the institution which supported, led and executed the technology.

Thus, the history of the "social technologies" dates back to the 40s with experiences in India and the People's Republic of China (Riskin 1983; Amhad, 1989). Then came the "democratic technologies" at the beginning of the 60s when Lewis Mumford denounced the political risks of production technologies on a large scale and in contrast proposed democratic technologies (Mumford, 1964), based on small - scale production with technologies moved by animal power or small machines, actively led by the community. According to Thomas (2009) the conceptual developments of Mumford are the antecedent of "appropriate technologies", whose primary objective was the production of technologies that were small - scale, purely family or community based, mature, low complexity, low content of scientific and technological knowledge, were low cost, and had low energy consumption and low environmental impact.

Undoubtedly, from the set of characteristics listed above, several have limited the broader production of goods and services through "alternative technologies", with one of the most important being small - scale production.

On the other hand, the "intermediate technologies" are those that propose the development of small industries oriented to solving local problems. They are distinguished from "appropriate technologies" because they are based on mature *industrial* technologies, are labor-intensive, and are geared to meet local consumer markets. However, intermediate technologies avoid latest generation technologies and equipment produced by highly complex industry (Schumacher, 1973; Pack, 1983; Riskin, 1983).

Appropriate technologies reemerged in the early 70 's , with the novelty of applying concepts of applied and economy engineering, seeking efficiency. According to Robinson, (1983) the definition of an "appropriate technology" should include: availability of skilled labor and its relative value, capital incorporated into the machinery, it consumables, the production process and the availability of human resources for its management . This reframing led to the assignment of a new mission, which was more inclusive, and included in its agenda not only the development of technologies to underdeveloped countries and populations living in extreme poverty, but also large - scale production aimed at mass markets in developed countries. During the decades of '70 and '80 appropriate technologies became a field of implementation of public policies and intervention of international support agencies (Thomas, 2009).

After the second phase of appropriate technologies comes the concept of "alternative technologies" , in order to overcome the issue left by the phase II of appropriate technologies that led to a massive industrial production, forsaking the technologies associated with poor communities. For that reason, Dickson (1980) raised the need to implement "alternative technologies" i.e. tools and techniques necessary to reflect and maintain modes of *non-oppressive social* and *non - manipulative production*, a non-exploitative relationship to the natural environment.

In the early 80 's in India, the concept of *Grassroots Innovations* was born ,whose relevance lies in turning to technologies of native peoples, i.e., an attempt to rescue the technological knowledge of vulnerable sectors of society. One of the premises of the approach is to recover the innovativeness of people from marginalized sectors of the population to generate solutions to practical problems with cheap, efficient and environmentally sustainable technological alternatives. Thus, most innovations are based on traditional knowledge of the communities they belong to (Gupta et al, 2003). However their major limitations are: the low scientific and technological content; relationship to the market and that technologies are oriented to punctual solutions (Thomas, 2009).

At the beginning of the decade of 2000, the concept of "social innovations" came forth which were mainly oriented to organizational development and dissemination of technologies to promote social change by meeting needs of disadvantaged social groups (Martin et al, 2007). Social innovation is concerned with achieving social, cultural and political goals; It not produced exclusively by experts or scientists, but includes practical knowledge derived from experience with an assistance component.

Moreover, the proposal conceived by Prahalad (2006) called “Base of the Pyramid” (BOP) focuses on the development of innovations to the market of the poor (80% of the world population), to meet their “true” needs. Prahalad (2006) suggests the private sector as an engine for poverty alleviation. There is a market in the Base of the Pyramid of 4 billion people, which only need to be treated as consumers and not as poor, to awaken their potential and achieve economic and social climbing out of poverty. To develop this huge market of 80% of the world population, traditional production and marketing approaches that serve the top of the pyramid do not work (Prahalad, 2006). A new approach is needed, oriented towards innovation that recognizes the real needs of the poor classes in the world. According to Thomas (2009), the BOP is based on market relationships, assumes the risk of crystallization of social exclusion in other ways, and probably the main beneficiary is the transnational company. In this context resurfaces a renewed “social technologies” concept. One of the most widespread today is that adopted by the “Social Technology Network” comprising products, with re-applicable methodologies developed in interaction with the community and represent effective solutions for social transformation (Dagnino et al, 2004). In Brazil the “Bank of Social Technologies” and later the “Social Technology Network” program were developed.

In order to close this brief summary, a filiation of eco-technology terminology will be presented. Recently Ortiz et al (2104) published the book “Eco - technology in Mexico” (“*La ecotecnología en México*”), which preparation began in the Eco-technologies Unit of the Ecosystems Research Center of the Autonomous University of Mexico (UNAM). The book has among its objectives to respond to the concept of eco-technology. In the specialized bibliography in English, the majority of the results concerning the word "Ecotechnology" refer to applications of ecological and industrial engineering. In Spanish the scientific references are few and usually are related to ecological applications (Ortiz, 2014).

In this book the need to develop a sustainable environmental and social model is presented, which includes a technology development project to reformulate the way technology is designed, created, disseminated, adopted and is integrated for the long term in society. A model that contributes to reducing poverty and vulnerability of the population in rural areas is neglected by the current technological model (Ortiz et al, 2014). The eco-technological model tries to encompass and give continuity to previous movements such as appropriate technologies, clean technologies and grassroots innovations. Ortiz et al (2014) argue that eco-technologies should meet certain environmental, social and economic factors, such as: To be accessible, especially for the poorest sectors of society; be focused on local needs and contexts; be environmentally friendly, promoting efficient use of resources, recycling and reuse of products; promote the use of local resources and their control; generate employment in regional economies, especially in rural areas where the population has had to migrate due to lack of opportunities; preferably be produced on a small scale and decentralized; be designed, adapted and disseminated through participatory processes, with dialogue between local and scientific knowledge (this is key to the peasant and indigenous context where local populations have very valuable collections of knowledge). For this reason Ortiz et al (2014) define eco-technology as follows: *devices, methods and processes that foster a harmonious relationship with the environment and seek to provide tangible social and economic benefits to its users, with reference to a specific socio-ecological context*.

Note that this definition does not fit the systemic definition of Quintanilla (2009) or the septuplet 1, because by Ortiz et al (2014) including in the above definition "methods and processes" the previous definition of the septuplet 1 is externalized. This means eco-technology does not refer only to the specific technological system T, but also to the relationships, procedures and sequence of events between T, the environment and users. From this perspective it is not valid that technologists or scientists talk about eco-technologies when referring to T as an element or device. Nor it is valid while T is not interfered in a transfer process to the society for which it was designed. Thus, the concept of eco-technology refers to technology itself but not individually as a T technological system but within the body of scientific knowledge, its methods and processes, the productive infrastructure development and its management strategies and dissemination.

Ortiz et al (2014) argue that eco-technologies can be designed to meet basic needs such as sanitation and cooking food, and serve complementary needs such as leisure and comfort. It also includes applications designed to counter local environmental impacts such as deforestation or pollution of water bodies and mitigating global impacts such as the emission of greenhouse gases into the atmosphere.

As it is seen and according to Thomas (2009) there are a variety of definitions accumulated over the last 50 years on technologies originally intended for a sector of the population suffering from poverty and technological deficit to meet even their basic needs. The concepts that attempt to support them derived from theoretical formulations, regulations and requirements for the design, development, production, management and evaluation of such technologies. However there are still many limitations, restrictions, discrepancies and inconsistencies identified in this historical summary. It seems inevitable the need to build new knowledge, new concepts, new analytical devices, oriented to overcoming these problems so as to improve public policies related to the socio - economic development of countries (Thomas, 2009), especially in poor countries in Latin America.

The restrictions, contradictions and significant limitations of different approaches that are presented can be mentioned: Technological determinism, supply, voluntarism, paternalism, the exclusive use of mature technologies, little use of scientific and technological knowledge, labor intensiveness, restriction to intensive use of machinery and complex systems, no use of scale economies, punctual resolution of problems (non-systemic solutions), ignorance of the relationships between the market or excess of production oriented to other sectors (commercial vision), partial or nonexistent use of available analytical tools (for example innovation economy), restriction of the dynamic nature of the market as an exclusive path of economic relationships, and limitations and ambiguity of definitions.

In addition to these restrictions there are others not considered by Thomas (2009), which must be taken into account for their relevance: a lack of a transfer of exprofeso methodology according to the customs, traditions and culture of the society to whom it is addressed; little or no participation of individuality or objective collectivity to state their family or community needs and personal requirements according to their needs and culture; few considerations to avoid altering the environment; lack of interest or planning by the technologists and scientists regarding transfer schemes and tracking technology to correct errors in order to avoid rejection and subsequent distrust of users; lack of public sector policies where the technology will operate; a lack of promotion or lack of public policies that guarantee the state's interest to solve certain problems; ontological ignorance: not allowing the understanding of the technological concept from its root, to understand its limits, its aims, its nature and its intrinsic relations framed perhaps in a systemic approach.

BASIC CONCEPTS FOR THE TRANSFER OF TECHNOLOGY

The transfer of technology and social methodology. As a public R & D institution of the UNACH, over 20 years ago the School of Engineering began with projects on ***social technologies*** in indigenous communities in the highlands of Chiapas under agreement with the Mexican Institute of Water Technology (*Instituto Mexicano de Tecnología del Agua* -IMTA) operating in Jiutepec, Morelos, Mexico. 16 years ago a rainwater collection system (CALLC) was built and transferred in the indigenous Tsozil community of Yalentay in Zinacantan, Chiapas, Mexico. Based on this experience, a sustainable home (CETA) was built in the same community, with nearly a dozen technologies coupled in a modular way in order to raise the standard of living of indigenous families and to conserve natural resources such as water, soil, air and forest. During the process of *transferring* of the CALLC in 1999, a series of questions arose, which were not only practical but also ontological (to be discussed in order to understand the methodological process outlined below). From these questions it was concluded that it was essential to emphasize and build the ontological basis of "*social methodology*" as a basis to design, develop, adapt, implement and transfer *appropriate technologies* aimed at solving community and environmental problems, generating dynamic social, technological and economic inclusion, aimed at *sustainable development*.

The reference model. The CALLC of Yalentay. As already stated, The School of Engineering of the UNACH and IMTA transferred in 1999 the "Community Rainwater collector (CALLC)" in Yalentay Chiapas, Mexico (Mundo et al, 1999). After more than 15 years it is still working under the care of the community who gives it maintenance through hydraulic indigenous committee, created by the villagers themselves.

Photo 1. Collector rainwater, Yalentay, Zinacantán, Chiapas.

Thus, in practical terms we can say that a scientific or technological product is successfully transferred when it is understood by its users, covers a personal or social need (utility good), it is used, operated, maintained or repaired by the same users (or they know where to go for this purpose). This was what happened with the CALLC, where now every April 15 the water festival is conducted, a popular religious celebration of syncretic character of this Zinacantecan people. Based on these experiences, the following project was designed: *Design, construction and transfer of an ecological house with appropriate technologies (CETA) for the sustainable development of indigenous communities in the highlands of Chiapas*, which fundamental objectives are to: a). Build and evaluate sustainable housing in Yalentay, consisting of a house of 50 m^2 or more (the surface area meets the standards of operation “Rural Housing Program for fiscal year 2014” of SEDATU), b). Evaluate more than ten appropriate technologies integrated into the house, with the goal of conserving natural resources such as water, soil, air, forest and also raise the standard of living of the people to overcome poverty.

The following outlines the technologies that make up the CETA in a modular fashion: a sustainable house, ecological bathroom, kitchen with ecological stove, water tank , home rainwater collector, bike water pump, ecological sink, irrigation system for agriculture, backyard solar panel kit, energy saving light bulbs, water saving showerheads, and water saving faucets (Mundo et al, 2014). Once built, the CETA will be assessed, among the most important variables, as follows: adaptation of the family to CETA, family health, family production activities with farm animals, backyard agricultural production activities, family economy, evaluation technique of each of the technologies CETA, integration and use of new technologies to their culture.

The project management unit will be the family and they will evaluate the CETA through the multidisciplinary work of Units of Higher Education (*Dependencias de Educación Superior*- DES) of the UNACH. The DES that will be potentially involved are: DES Engineering and Architecture; DES of Health Sciences; DES of Agricultural Sciences; DES Social Sciences and Humanities; DES Administrative and Financial Sciences; DES Language Teaching and DES University Development Centers. By way of example and just to give an idea, since each DES develops its own methodology, only some basic questions must be answered in the process of transferring the CETA, once the family that is designated by the community indicates their space needs, design and services needed within the CETA: Has the family appropriated the CETA? Is the architectural and civil design adapted to their customs? Did it improve the standard of living? How did the occupant's health evolve before and after the CETA? Did it improve their family economy with backyard agriculture for self-consumption and production? Did it improve their diet? Did it improve their economic level with the inclusion of animals and poultry? Is family budget better managed? Were the technical communication materials (videos, manuals, brochures) translated by each DES to Tzotil used? How did they benefit? Is the social methodology for the technological transfer adequate or does it need to incorporate variables not considered in the process? Did audiovisual materials prepared by each DES into the native language help the transfer process and the dissemination of technology? Were the architectural spaces, which incorporated their customs into the sustainable house, adequate? What was necessary to incorporate them? What is the environmental impact of CETA? Are construction materials relevant in terms of cost, availability, durability, comfort? Were the uses and customs of all appropriate technologies of the CETA incorporated? What adaptations and improvements need to be done?

Three basic methodological aspects that must be considered not only because they are indispensable per se, but because they also worked in Yalentay and cut across all DES set out are: 1. *The Social Dynamics* (*SD*). If the SD is defined as "... the flow of customs, practices and beliefs of a society, specified as mechanisms governing the behavior of the masses against certain stimuli in certain circumstances, responding to social conditioning to which the individual or society has been exposed during the course of his life experience and the subconscious (emotions and instincts included) "then it is essential to take into account the following hypothesis: a. The SD is critical to establishing the objectives and design of any technology, especially for poor communities, and for their transfer. The CETA must correspond to the SD, b. The SD marks the starting point and the direction of making social and economic technical project decisions, c. The SD is the basic technological design of the CETA, d. The SD determines the success or failure of the project and its transfer.

For these reasons it is essential to consider within the transversal methodologies Conversely Making Decisions (CMD) used in the project CALLC in Yalentay (the apex to the base of the pyramid in a reverse pyramid polyhedron, where the apex is resting on the reference plane, i.e., at the origin of the technology, the project itself, and the needs of the community). So now the vertex is the family as a starting and management unit. In simple terms: *you need to go in reverse in the decision making of the project* (from planning to completion) which means starting from the individual need outlined in the collective needs of the family. THE TDI or CMD is a step before community participation, ie, it starts with the individual and family participation. The specific needs of each individual with respect to the project are determined, without losing sight that the management unit is the family. It is certainly a long and complicated but methodologically more productive way, especially in terms of appropriate technologies for small rural communities.

To reverse the decision pyramid, the methodology and technology transfer design goes from apex to base, from the need of the individual to the needs of the family (vertex as a management unit) to the community decisions and arrangements. The minimum basic questions are: What do you need? How do you need it? For what do you need it? 2. *The technological dynamics* (*TD*), closely linked to the SD, TD should assume all hypothesis SD lines set out above to reduce the following risks: lack of public policy on the issue, resulting in the lack of institutional resources, absence of a permanent local structure of decision-making, lack of training, mistrust and resistance of the people to new technology that can be perceived as unstable or unreliable, cultural taboos (for example, many indigenous communities do not like chlorinating water) , social division of labor associated with political and religious issues (e.g., Protestants no longer cooperate), the government must pay everything (historical paternalism), territorial conflicts, conflicts of sources of water supply, social conflicts in general, either detected or potential . The technological dynamic is represented by the septuplet 1, the system of actions and intentions relations (2 and 3) and all the properties contained in the section “ontological aspects of technology.” 3. *The Economic Dynamics* (*ED*) is unrestrictedly associated with SD and TD. The ED should assume all hypothesis of SD and properties and limitations of TD. ED is almost always a limited element. Its limitation is void if there is an international or national source of public or private nature that supports it financially, not only during the design and construction of the project but also for reasonable evaluation and follow - up time after the transfer. One of the biggest problems with “ED” is its narrowing or nullification, because it directly affects SD and TD, disabling the entire process and creating more distrust in the community, which is sometimes irreversible, with historical consequences especially in indigenous communities.

Because in Yalentay the development of an exprofeso methodology has been proven for the transfer of technology, the Mexican state should include this issue in public sector policies. The bottleneck is not science or technology, or the theoretical aspects, nor in the social aspect, the bottleneck is in the appropriate technology transfer to small rural communities in the country, with special emphasis on indigenous communities by the difficulties that language and customs represent.

CONCLUSIONS

By way of example, two technologies were presented to discuss the genesis of the conception of technologies for poor communities, from alternative technologies, through democratic Mumford technologies to the contemporary concept of eco-technologies. Those that were taken as examples were community rainwater collector (CALLC) transferred to the Tzotzil indigenous community of Yalentay in the highlands of Chiapas, Mexico and the Sustainable House (CETA) which will be built in the same community.

The CALLC is a social technology because the Yalentay community has been using it for more than 15 years. It was the product of a great effort of a successful methodological transfer. Yalentay inhabitants were not only taken into account for the design of CALLC but also participated in its construction. The CALLC adapted to their specific needs and culture. The inhabitants of Yalentay understand the concept, give maintenance every April 15 in the "syncretic water festival" and have incorporated it into their way of life. It is currently administered and managed by the community independently of the institution that promoted, built and transferred it. But it is also an appropriate technology because the CALLC is a system that uses methods and processes that provide a harmonic relationship with the environment and provides social services, tangible economic benefits to the community of Yalentay (Transferred over 15 years ago) and has a specific socio-ecological context. The CALLC used scientific knowledge such as: The equation for the conservation of mass and the equation of conservation of energy and momentum.

Therefore the CETA and CALLC confirm that they are "social technologies" but also "appropriate" even "eco-technologies". This fact reveals the ambiguity of the current definitions of the studied currents.

One way to take away this ambiguity and refine their nature, is the scope in terms of its subject is the *systemic approach* (see endecatupla 1) to be from the philosophy of these technologies, i.e., from its ontology. For that reason, in this scientific paper the ontological aspects of the design of technology were exposed, its nature as an object of study, their category and their properties as well as the basics of technology transfer for social appropriation by reference to the CALLC. On the other hand, advancements were outlined from the *systemic approach based on ontological aspects* of technology that enable in the future the reduction of ambiguity to the diversity of denominations of "social technologies" accumulated over the past 50 years, which were designed originally to a sector of the population suffering poverty and technological deficit to meet even their basic needs. These theoretical elements will build new knowledge, new concepts, and new analytical devices designed to overcome these problems.

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