

## THE USE OF RENEWABLE ENERGY RESOURCES AS THE TRIGGER FOR RURAL DEVELOPMENT AND POLICY PLANNING IN ARID-COASTAL ZONES OF BAJA CALIFORNIA, MEXICO.

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### ABSTRACT:

In most countries of the world, people living in urban areas have access to efficient and modern energy supplies. Rural populations, however, are generally less fortunate and, especially in less industrialized countries, rely on traditional fuels, or energy and electricity production systems are costly and inefficient. Mexico's rural communities present not only the lack of electricity, but too many other needs. The objective of this study is to design a rural development strategy for remote communities of Baja California state in Mexico, where the energy and the use of renewable energy resources (*v.gr.* solar ad aeolic) are considered as the trigger for development, based on the active participation of the local and regional governments, the academic sector and the inhabitants of the communities. As it has been mentioned, the energy is considered as a trigger for the development of these sites, however, education, water supply and treatment, waste management, health services, city planning, social problems, among others, are also necessary to be solved.

Baja California's Energy policy is based on the use of fossil fuels, even when the highest capacity geothermal field (Cerro Prieto) of Latin America is located in this state; it is the second largest in the world. The state electricity net is not integrated to Mexico's energy grid; however it is to Southern California in USA. This study includes the reconnaissance of the communities, which includes the natural and social capital; the needs, life conditions, potential natural resources available, and conflicts, that were declared by the key actors and inhabitants involved. A conceptual framework based on the theory and social practice, is proposed in order to design and implement a development programme for these areas. Also, the study proposes how to establish the necessary mechanisms to communicate between the different actors involved and to conciliate with the simultaneous demands for generalizable actions and location-specific solutions. The Complex System theory has been used by an interdisciplinary team of actors in order to develop the participative design and strategies of rural development. The results of the study are presented as good tools to the decision-makers in order to change the paradigm of electricity generation from resources restricted to fossil fuels and to encourage and prove that solar and wind resources are feasible to be integrated into the Energy Policies and are good resources to be used not only in rural areas but in urban areas too.

**Keywords:** rural electrification, rural development, complex system theory, renewable energy resources, coastal policy planning.

## 1. INTRODUCTION

The energy needs of rural people are directly linked to their social and economic lives; they vary greatly between different social groups and between different communities and locations. Energy demand is subject to changes in the user's socio-economic status and it will always be influenced by technical and economic developments, such as the introduction of new or improved appliances designed to be more energy efficient or environmentally friendly (Anderson *et al.*, 1999). It is very necessary to identify first, how the energy is going to be used and in what technical and socio-economic conditions is required, furthermore, in Mexican rural communities is very important to identify the traditional knowledge on energy issues.

On the other hand, the concept reviews of "quality of life" take us to the definition of "needs", derived from the concept of development that was proposed after the Second World War. At that time, the objective of development was to create, in the underdeveloped countries, the necessary conditions to implement the development model of advanced societies and in this way, to try to eliminate poverty. A high industrialization and urbanization, rapid growth of material production, increase of the quality of life, as well as the adoption of education and "modern" cultural values characterize this model. The accumulated experience of aid and development has shown a high rate of failure in aid projects due to inadequate consideration of local culture and conditions and it more obvious when "foreign experiences" from developed countries are applied to underdeveloped ones. It is evident, that in the last four decades, poverty has been extending more around the world and there are clear evidences of the damage to environment that this model has provoked. We have been faced with a choice between quality and quantity, a handful of culturally sensitive but irreproducible projects or actions which ignore and damage local cultures and which are not sustainable since they have been imposed from outside. The nature of need in rural communities is changing. If needs and aspiration were static it would be arrogant to suppose identification of the most appropriate techniques could be achieved through the intervention of outsiders.

However, the nature of the problems being faced in developing villages is changing at an unprecedented rate. The indigenous technical knowledge is often inadequate for the problems presented by ecological degradation, changing aspirations and new social solutions. For the developing world, depletion of natural capital (forest, energy, and minerals) and damage from carbon dioxide emissions is estimated to be 5.8 percent of GDP. Environmental health risks account for 20 percent of the total global burden disease. In addition, the huge costs of global environmental problems need to be factored into domestic development policies. The poor, especially women and children, often bear much of the burden of environmental degradation. Thus, natural capital is crucial for a sustained growth, and its conservation and augmentation are crucial to national and international development strategies, World Bank (2000).

The energy needs of rural people are directly linked to their social and economic lives and vary greatly between the social groups and between the different locations. For instance, in Mexico the rural areas vary depending on the region of the country. Southern Mexico's rural communities use wood as a main energy resource, whilst in the northern region, rural communities use diesel generators to produce electricity. In order to determine energy service needs, it is necessary to identify how the energy is to be used and in what technical socio-economic conditions will be required. We must remember that this is a dynamic process. The Baja California state rural communities are characterized to be located in an arid-coastal environment. The distance between these and the urban centers (Figure 1) is too big and there

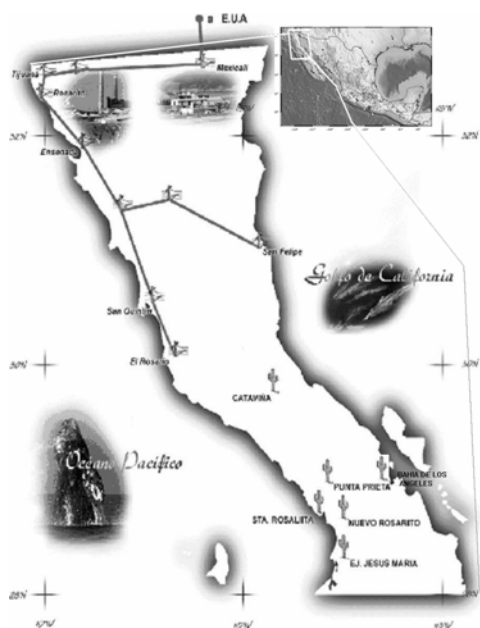


Figure 1. Study area.

are protected areas due to the endemism of flora and fauna species. Beside poverty, these communities present some other problems due to lack of services (*v.gr.* electricity and water supply), lack of infrastructure, low education levels, lack of basic products, deterioration of the social capital, over exploitation of some of their natural resources and environmental degradation. This situation has been affected mainly by the national economic situation, by adjust structural measures that the country has implemented to face it, and by the decrease of fishery resources from which these communities were depending on, partially or totally. Furthermore, associated to the economic deterioration, the communities have to face with problems that are equally serious in the social environment: social security, violence, drugs and alcohol consumption.

The situation is particularly critical in most of these communities and requires urgently implementing programmes to stop the economic and social deterioration, as well as to begin to see a better perspective for the future. To provide the basic services (*v.gr.* electricity), the access to knowledge and culture, to fortify the productive activities and specially the diversification of these, constitute the essential elements for a development strategy. It is a challenge not only in the national context but in the international too, however, the institutions and the whole society must face it and try to reach a sustainable rural development even the economic restrictions in the developing countries, if not, the social and environment consequences will be worse due to the poverty rates and social deterioration. It is obvious that the electricity is not the only need of the rural people; hence, it is necessary to integrate energy planning into other development sectors and in this project, electricity has been a very important tool to convince the decision makers and we truly hope that if renewables become successfully applied in these rural areas, will allow the opportunity to expand their use in urban regions. Energy planning cannot be divorced from other aspects of rural development such as agriculture, rural small industry, and services including health clinics, education and schools, hence, it is necessary to articulate the energy supply to the rest of the needs of these communities. For example, the people of these communities have mentioned energy as the first need not only for domestic purposes but also for other activities. Where energy services are required by the various sector development initiatives, there is an opportunity to develop rural energy supply options to supply both existing needs as well as those developed in previous initiatives. In this way, the benefits of energy supply can be maximized, with the overall benefits from the scheme extended to supply more than just basic energy needs. In many development projects, energy is not simply an add-on, but an essential ingredient for success. In such cases, the energy dimension of a rural development programme should be integrated into projects from an early stage. One of the purposes of this study is precisely to see “development” as an integral tool in which people and actors from the different sectors are the key. Participation of these actors must give the ideas of what kind of development do these communities want, furthermore, it is necessary to consider that in underdeveloped countries such as Mexico, we must elaborate our own policies for the reduction of poverty and community development, in which the local and regional, as well as the national priorities must be integrated. The decisions must depend of the socio-political context, the structural,

and the cultural. We must not continue conceptualizing the development as ‘economic development’ only, as it has happened in the past, because the experience of the last 40 years shows us that these concepts are different.

This study proposes an integrated and participative vision of the involved actors in the development processes of the south region of Baja California State in Mexico using the Complex Systems Theory described by Morin (1981) and Morin *et al.*, (1999). We consider that it is necessary a class of thinking that links the multiple aspects related to development, which respects the diversities and recognize these as a unit, trying to discern the interdependencies. The Complex Systems theory requires of a radical thinking, which allow us to reach the root of the problems, a multidimensional approach, which could be able to conceive the recursive relation that has begun to develop between the earth sciences, the ecology and the social sciences. It is necessary to develop an ‘ecologized’ thinking that instead of isolate the study objects, consider them in and through its relation auto-eco-organizational, related to the cultural, social, economical, political and environmental context. The development of rural communities is not isolated from these, and as it has been mentioned by Morin (1981), to work with this Theory allow us to consider the interdependency that exists among the different disciplines, sectors and factors that are related to reach a sustainable development programme for these communities. To use the Complex Systems Theory also allow us to have another kind of vision about the different problems involved in rural development. Problems are spatially and temporally interdependent, whereas disciplinary research isolates problems from one another. We want to raise the consciousness conducive to the promotion of interdisciplinary research. Fractured thinking, which cuts up everything global, ignores anthropological complexity and the planetary context. Yet it is not sufficient merely to brandish the flag of globality: One must associate the global elements within a complex, organizational articulation, and one must contextualize this very globality. The necessary reform of thinking is that in which will generate a complex system context. We want to develop a participative strategy of rural development with this kind of multi-dimensional view because once again, we are faced with the inseparability of the problems related to development, with the recursive or circular character as described by Morin [3], in which each depends on the other. This makes the reforms of thinking more difficult, and at the same time, all the more necessary, as only a complex thinking could consider and deal with this interdependent circularity.

Development involves simultaneously the unfolding of individual autonomies and the increase in communal participations, both neighborly as well as planetary. More freedom and more community, more self and less selfishness are essential according to Morin [2]. Such and idea of development makes us aware of a key phenomenon, underdevelopment grows apace with techno-economical development.

## 2. METHODOLOGY

We already described the Complex Systems Theory that will be applied in the whole stages of this study; however, there are certain specific methodologies that will be applied for the different stages. For the reconnaissance of the six communities under study, the Participatory rural appraisal (PRA) has been used. This methodology includes the techniques, methods and approaches of the local knowledge of the communities; this has been described by the World Bank (2000), Scrimshaw *et.al.* (1992) and Chambers (1992). By means of this methodology, the data was and will be in future studies collected. To choose the best energy choice among

the available options will depend on a number of factors as: availability of sufficient energy at times when the energy service is required, comparative capital and running costs of each option, local availability of the technology and maintenance support, and quality of energy service provided. One of the objectives that has been accomplished was to identify the number of village people and to characterize these villages, in order to include all the facts concerning, for example: the marginalized groups, the minorities, the ancient people, the disadvantaged groups (disabled), professionals, people that do not live in the villages the whole year, visitors and/or tourists, main activities of each group people, dynamic of the population (migration), among so many others. To determine the present quality of life of the inhabitants we will apply the methodology proposed by Boltvinik and Hernández (2000) related to the satisfied basic needs (SBN) or direct method. We analyzed each one of the components of quality: housing, services, energy supply, education, income, etc. All the surveys and interviews with the inhabitants as well as with the key actors of the government agencies, followed the Miles and Huberman (1994) methodology which includes the sampling based on the own characteristics of each one of the communities. Key informants will be first identified. The analysis and data processing used the qualitative statistics proposed by Miles and Huberman (1994) and that one established by Taylor and Bogdan (1998). Finally, the strategy of rural development has been elaborated by the academics, the government agencies actors and the inhabitants of all the communities. The surveys, interviews, community meetings, workshops, etc. were key activities in order to be sure that all the actors have participated and all agree with the final proposal.

### 3. RESULTS AND DISCUSSION

A multi-disciplinary team has been working in different disciplines: urban planning, tourism (low impact), resource management (related to the flora and fauna of the region), desalination of sea water, energy and education. Previous studies were carried out in these communities related to evaluate the potential use of renewable energy, by Quintanilla-Montoya (2003) and those from one of the communities is shown in Figure 2. Also, an Integrated Technology Assessment system of the alternative energy sources of Baja California was proposed by Quintanilla-Montoya (2003). The monitored results of the assessment of solar and wind resources to be used for electrification, proved that these are present in enough amounts to provide electricity to most of the communities. Furthermore, and due to the scarcity of meteorological data, two sites are under monitoring in the present and three more will be in the near future, in order to compare with the modeled results of Quintanilla-Montoya (1999) with the real ones monitored *in situ*. It is also important to mention that based on these studies, the state government has implemented an electrification programme in the region, providing unfamiliar PV systems that allow the inhabitants to use at least two bulbs for lighting, one small TV/radio. The average energy consumption by two of these communities has been determined (approximately 120 kW/month) based on the costs of electricity that the inhabitants have paid for it. In both, the electricity comes from a diesel generator and the price that people have to pay is three times more than what people pay in urban areas.

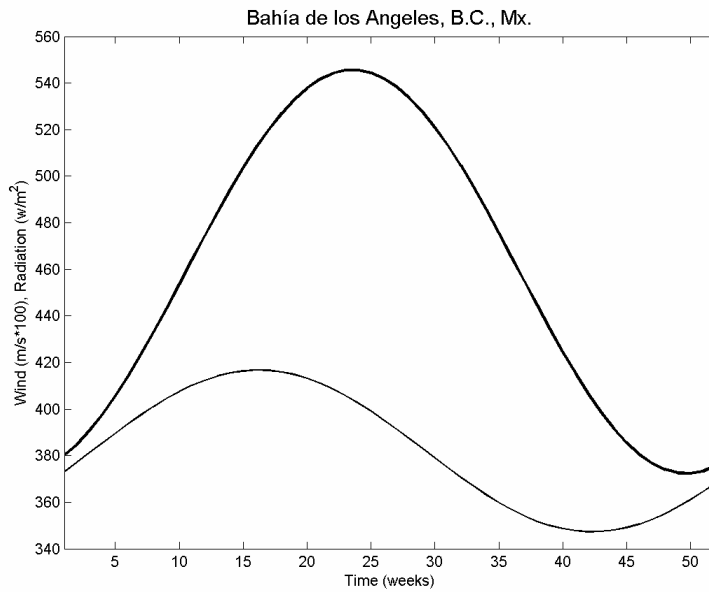


Figure 2. Adjusted seasonal cycle of wind speed (-) and radiation (—) for one of the communities.

The high consumption of electricity in these poor villages is due to the domestic used appliances that come from USA in 'second hand stores'.

We have identified the main activities that prevail in each community and how energy will be used on these. These activities include: cattle, agriculture, tourist services, fisheries and aquaculture. Many energy supply schemes have been implemented in Mexico, including the use

of renewals but the failure of these has been due to the acceptance of these technologies in the different regions and that these programmes were not seen as an essential part of a strategy for rural development, as we see it. In this study we propose the way in which the energy service requirements to the rural communities could interact as a whole. Some issues we think can have an impact on scheme success and at this point we recommend being included in a successful electrification rural programme:

- The decision-making process and management
- The way in which energy service needs are assessed
- Ability to pay and tariff levels
- Competition and reliability
- Relationship with equipment suppliers which also include the training for maintenance
- Appropriate financing options
- Respect for the different local cultures applied to the use of energy
- Acceptance of the new technologies in their cultural values

We present also alternative sources of employments based on the activities declared by the inhabitants of the communities, as well an integration of these with the energy supply (from solar and wind resources), as a general strategy of how development must be established in the region.

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