AN ANALYSIS OF RENEWABLE RESOURCE DEVELOPMENT ALTERNATIVES FOR THE NORTHERN ARID REGION OF MEXICO: Study Prospectus

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PREFACE

In 1980, IIASA joined with the Centro de Investigacion en Quimica Aplicada (CIQA) in order to study alternative production chains based on the renewable resources of the Northern Arid Region of Mexico. This study applied the "WELMM Approach" developed at IIASA. Its objective was to account for the basic resources used and processed along alternative production chains, from cultivation and harvesting of the plants to the final products.

WELMM analyses of each of the production chains are now being completed, and IIASA and CIQA have decided to expand their cooperative efforts to include an analysis of alternative development projects for the Northern Arid Region based on these production chains. This paper presents a prospectus for the expanded study.

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"We shall use our abundance of petroleum to generate other resources which are renewable and which can can be multiplied through work".

President Lopez-Portillo 1979

1 INTRODUCTION

The periodic headlines of dizzying additions and extensions to oil reserves sometimes obscure the fact that Mexico's endowment of certain natural resources is anything but rich. Approximately 50 percent of the two million square kilometers of its land area are arid or semi-arid. In the two main deserts (the Chihuahuan desert and the Sonoran desert), the scarcity of water and the harshness of the climate are such that a substantial proportion of the population in rural areas lives at the subsis-

tance level, and is often forced to migrate to surrounding cities or even abroad in search of better living conditions.

These marginal lands pose a serious policy dilemma. On the one hand, marginal lands are costly to develop and usually of relatively low productivity. On the other hand, with a large and growing population and ever increasing urban congestion, Mexico can ill afford to disregard the potential of 50 percent of its land area.

This paper describes a study of development alternatives for the Northern Arid Region of Mexico based on the use of renewable resources. The Northern Arid Region, which is located in the Chihuahuan Desert, covers roughly 125000 square kilometers, and is comprised of 24 counties in 5 states: Coahuila, San Luis Potosi, Neuvo Leon, Zacatecas, and Durango.

The plan of the paper is as follows. In Section 2, we provide a brief discussion of the problem addressed by this study. As this discussion will show, development of arid and semi-arid lands has been an enduring concern of the Mexican government. Plans and programs have stressed land reform, investment, and technical assistance for these regions. At the same time, the government has searched for promising development strategies by supporting research and development applicable to arid regions. Our study is an outgrowth of the Mexican government's R&D program.

In section 3 we explain the objectives of our study. As that section will state, our immediate purpose is to analyze the prospects for successful development of the Northern Arid Region

of Mexico based upon the cultivation and processing of selected native plants. Less immediately we hope that our analysis will serve as a model for similar analyses of development projects in arid or semi-arid regions in other parts of the world.

Section 4 summarizes the investigation to be undertaken. This study will be conducted jointly by the Centro de Investigacion en Quimica Aplicada (CIQA) and the International Institute for Applied Systems Analysis (IIASA).

2 THE PROBLEM

Some of the Mexican government's earliest initiatives to promote rural development focused on arid lands. In the late 1930's, substantial expansions of the irrigation system in arid and sem-arid regions were undertaken. In 1954, the federal Department of Agriculture established state Committees for the Improvement of Arid Lands. These committees were mainly concerned with the planning of federal investments in arid regions in their respective states. In 1962, the federal government created the Interdepartmental Commission on Arid Lands, comprised of the departments of Agriculture,Industry and Commerce, and Agrarian Reform and Colonization. This commission was created to deal with the economic and social problems of the "candelilleros", the group of people in arid regions who make their living by extracting wax from candelilla.

During the 1950's and 1960's, many other governmental initiatives were taken. Several special offices were established

to deal with the problems of organization of production and commercialization of natural resources in arid regions. For example, the Fideicomiso del Fondo Candelillero was established as a part of the Banco Rural to provide materials, working capital, and certain supporting production services (e.g. transportation) to the candelilleros.

Early in the 1970's efforts were made to institutionalize regional planning and coordination for Mexico's arid lands. At the national level, the Comision Nacional de las Zonas Aridas (National Commission for Arid Lands -CONAZA) was established to integrate and coordinate the implementation of development programs for arid regions. CONAZA was also given the responsibility for recommending specific actions to national ministries with programs in arid regions, such as the departments of Agriculture and Hydraulic Resources, Public Works and Human Settlements, and Education and Health.

A particularly important event during this period was the establishment of the Consejo Nacional de Cienca y Tecnologia (the National Council for Science and Technology-CONACYT). Founded in 1970 as the result of a study by the scientific community demonstrating the urgency of greatly increased support for science and technology, CONACYT was charged with promoting and coordinating Mexico's scientific and technical development.

One of the first steps taken by CONACYT was to establish specific programs in those areas identified as critical for national or regional development. Arid regions were considered to be a critical problem area in which scientific and technical

contributions were needed. In 1972, a joint CONAZA-CONACYT program was initiated which embraced a number of projects on the development of renewable resources in arid regions.

CIQA was founded in 1974 as a part of CONACYT's policy to encourage sppecialized regional centers of scientific excellence. In 1976, because of the strongly-felt need to decentralize and institutionalize R&D activities on arid regions, CIQA was designated by Presidential Decree as a Decentralized Public Institution and directed to do basic and applied research on the development of arid lands' natural resources. As an important step in responding to this directive, CIQA undertook a series of studies of scientific and technological aspects of production based upon plants native to the Mexico's arid lands. These investigations resulted in a number of significant technical advances such as the Saltillo process for production of rubber from guayule.

The mid-1970's brought increasing concern that more coherence and coordination needed to be introduced into development policy and planning. In a policy decision designed to provide a comprehensive framework for planning, in 1977, the Mexican government established the "Plan Global de Desarollo" (global development plan) as a guideline for the development of Mexico. The general goals of this plan are the following:

- Reinforce national independance
- Provide employment and a minimum level of well being
- Promote a rapid, efficient and sustained economic growth

- Improve the distribution of income among people, factors of production, and the different regions.

These global objectives are served by a series of policies among which the most important concern food production, the agro-forestry sector, and the control of population growth. These policies are stated in several plans and programs such as the Agro-Industrial National Plan, the Antidesertification Program, the Mexican Food System, and the National Industrial Development Plan. A common characteristic of all of these plans is the stated intention to use the revenues from oil production to finance regional development plans with special emphasis on the utilization of renewable resources.

With the establishment of the Global Plan, in 1977 the President also established the Coordinacion General del Plan Nacional de Zonas Deprimas y Grupos Marginados (COPLAMAR) in the office of the President of the Republic, and established a National Plan for Depressed Areas and Marginal Groups, which is coordinated by COPLAMAR. The objectives of this plan are to promote actions at the national scale that will foster economic activity and social infrastructure to improve the well-being of social groups and areas that have not yet benefited from development policies. Arid and semi-arid regions and their peoples are an important element of this constituency.

Reflecting the concern that national efforts be coordinated to promote the development of the nation, CIQA's research program has evolved to examine the possible contributions that the plants and processes it has investigated could make to national efforts to develop Mexico's arid and semi-arid lands. As basic

scientific and technical projects began to yield results, CIQA began to search for specific regions in the Chihuahuan desert suitable for the deployment of the technologies it had researched. In 1977, studies were initiated to identify regions that historically had depended upon the exploitation of renewable resources. Based upon these investigations, the Northern Arid Region was identified and a series of studies of various aspects of this region were begun.

Today,CIQA's concern is to study the feasibility of establishing an agro-industrial complex based on six plants (guayule, candelilla, larrea, yucca filifera, yucca carnerosania and lechuguilla for producing respectively rubber, wax, flavonoids, saponina and fibers) within the Mexican Northern Arid Region. On a priori grounds, the possible development of projects based on these native plants makes a lot of sense. Because of the scarcity of resources available for development projects, the development of the arid and semi-arid regions in Mexico must be adapted to the existing climatic and resources of the region, and would have to provide protection against the desertification process.

A seemingly sensible way of proceeding would be to rely on the existing renewable resources of these areas. Indeed such a strategy would present two main advantages. First it would be ecologically coherent with the climatic regional characteristics; the plants which would be considered play an important role in soil protection, water balance and local climate. Second, it would build upon existing activities in these re-

gions; small communities presently process some local native plants on a small scale in order to extract (mainly) fiber and wax.

The effects and ramifications of such projects, however, would extend well beyond the boundaries of the Northern Arid Region. Development projects based on these plants would have consequences for Mexico's efforts to promote import substitution and to promote the development of particular domestic industries. All of these factors are important considerations in the evaluation of development projects based on the above-named crops.

3 OBJECTIVES

The objectives of our study of alternative development projects for the Northern Arid Region are to answer four basic questions:

- Which, if any, of the many possible production processes that could be based on the six plants named above should be deployed in the Northern Arid Region?
- At what scale should they be deployed?

-When should they be deployed?

-What will be the consequences of the implementation of these projects for the development of the region?

By answering these questions, we hope to contribute to the process of project selection for the development of the Northern Arid Region. As a serendipitous byproduct, we hope (we do not promise) that our analysis will provide a useful point of departure for similar analyses in other arid regions of the world. Over 30 percent of the land area of the earth may be classified as arid, and some 17 percent of the earth's current population lives in these regions. All of the reasons that compel the government of Mexico to search for sensible strategies for the use and protection of these lands are equally valid for the other nations containing arid regions.

4 STEPS OF THE STUDY

Figure 1 below provides an overview of the major steps of the study. As can be seen, five major steps are envisioned. Each of these steps is discussed in the following paragraphs.

a. Baseline description of the region

In this step, baseline trends and conditions in the region will be identified. The baseline will include a description of non-human resources in the region and the human settlements that have been organized around them. Our objective in defining the baseline is to provide the information needed to ascertain whether or not the resources required for the production chains to be considered are (or could be) available. For example, one of the scenarios to be evaluated (see the discussion of

scenarios in paragraph c below) will consider the possibility of harvest of wild stands. In order to analyze this scenario, data on the availability of wild stands are needed. These data will be provided in the baseline description of the region.

Since our analysis will necessarily consider the future, the baseline data we develop will also include a projection of the region as it might be expected to be in the future in the absence of development projects of the type we shall analyse. Future projections will be based both on a consideration of trends and on a consideration of the provisions of various plans bearing upon the Northern Arid Region.

b. Analysis of production chains

As noted above, development projects based upon one or more of six native plants are to be considered. In this step of the study, alternative production chains for each of the six plants will be broken down into unit elements (e.g. cultivation, collection, transportation, processing, distribution, and marketing) and the resource requirements of each element will be analyzed. Some of the alternate processes for each stage in the chain do not involve strictly fixed technical coefficients. For example, the rotation period for guayule forests is a decision variable. Time is substitutable for other inputs (e.g. water, bioregulators, etc.). In our analysis of production chains we will give high priority to identification and analysis of such substitution possibilities.

c. Design of alternative scenarios

The analysis of the region and of production chains having been done, specific scenarios representing alternative development strategies will be designed. Based upon these previous analyses, specific production chains will be selected, geographically located, and scaled. Several alternatives and combinations will be developped. These scenarios are intended to be reasonable (but not necessarily optimal) alternatives as a basis for analysing the collective effects of an agro-industrial complex.

Three basic types of scenario will be considered. The first type of scenario is an extrapolation of current trends assuming that nothing is done to change the present state of explotation of renewable resources in the region. The last two types of scenario are based on the assumption that decisions are taken to encourage the use of these productive chains for agro-industrial development. Two levels of encouragement are considered:

(1)Slow commercialization with a strong emphasis on job generation,use of wild stands and forestry, and moderate need for technology

(2) Rapid commercialization calling for a strong market demand orientation,intensive technological innovation, forestry and dry-land agriculture, and high managerial skill.

d. Analysis of scenarios

In this step of the study, each of the scenarios will be analyzed against a set of criteria consistent with the broad objectives set forth in the global development plan (see section 2). In this regard, four classes of criteria have been identi-

fied and will be applied.

The first class of criteria is resource sustainability. These criteria require that the production methods and scales adopted result in yields that do not diminsh systematically over time. For example, these criteria would rule out production chains that resulted in degradation of the soil of the region. Satisfaction of these criteria insures that the plan would be consistent with the Mexican government's intent to promote development based on renewable resources(see Section 2).

The second class of criteria is economic sustainability. These criteria require that, with proper management, implementation of the plan will generate economic returns sufficient to cover the full cost of implementing it.

The third class of criteria is social compatibility. The plan must be consistent with the customs and aspirations of Mexicans living in the Northern Arid Region. It must also be consistent with established norms for social equity and social development.

The fourth class of criteria is political compatibility. These criteria require that the plan not involve political decisions that are impossible given current and foreseeable conditions in Mexico (e.g. reversal of the land reform process). They also require that the plan be compatible with related plans, such as those to combat desertification, to encourage decentralization, and the Global Development Plan.

The analysis of scenarios according to these classes of criteria undoubtedly will suggest some adjustment of the

scenarios and reanalysis. This is indicated by the feedback loop shown in Figure 1.

e. A basis for planning

After several iterations, our hope is to have conducted enough analysis to provide the basis for decisions to be made concerning whether or not, and if so how and when to include development projects based on the technologies investigated in this study in Mexico's development plans.

Realistically, we already know that many of the important parameters on which decisions must rest are unknown or known only with great imprecision. Therefore, we also know that our results and conclusions will be in the form of conditional straregies for sequential decisionmaking, rather than conclusions that a specific decision (i.e. build a 100000 tpy guayule processing plant based on the Saltillo process) is best.

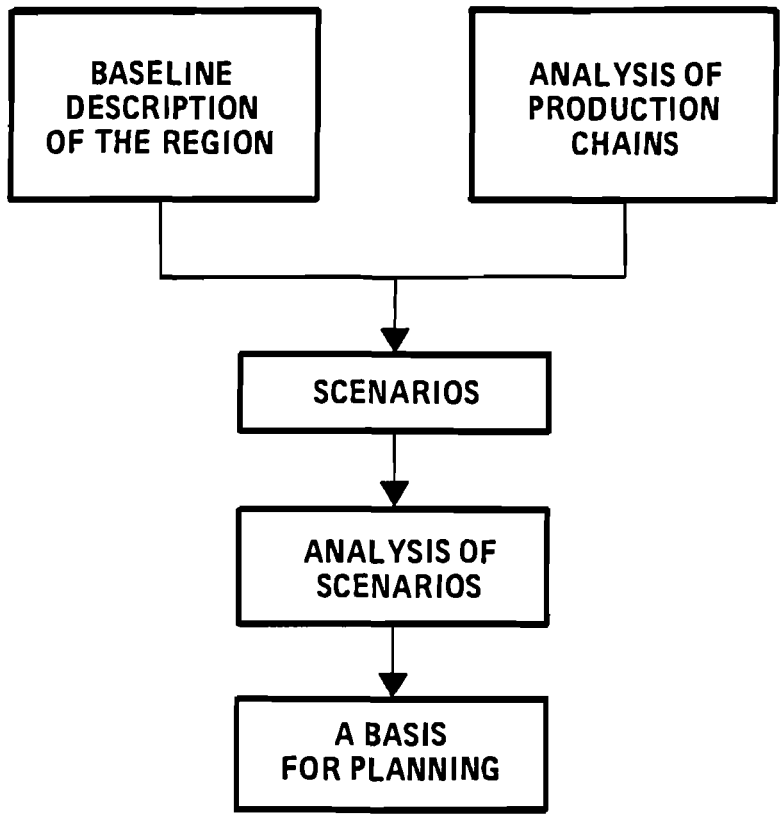

Figure 1. Overview of the project.