

**WATER AND LIVELIHOODS:
A PARTICIPATORY
ANALYSIS OF A MEXICAN
RURAL COMMUNITY**

N.T. Pérez Izadi and M. Cahn

Research Report 00/01
December 2000

Farm and Horticultural Management Group
Lincoln University

ISSN 1174-8796

Farm and Horticultural Management Group

The Farm and Horticultural Management Group comprises staff of the Applied Management and Computing Division at Lincoln University whose research and teaching interests are in applied and theoretical management and systems analysis in primary production.

The group teaches subjects leading to agricultural/horticultural commerce and science degrees, though the courses offered also contribute to other degrees.

The group is strongly involved in postgraduate teaching leading to honours, masters and PhD degrees. Research interests are in systems modelling, analysis and simulation, decision theory, agribusiness and industry analysis, business strategies, employment relations and labour management, financial management, information and decision systems, rural development and also risk perceptions and management.

Research Reports

Every paper appearing in this series has undergone editorial review within the group. The editorial panel is selected by an editor who is appointed by the Chair of the Applied Management and Computing Division Research Committee.

The views expressed in this paper are not necessarily the same as those held by members of the editorial panel, nor of the Group, Division or University. The accuracy of the information presented in this paper is the sole responsibility of the authors.

Copyright

Copyright remains with the authors. Unless otherwise stated permission to copy for research or teaching purposes is granted on the condition that the authors and the series are given due acknowledgement. Reproduction in any form for purposes other than research or teaching is forbidden unless prior written permission has been obtained from the authors.

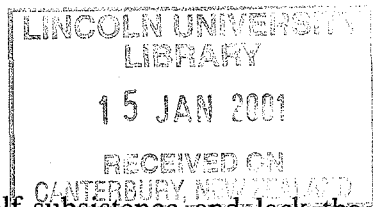
Correspondence

This paper represents work to date and may not necessarily form the basis for the authors' final conclusions relating to this topic. It is likely, however, that the paper will appear in some form in a journal or in conference proceedings in the future. The authors would be pleased to receive correspondence in connection with any of the issues raised in this paper. Please contact the authors either by email or by writing to the address below.

Any correspondence concerning the series should be sent to:

The Editor
Farm and Horticultural Management Group
Applied Management and Computing Division
PO Box 84
Lincoln University
Canterbury
NEW ZEALAND

Email: postgrad@lincoln.ac.nz



SUMMARY

Over 70% of Mexican farms produce only for self-subsistence and lack the necessary economies of scale to be commercial. In the arid and semi-arid regions of the country, which represents 52% of Mexico's total land, farming is difficult and poverty is common. These zones are distinguished by a low level of public investment, scarce official support, lack of inter-institutional coordination and non-existence of an integrated policy for development. Whether development has occurred as a result of the diverse range of projects and programmes is uncertain.

Participatory research, was used to evaluate the effect of the project 'Water and Life' on the development of the rural community of San Felipe (situated in the semi-arid region of Mexico). The research sought to determine whether the community of San Felipe is sustainable by exploring the processes by which people achieve (or fail to achieve) sustainable livelihoods. Also the research evaluated whether the project 'Water and Life' assisted in the process of achieving sustainable livelihoods in San Felipe. Lessons learnt for future development endeavours are derived from the study.

Through the use of PRA techniques, research revealed that the community of San Felipe is very vulnerable and cannot secure enough food for its inhabitants. The project 'Water and Life' has brought about positive changes to the community, one of its major achievements has been to provide the community with three rainwater harvesting systems with a storage capacity of approximately 1.2 million L. However, the project has only partially satisfied the needs of the community and the project has not reduced the vulnerability of the community markedly. Moreover, food security is still an unattainable goal for the community and the benefits of the project are likely to disappear in 25 or 30 years.

Research identified opportunities for San Felipe to improve its livelihood sustainability by better management of its valuable natural resources. In addition, improved participation of women in decision-making, increased coordination of formal groups of the community and the training of women and youth could significantly reduce the vulnerability of San Felipe if addressed by the project 'Water and Life' and the community.

Key words: holistic development, sustainable livelihoods, needs, participatory research, semi-arid land, rainwater harvesting.

CONTENTS

ABSTRACT.....	II
SUMMARY	II
CONTENTS	III
LIST OF TABLES	V
LIST OF FIGURES	V
ABBREVIATIONS AND ACRONYMS.....	VI
CHAPTER ONE: INTRODUCTION	1
1.1 BACKGROUND.....	1
1.2 RESEARCH OBJECTIVES	1
1.3 REPORT STRUCTURE.....	2
CHAPTER TWO: LITERATURE REVIEW	3
2.1 INTRODUCTION	3
2.2 DEFINING DEVELOPMENT	3
2.2.1 <i>Crisis Affecting the World</i>	3
2.2.2 <i>Addressing the World Crisis</i>	4
2.3 POVERTY	4
2.4 SUSTAINABILITY	5
2.4.1 <i>DFID Sustainable Livelihoods Framework</i>	6
2.4.1.1 Vulnerability Context.....	7
2.4.1.2 Livelihood Assets	7
2.4.1.3 Transforming Structures and Processes.....	7
2.4.1.4 Livelihood Strategies.....	8
2.4.1.5 Livelihood Outcomes	8
2.5 PARTICIPATION	8
2.6 SUMMARY.....	9
CHAPTER THREE: RESEARCH METHODS AND DESIGN.....	10
3.1 INTRODUCTION	10
3.2 RESEARCH DESIGN	10
3.2.1 <i>First Phase: Participation of the Stakeholders in the Design of the Research</i>	10
3.2.2 <i>Second Phase: Collection of the Secondary Data</i>	11
3.2.3 <i>Third Phase: Community Participatory Research</i>	12
3.2.4 <i>Fourth Phase: Community Action Plan</i>	15
3.2.5 <i>Fifth Phase: Semi-structured Interviews</i>	15
3.2.6 <i>Methods</i>	15
3.2.6.1 Semi-structured Interview	15
3.2.6.2 Focus Group.....	16
3.2.6.3 Mapping	16
3.2.6.4 Transect Walks.....	16
3.2.6.5 Time Line.....	16
3.2.6.6 Ranking, Scoring and Matrices	16
3.2.6.7 Venn Diagrams.....	16
3.2.6.8 Flow Diagrams	16
3.2.6.9 Daily Schedule	17
3.2.6.10 Brainstorming, Observation and Informal Discussions	17
3.3 CONSTRAINTS	17
CHAPTER FOUR: BACKGROUND TO THE CASE STUDY	18
4.1 INTRODUCTION	18
4.2 MEXICAN AGRICULTURAL SECTOR.....	18
4.3 MEXICAN SEMI-ARID AND ARID REGION	18
4.4 WATER HARVESTING TECHNIQUES.....	19
4.4.1 <i>Run-off Agriculture</i>	20
4.4.2 <i>Run-off Storage</i>	20
4.4.3 <i>Mexican Rainwater Harvesting Techniques</i>	21

4.5 PROJECT 'WATER AND LIFE'	21
4.6 EJIDO OF SAN FELIPE	23
4.6.1 <i>Doctor Arroyo</i>	23
4.6.2 <i>San Felipe</i>	24
4.6.2.1 Human Water Consumption.....	24
4.6.2.2 Vegetable Garden Production.....	25
4.6.2.3 Traditional Productive Activities.....	25
4.7 SUMMARY.....	25
CHAPTER FIVE: RESEARCH RESULTS.....	26
5.1 INTRODUCTION	26
5.2 SUSTAINABLE LIVELIHOODS ANALYSIS –SAN FELIPE	26
5.2.1 <i>Vulnerability Context</i>	26
5.2.1.1 Government Trends.....	26
5.2.1.2 Seasonal Price, Produce and Employment	27
5.2.1.3 Erratic Rainfall and Droughts.....	28
5.2.1.4 Hails, Eclipses, and Hoar Frosts.....	29
5.2.1.5 Coyotes.....	29
5.2.2 <i>Livelihood Resources</i>	30
5.2.2.1 Human Capital	30
5.2.2.2 Social Capital	30
5.2.2.3 Natural Capital	31
5.2.2.4 Physical Capital.....	33
5.2.2.5 Financial Capital	34
5.2.3 <i>Institutions and Organisations</i>	35
5.2.4 <i>Livelihood Strategies</i>	35
5.2.4.1 Rainfed Agriculture.....	35
5.2.4.2 Livestock.....	36
5.2.4.3 Ixtle Extraction.....	36
5.2.4.4 Migration.....	36
5.2.4.5 Pen Animals and Native Crops.....	37
5.2.4.6 Fruit Orchards	38
5.2.4.7 Vegetable Garden.....	38
5.2.4.8 Occasional Jobs.....	38
5.2.5 <i>Livelihood Outcomes</i>	38
5.3 EVALUATION OF THE 'WATER AND LIFE' PROJECT.....	39
5.3.1 <i>Relevance</i>	39
5.3.1.1 Subsistence.....	40
5.3.1.2 Protection	41
5.3.1.3 Understanding and Creation.....	41
5.3.1.4 Participation and Freedom.....	42
5.3.1.5 Identity and Affection	42
5.3.2 <i>Impact</i>	43
5.3.3 <i>Sustainability of Project Benefits</i>	43
5.4 SUMMARY	44
CHAPTER SIX: CONCLUSIONS.....	45
6.1 INTRODUCTION	45
6.2 SUSTAINABLE LIVELIHOODS.....	45
6.3 EVALUATION OF THE PROJECT 'WATER AND LIFE'	46
6.3.1 <i>Achievements</i>	46
6.3.2 <i>Problems</i>	47
6.4 RECOMMENDATIONS FOR THE PROJECT 'WATER AND LIFE'	47
6.5 LESSONS LEARNT	48
REFERENCES.....	50

LIST OF TABLES

<i>Table 1: The Evolution of Thinking about Poverty</i>	4
<i>Table 2: Stakeholder Analysis</i>	11
<i>Table 3: Secondary Data</i>	12
<i>Table 4: Community Participatory Research Design</i>	12
<i>Table 5: Participatory Techniques for the Community Research</i>	14
<i>Table 6: Additional Participatory Techniques</i>	15
<i>Table 7: Arid and Semi-arid Zones Characteristics</i>	19
<i>Table 8: Main Project's Outputs in San Felipe</i>	22
<i>Table 9: Matrix Scoring for Productive Activity Analysis</i>	28
<i>Table 10: Water Resource Management</i>	32
<i>Table 11: Matrix Scoring for Poverty Analysis</i>	34
<i>Table 12: Preference Ranking of Local Products</i>	37
<i>Table 13: Basic Food Consumption</i>	37
<i>Table 14: Impact of the Project</i>	39

LIST OF FIGURES

<i>Figure 1: Sustainable Livelihoods Framework</i>	7
<i>Figure 2: Rainwater Harvesting Concept</i>	20
<i>Figure 3: Rainfall Patterns</i>	24
<i>Figure 4: Flow Chart of Local Product Links and Problems</i>	30
<i>Figure 5: Map of San Felipe</i>	32

ABBREVIATIONS AND ACRONYMS

CEC	Commission for Environmental Conservation
CONAZA	Comision Nacional de las Zonas Aridas National Commission for the Arid Zones
DFID	Department for International Development of the United Kingdom
GDP	Gross Domestic Product
GNP	Gross National Product
IDS	Institute of Development Studies at the University of Sussex
IISD	International Institute for Sustainable Development
ITESM	Instituto Tecnologico y de Estudios Superiores de Monterrey The Monterrey Institute of Technology and Higher Education
NGO	Non Government Organisation
PAR	Participatory Action Research
PE	Participatory Evaluation
PRA	Participatory Rural Appraisal
PROCAMPO	Programa de Apoyos Directos al Campo Agriculture Direct Aid Programme
PROGRESA	Programa de Educacion, Salud y Alimentacion Education, Health, and Nutrition Programme
RRA	Rapid Rural Appraisal
UANL	Universidad Autonoma del Estado de Nuevo Leon Nuevo Leon State University
UNDP	United Nations Development Programme

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Arid and semi-arid land represents 52% of Mexico's total land (CONAZA, 1999a). These zones are distinguished by fragile ecosystems with erratic rainfall of up to 700 mm per annum and periodic droughts (IISD, 1999b). Mexican arid and semi-arid zones are characterised by communal farming systems that support only a marginal existence (CONAZA, 1999a; Wilson and Thompson, 1993). The prevailing productive activities of the region are rainfed agriculture and cattle breeding. However, crops frequently fail due to adverse conditions and the quality of the cattle is poor. Communities depend on irregular income opportunities such as income from wild resources and occasional jobs such as the construction of highways and other works on government projects (CONAZA, 1999a).

In these areas there is a low level of public investment, scarce official support, lack of inter-institutional coordination and non-existence of integrated policy for development (CONAZA, 1999a). In arid and semi-arid lands development endeavours are inconsistent and varied due to the many types of aid projects. Development projects range from national programmes to individual initiatives sponsored by private commercial sponsorship and individual benefactors. Most of the individual initiatives do not have a theoretical basis and rather, are based on past experiences.

One of these individual initiatives is the project 'Water and Life', its purpose is to introduce a new water culture in the Mexican semi-arid rural region to improve the life quality of the peasants, through the establishment of rainwater harvesting techniques (Velasco-Molina, 1999). The project 'Water and Life' is attached to the ITESM University and originated as a response to the university's mission to foster sustainable development. The project selected San Felipe as the first community to receive the new technologies. San Felipe is a small community of 73 inhabitants. Few people have regular employment and their other productive activities depend on water, which is limited.

1.2 RESEARCH OBJECTIVES

To determine whether development has occurred or not, development needs to be judged not only in terms of economic growth, but also in terms of elimination of poverty, sustainability and people empowerment (Speth, 1994). The purpose of this research is to evaluate the effect of the project 'Water and Life' on the development of the community of San Felipe.

To evaluate the project 'Water and Life' first the livelihoods of San Felipe were analysed. Once a holistic and integrated picture of San Felipe was depicted, the role of the project in the achievement of sustainable livelihoods in San Felipe was analysed. For the analysis of the community and the project 'Water and Life', two complementary holistic frameworks were selected: the DFID sustainable livelihoods analysis and the Max-Neef human scale development approach.

The specific research objectives are to:

1. Determine whether the community of San Felipe is sustainable by exploring in a holistic and integrated way the processes by which people achieve (or fail to achieve) sustainable livelihoods.
2. Evaluate the project 'Water and Life' in relation to its ability to assist in the achievement of sustainable livelihoods in San Felipe, as explored by objective 1.
 - 2.1. Determine to what extent the project has satisfied, and will in the future satisfy, the needs of the community.

- 2.2. Determine to what extent has the project activities have brought about changes for the betterment of the community, and whether there are changes likely in the future.
- 2.3. Determine the sustainability of project benefits.
3. Identify the lessons learnt for future development endeavours.

1.3 REPORT STRUCTURE

Chapter two introduces the conceptual framework for this research. Chapter three describes the research methods and design. Chapter four depicts the background to this case study while chapter five shows the research results obtained in the field using the DFID sustainable livelihoods framework and Max-Neef human scale development approach. Finally, chapter six draws together the conclusions and suggests recommendations for the improvement of the project 'Water and Life' and lessons learnt that can be used in future development endeavours.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This research is based on assumptions and methods that not only generate research results but also facilitate sustainable development. Chapter two introduces the conceptual framework of this research. The main themes of development discourse: its concepts, paradigms, goals, and strategies are brought together to provide a framework from which it can be judged whether sustainable development has occurred or not in a project. This then serves as the basis for the study and evaluation of San Felipe community and the project 'Water and Life'.

2.2 DEFINING DEVELOPMENT

2.2.1 Crisis Affecting the World

Modern theories of development and countless development projects concentrate their endeavours in three major crises affecting the world: poverty, environmental failure, and denial of human rights (Smith, 1997; Ekins, 1992; Korten 1990). Different approaches are taken to solve these three crises. Four dominant approaches to development have evolved over the last half of the 20th century:

1. Rapid economic growth. The dominant approach during the post-World War II period, emphasises on the total value of economic production and less on the role of the individual. This approach assumes that western market economies have achieved rapid and sustained growth and that 'third world' countries should follow the western path of development (Regan, 1996). This development approach has a focus in linear and convergent development through stages of growth, top-down decision-making processes, reliance on a trickle-down effect for distribution of resources and non-sustainable exploitation of natural resources (Chambers, 1997; Cernea 1991).
2. Development as structural change. Emerged in the mid 1970s, in this approach development is defined as economic, political, social and cultural independence with an explicit commitment to social justice and to equality in the distribution of wealth and resources (Regan, 1996; UNDP, 1999b).
3. Development as liberation. Emerged at the time of the democratisation movements of the late 1980s and early 1990s in Africa, Latin America and Eastern Europe. Emphasises on the integrity and humanity of each person and on the creation of circumstances in which such traits can be realised. The traditional view of economic growth is seriously challenged because it is argued that over-concern with material well-being creates just as many problems as it solves. The developed countries are seen as mal-developed (Regan, 1996; UNDP, 1999b).
4. Gender, culture and the environment. These issues have been significantly absent from the mainstream of development in the past. In recent years, the recognition of the subordination of women in gender relations, the acknowledgment of traditional knowledge, culture diversity and the awareness of environment deterioration have contributed to a more rounded and sensitive definition and concept of development (Regan, 1996). The inclusion gender, culture and environment awareness has enhanced the seeking of justice and liberation by development endeavours.

The appearance of new approaches to development denote a major change in paradigm that could be explained as a change from a vision 'centred in things' to a new one 'centred in people' (Chambers, 1995). This shift is also described by Max-Neef (1991, p.16): "development is about people and not about objects". Korten (1990) differs on terminology,

naming the things-centred paradigm as 'development as growth', where both human and environmental considerations are being subordinated to the goal of economic growth. He claims that the critical issue for the 1990s is not growth, it is transformation.

However, economic issues have not been ignored in more recent approaches to development but rather other issues, such as participation, human rights, and gender, are seen as equally important. The development concept has evolved into more holistic approaches that integrate economic, social, political, cultural and spiritual aspects of human endeavour.

2.2.2 Addressing the World Crisis

How can it be judged whether development has occurred? That is, how can it be known when the crisis of poverty, environmental failure, and denial of human rights have been addressed. Korten (1990) suggests that the solution for these three crises resides in the transformation of the societies' institutions, technology, values, attitudes and behaviour. The transformation must address three basic needs: justice, sustainability and inclusiveness (Korten, 1990).

Development endeavours that take a more people-centred approach to these crisis promotes goals such as sustainable livelihoods, local participation, empowerment, and emancipation of women and children (The World Bank, 1999; UNDP, 1999a). In general, it seems that the concepts of poverty, sustainability and participation are key to understand the process of development. These issues are developed in the following sections.

2.3 POVERTY

Poverty has been defined in many different ways. Kunbar and Squire (1999) highlight the progressive broadening of definition and measurement of poverty, from a narrow income/consumption approach to other dimensions of living standards such as longevity, literacy and health, and most recently, to concerns with risk, vulnerability, powerlessness and lack of voice. As shown in Table 1, this broadening changes remarkably the thinking about measurements and strategies to reduce poverty.

Table 1: The Evolution of Thinking about Poverty

Definition of Poverty	Measurement	Strategies
Lack of income or commodities.	Poverty lines (budget for minimum subsistence).	Expansion of per capita income (economic growth).
Lack of long lives, health services and education.	Human poverty index (Longevity, literacy and living standard). 1) Longevity = % of people who die before age 40. 2) Literacy = % of adults who are literate. 3) Living standards = % of population with access to health services, safe water, and % of malnourished children under age 5.	Investment in better health and education.
Risk and vulnerability, powerlessness and lack of voice.	Participatory Poverty Assessment (views about poverty from the poor themselves).	Safety nets, access to credit and participation.

Source: based on Kunbar and Squire, 1999

Traditional approaches to development have fostered consumerism due to the narrow perspective of poverty as income and consumption. However, nowadays it is evident to see that excessive consumption damages the environment and generates gross inequalities (UNDP, 1998; Korten, 1996).

A broader approach of poverty is 'human scale development' described by Max-Neef (1991), where poverty is defined and measured beyond the income/consumption concept. Max-Neef, a Chilean economist who has worked for many years with the problem of development in the third world, criticises the conventional models of development that have led to increasing poverty, massive debt and ecological disaster for many communities. Max-Neef (1991) asserts that fundamental human needs are finite, few and classifiable, which contradicts the conventional supposition that human needs are infinite and that an increase in consumption clearly contributes to human development

Max-Neef (1991) classifies the fundamental human needs as subsistence, protection, affection, understanding, participation, idleness, creation, identity, and freedom. Therefore, different countries may present different 'poverties' and 'wealths' that need to be addressed. While many countries have been classified as 'developed' because of an adequate satisfaction of the needs of subsistence, protection and freedom, they may present serious dissatisfaction on such needs as identity and affection. Thus poverty is a multi-dimensional phenomenon. These dimensions include spiritual poverty, which is considered to be manifested by the spread of values of over-consumption. Thus not only under-consumption, but also excessive consumption that has generated pathologies of poverty. For instance, Smith (1997, p.3-4) describes a spiritual poverty that affects the urban, industrialised world:

Cities grow too big with little sense of community; people are increasingly mobile, focussed on individual competition and consumerism, and are bombarded with media messages. The ties that compassionately bond human relationships are disturbingly weak. Too many people are vaguely discontent or living on the edge of anger. Rising rates of addictions to drugs and alcohol, child and sexual abuse, battery, family violence, loneliness, obesity, depression, and suicide attest to widespread confusion and emptiness. This is a poverty of spirit. It also cyclical, revealing symptoms of poor health that also lead to limited opportunities in life.

Housing, cars, food and other wants are commonly referred to as needs. However, Max-Neef (1991) defines them as satisfiers. Max-Neef (1991) lists five types of satisfiers: violators or destroyers, pseudo-satisfiers, inhibiting satisfiers, singular satisfiers and synergic satisfiers. Many development approaches focus on achieving specific satisfiers without really reflecting on whether there are any other satisfiers that could more adequately address the identified need.

The approaches to development have broadened to a more holistic focus, and paradigms have become more people-centred. As well, poverty assessment has evolved from simple poverty lines to a more participatory approach where poor people are given the opportunity to contribute to the definition of poverty. With this new approach, risk, vulnerability, powerlessness and lack of voice have been identified as dimensions of poverty. By adding these dimensions to the poverty phenomenon, sustainability and participation have been integrated into poverty reduction strategies (DFID, 1999; World Bank 1999; UNDP, 1999a; IISD, 1999a; Korten, 1996).

2.4 SUSTAINABILITY

While there are many different definitions of sustainable development, most are variations of what was expressed by the World Commission on Environment and Development in their 1987 report 'Our Common Vision' (The Earth Council, 1999; UNDP, 1999c; Singh and Strickland, 1994). The report defines sustainable development as follows:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of

limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. (The World Commission on Environment and Development, 1987, p.43).

Sustainable development has interdependent economic, social and environmental dimensions that can no longer be seen as separate issues. It has been recognised that the eradication of poverty is a requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world (UNDP, 1999c; DFID, 1997; Agenda 21, 1992). It has also been recognised that environmental issues are best handled with the participation of all concerned citizens, at the relevant level. Thus for example, women's full participation is essential to achieve sustainable development (DFID, 1997; Agenda 21, 1992).

In the last decade it has become evident that there is a need to integrate poverty reduction strategies, sustainable development and participation and empowerment processes into a framework for policy analysis and programming. The term 'sustainable livelihoods' has become the concept used to link together socioeconomic and ecological policy considerations (UNDP, 1999c; DFID, 1999; IISD, 1999a; Korten, 1996; Loubser, 1996).

Livelihoods are the means, activities, entitlements and assets by which people make a living (UNDP, 1999c; Hoon, Singh and Wanmali, 1997; Loubser, 1996). In many 'developed' countries the concept of single wage earner in a career job is common. In contrast, livelihood structures in 'third world' countries are complex, usually integrating the incomes, skills and services of the family in an effort to reduce the risks associated with living near subsistence (IISD, 1999a). People can have several sources of livelihoods and a variety of strategies for securing a livelihood. A livelihood system is dynamic and embraces both the present availability of the means to make a living and the security against unexpected shocks or crises that threaten livelihoods (Hoon, Singh and Wanmali, 1997; Loubser, 1996).

In general, sustainable livelihoods can be defined as:

Sustainable livelihoods are derived from people's capacity to make a living by surviving shocks and stresses and improve their material condition without jeopardizing the livelihood options of other people's, either now or in the future. This requires reliance on both capabilities and assets (i.e. stores, resources, claims and accesses) for a means of living. A livelihood is sustainable if it can cope with, recover from and adapt to stresses and shocks, maintain and enhance its capabilities and assets, and enhance opportunities for the next generation. (Hoon, Singh and Wanmali, 1997, p. 5).

An example of a framework based on the concept of sustainable livelihoods is described below.

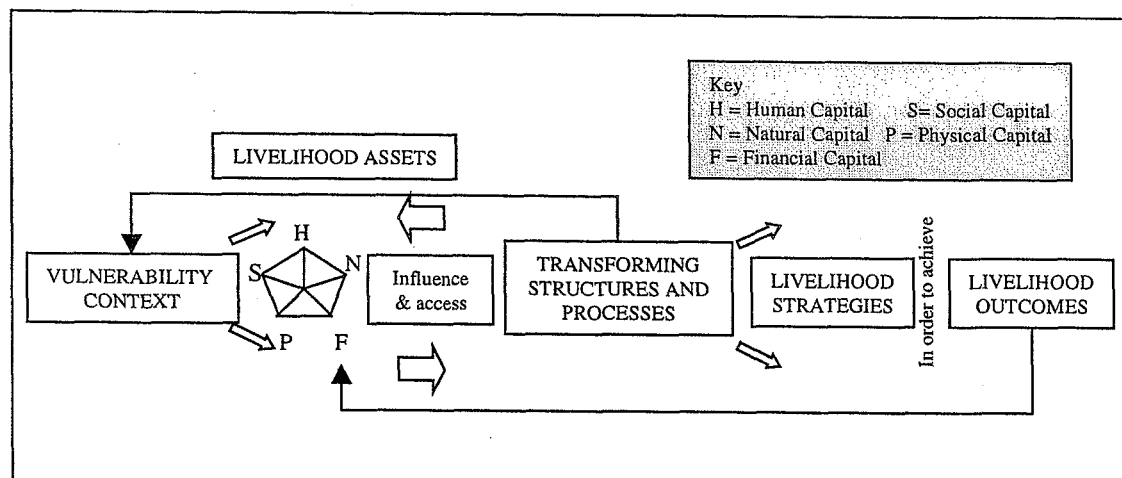
2.4.1 DFID Sustainable Livelihoods Framework

The livelihoods framework is a tool to improve the understanding of livelihoods, particularly the livelihoods of the poor. The framework is centred on people, and focuses in the strengths of the community, not the needs (DFID, 1999). It does not work in a linear manner and does not try to present a model of reality.

As shown in

Figure 1, livelihoods are shaped by a multitude of different forces and factors that are themselves constantly shifting (DFID, 1999).

Figure 1: Sustainable Livelihoods Framework



Source: adapted from DFID, 1999

2.4.1.1 Vulnerability Context

The vulnerability context frames the external environment in which people exist. It is classified in trends, shocks and seasonality. For example, the vulnerability context of a community could be analysed by population and technological trends; natural, economic or conflict shocks; or the seasonality of prices and production. The vulnerability context is important because it has a direct impact upon people's asset status and the options that are open to them in pursuit of beneficial livelihood outcomes (DFID, 1999).

2.4.1.2 Livelihood Assets

Also known as livelihood capitals, these are classified as human, natural, financial, social and physical assets. Livelihoods are built upon these assets; they are the strengths of the community and could ensure sustainability if nurtured and combined in innovative ways (DFID, 1999). In

Figure 1, the livelihood assets are represented as a pentagon. Human capital represents skills, knowledge and ability to labour and good health. Social capital represents social resources such as networks, formal groups and relationships of trust. Natural capital comprises the natural resource stocks such as water, the land, the forests, and services such as waste management and erosion protection. Physical capital comprises the basic infrastructure and producer goods needed to support livelihood, such as roads and telecommunications. And financial capital denotes the financial resources that people use to achieve their livelihood objectives, such as availability of cash (DFID, 1999).

2.4.1.3 Transforming Structures and Processes

Transforming structures and processes refers to the institutions, organisations, policies and legislation that shape livelihoods. Structures and processes are of crucial importance for sustainability because they determine the access, terms of exchange, and returns from assets and livelihood strategies (DFID, 1999). Examples of structures are the government and the private sector. Examples of processes are laws, policies, culture and institutions.

2.4.1.4 Livelihood Strategies

Livelihood strategies denote the range and combination of activities and choices that people make or undertake in order to achieve their livelihood goals (including productive activities, investment strategies, reproductive choices, etc.) (DFID, 1999).

2.4.1.5 Livelihood Outcomes

Livelihood outcomes are the achievements or outputs of the livelihood strategies. These are classified in 1) more income; 2) increased well-being; 3) reduced vulnerability; 4) improved food security; and 5) more sustainable use of the natural resource base (DFID, 1999).

2.5 PARTICIPATION

'Participation' is a term that has been included in the development discourse since the 1950s and 1960s. The 1950s and the 1960s saw the start of an emphasis on community development, where initiatives of development assistance and of planned interventions sought to involve local people in efforts to improve their community (UNDP, 1999d).

Despite the multitude of participatory approaches that are recognised in the development world, Korten (1990) criticises current development practice as systematically depriving substantial segments of the population of the opportunity to make recognised contributions to the improved well-being of society. This situation is well described by the Bahá'í International Community (1995, p. 2) as follows:

Despite acknowledgment of participation as a principle, the scope of the decision-making left to most of the world's population is at best secondary, limited to a range of choices formulated by agencies inaccessible to them and determined by goals that are often irreconcilable with their perceptions of reality.

Korten (1990) calls for 'inclusiveness' to eliminate this repression by giving the right to everyone who chooses to, to be a productive, contributing community member and to be recognised and respected for this contribution. Most of the latest development discourse supports inclusiveness and participation. Many well-established traditions have put participation, action research and adult education at the forefront of attempts to emancipate disempowered people (Pretty et al, 1995). However, so called participation may not always contribute to the process of inclusiveness as described above.

However, as the development paradigms have become more people-centred, the concept 'participation' has also evolved. Participatory development, as it is known today, arose as a reaction to the failure of development to improve the majority poor of third world countries. It has been particularly popularised by Gordon and Chambers, and more recently by Korten (Rennie and Singh, 1996).

Participation can interpreted and described in several ways:

1. Participation as a means. People and their participation is used as a tool by outsiders for the achievement of some implicit or intentionally concealed aim. In this way participation becomes the means whereby such aim can be implemented more effectively (UNDP, 1999d; Rocheleau and Slocum, 1995). This participation is sometimes referred to as 'technical' (Selener, 1997), or described as a 'co-opting practice' to mobilise local labour and reduce costs (Chambers, 1995).
2. Participation as an end. Participation is seen as a goal itself where it is sought to empower people. Participation becomes an instrument of change and it can help to break the exclusion of poor people and provide the basis for their more direct involvement in development initiatives (UNDP, 1999d). It describes an empowering process which enables local people to do their own analysis, to take command, to gain in confidence, and to make their own decisions (Chambers, 1995; Rocheleau and

Slocum, 1995). This type of participation has also been described as 'political' participation (Selener, 1997).

3. Pseudo-participation. Participation is used for the manipulation of people to do what the outsiders perceive as important for their own benefit rather than to empower the participants. This type of participation could be referred to as 'paternalism', where participants are treated as passive objects, incapable of taking an active part in the process (Selener, 1997). Participation is used as a cosmetic label, to make whatever is proposed appear good. Donor agencies may be required to use participatory approaches, and although some participatory techniques and traditions are used their reality is still top-down in a traditional style (Chambers, 1995).

Not all interpretations of participation will foster the process of eliminating repression and promoting inclusiveness. Only if participation is used as an end can it be a tool to empower deprived segments of society.

2.6 SUMMARY

How can it be judged whether development has occurred? To answer this question the chapter started by defining development and recognising that the world's main development problems are poverty, environmental degradation and denial of human rights. It was determined that these problems can be solved by addressing the needs of justice, sustainability and inclusiveness. The chapter continued by describing the threads of poverty, sustainability and participation which are essential elements of contemporary development. Emphasis has been placed on Max-Neef approach and DFID sustainable livelihoods framework. The elements addressed offer a holistic conceptual framework from which successful development endeavours within communities and projects can be identified.

CHAPTER THREE: RESEARCH METHODS AND DESIGN

3.1 INTRODUCTION

The objective of this research is to evaluate the effect of the project 'Water and Life' on the development of the community of San Felipe. As identified in the literature review, poverty, sustainability and participation are essential elements to take into account when judging development. Thus, the research was designed to explore the sustainability of San Felipe's livelihoods using the DFID sustainable livelihoods framework as a first stage in the evaluation of the project 'Water and Life'. The second stage concentrates on determining the relevance and impact of the project 'Water and Life' in the achievement of sustainable livelihoods in San Felipe. For this second stage the Max-Neef human scale development approach was used as a basis.

To gather the necessary data, the research methods and design must be congruent with the sustainable livelihoods framework and the Max-Neef human scale development approach. This chapter describes the research methods and design.

3.2 RESEARCH DESIGN

The research methods and design are based on the critical social science and feminist research approaches. The purpose of the study is exploratory. It is an applied research based on participatory action research and participatory evaluation. The research is a qualitative single-case study that gathers data through participatory rural appraisal techniques.

The research design evolved in accordance to PAR assumptions and PRA foundations of methods, sharing, behaviour and attitudes. Participation is seen as a goal in itself seeking to empower people, and thus involves participants in the design process as well as the analysis process. This goal is not sacrificed for the creation of research results. The design of the research can be divided into five phases:

1. Participation of stakeholders in the design of the research.
2. Collection of the secondary data.
3. Community participatory research.
4. Community Action Plan.
5. Semi-structured interviews.

Parallel to these five phases, valuable information was collected through observation and informal discussions with the different stakeholders of the community.

3.2.1 First Phase: Participation of the Stakeholders in the Design of the Research

For the first phase it was important to identify the stakeholders of San Felipe and the project 'Water and Life'. The most important stakeholders of San Felipe are presented in Table 2.

Table 2: Stakeholder Analysis

Stakeholder groups	Interest(s) at stake
Municipality Mayor	To look after the welfare of the municipality of Doctor Arroyo.
San Felipe Commission	To execute the decisions of the community and to represent the community of San Felipe to wider institutions.
Coordinator of the project 'Water and Life'	To introduce a new culture of water in the Mexican semi-arid rural region. To improve the life quality of the peasant population.
Assistant coordinator of the project 'Water and Life'	To support and follow up the activities of the project 'Water and Life'.
San Felipe community Women Men Youth Children	To better their own situation and for future generations.
Primary teacher	To teach the children. (An outsider, not a member of the community)
Kindergarten teacher	To teach the children.
Evangelical priest	Offer Sunday service. (An outsider, not a member of the community).
ITESM	Foster research and extension that contributes to the sustainable development of Mexico.
Donors	Not directly involved as their funds are donated to and are the responsibility of ITESM.

The coordinator of the project 'Water and Life' and the Commission of San Felipe were selected to participate in the design of the research because they are key gatekeepers of the community. Without their participation it would be very hard to carry out research inside the community and generate rapport.

The coordinator of the project 'Water and Life' was asked if there was any information that he would like to obtain through this research. The coordinator expressed his interest and concern in knowing what would happen to the project's benefits when the project finishes. This interest was included as one of the objectives of the research.

The Commission of San Felipe participated in the design of the participatory community research. The Commission determined the dates, venue, schedules, and selection of people who would participate in the research. The Commission was responsible for the organisation of the community research; they informed and invited the participants.

3.2.2 Second Phase: Collection of the Secondary Data

Secondary data was collected and its purpose is shown in Table 3. There was broad statistical information, and general data about the semi-arid region of Mexico. However, there was little information available about the project 'Water and Life' and about San Felipe.

Table 3: Secondary Data

Secondary Data	Purpose
Government statistics and documents. Historical archives. Academic research. Population census data. Project 'Water and Life' archives: San Felipe rainfall 1996-1999. Water consumption from the vegetable garden cistern. Vegetable garden production. Manual irrigation of the peach orchard. Medicine consumption April-August 1999.	Obtain background information about the region and the project 'Water and Life' Determine the vulnerability context of San Felipe Determine the organisations and institutions that exist and have influence upon San Felipe's livelihoods.

3.2.3 Third Phase: Community Participatory Research

The participatory research carried out in the community was designed with the Commission one week before the actual community research (Table 4). The aims of the research were presented to the Commission, and it was explained that the findings would not necessarily be translated into action unless the community was able to implement the action by their own means. The reason for this was so that the community did not have unrealistic expectations of benefits from the research process.

Table 4: Community Participatory Research Design

Days	Groups	Schedule	Details
Sunday	Arrival 11.30 am		Dates: 26 July- 1 August 1 day: 6 hours \$40.00 ½ day: 3 hours \$20.00 Place: 'La Corregidora' (Old Kindergarten)
Monday	5 men (Group 1)	9-12 a.m., 1- 4 p.m.	
Tuesday	5 men (Group 2)	9-12 a.m., 1- 4 p.m.	
Wednesday	5 women (Group 3) Youth group (6 men, 3 women)	9-12 a.m., 4-7 p.m. 7-8 p.m.	
Thursday	5 women (Group 4)	9-12 a.m., 4-7 p.m.	
Friday	2 men and 2 women (Group 5) Community session	9-12 a.m. 5-6.30 p.m.	
Saturday	Feedback to the coordinator		
Sunday			

It was decided to have participants in groups of five members with each group working with the researcher for one day. These groups were segregated by gender, and were composed of married people with an age range of 23 to 70 years old. The selection of the first four groups was left to the discretion of the Commission. The fifth group (Friday) was composed by one of the members of the former groups (Table 4). Due to the fragility of the community whereby a day without work is a day without eating, and because the research did not have any tangible benefit to the community, it was decided to acknowledge the work of the participants with a symbolic payment. However, the youth group and the community session were arranged without any payment.

For women to feel comfortable and express themselves freely it was necessary for the researcher to meet separately with the women and the men (Table 4). The gender segregation of groups was essential because it brought insights into how access to and control of domestic and community resources varied according to gender, and clarified the roles and activities of men and women (Rietbergen-McCracken and Narayan, 1998).

The Commission played an important role in the success of the week. Their advice made it possible to design schedules that suited the people, especially making it possible for the women and youth to attend (Table 4). The ten people selected by the Commission covered 11 families from the 13 families living in the community. The other two families were omitted because one family had migrated temporarily, and the other family does not have children and is seldom in San Felipe. Therefore, the selection made by the Commission covered all the inhabitants of San Felipe apart from the children. Children could not be included because they were on school holidays and the primary teacher was not available. This situation made it impossible to gather the children.

Techniques used in the different groups are shown in Table 5. The data was triangulated by collecting the same information from different groups and by different techniques. Groups also participated in taking pictures and video recording. Original results, including a copy of the pictures and video taken, were left with the Commission. The video taken during the week was shown after the community session (Table 4).

The researcher lived in San Felipe during the field research. The Commission arranged accommodation and food for the researcher for the week. They also arranged transportation to and from San Felipe because public transport to San Felipe is available only once a week.

Table 5: Participatory Techniques for the Community Research

Technique	Group	Purpose
Mapping	G1	Identify resources and problems regarding community management and use.
Time Line	G1	Identify the most important events that had occurred in San Felipe. Identify trends and shocks.
Matrix Scoring	G1	<p>Wealth Ranking Identify the criteria used by local people to measure poverty. Determine levels of poverty and the poorest in the community. Determine desired livelihood outcomes. Identify needs.</p> <p>Productive Activity Analysis Identify and evaluate the men's major productive activities and the livelihood strategies of San Felipe. Identify the strategies that they use to cope with stresses and shocks.</p>
Matrix Analysis	G1	Analyse the sustainability of project benefits
	G2	Analyse the main sources of income and expenditure in the household Identify the strategies that people use to cope with stresses and shocks.
	G3	Determine food and water consumption trends Identify the needs regarding food and water Identify the strategies that people use to cope with stresses and shocks.
	G4	Determine food and water consumption trends. Identify main sources of water for consumption and household use. Identify the strategies that people use to cope with stresses and shocks.
Transect walks	G2	Obtain background information of the community.
	G3	Identify main productive activities.
	G4	Identify needs and problems. Identify the strategies that people use to cope with stresses and shocks.
Ranking	G3	Identify and prioritise the main local products of the community and.
	G4	Identify the strategies that people use to cope with stresses and shocks.
Flow diagram	G3	Identify the major problems and their causes.
Daily Schedule	G3	Determine the productive and reproductive activities of women and their role in the project
Brainstorming	G3	Identify the benefits of the project
Focus Group	YG	Identify the vision of the youth about San Felipe and how they perceive the project in their future life.
Community Session	G5	Obtain feedback from results and prepare the results for the community session.
	Comm- community	Share the results with the community.

G1: Group 1 (men) G2: Group 2 (men) G3: Group 3 (women)
G4: Group 4 (women) G5: Group 5 (mixed) YG: Youth Group (mixed)

3.2.4 Fourth Phase: Community Action Plan

One week after the participatory community research, the Commission was asked to elaborate an action plan based on the issues raised during the participatory research. The purpose of the action plan was to commit the research to a practical activity that could benefit the community. Its other purpose was to determine which needs and problems identified in the research could be solved without external aid.

3.2.5 Fifth Phase: Semi-structured Interviews

Only key informants were selected for semi-structured interviews. These key informants were interviewed separately because their inclusion in group discussions would bias the response of the other participants. Description of the semi-structured interviews and other additional participatory techniques are shown in Table 6.

Table 6: Additional Participatory Techniques

Technique	Informant	Purpose
Semi-structured interview	Coordinator of the project Assistant coordinator of the project	Obtain background information about the region and the project 'Water and Life'. Identify strengths and weaknesses of the project. Determine level of participation of the people. Determine impact and relevance of the project. Identify livelihood strategies of San Felipe. Identify livelihood resources of the region.
	Mayor of Doctor Arroyo	Obtain background information on Doctor Arroyo, its projects and priority needs. Determine the impact of the project at the district level. Determine the organisations and institutions that exist and have influence upon San Felipe's livelihoods.
Venn Diagram	Coordinator of the project	Identify the key groups and individuals in San Felipe and the project 'Water and Life'.
Observation and informal discussions	Community Project Staff	Obtain background information about the community and the project. Identify needs and problems. Identify resources and activities and the way they cope with stresses and shocks. Identify livelihood outcomes.

3.2.6 Methods

3.2.6.1 Semi-structured Interview

Also called conversational interviews, semi-structured interviews make use of a flexible interview guide to ensure that the interview remains focused on the research issue at hand while keeping the conversation informal enough to allow participants to introduce and discuss issues that they deem relevant (Rietbergen-McCracken and Narayan, 1998; The World Bank, 1996).

3.2.6.2 Focus Group

A focus group is a semi-structured consultation with a small group to explore people's attitudes, feelings, or preferences, and to build consensus. A focus group is a compromise between participant observation and preset interviews (The World Bank, 1996).

3.2.6.3 Mapping

Mapping is a means of collecting data about people's own perspective of their environment and locality. A map can display visually geographic features, common social characteristics or local resources and their location. It not only provides information about physical characteristics but can also reveal much about the socio-economic conditions and how the participants perceive their community (Rietbergen-McCracken and Narayan, 1998; Young and Hinton, 1996).

3.2.6.4 Transect Walks

Transect walks are walks around the community accompanied by the local people in order to observe the people, surroundings and resources (de Negri et al, 1998), and gain information from the local people about the observations.

3.2.6.5 Time Line

A time line is a linear presentation of local history or trends. Time lines indicate the changes that have happened in the community over time and significant events in the history of the community (Young and Hinton, 1996).

3.2.6.6 Ranking, Scoring and Matrices

These techniques are very commonly used tools and have a broad application. They can be broadly classified into four types (Jones, 1996):

1. Ranking. Elements are ranked in order of preference or importance.
2. Matrix Ranking. Involves listing the elements down one side, and the criteria on which they are judged, gained from informal discussion with participants, across the top. Each element is ranked in terms of each criteria.
3. Matrix Scoring. Based on the same principle as matrix ranking but the elements are not simply ranked but also scored. In this way not only are preferences found, but the relative weight given to each preference is indicated.
4. Matrix Analysis. It does not involve scoring or ranking, per se, but uses other indications of frequency.

3.2.6.7 Venn Diagrams

Venn diagrams are usually used to identify key institutions, organisations and individuals, and their relationship with the local community or other group. On the Venn diagram, each institution is represented, usually by a circle, and the size of the circle represents the importance and the distance or degree of overlap is the level of interaction that occurs (Jones, 1996).

3.2.6.8 Flow Diagrams

Flow diagrams are graphical representations of processes on chains of events. They help communities to analyse the impact of different problems and solutions and they help to illustrate linkages between different events (de Negri et al, 1998).

3.2.6.9 Daily Schedule

Daily schedules are useful as a way for community members to show how they spend their day (Rietbergen-McCracken and Narayan, 1998). One of the techniques is to make a linear presentation of the activities.

3.2.6.10 Brainstorming, Observation and Informal Discussions

These three techniques are simple and self-explanatory techniques that are very valuable for the collection of qualitative data (Chambers, 1992).

3.3 CONSTRAINTS

1. One of the major constraints was the limited time to carry out the research. It took one month to build rapport with the different stakeholders and collect the secondary data. It was a slow process that was not under the control of the researcher. It was only possible to spend 17 days in San Felipe as the researcher became ill, there was limited transport, the researcher could not impose on village hospitality and the budget was limited.
2. Timing of the research caused some constraints. School holidays and the absence of the primary teacher made it impossible to involve the children. There was also a seasonal bias in that participants raised problems mainly of the season they were experiencing at the time the research was carried out. Ideally, the researcher should return at another time of the year to verify results and avoid this bias.
3. Lack of indicators and clear objectives made the evaluation of the project 'Water and Life' difficult. It was not known with certitude what was expected of the project nor what the criteria for success, efficiency or effectiveness were.
4. Women's groups struggled to speak out as they were not used to expressing their opinion. Women needed to bring their children along to the sessions, which made the facilitation of the techniques difficult. Women did not participate in the initial design of the research because all the members of the Commission are men. However, the women were able to make suggestions as the research progressed.
5. Despite the fact that the project coordinator was not present during the research, some of the participants felt concerned about addressing the project. They felt loyalty to the coordinator of the project (especially the Commission members) and were reluctant to discuss the shortcomings of the project 'Water and Life'.
6. The community session, which was carried out by the individuals of the community, took more time than expected and at the time for feedback it started to rain. Therefore the community plan was designed by the Commission and not by the community. It was not possible to organise another community session after the first one.
7. The last month of the research the coordinator of the project 'Water and Life' became severely ill. Therefore, further interviews or feedback of the results was not possible.
8. Because of the nature of this research, uncertainty as to what was going to be achieved was an on-going feature during the fieldwork. There was uncertainty about who the stakeholders would be and the participation of stakeholders in the research design. There was uncertainty as to the participation of the community in the collection and analysis of the data. There was uncertainty as to the ability to implement the research due to the limited budget and the susceptibility of the researcher to health problems caused by the adverse living conditions of the area. Flexibility was the key to the successful completion of this research. The formulation of the action plan is an example of this flexibility, where it could not be carried out as expected due to the participation of the local people in the presentation of the findings.

CHAPTER FOUR: BACKGROUND TO THE CASE STUDY

4.1 INTRODUCTION

This chapter reviews the relevant secondary data. This secondary data review provides the necessary contextual background to the case study. Sources include national and regional statistics, government agencies' documents, census data, the project 'Water and Life's' documents and regional academic research.

4.2 MEXICAN AGRICULTURAL SECTOR

Historically, Mexico has been a net agricultural importer. As described by the Canadian Embassy in Mexico (1997), Mexico's agri-food sector cannot produce enough food to feed its current population of 93 million. Agricultural production makes up only 5.4% of the GDP and is declining as the economy develops and diversifies. Over 70% of Mexican farms are subsistence or community farms and lack the necessary economies of scale to be commercial. Mexico has 27 million productive hectares but the average farm size is 5 hectares and less than 7 million hectares have access to irrigation.

As explained by Wilson and Thompson (1993), approximately 40% of the agricultural land in Mexico is controlled by organised communal farming systems named 'ejidos'. Gutierrez (1996) describes the ejido as an extension of land owned by members of a given rural community and administered and represented by an elected government body consisting of three people. This elected government body is known as a Commission¹. The Agrarian Law regulates the creation and operation of the ejidos and communities (CEC, 1995).

Heterogeneity is a dominant characteristic of the Mexican ejido. The variability in size, resource base, technology and productivity is striking. According to Wilson and Thompson (1993), some ejidos control 30,000 ha and have 1,000 members. Others may own 100 ha which are farmed by 10 families. In the irrigated ejidos of northwest Mexico, commercial crops are grown with the most modern agricultural practices. The majority of the ejidos in central Mexico produce subsistence crops such as corn and beans, while in semiarid and arid regions, herders shepherd goats through desert lands which support only a marginal human existence.

There are several national programmes that foster the ejido's development. One of them is PROCAMPO, which is a direct aid programme for agriculture. PROCAMPO has compensated the producers who became negatively affected by the commercial liberalisation of Mexican agriculture in 1994. It has consisted of a uniform payment of \$70 USD per hectare per agricultural cycle. PROCAMPO has compensated 3.3 million producers and has involved 14.9 million hectares. The majority of beneficiaries have been small or middle producers, landowners or ejidatarios who directly work their parcel of land. PROCAMPO is complemented by the 'La Alianza para el Campo' programme, which provides a wide range of possibilities of aid for agricultural productive activities in coordination with the states. Consumers have been compensated by PROGRESA, which provides direct aid to poor Mexican families. (Martinez et al, 1999).

4.3 MEXICAN SEMI-ARID AND ARID REGION

As reported by CONAZA (1999a), arid and semi-arid regions cover nearly 52% of the land area of Mexico. The main characteristics of the Mexican arid and semi-arid regions are described in Table 7.

¹ 'Comisariado'.

Table 7: Arid and Semi-arid Zones Characteristics

Phenomena	Characteristics
Fragile ecosystem	<ul style="list-style-type: none"> • Long and recurrent drought. • Scarce rainfalls and high evapotranspiration rates. • Aquifer insufficiency and dejection of permanent sources of water provisioning. • Over-exploitation of natural resources. Aquifer over-exploitation has caused the introduction of salt water penetrating nearly 100 Km inside national territory. • Drought, high temperature, sporadic rainfall. • Furtive hunting and species traffic. • Extinction.
Subsistence economy	<ul style="list-style-type: none"> • Auto-consumption seasonal agronomy, with high risk of natural disasters. • Expansive cattle breeding with poor quality flocks, and livestock over-pasturing. • Insufficient productive infrastructure and prevalence of traditional production systems with poor technology. • High economic dependency on wild resources harvest. • Meagre producers organisation. • Serious decapitalization of peasant economy. • Insufficient integration of women into commercial activities.
Social exclusion	<ul style="list-style-type: none"> • Deployed and isolated small communities and low population density. 85% of localities have a population under 2, 500 inhabitants. • Strong country to city migration. 400,000 people are estimated to abandon the countryside yearly, especially young people. • Deficient infrastructure and health services, and serious incidence of respiratory and gastrointestinal diseases. • Serious levels of malnutrition. • Precarious conditions of housing and environment. • High rate of illiteracy.
Institutional framework	<ul style="list-style-type: none"> • Low level in public investment and scarce official support. • Lack of inter-institutional coordination. • Non-existent integrated policy for developing arid zones.

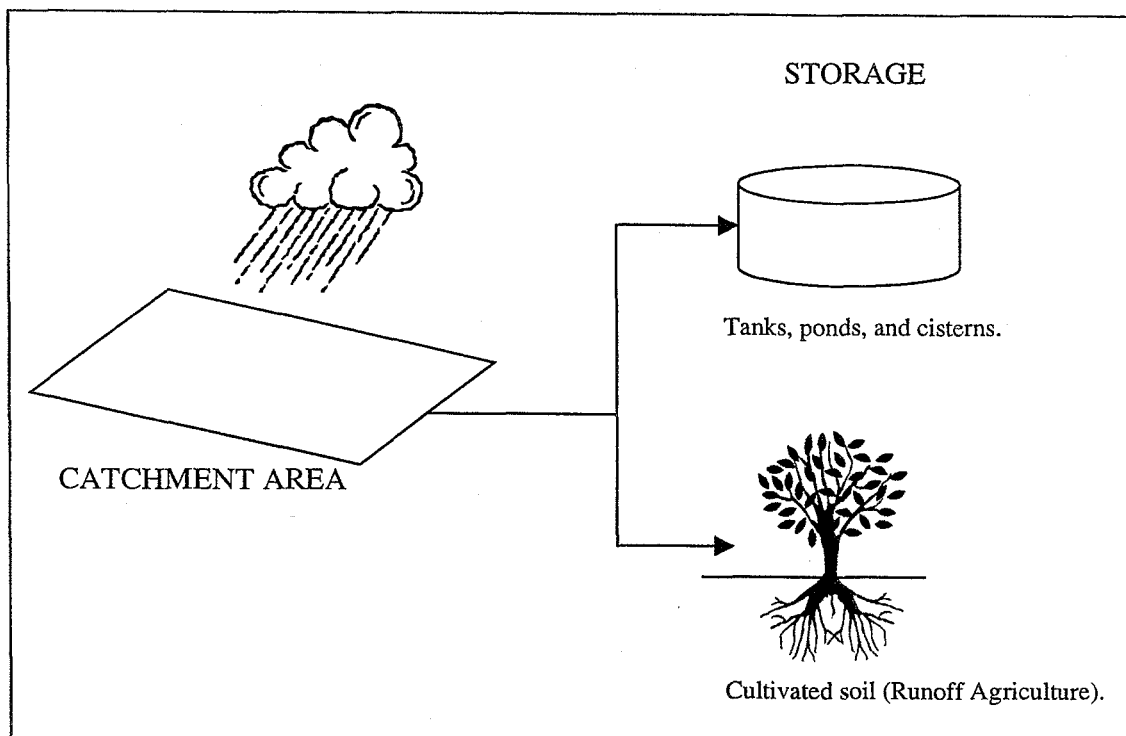
Source: adapted from CONAZA, 1999a

4.4 WATER HARVESTING TECHNIQUES

Though most of the rainfall patterns in arid and semiarid lands are erratic, total rainfall is considerable. Harvesting this rainwater can provide water for regions where other sources are too distant or too costly. Various forms of water harvesting have been developed traditionally throughout the centuries.

As shown in Figure 2, all water harvesting techniques are based on the same concept: to harvest run-off from a large catchment area and to concentrate the collected water in a smaller area for storage. Water can be stored in cultivated soil where its moisture is significantly increased to satisfy the water requirements of crops until the next rainfall event. This technique is known as run-off agriculture. Water can also be stored in tanks, ponds and cisterns for human and livestock consumption and supplementary irrigation (Siegert, 1995).

Figure 2: Rainwater Harvesting Concept



Source: based on Siegert, 1995

4.4.1 Run-off Agriculture

In run-off agriculture the principles and practices depend on rainwater harvesting as described in Figure 2. For a successful harvest, the crop's water requirements and general water conservation techniques are crucial. Some deep-rooted, drought-resistant fruit trees can be grown very successfully using run-off agriculture. There are three main techniques of run-off agriculture: water-spreading, microcatchment farming, and contour catchment farming. The Advisory Committee on Technology Innovation (1974) describe the techniques as follows:

- Water-spreading. This is a simple irrigation method where floodwaters are diverted by ditches, dykes, small dams, or bush fences from their natural course and spread over adjacent floodplains for growing crops or pastures.
- Microcatchment. Rainwater-catchment basins are built around plants, forcing rainfall from a larger than normal area to irrigate the plant. For instance, microcatchments used in Israel range from 16 m² to 1,000 m², depending on the water harvest expected.
- Contour catchment. This is a modification of microcatchment farming. It employs a series of terraces that shed water onto a neighbouring strip of productive soil.

4.4.2 Run-off Storage

New developments and improvements in rainwater harvesting are focusing on finding ways to maximise run-off catchment and minimise storage losses. The basic principle used to increase the run-off catchment is to make the soil surface more impermeable. On the other hand, storage losses can be minimised by reducing evaporation and seepage losses from tanks, ponds and cisterns. Losses in soil can be minimised by reducing cropland percolation losses (Advisory Committee on Technology Innovation, 1974).

4.4.3 Mexican Rainwater Harvesting Techniques

In 1975, a research project was undertaken by two Mexican universities² in the southern semi-arid area of Nuevo Leon, to investigate the application of rainwater harvesting technologies for human, livestock and dry farming use (Velasco-Molina and Carmona-Ruiz, 1984). As a result of the five years of research, eight systems were optimised physically and economically in a model called 'Vecar type – 500,000 L', which has an expected operational life of 15 years. This model was implemented in 18 ejidos of Doctor Arroyo and in one ejido of 'Mier y Noriega', both municipalities of southern Nuevo Leon (Velasco-Molina and Carmona-Ruiz, 1984).

4.5 PROJECT 'WATER AND LIFE'

The Monterrey Institute of Technology and Higher Education (ITESM), which participated in the rainwater harvesting system research in 1975, launched a new mission in 1996. This mission fosters the education of individuals who are committed to the social, economic, and political improvement of their communities, and who are internationally competitive in their areas of speciality. A further part of ITESM's mission is to carry out research and extension relevant to Mexico's sustainable development (ITESM, 1996).

As a response to this mission one of the lecturers and researchers of the institute, who participated actively in the rainwater harvesting systems project in 1975, decided to start a new project. According to the narration of the people from 'San Felipe' ejido, this lecturer and researcher went to the 19 ejidos where the Vecar type rainwater harvesting systems had been installed. From all the ejidos only San Felipe had maintained the system in good condition. Also at that time San Felipe was the poorest ejido of Doctor Arroyo (Velasco-Molina, 1999). The researcher selected the ejido of San Felipe as the first community for the project. He called the project 'Water and Life' and officially started on the 19 January, 1996.

The purpose of the project is to introduce a new water culture into the Mexican semi-arid rural region to improve the life quality of the peasant population (Velasco-Molina, 1999). This is intended to be achieved through the establishment of water harvesting techniques such as rainwater harvesting systems, microcatchments, contour ridges, and domestic rainwater collectors. The project intends to use solar energy in the different systems mentioned above (Velasco-Molina, 1999). The project's main activities are described in Table 8. Local men, who are paid a minimal wage by the project, have undertaken the construction work. The wage is much lower than payment from other occasional jobs, but has become a relatively regular source of income for the households since the project began. During construction work, local men learnt how to build rainwater harvesting systems and use run-off agriculture techniques. Five local men have been trained for the vegetable gardening. However, women, youth and children have remained passive participants of the project. Maintenance of project's outcomes is organised by the Commission and mostly is not paid.

The staff for the project 'Water and Life' consists of one coordinator and an assistant who visit the ejido of San Felipe fortnightly. The coordinator acquires economic resources from government donors, private commercial sponsors, and personal benefactors.

As the university coordinates the project the funding must be transferred through the university. Once the funds have been transferred, the coordinator allocates the funds to the different project activities. He first informs the authorities of San Felipe how these funds are going to be used in the ejido and then explains to the community what the purpose of the activities are.

² ITESM and UANL

Table 8: Main Project's Outputs in San Felipe

Technology	Description	Local Use	Date
Rainwater Harvesting System. (Vecar type)	<ul style="list-style-type: none"> • 2,100 m² run-off catchment using polyethylene film, 0.010 " thick, covered with gravel. • Storage cistern of 500,000 L capacity. <ul style="list-style-type: none"> • Chlorosulphonate polyethylene water proof film, 0.036 " thick. • Cover for reducing evaporation: Steel sheet R-90 calibre 22. 	<ul style="list-style-type: none"> • Vegetable garden of 1/20 ha. • Human consumption. (drinking, cooking and occasional bathing). • Other project activities such as cisterns and catchment areas building. • Manual irrigation of the peach orchard. 	<p>Rebuilt in January, 1996.</p> <p>Budget (\$350,000)</p>
Run-off Solar Module	<p>It is based on run-off farming, it includes:</p> <ul style="list-style-type: none"> • 4 absorption terraces. Cultivation area/run-off is: 1/3. Bywash channel for each terrace. • 107 plum trees (<i>Prunus domestica</i> L.). • Rainwater embankment collector of 1,089 m²; with a run-off channel of 73.5 m; 0.5m² transverse section; 1.8 m of wet perimeter and 153 m² of exposed area. • Silt trap with 9.3 m³ net capacity connected to a storage cistern with 472 m³ net capacity; and 15 m³ of sedimentation volume. • Solar arrangement with: <ul style="list-style-type: none"> • Four 64W Photovoltaic cells. • Solar pump with 3,679 L/day extraction capacity. • 30 m³ irrigation cistern, and 2.5 m³ sedimentation volume. 	Irrigation of 107 plum trees (<i>Prunus domestica</i> L.).	Plum orchard was planted in July, 1998.
Vegetable Garden	1/20 ha.	Self-consumption.	First production in September, 1997.
Microcatchment System for Peach Orchard	1.52 ha orchard with 174 Peach trees (<i>Prunus persica</i>) with 70 m ² individual catchment. Slope: 5.32%.	Irrigation of the peach orchard.	June, 1996.
Rainwater Harvesting System. (Lt type)	<ul style="list-style-type: none"> • 484 m² run-off area made with laja stone. • 166,000 L storage cistern. 	Emergency irrigation for the peach orchard.	<p>Still in process of completion</p> <p>Budget (\$230,000)</p>

Technology	Description	Local Use	Date
Kindergarten with Roof Catchment.	<ul style="list-style-type: none"> • 1 adobe room with impermeable roof. • 3 storage cisterns of 2,500 L each. • Furniture (blackboard, desk, bookshelf, chairs and tables). 	Children classes.	\$35,000
First-Aid Kit	Basic medicine such as antibiotics, pain-killers, fever control, diarrhoea, etc. First supply was free, while following supplies were paid by the community and supplied by the project.	First-aid.	November, 1998.
Monthly Food Donations per Household	Handout per ejidatario: lard (1 Kg), beans (1 Kg), rice (1 Kg), lentils (1 bag), pasta (3 bags), corn flour (1 Kg). Sometimes Oil (0.5 L)	Self-consumption.	
Irregular Donations <ul style="list-style-type: none"> • Chickens. • Bicycles. • Clothing. • Christmas gifts. • Candies. • Others. 	Second hand collects that are donated to the community. Some business sponsor goods (i.e. chickens).	Personal use and consumption.	

Source: Project Water and Life records, interview with the project's coordinator, and personal observations

4.6 EJIDO OF SAN FELIPE

4.6.1 Doctor Arroyo

San Felipe is one of the 106 ejidos of Doctor Arroyo municipality and is situated in the state of Nuevo Leon. Doctor Arroyo has a population of 37,363 and an area of 438,220 ha approximately (INEGI, 1995).

According to the INEGI (1995), 64.8% of Doctor Arroyo's active population is dedicated to the primary sector³, from which 95.3% is dedicated to agriculture and the remaining 4.7% to livestock activities, mainly goat grazing. From the 106 ejidos, only 3 have irrigated land. The remaining 103 ejidos are devoted to rainfed agriculture. The main crops are maize, sorghum, beans and potato. Pastures and apples are also cultivated in the region.

Most of Doctor Arroyo is semi-arid, with an average rainfall of 302.2 mm (INEGI, 1995). Doctor Arroyo forms part of an arid plain, with an altitude above sea level fluctuating between 1,500 m and 2,000 m. It is characterised by mountains separated by undrained basins or valleys. One of the remarkable features of this region is that there are no rivers or permanent streams, rainfall patterns are erratic and rainfall is lost to run-off or evaporation. The main sources of water for human and animal consumption are ponds, and water ponds with an impermeable surface called 'aljibes' (Velazco-Molina and Carmona-Ruiz, 1984). In southern Nuevo Leon ponds are the major source of superficial water for 2.5 to 3 months of the year while the remaining 9 or 10 months are completely dry (Velazco-Molina and Carmona-Ruiz, 1984). These ponds are used by humans and livestock alike, and they are therefore very insanitary. Aljibes lose water by evaporation (7-8 mm/day) and sedimentation is high (30-40 cm/year) (Velazco-Molina and Carmona-Ruiz, 1984).

³ Agriculture, livestock, silviculture, hunting and fishing.

In terms of underground water, in 1984 Doctor Arroyo had 27 wells with an average coverage radius of 7,800 m (Velazco-Molina and Carmona-Ruiz, 1984). However, wells do not give a constant supply of water so a large proportion of the population is dependent on ponds and aljibes. Also, the underground water has a very high saline concentration⁴ and cannot be used for human consumption and sometimes not even for livestock consumption (Velazco-Molina and Carmona-Ruiz, 1984).

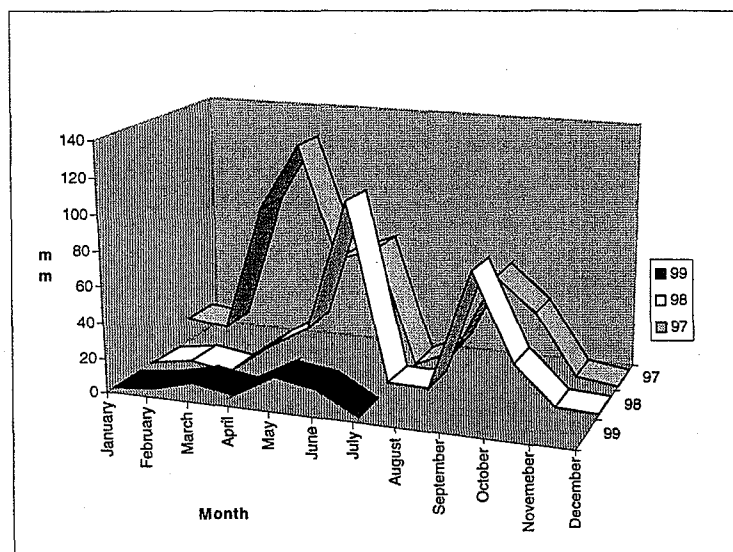
4.6.2 San Felipe

San Felipe is an ejido with a population of 73 inhabitants (Censo, 1998). San Felipe is 1,650 m above sea level, has a surface of 2,080 ha and its climate is Bsokx': temperate with warm summers and rainfall distributed between summer and winter (Velasco-Molina, 1999).

As in Doctor Arroyo, rainfall in San Felipe is minimal and its patterns are inherently erratic. The community has been experiencing a severe drought in the last 10 months. From November 1998 to July 1999 rainfall was only 44.6 mm. In the years 1996/97 and 1997/98 during this period (November-July) rainfall was 161.8 mm and 359.9 mm respectively.

Figure 3 shows clearly that last year's rainfall does not follow the former years pluvial patterns.

Figure 3: Rainfall Patterns



Source: Project records from the peach orchard rain gauge

4.6.2.1 Human Water Consumption

Before the project 'Water and Life', the community's water consumption was supplied by the rainwater harvesting system (Vecar type). This rainwater harvesting system is commonly referred to amongst the locals as vegetable cistern. After it was repaired in January 1996, it has been used for the cultivation of the community's vegetable garden and other occasional needs of the project such as manual orchard irrigation or for construction purposes. People obtained their water for home consumption from the ejido's natural spring.

During the drought most of the ponds dried up. Therefore, human and livestock demand became too high for the spring's limited supply. In May 1999, the community, in consultation with the project coordinator, started to collect their water from the vegetable

⁴ An electric conductivity of 3336 μ MHOS/cm at 25 C.

cistern. It was agreed that it would be used only for drinking, cooking and occasional bathing. From the period May to July the project has provided 45,006 L. A household consumes an average of 1,220 L each month.

The peach orchard sometimes is manually irrigated to prevent the trees to reach its 'permanent wilting point'. The water for the manual irrigation is obtained from the vegetable. Manual irrigation was scarcely needed in the first three years of the project. However, since November 1998 the drought has caused manual irrigation to increase considerably. From November up to July, 1999 it was used approximately 70,600 L from the vegetable cistern. The increase in manual irrigation justified the construction of another rainwater harvesting system (Lt type) with a storage capacity of 166,000 L. This system is still in construction and will be used as emergency irrigation for the peach orchard.

4.6.2.2 Vegetable Garden Production

The project has been recording the production of the vegetable garden. First production dates from September 1997. Production has been shared out to the ejidatarios who are only men of 17 years old or more. Vegetable garden production fell dramatically after November 1997. Production virtually ceased in November 1998.

4.6.2.3 Traditional Productive Activities

In San Felipe traditional livelihood strategies are unable to secure enough food for the community. San Felipe's most common farming activity is rainfed agriculture, while the grazing of livestock, mainly goats, is also practiced. Produce from rainfed agriculture is intended for self-consumption, but is severely affected by the erratic rainfall pattern resulting in only 3-4 successful harvests in every ten years. Livestock also suffers from a lack of reliable sources of water and recurrent droughts. Most farmers in San Felipe lack the financial capital to purchase livestock and therefore take care of more wealthy farmers' cattle for 50% of the offspring. However, due to the fragile ecosystem of the region and poor quality cattle, reproduction rates are low and the number of offspring is minimal. Women raise pen animals but due to local predators, lack of food, and fences this activity does not satisfy the household needs.

Survival often depends on the extraction of a natural fiber called 'ixtle' and the harvest of seasonal wild resources such as dates, 'cabuche', and 'mezquite'. Another important source of income is remittances from individuals that migrate temporarily to nearby cities or to U.S.A. Both sources of income are irregular and unreliable due to seasonality, low price, risk, and poor management. Housing and transport are very limited and costly. Lack of transport and infrastructure reduces the access to markets to sell products, and in addition phone, health services, and medicine are minimal.

4.7 SUMMARY

This chapter presents the background to the case study. It reviews the Mexican agricultural sector, its organisations and policies. It describes the situation of the arid and semi-arid region of Mexico and the socio-economic diagnosis of the area. Mexican arid and semi-arid regions are characterised by social exclusion, a fragile ecosystem, and a subsistence economy. Provision of water is one of the nation-wide strategies to mitigate the poverty of this region. Water harvesting technologies have been developed as a means to increase the availability of water and some projects have been implemented using these technologies. One of these projects is the project 'Water and Life', implemented in the ejido of San Felipe, Doctor Arroyo.

CHAPTER FIVE: RESEARCH RESULTS

5.1 INTRODUCTION

To evaluate the effect of the project 'Water and Life' the presentation and discussion of the research results has been divided into two main sections. The first section is an analysis of the livelihoods of San Felipe using the DFID sustainable livelihoods approach. This study of livelihoods is the first stage for the evaluation of the project 'Water and Life'. Once a holistic and integrated picture of the San Felipe's livelihoods has been depicted, the second section discusses the role that the project 'Water and Life' has played in the achievement of sustainable livelihoods in San Felipe. The project is discussed in relation to its relevance, impact and sustainability of benefits in San Felipe. For this purpose Max-Neef's human scale development approach is used.

The DFID sustainable livelihoods analysis and Max-Neef's human scale development approach are two holistic frameworks that complement each other. Because of their holistic nature, both models overlap in some of the discussion issues. However, it was decided to include both separately because while the sustainable livelihoods analysis focuses on the strengths of the community (DFID, 1999) Max-Neef concentrates on the satisfaction of needs (Max-Neef, 1991).

5.2 SUSTAINABLE LIVELIHOODS ANALYSIS –SAN FELIPE

As discussed in the literature review, elimination of poverty and environmental degradation and the eradication of denial of human rights by addressing the needs of sustainability, justice and inclusiveness, form the basis of the conceptual framework of this research. DFID, UNDP, IDS, and the IISD have integrated these concepts in the term 'sustainable livelihoods' and developed a framework analysis. The sustainable livelihoods framework provides a holistic and integrated view of the process by which people achieve, or fail to achieve, sustainable livelihoods (Scoones, 1998; cited in Brock, 1999). The framework is used as a basis in this discussion to determine whether the community of San Felipe is sustainable in the context of development.

5.2.1 Vulnerability Context

Some specific shocks, trends, and seasonalities influence directly and indirectly the wider availability of assets, such as food, income, transport and livestock, in San Felipe. Shocks, trends and seasonalities make the community vulnerable because people have limited or no control over them. The research results identified trends in governance, seasonality of produce and employment and natural shocks that conform to the vulnerability context of the ejido of San Felipe. Generally, San Felipe is very vulnerable with low local availability of food and lack of regular income-earning opportunities.

5.2.1.1 Government Trends

In general, national, regional and local policies tend to increase the vulnerability of San Felipe. National aid programmes are becoming stricter, the municipality has left aside San Felipe from their aid programmes and projects, and the local Commission which has been key for the project 'Water and Life' will change its members very soon.

National secretariats and development programmes such as PROCAMPO are set up to assist the marginal areas through direct aid. Rainfed agriculture exists due to the uniform payment by PROCAMPO that motivates farmers to cultivate the land although they know it will be fruitless. Communities and ejidos are accustomed to this paternalistic direct aid where they become dependent and attached to unsustainable livelihood strategies. The

inertia of this trend is very hard to change, especially when there is still a vast range of national and regional paternalistic aid programmes.

The national direct aid programme for agriculture, PROCAMPO, is becoming stricter in their criteria for providing aid. So far, the ejidatarios of San Felipe have been able to receive the aid even though some of them have not met all the criteria. However, this year they were paid only \$72.00/pesos for a maximum of five ha instead of the normal \$300.00 pesos/ha. Farmers have become used to rainfed agriculture, a livelihood strategy that does not return the investment if not subsidised.

The trend of municipality government and the project 'Water and Life' is to foster range land and discourage grain agriculture. Doctor Arroyo's \$4 million pesos project for conversion of lands from grain to pasture is an example of this trend. This trend could be an opportunity for the ejidatarios to convert from rainfed agriculture land to pasture growing. However, it is important to point out that because San Felipe has been funded by the project 'Water and Life' it is not a priority for the municipality as mentioned by the mayor of Doctor Arroyo during the interview.

An obstacle for the continuity and implementation of new projects is the ejido's policy of electing a new Commission every three years without having the opportunity to re-elect members could be. At the moment, San Felipe is lead by a very effective Commission whose members are wholeheartedly supportive of the project 'Water and Life'. However, this Commission ends in February 2001, and this change could affect the outcomes of the project especially in the maintenance of the project's outcomes.

5.2.1.2 Seasonal Price, Produce and Employment

Seasonal shifts in prices, employment opportunities and food availability are the greatest and most enduring sources of hardship for poor people (DFID, 1999). All income-earning opportunities, with the exception of the ixtle extraction, are seasonal and subject to shifts in prices. Most of the staple food is purchased so income is necessary to assure food availability.

The orchards, the mezquite, dates, cabuche, nopal and prickly pear are seasonal crops restricted to a few months of the year. The prickly pear is used for self-consumption while the orchards, mezquite, dates and cabuche are income-earning opportunities. Goats are also seasonal but are better income-earning opportunities than the seasonal crops because the goats breed twice a year. Milk is used for self consumption. The markets are very unpredictable and thus prices fluctuate, as in the case of the mezquite where only those who have a van can transport the mezquite and get a better price while the rest of the ejidatarios have to be content with the price set by the buyers no matter how low it is. Only two households in San Felipe have vans.

Rainfed agriculture is not considered seasonal because its harvest is quite uncertain depending on the rainfall and not on a specific month. Rainfed agriculture is for self consumption, however participatory analysis of the productive activities (Table 9) revealed that due to its uncertainty it is considered the most risky and the worst of all productive activities. Rainfed agriculture provides part of the staple food, maize and beans, but is so vulnerable that these crops are normally purchased.

Table 9: Matrix Scoring for Productive Activity Analysis

Productive Activities	Seasonal Harvesting	Water	Money	Human Consumption	Work	Seasonal Rainfall	Risk	Total	Position
Project 'Water and Life'									
• Peach orchard	2	2	1	1	2	---	1**	9	2
• Plum orchard + solar module	2	1	1	1	2	---	1**	8	1
• Vegetable garden + cistern	---	2	--- (5)	1	5	---	1	14	3
• Irrigation cistern for peach orchard	---	3	3	--- (5)	5	---	--- **	16	5
Rainfed agriculture	---	3*	--- (5)	4	5	2	5	20	8
Goats	1	3	1	2	5	---	4	16	5
Cows	---	3	1	5	2	---	4	15	4
Mares	---	3	--- (5)	--- (5)	3	---	4	20	8
Donkeys/Mules	---	3	--- (5)	--- (5)	3	---	4	20	8
Ixtle Extraction	---	2*	3	--- (5)	4	1	3	18	7
Mezquite	2	2*	2	--- (5)	1	1	3	16	5
Dates	2	2*	2	--- (5)	1	1	3	16	5
'Cabuche'	2	2*	2	3	1	1	3	14	3
'Nopal' and prickly pear	2	2*	--- (5)	3	1	1	3	17	6

* Activities that need water but are not irrigated.

** Activities for the future of San Felipe

Occasional work is very unpredictable. The project's jobs for the construction of the rainwater harvesting systems and other buildings have become one of the steadiest sources of income. However, the demand for workers fluctuates according to the project's activities, and payment is low at \$25 pesos/day. Occasional jobs for the construction of highways are random. The pay is higher \$75 pesos/day but it requires a fixed eight hours of intense work.

5.2.1.3 Erratic Rainfall and Droughts

Rainfall in San Felipe is inherently erratic and most of it is lost to run-off. The rainfall pattern affects the rainfed agriculture, making harvests irregular. According to participants the last good harvest was in 1967. Farmers stated that since 1996 they have not harvested any grain, and at the best pasture for their animals. The coordinator of the project 'Water and Life' pointed out that in a decade, farmers only harvested three to four years and then the harvest lasted at the most only four months.

Droughts are natural shocks of particular importance to San Felipe. Droughts dramatically affect the rainfed agriculture and livestock.

Participants, both women and men, stressed the struggle to provide water for their animals during four months of drought. Only two households had vans to bring water from other

ejidos. The rest of farmers needed to take their animals up to the spring every three or four days. One of the participants lost seven of his 10 cows, while other lost seven goats and 15 kids. No water from the rainwater harvesting systems was provided to cope with this problem.

Farmers have ploughed their land since December 1998. However, not even pasture has grown this year. Farmers have invested this year in ploughing 8 to 16 ha. Due to the drought, ejidatarios could not comply with PROCAMPO's criteria to grow a minimum number of plants to qualify for aid; those farmers were paid less. Farmers will not be able to pay the cost invested and they will be forced to sell animals. The coordinator of the project 'Water and Life' does not support rainfed agriculture, which he believes has kept the farmers in misery. For this reason no water from the rainwater harvesting systems was allocated to rainfed agriculture.

The most recent drought affected the peach orchard where a major effort was needed to keep the peach trees alive through manual irrigation. The water was obtained from the vegetable cistern, from November 1998 up to July 1999. Approximately 70,600 L were used from this cistern. Trees were kept alive but there was no peach harvest.

During the drought vegetable production was suspended to provide water to the households. The rainwater harvesting systems have been a very effective adaptive strategy for San Felipe. Before the first system was built, a severe drought like the one in progress would cause the inhabitants of San Felipe to abandon their home areas.

The three rainwater harvesting systems that provide 1.2 million L of water reduce considerably the vulnerability of San Felipe to erratic rainfall and droughts in regard to human consumption and the orchards. However, the systems do not reduce the vulnerability of the rainfed agriculture and livestock, although potentially they could.

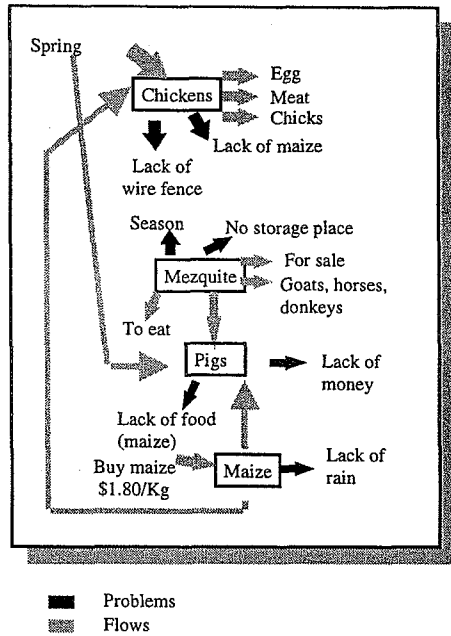
5.2.1.4 Hails, Eclipses, and Hoar Frosts

During participatory analysis, orchards were ranked as the productive activities with least risk because they have the water secured (Table 9). However, harvests could be lost due to hails, eclipses or hoar frosts. Farmers explained that the eclipse affected the peach orchard this year and trees did not give fruit. The coordinator of the project 'Water and Life' respects the farmer's point of view but he is convinced that there was no peach harvest this year because of the drought. Eclipses are a phenomenon which traditional knowledge recognises as a cause of damage for the trees; however, scientifically this view is still not recognised. Some of the farmers explained the eclipse as a phenomenon where the sun changes colour to a very pale yellow and burn the tender parts of the plant. It seems evident that the eclipse that the farmers refer to it is a different event than the obscuring of the light of the sun.

5.2.1.5 Coyotes

The women demonstrated by means of a 'flow diagram' that the breeding of pen animals is very vulnerable at the moment because they do not have any means to protect their chickens, ducks and turkeys from coyotes. Corrals made of sticks are easily invaded by the coyotes. Most of the women cannot afford cages or wire fences for their pen animals. Lack of maize is another obstacle to acquiring more pen animals (Figure 4).

Figure 4: Flow Chart of Local Product Links and Problems



5.2.2 Livelihood Resources

The livelihood framework identifies five kinds of core assets or capitals upon which livelihoods are built. These types of capital are human, natural, social, physical and financial. San Felipe has very limited access to most of these types of capital, however the assets available are the strengths of the community and these have the potential to be converted into positive livelihood outcomes. The assets and their limitations which were identified from the results are described below.

5.2.2.1 Human Capital

The ejido only provides kindergarten and primary school education. The children who study at secondary and high school need to study in other neighbouring communities. These youth are therefore not in San Felipe most of the time, and generally they migrate because there are no work opportunities in San Felipe.

One of the young women is a kindergarten teacher; she teaches the children in San Felipe and monitors the first-aid kit. Another young woman is a nurse; she takes care of injuries and monitors the consumption of water. The probability that these young women migrate to better opportunities is quite high.

The only source of skill training is the project 'Water and Life'. However, it has not provided training for the youth and the women. Only adult ejidatarios have learnt skills.

5.2.2.2 Social Capital

The Commission is the only formalised group in San Felipe. The San Felipe Commission has played a major role in the implementation of the project. There are strong bonds of trust between the coordinator of the project 'Water and Life' and the Commission. These bonds have meant that both parties work together for the project. The treasurer and the president of the Commission have been the key to the success of the project. However, the Commission has failed in organising the ejidatarios for the different works and 'faenas' needed. Only the president and treasurer of the Commission have taken care of the vegetable garden when none assumed responsibility. The Commission feels responsible for the project's assets. However, this responsibility has not been passed to others in the community.

There is no formalised group of women or youth. The community does not have a meeting place. The Commission and the ejidatario's assembly need to meet in the entrance of the company store. School buildings are not always available because only the teachers have the key.

There are strong relationships of trust, reciprocity and exchanges within the community. The unity of the community and the trust in the long-term benefits of the project are highlights of San Felipe. This integration facilitated the construction of the rainwater harvesting systems at such a low cost. The community has proven their capacity to maintain a shared infrastructure. From all the ejidos where the rainwater harvesting system (Vecar type) was tested, San Felipe was the only community that still preserved the system in good condition. Another advantage is that households are related to each other, which makes the bonds of trust, reciprocity and exchanges stronger.

San Felipe lacks the networks and connections which expand their access to wider institutions. These networks and connections are possessed by the coordinator of the project, but the Commission does not have the capacity to obtain economic resources by itself.

5.2.2.3 Natural Capital

San Felipe has a variety of natural resources that could be combined to achieve successful livelihood strategies (Figure 5). Unfortunately, this is not happening in San Felipe at present. Actual livelihood strategies have not been able to reduce the vulnerability of the ejido. However, the natural capital represents a potential opportunity to achieve sustainable livelihoods in San Felipe.

Water is the most important natural resource of the region. The sources of water are five ponds, one well, one spring from which water is pumped to a white tank, and two rainwater harvesting systems with storage cisterns of 500,000 L each (Figure 5 and

Land is another natural resource. Every ejidatario has his own plot which he is responsible for cultivating (see farmers' fenced field in Figure 5). The remaining land is mainly range land and remains in the communal ownership of the ejido. Plots belong to the ejidatarios and not to the community, and can be sold or rented. Plots are fenced and are more valuable because animals cannot get inside. At the moment this land is used only for rainfed agriculture but it could be used for other activities such as pasture growing or agro-forestry. For instance, mezquite picking is carried out inside the farmers' fenced field because animals consume the fruits of the remaining mezquites in the communal area. It is important to remember that the municipality is supporting the ejidatarios of the region with \$4 million pesos for the conversion of grain to pasture.

Native plants are another important resource in the region. These resources are not planted, and they grow wild in the ejido. The native products that have a market are cabuche, mezquite, dates, and ixtle. Nopal, prickly pear and palm flowers are used for self-consumption and do not have a market. Mezquite and dates are a very good food rich in polysaccharides for livestock. They are mainly used for animal consumption but are also suitable for humans.

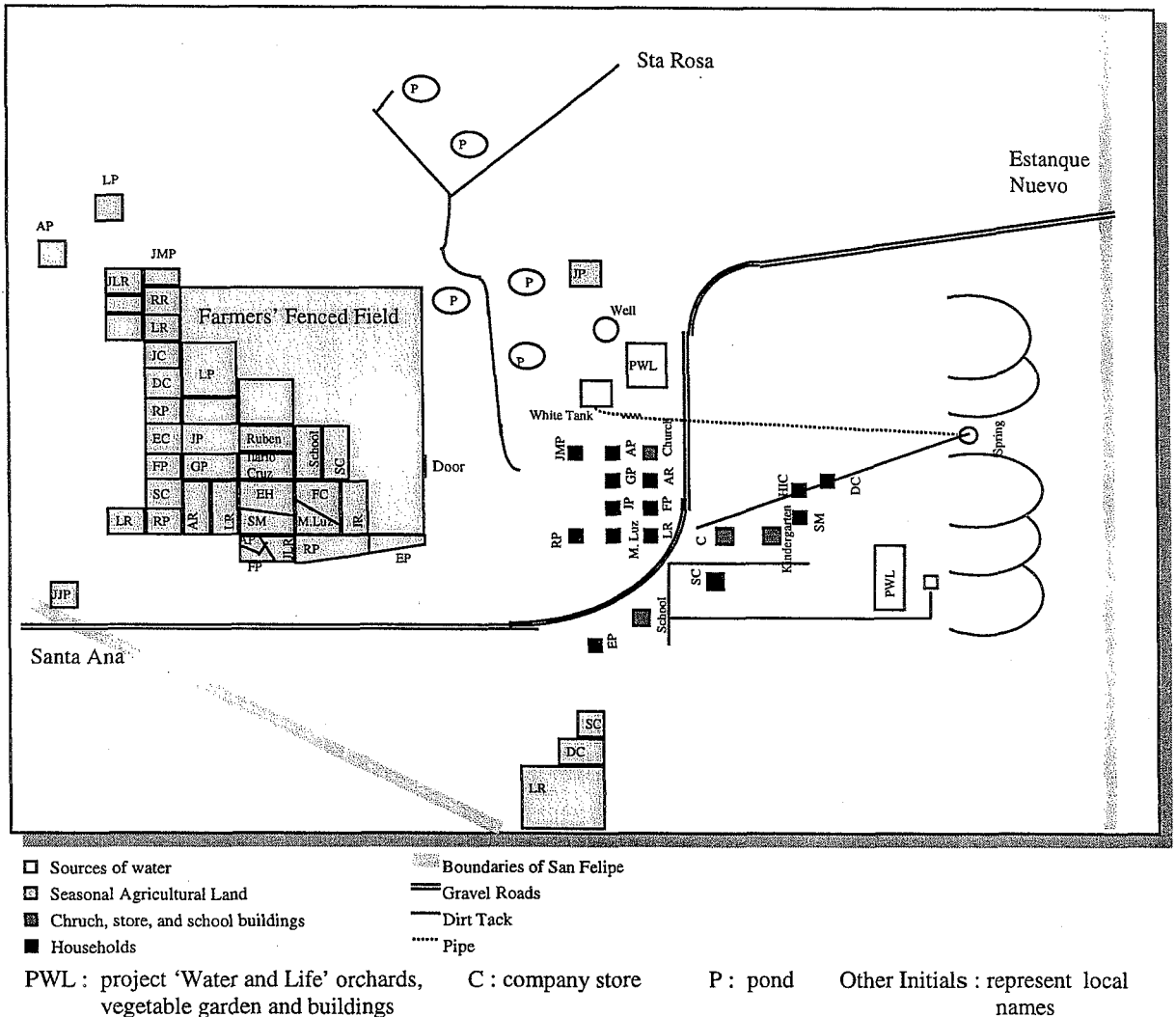
Table 10). Another system with a storage cistern for 166,000 L is in the process of being constructed.

Management of the project's systems is controlled. The community does not use these sources without consultation with the coordinator of the project 'Water and Life'. In August 1999, the vegetable cistern was at a level half of its capacity and the plum cistern

was 2/3 of its capacity. Some of that water could have been used for livestock or other activities without affecting the plum orchard. The water from the rainwater harvesting systems could be better managed.

Sources of water from the project 'Water and Life' are seen by the community as sources with a fixed purpose that cannot be changed. Those sources of water that are not monitored are used freely. This is the case of the silt trap from the solar module, which has the capacity to store up to 9,000 L when it rains, and it is not monitored by the project. However, those sources that are unconstrained run out fast and are in need of better management.

Figure 5: Map of San Felipe



Land is another natural resource. Every ejidatario has his own plot which he is responsible for cultivating (see farmers' fenced field in Figure 5). The remaining land is mainly range land and remains in the communal ownership of the ejido. Plots belong to the ejidatarios and not to the community, and can be sold or rented. Plots are fenced and are more valuable because animals cannot get inside. At the moment this land is used only for rainfed agriculture but it could be used for other activities such as pasture growing or agroforestry. For instance, mezquite picking is carried out inside the farmers' fenced field because animals consume the fruits of the remaining mezquites in the communal area. It is

important to remember that the municipality is supporting the ejidatarios of the region with \$4 million pesos for the conversion of grain to pasture.

Native plants are another important resource in the region. These resources are not planted, and they grow wild in the ejido. The native products that have a market are cabuche, mezquite, dates, and ixtle. Nopal, prickly pear and palm flowers are used for self-consumption and do not have a market. Mezquite and dates are a very good food rich in polysaccharides for livestock. They are mainly used for animal consumption but are also suitable for humans.

Table 10: Water Resource Management

Source	Use	Quality	Access
Ponds	<ul style="list-style-type: none"> • Livestock and pen animals • Washing clothes and mopping 	Low	Uncontrolled
Well	None	Salted	Uncontrolled
Spring	<ul style="list-style-type: none"> • Livestock and pen animals • Human consumption • Household 	Fair	Uncontrolled
Rainwater harvesting system (Vecar type)	<ul style="list-style-type: none"> • Vegetable garden • Human consumption • Other project activities such as constructions • Manual irrigation of the peach orchard 	High	<ul style="list-style-type: none"> • Monitored by the project 'Water and Life' • Access for water consumption only Wednesdays and Sundays.
Solar Module	Plum orchard	High	Controlled
Solar Module Silt Trap (blue tank)	Bathing, washing clothes and dishes, mopping Pen animals and house plants	Fair	Uncontrolled
Rainwater harvesting system (Lt type)	Peach orchard	High	Controlled

5.2.2.4 Physical Capital

In general, physical assets are very constrained in San Felipe. This limits the advantages of the other capital in the ejido. Transport and household, two of the four criteria selected during participatory poverty analysis of households (Table 11), are very limited, especially transport.

Table 11: Matrix Scoring for Poverty Analysis

Family	Members	Household	Livestock	Transport	Sources of Work	Total	Position
1. PM	6	2	10	15	4i	31	7
2. PG	4	14	6	15	5p	40	12
3. PCa	6	9	4	1	5p	19	4
4. PC	8	1	2	1	2t	6	1
5. PE	7	11	11	15	2t	39	11
6. PI	2	13	8	2	5p	28	6
7. RIP	7	15	15	2	3m	35	8
8. RI	7	4	1	2	4c	11	2
9. PCo	5	12	15	15	3m	45	15
10. PS	4	4	3	15	5p	27	5
11. PGa	6	10	15	15	1E.U.	41	13
12. CR	4	4	15	15	3m,i	37	9
13. CM	6	4	9	2	1E.U.	16	3
14. MGS	Elderly	3	5	15	15	38	10
15. MGL	Elderly	5	7	15	15	42	14

m: 'Mezquite'

t: Project staff job (temporary)

c: Company Store

E.U.: Work in the USA

p: Project

i: 'Ixtle'

The community has a gravel road that connects the ejido with Santa Ana and Estanque Nuevo (Figure 5). To travel to Santa Rosa or El Pequeño there are only dirt roads, which makes it difficult when it rains because vehicles can get stuck. Only five families have transport, however this transport is not suitable for travelling long distances (i.e. Matehuala or Monterrey). Those who do not have transport are very vulnerable as the public transport travels from Santa Ana to Amaro only once a week. Travel to cities is expensive. People without transport have limited access to phones, health services, medicine and markets to sell their products. Also, they are unable to fetch large amounts of water from different ejidos, or to irrigate their rainfed plots if necessary.

Some of the houses are very small or in very bad condition. Only two houses have latrines, which is the household's major priority (Table 11).

People fetch water for self-consumption from the white tank and the vegetable cistern. According to the community the water from the vegetable cistern is of better quality than the spring. Physical assets restrain the water consumption of the household: some of the women are unable to fetch more water because they do not have enough containers to store it or a wheelbarrow to transport the water.

5.2.2.5 Financial Capital

Financial capital is very limited in San Felipe, and people do not have access to banks. This capital, like the physical capital, constrains the use of the other capitals.

Liquid assets, such as livestock, are the only available stocks in San Felipe. People do not have cash savings or bank deposits. When there is an emergency they sell their cattle, especially cows. Cows are not used for milking and not even for breeding. Most of the farmers use cows as financial capital to pay debts or overcome emergencies.

The only regular source of income in San Felipe is the ixtle extraction. A few households have relatives living in large cities or in the USA; however, there is not a regular inflow of remittances. Other productive activities are seasonal or occasional and do not provide regular inflows of money to the households.

People are able to earn an average of \$30.00 pesos a day on a casual basis, which is only for daily subsistence. Other purchases are made on credit or by loans from relatives or friends. To pay the loans they usually sell an animal, or they migrate to work.

5.2.3 Institutions and Organisations

The institutions and organisations that affect San Felipe are very important because they limit the access of different groups of the community to San Felipe's assets and livelihood strategies. Drawn from the results, the relationships between organisations are described below.

The only organisation based in San Felipe is the Commission. When a decision needs to be made they call an assembly with all the ejidatarios and take action. It is this assembly that has the power to make changes in the community. The Commission and the assembly are made up of men only so women are excluded from the decision-making. For instance, for the women to take care of the vegetable garden it needs to be decided by the ejidatario's assembly. The ejidatarios and the Commission have access to PROCAMPO and deal directly with this programme. Women do not have access to this national aid project.

The Commission has access to the Mayor of the municipality of Doctor Arroyo. The Commission reports to the Mayor such needs as a tractor, electricity, and others. The Commission does not have any other access to resources other than the project 'Water and Life'.

The Commission also deals with the coordinator of the project 'Water and Life'. However, the Commission is informed and consulted but does not manage the project's assets. Final use of the project's water resources is decided by the coordinator. The Commission does not have access to the project's donors, and their only link is the coordinator of the project 'Water and Life'. At the moment the Commission does not have the capacity to develop the ejido's own projects and seek for economic resources independently. The relationships among the organisations exclude the women from any participation in the decision-making.

The change of the agrarian law in 1992 put the land back into the market as a commodity. This could have grave consequences for the project 'Water and Life' if the assembly of ejidatarios decides to parcel the communal land where the orchards or the rainwater harvesting systems are and sell it. It also could be a source of conflict within the community and therefore increase the vulnerability of San Felipe.

5.2.4 Livelihood Strategies

There is in San Felipe a range of activities and choices which are a result of a combination of the community's assets, organisations and policies, and are influenced by its vulnerability context. People undertake these strategies in order to achieve their livelihood goals. From the results eight livelihood strategies were identified: rainfed agriculture, livestock, ixtle extraction, migration, pen animals and native crops, fruit orchards, vegetable garden and occasional jobs (Table 9 and Table 11). All of these strategies have failed to reduce the vulnerability or to improve the food security of the ejido.

5.2.4.1 Rainfed Agriculture

All ejidatarios of San Felipe dedicate their time and work to grow maize and beans through rainfed agriculture. All individuals and groups of respondents agreed that this productive

activity is the least viable of the productive activities available in the region. Investments of cost, labour and time are spent year after year in this activity without obtaining any significant benefits.

However, farmers identified the rainfed agriculture (Table 9) as their main productive activity despite its lack of viability. There are several factors that foster this strategy:

1. Tradition. Maize and beans are traditional food needs of the household. A household eats an average of 11.5 Kg of corn flour and 3.6 Kg of beans per week. Maize is not a cash crop but a very important crop for their own consumption and for their animals. Also, as respondents mentioned, it is a tradition left by their grandparents.
2. PROCAMPO. This national aid programme is a major incentive for the farmers to remain engaged in rainfed agriculture. Through this national project, farmers are paid back their ploughing and seed investment. Thus ejidatarios do not have any money to lose, so they keep trying every year. Farmers hope that they can harvest some maize for food and, if not, at least the vegetative parts of the plants provide pasture for their animals. Another important point is that in this aid project the farmers have committed themselves to cultivate a certain amount of land. As long as there is coverage for the cost of cultivating, farmers are willing to take risks and continue with rainfed agriculture.

5.2.4.2 Livestock

The handling of cattle is carried out by men. Cows and goats are ranked by the ejidatarios as the 4th and 5th best activities in San Felipe respectively (Table 9). Farmers' main strategy is to have some animals through shared farming due to lack of financial capital to purchase the animals.

At the moment the main risk with these productive activities is the lack of water. Another problem is that pasture areas are not fenced and animals from neighbouring ejidos eat the pasture and the mezquites. Fenced plots are used only for rainfed agriculture where animals are fed crop plants if the harvest is not achieved.

5.2.4.3 Ixtle Extraction

Ixtle extraction is the only activity that can generate money any time of the year and that has a market. It is not a seasonal crop, and it is still available, although in lesser quantities, during droughts. Price is not dependant on seasons, and price has increased through the years from \$1.50/Kg to \$9.95/Kg although the value of goods has also increased so there has not been any change in the acquisitive power of the people. Distribution is easily facilitated through the company store.

This strategy is undertaken mostly by men. Women practise it only in times of extreme need. Ixtle extraction is considered amongst the most laborious activities after rainfed agriculture, the vegetable garden, and the goats (Table 9). Only skilled people can extract 5 to 6 Kg of ixtle per day so they can earn around \$60.00 pesos. However, in San Felipe most of the farmers can extract only 0.5 to 3 Kg of ixtle. The majority can earn \$5.00-\$30.00 pesos which is only enough to eat. One of the main changes that occurred when the project 'Water and Life' was implemented is that inhabitants of San Felipe stopped extracting ixtle. During discussions with the youth of San Felipe, they did not mention ixtle extraction as a source of income.

5.2.4.4 Migration

Migration is the strategy used to repay significant amounts of money, e.g. machinery hired on credit, and loans from relatives and friends. Usually it is the men who migrate, but sometimes women migrate too.

Migrating to the USA is considered the best source of work in San Felipe (Table 11). However, as some of the participants highlighted, people go to the USA, buy some clothes, bring a small amount of savings home and after some months the families remain the same. This migration is illegal and very risky. 'Coyotes' are the only ones who benefit from this illicit strategy earning \$700 USD for each person that they pass successfully over the border.

Migration to other ejidos with large plantations or nearby cities also occurs where the people work as labourers. Farmers can save very little because they need to pay for their expenses of travel, accommodation and food while they are away.

Some of the junior youth and youth have been sent away from San Felipe to follow their secondary and high school studies. Most of them never return to San Felipe because they migrate to cities to search for work. The only professional employment available in San Felipe is kindergarten or primary teaching. Even if young people qualify in teaching there is no certitude that they will come back to San Felipe. They may be appointed to another area.

5.2.4.5 Pen Animals and Native Crops

Women's main livelihood strategy is the breeding of pen animals such as chickens, turkeys, ducks and pigs to provide them with a range of products (Table 12). Those families that have goats use the milk to produce cheese for the household. Another women's strategy is to use native plants such as nopal and prickly pear, palm flowers and cabuche as supplementary complements to the staple food consumption (Table 12).

Table 12: Preference Ranking of Local Products

Chickens/chicks/egg	■■■■■■■■	Maize	■■■■■
Pig	■■■■■	Prickly pear	■■■■■
Nopal	■■■■	Cabuche	■■■
Palm Flower	■■■	Turkeys	■■■
Peach	■■■		

However, most of the staple food is purchased. Oil, wheat flour, rice, pasta, sugar, potato, salt, and soft drinks are goods that are not produced in San Felipe but are consumed (Table 13). The production of maize and beans through rainfed agriculture has proven to be inefficient and unreliable, and these two staple crops also need to be purchased. The number of pigs raised in San Felipe is minimal, thus lard needs to be bought most of the time.

Table 13: Basic Food Consumption

Staple Food	Weekly consumption	Staple Food	Weekly consumption
Corn Flour (Kg)	11.5	Wheat Flour (Kg)	5
Beans (Kg)	3.6	Oil (L)	1.6
Lard (Kg)	0.8	Maize (Kg)	5.5
Potato (Kg)	1.6	Rice (Kg)	1.3
Pasta (bag, 250 gr).	3.6	Chilli/ Tomato/ Onion (Kg)	0.5
Salt (bag)	0.5	Sugar (Kg)	1.8
Soft drink (bottle)	19.6	Eggs (Kg)	3.3

The sale of cash native crops such as mezquite, dates and cabuche is an income-earning strategy carried out by all members of the household (Table 9). Major shortcomings are that these products are seasonal, and that there is neither storage place for them nor do the farmers have transport to market them. This situation forces the farmers to sell the products at the price set by the buyers.

5.2.4.6 Fruit Orchards

According to the coordinator of the project, the fruit orchards are mainly to provide food for the households of San Felipe. However, farmers hope that the orchards will become an income-earning source (Table 9). Due to lack of transport, the only viable way to market the fruits is through the company store. However, the company store has not yet been consulted and the situation is uncertain. Those few who have transport, will have the option of selling the product in other ejidos or finding a buyer. The rest of the people would not be able to generate any income out of the harvest unless they are helped in some way.

Because the orchards have not yet produced in large amounts, one can only speculate about the benefits and problems that the harvests will bring and how this will affect the livelihood strategies of San Felipe.

One major advantage the fruit orchards have is that they have more water availability because they are supported by the project's rainwater harvesting systems.

5.2.4.7 Vegetable Garden

The vegetable garden fulfils the same function as native non-cash products such as nopal, prickly pears, palm flowers and others. The major advantage over the other strategies is that it has more access to water due to the rainwater harvesting system.

Vegetables are only a supplement to the staple food, which still needs to be purchased. Tomatoes are the only vegetables that have been planted that are a basic need for the household. If plums and peaches are not sent for sale they also will be supplements which will not modify the money expenditure for food consumption.

It is important to point out that the use of non-cash products is a women's strategy. However, the project has trained and made the men responsible for the vegetable garden. During field research, women expressed their opinion that the garden should be left to the care of the women.

5.2.4.8 Occasional Jobs

The temporary jobs offered by the project have become a substitute for ixtle extraction although the pay is low at \$25 pesos/day. Project jobs have especially benefited those who are not very skilled in the extraction of ixtle. Work on the project is the only source of income for five families while others have diversified their livelihood strategies combining project work with mezquite picking and ixtle extraction (Table 11).

Other occasional jobs, such as the highway constructions, are good earning-opportunities for the ejidatarios of San Felipe. However, they are so sporadic that people cannot rely on this type of work to make a living.

5.2.5 Livelihood Outcomes

Livelihood outcomes are the achievements or outputs from the livelihood strategies. The outcomes can be classified in the following categories: more income, increased well-being, reduced vulnerability, improved food security and more sustainable use of the natural resource base (DFID, 1999). Although the five categories of desired outcomes were expressed during field work, the two outcomes that most concerned the participants were reduced vulnerability and improved food security.

During group discussions Group 1 pointed out that income should not be included as part of the wealth ranking because “the more we earn the more we spend; the only way is through sources of work.” Ejidatario’s major concern is the irregularity of their income due to the seasonality of native products and livestock, their vulnerability to drought, and the inexistence of paid employment. Inhabitants of San Felipe are conscious that occasional jobs are temporary or so uncertain that one cannot rely on them. Lack of water for their traditional strategies and minimal financial and physical assets force the families to live very precariously with no cushioning against the adverse effects of the vulnerability context.

Food insecurity was especially stressed by women during an impact analysis (Table 14). The monthly food handout has mitigated their vulnerability in this regard; however, it is not a sustainable measure. The vegetables, the peaches, and the plums will not be substitutes for the basic foods, which include corn flour, beans and oil that still will need to be purchased.

Table 14: Impact of the Project

Before	After
<ul style="list-style-type: none"> • Suffered from lack of water • Hunger • Lack of jobs • Dependent on ixtle extraction 	<ul style="list-style-type: none"> • Enough food (food handouts) • Clothes, shoes • Sheets, pillows, duvets • Toys • Dishes • Bicycles • Water • Sources of work • They do not extract ixtle anymore

The first-aid kit will not function when the project finishes because there would be no one to supply the medicine from Monterrey or Matehuala. The inhabitants of San Felipe will become as vulnerable as before.

5.3 EVALUATION OF THE ‘WATER AND LIFE’ PROJECT

It is important to take into account that the project ‘Water and Life’ has been undertaken by one single person as a response to the ITESM change of mission to a more development centred focus. The project evolved in a pragmatic way rather than being based on a theoretical development approach. Achievements of this project should be acknowledged on that basis. ITESM did not have the economic capacity to hire development experts or interdisciplinary groups to implement the project ‘Water and Life’.

No indicators were developed on which to evaluate the project ‘Water and Life’ in San Felipe, nor clear objectives. There were only technical indicators to determine the efficiency of the rainwater harvesting systems.

5.3.1 Relevance

To evaluate a project it is important to know whether the project addresses the community needs. Max-Neef’s (1991) approach will be used for analysing the relevance of the project. As explained in the literature review, Max-Neef presents a more holistic approach to poverty where needs are finite, few and classifiable instead of the conventional concept of needs as infinite where increased consumption is the solution. The community recognised this when they said that income was not part of the poverty analysis.

Using the Max-Neef (1991) approach, it is clear that stakeholders commonly refer to satisfiers and not needs. Thus, a hospital, a rainwater harvesting system, goats, or roads are not needs but satisfiers of the needs of either subsistence, protection, affection, understanding, participation, idleness, creation, identity or freedom.

5.3.1.1 Subsistence

Water is the most scarce resource and the community expressed their opinion that there is still not enough water. They pointed out that their major need is water for human consumption and bathing. Other needs of water were livestock and household use such as washing dishes, clothes, and pen animals.

Other productive activities that need water are rainfed agriculture, ixtle extraction, mezquite, dates, cabuche, nopal and prickly pear (Table 9). However, farmers explained that these activities would not be irrigated even if there was water available.

The project has addressed the need for water for human consumption supplying it from the vegetable cistern. In the period of three months, the project has provided 45,000 L for household drinking, cooking and occasional bathing. However, this measure is only temporary and only started in May 1999 because the spring ran out of water completely. Household water needs for washing clothes, pen animals, house plants and mopping are satisfied by other sources of water. An average of 5,272 L per month is consumed in each household (1,318 L per week). The project supplies an average of 1,220 L per month which represents 23% of the overall household consumption.

The coordinator of the project is aware of the need for water for human consumption. He proposes as a satisfier a rainwater harvesting system called 'Roof Catchment' with a capacity of 200,000 L. It costs \$800,000.00 pesos because it requires stainless steel for its construction. It is designed to provide water of the best quality for human consumption and it is not intended for any other use. The only reason he has not build it is because of lack of economic resources.

With a \$800,000.00 pesos budget two rainwater harvesting systems (Vecar type) of 500,000 L could be built (\$350,000.00 pesos each). The Vecar type systems were designed as a physically and economically optimised version of other harvesting models, including the roof catchment (Velasco-Molina, 1984). It can be used for human as well as animal consumption (Velasco-Molina, 1984). Human consumption was the former use of the Vecar system before its reparation in 1996. After that, the water was reallocated for vegetable production and the human consumption was obtained from the spring. It is important to point out that inhabitants of San Felipe consider the vegetable garden cistern of better quality than the spring.

The main household food needs are purchased or provided by the project. As shown in Table 13, the staple food is beans, maize, corn flour, wheat flour, rice, pasta, potatoes, eggs, lard, oil, chili, tomatoes, onion, salt, sugar, and soft drink. With the exception of tomatoes and sometimes eggs, the rest of the food needs are not produced in San Felipe. Carbohydrates contribute more than 50% of the energy in the diet and grain products, legumes, tubers, roots and some fruits are rich in complex carbohydrates (FAO, 1999). Vegetables, such as silver beet and cabbage, and fruits, such as peaches and plums, do not satisfy the need for fat, protein and carbohydrates that the traditional staple foods provide. Also, it is important to remember that there are native vegetables and fruits in the region such as nopal, prickly pear, cabuche and palm flowers (Table 12).

The project has addressed the need for food. Women assert: "Hunger was eradicated from San Felipe since the doctor [coordinator of the project] came." The project has addressed this need through the temporary jobs offered by the project that have provided the farmers with a regular income, although it is barely enough for daily consumption. Also, the monthly food handouts provide households with enough staple food to survive. Moreover,

some chickens were donated to the women and have supplied eggs to the households. The vegetable garden and the orchards have not addressed this need as significantly as these three former activities.

5.3.1.2 Protection

The irregular nature of sources of income is a major problem identified by the men of the community. They proposed secure sources of work as the solution to satisfy this need. There is not a saving culture amongst the farmers, thus there is poor management of seasonal incomes from dates, cabuche, and mezquite. Lack of savings is exacerbated because the financial assets for saving are minimal. The project has satisfied this need with the jobs offered for the construction of the systems. However, the long term benefit is the orchards. Management of the orchards is still uncertain. Markets, distribution and prices are still unknown. Also, it will be a seasonal income and will not satisfy the need for a regular income.

There is a need of protection against natural disasters such as droughts, eclipses, hails, and hoar frosts, which not only affect the people but their productive activities. The project has addressed the need of protection during droughts with rainwater harvesting systems which effectively store water for those months of severe drought. With the completion of the most recent system, San Felipe will have a capacity to store approximately 1.2 million L. However, this water is allocated for the orchards and the vegetable garden and is not used for livestock or rainfed agriculture. There is no preventive measures against hail or frost for the orchards.

Health is another issue that farmers brought up. The lack of transport and a nearby health facility previously forced the inhabitants of San Felipe to pay for travel, food and sometimes accommodation in order to address a health problem. In cases of urgent attention there are no options: there is no rapid access to a hospital or special medicine. The project has satisfied this need with a first-aid kit. Women stressed the importance of this kit and the great benefit that it has brought to San Felipe. Families do not need to travel to Matehuala to obtain medicine except in special circumstances.

Another problem raised in discussion was the lack of control over other ejido's animals that consume the resources of San Felipe, especially pasture and water. To address this need the project is planning to fence the 30 Km of the ejido's perimeter. It is important to point out that there is already a fenced area in San Felipe (Figure 5) that is used for rainfed agriculture, although in the last three years this fenced area has served to feed the livestock with a few dried maize plants that did not produce a harvest. Some of the ponds are already fenced to prevent animals from other ejidos drinking from them.

The assistant coordinator asserts that the main need that San Felipe has is housing. He points out that the families do not have a dignified place to live. He proposes to build a house in partnership with families, where the project provides the roof (which will also be used as a rain catchment area) and the storage cisterns, while the families will build the walls. Farmers did use households as one of the criteria to measure poverty, although major priority was given to the latrines (Table 11).

5.3.1.3 Understanding and Creation

The coordinator of the project has provided extensive information about the project's activities. Farmers are skilled in tracing and levelling, forming microcatchments, replicating former constructions, preparing seedbeds and training other farmers. Not all the farmers have been trained, five men have been trained for the vegetable garden and two have been trained in tracing and levelling. No women or youth have been trained. There are some aspects of the project that the ejidatarios have not yet been trained for e.g. spraying and pruning.

The project also addressed the need of understanding by building a kindergarten. Besides being a means for providing education, the kindergarten was built as a prototype house for the semi-arid region. Thus, the roof is used as a catchment area and the water is stored in three cisterns. It is also planned to install a solar system in the kindergarten.

5.3.1.4 Participation and Freedom

San Felipe has participated in the project 'Water and Life' by consultation and for material incentives (Pretty, 1994). The project has consulted with the Commission and has listened to their views, however it is still the project that has defined the problems and solutions. Farmers have already expressed their opinion about the need for a source for water consumption and household needs, and another for livestock. Although it has been acknowledged and future planning is directed towards that opinion, these needs were not addressed first. The Commission was consulted about the management of the cisterns but in the end the decision was made by the project coordinator and the Commission respect it unconditionally. That is why the water from the cistern was not used for the animals or the rainfed agriculture, although it meant losses of animals and investment.

Farmers have participated by working on the construction of the systems and orchards. People have participated providing labour in return for cash and the ownership of the systems and orchards. However, this kind of participation runs the risk that when the incentives end, people will not prolong the activities as *faenas*. This phenomenon has already happened with the vegetable garden and the plum orchard where only the president and the treasurer of the Commission undertake the *faenas*. Some farmers feel that they have a stake in the project, particularly those who are part of the Commission and especially the president and the treasurer. It is important to point out that these two persons are regularly paid.

Women's participation has been passive. They are only told what is going to happen or has already happened. During the field research women expressed their interest in taking care of the vegetable garden. Although the vegetable garden is for self consumption, and women are in charge of food preparation they do not participate in deciding what kind of vegetables will be planted. No women have been trained for the cultivation of vegetables.

The project's rainwater harvesting systems are controlled and the inhabitants of San Felipe cannot use the harvested water freely. Quantity is not limited, but is monitored for consumption statistics and water management. Project control over the cistern is reasonable to assure the proper management of the water. However, it is important for the community and the Commission to begin learning about the management of these resources with training by the project before the project finishes. Sudden control of the cistern by the community could generate over-consumption and conflict.

5.3.1.5 Identity and Affection

The coordinator of the project 'Water and Life' is highly appreciated in San Felipe. The coordinator has been able to build not only rapport but also friendships amongst the families. Farmers acknowledge the coordinator's commitment to the community and constancy. He has come every fortnight to San Felipe, or he has made sure that someone else was there. The coordinator is a well respected personality in the community. The project has acknowledged the Commission which is the traditional authority of San Felipe.

Rainfed agriculture, although identified as the least productive activity, was also justified as a tradition left by their parents and grandparents (Table 9). Although unfruitful it is based on the cultivation of maize and beans which is the traditional staple food of the country. The project is consciously trying to eradicate this livelihood strategy because it has caused the inhabitants of San Felipe to remain in misery.

5.3.2 Impact

As mentioned by Doctor Arroyo's Mayor, San Felipe used to be the poorest ejido of the municipality until it was aided by the project in 1996. The project has helped San Felipe to be less vulnerable to droughts. Without the rainwater harvesting systems built by the project there would not be enough water even for human survival. The project has made possible the cultivation of vegetables and orchards that would be an impossible task with San Felipe's former sources of water. Other projects have tried to foster the plantation of orchards (e.g. the pistachio project in 1985) but have failed because they have not increased the water asset. Farmers highlight that the 'Water and Life' project's productive activities (i.e. orchards and vegetable garden) are the best because their water is assured (Table 9).

The project has eradicated hunger from the village by the monthly food handouts and the temporary jobs. However, these are not sustainable measures, and benefits will disappear when the project ends. Jobs and food handouts have resulted in people stopping extracting ixtle which was the livelihood strategy previously practised for daily subsistence. Farmers have high expectations of the plum and the peach orchards as sources of income. However, they have not yet produced a commercial harvest and the orchard's production has not brought about change in the community. Similarly, the first-aid kit has greatly benefited the community, but it is not a sustainable measure because when the project stops supplying the first-aid kit it will run out of medicines.

The purpose of the project is to introduce a new culture of water in the Mexican semi-arid rural region to improve the life quality of the peasant population through the introduction of water harvesting techniques. The techniques have been adopted successfully, and the expected impact of improving the life quality has been achieved in the short term by temporary jobs, food handouts, and medicine supply. There is a considerable increase in the water resource in San Felipe, but whether the management of this resource has changed is uncertain. Traditional sources remain without any monitoring or management, while the project's sources remain managed by the coordinator. The coordinator does consult about management with the Commission but the final decision is his.

Although the project 'Water and Life' has had a great impact in San Felipe, the project has not brought about changes in the Mexican semi-arid rural region. San Felipe with a population of 73 inhabitants, represents 0.20 % of the population and 0.50% of the surface area of Doctor Arroyo. The project does not have an impact at the state or the municipality level. General comments about the project from the government dependencies and the Mayor of Doctor Arroyo have been that it is a large amount of money invested in a very small ejido.

Another aspect of the project is its further implementation in other ejidos of the area. The economic resources needed, the commitment of the community, and the constancy of the coordinator of the project are factors that cannot be repeated easily.

5.3.3 Sustainability of Project Benefits

The project coordinator's major concern was what would happen with the benefits already implemented if the project terminated at this moment. As the assistant coordinator pointed out, a culmination of the project would cause instability because there are situations that are not defined yet that should have been defined before.

If the project terminates, the food handouts, the casual jobs, and the first-aid kit will be finished. As before, the staple food will be scarce, and the vegetable garden will not be sufficient to provide enough carbohydrates for survival. Rainfed agriculture would remain inefficient and would not provide enough food to satisfy the household's need. There would be no regular sources of income, and people would return to ixtle extraction,

especially in those months that there is no income from seasonal crops. Food security would be as vulnerable as before.

The Commission changes in February 2001, so the president and the treasurer who are key stakeholders in the project will lose their authority. They will not have any authority to assign faenas. Maintenance of the benefits remains uncertain, and there is a high probability that only some families will dedicate their time working in the vegetable garden and in the orchard. However, because it is a community asset, benefits need to be shared amongst all families whether or not they have contributed their labour. Intense work and not enough benefits could decrease the commitment of the families. Moreover, the market for and the price of the orchard production are uncertain, and although income may be forthcoming presumably the management of the money would remain the same as other seasonal incomes such as mezquite, cabuche and migration.

Most probably, because of the high respect that the community feels towards the coordinator of the project, the water will still be used for the same purposes as when the project was in progress. However, the management of the systems remains uncertain. The solar module and the Vecar system will not last more than 25 or 30 years and farmers affirm that they would not have the economic resources nor the accessibility to buy the materials, i.e. polyethylene film, steel sheets, etc. The benefit of the systems is likely to disappear after that period.

5.4 SUMMARY

Using the results from the participatory research, San Felipe's livelihoods were described and their sustainability analysed by determining vulnerability context, resources, institutions and organisations, strategies and expected outcomes. With this holistic and integrated picture forming a background, the project 'Water and Life' was evaluated according to its relevance, impact and sustainability in the achievement of sustainable livelihoods.

CHAPTER SIX: CONCLUSIONS

6.1 INTRODUCTION

This chapter draws together separate conclusions for the sustainable livelihoods analysis and the evaluation of the project 'Water and Life' presented in the previous chapter. These conclusions are integrated by suggesting recommendations for the improvement of the project 'Water and Life' and the lessons learnt from the research that can be used in the future.

6.2 SUSTAINABLE LIVELIHOODS

The sustainable livelihoods framework presents a holistic and integrated view of the processes by which people achieve their livelihoods. San Felipe's inhabitants have failed to achieve sustainable livelihoods and the vulnerability of the community remains high. National direct aid programmes and the project 'Water and Life' have so far only temporarily reduced the vulnerability of the ejido.

San Felipe's main strength is its natural resources. Although existing livelihood strategies have failed to achieve the livelihood outcomes of less vulnerability and improved food security, the natural assets of San Felipe present potential opportunities. These potential opportunities to achieve sustainable livelihoods are:

1. 1.2 million L of water provide a range possibilities to better livelihood strategies.
2. 107 plum trees and 174 peach trees are a potential income-earning opportunity to reduce vulnerability and assure food security in San Felipe.
3. Mezquite, dates and cabuche are native cash crops with a set market and could be cultivated to increase production. Lechuguilla, from which ixtle is extracted, is another resource that could be cultivated. Processing of these native plants has the potential to increase their value in the market.
4. Fenced land could be used for strategies other than rainfed agriculture, such as agroforestry or pasture growing. Doctor Arroyo's government is aiding with \$4 million pesos the conversion of agriculture land to pasture land.

Some of the ejidatarios of the community are key resources of San Felipe. However, further development of the social capital is required. Also, sources of human capital, such as educated young people, are lost to migration. For the community to make use of their knowledge, and develop their own projects and construct their own microcatchments and rainwater harvesting systems it is necessary to improve the Commission's networks and connections to donors and wider institutions. In this way the Commission could substitute the role of the coordinator of the project 'Water and Life' and provide the community with economic resources when the project has completed.

It is also important to create more formalised groups, especially for women, that could work to improve the food security in the community. Women could be trained in strategies that improve food security such as vegetable gardens, pen animals, and food conservation. Formalised groups also provide women with a means to increase their participation in the decision-making of the community, which is crucial to the achievement of sustainable livelihoods in the community.

The physical and financial capitals are the major shortcomings of San Felipe. They increase the vulnerability of the community. Natural assets such as orchards, mezquite, dates and cabuche cannot be exploited to their maximum due to lack of storage facilities, transport and poor distribution networks. Income is not used properly due to lack of financial assets, lack of a saving mentality and lack of skills in financial management.

To achieve the goals of reducing vulnerability and increasing food security, it is necessary for community members to either change the management of their income, find regular paid work or become self sufficient in basic food requirements. At the moment, regular paid work is not an option and the only strategy available that could resemble a regular paid job is the ixtle extraction, which has practically disappeared since the project 'Water and Life' started. Seasonal income is normally spent immediately and not saved for the future. Thus, there are three options:

1. Improve the ixtle extraction as a strategy by skill training, the mechanisation of the extraction, lechuguilla plantations, to process the fibre into products to increase prices and find niche markets.
2. Improve the management of the seasonal income from livestock, orchards, mezquite, dates and cabuche.
3. Make rainfed agriculture a sustainable livelihood strategy. This can be achieved by irrigation. Rainwater harvesting systems and contour ridges are solutions to reduced the risk of the rainfed agriculture. These measures could also secure the aid from PROCAMPO.

6.3 EVALUATION OF THE PROJECT 'WATER AND LIFE'

The project has brought about changes for the betterment of the community, thus the impact has been positive. However, these changes have only partially met the needs of the community according to Max-Neef analysis. Also, the project is not sustainable where benefits are likely to disappear after 25 or 30 years.

The project has achievements that need to be acknowledged as well as problems that need to be addressed for future improvement of the project. These achievements and problems reflect the relevance, impact and benefits sustainability of the project 'Water and Life'.

6.3.1 Achievements

The project has provided the community with three rainwater harvesting systems that have an overall storage capacity of 1.2 million L. The water provided is of a high quality, and there are minimal losses for infiltration and evaporation. These systems have satisfied to some extent the need of subsistence and protection for the ejido of San Felipe.

A fully-furnished kindergarten with a water storage system of 7,500 L caught from the roof has been provided by the project. This kindergarten satisfies the need of understanding because it offers the young children an ideal environment and the suitable tools to learn. It also presents to the community a model of a prototype house for the semi-desert.

The project has provided training to some of the male members of the community. Two of the ejidatarios are now skilled in topography and five in the vegetable garden cultivation. Also, the ejidatarios are able to copy or repair the systems if the economical resources are available and the materials accessible.

The coordinator has respected the Commission's authority and the Commission members have been consulted on the project's activities. The Commission has thus participated by consultation. Similarly the ejidatarios have participated by working in the construction of the different systems. This has satisfied partially the need of participation of the Commission and the ejidatarios of San Felipe, however it does not reach the higher levels of participation (Pretty et al, 1995).

The coordinator of the project has been successful in building rapport with the community. The coordinator has been able to build trust and vision amongst key members of the ejido. This has satisfied the need of affection and identity of the ejido of San Felipe.

6.3.2 Problems

The project 'Water and Life' has created a false sense of food security in San Felipe. Monthly food handouts and occasional jobs have eradicated hunger from the community. However, these measures are not sustainable and San Felipe may be worse off when the project is completed because traditional livelihood strategies have been lost. Since the project has been implemented, the livelihood strategy of ixtle extraction has practically disappeared. Ixtle extraction is the only available sustainable option for a regular income. Similarly, the first-aid kit has impacted very positively on the health of the community but this activity will also finish when the project stops supplying the medicine.

The community of San Felipe has limited control over the rainwater harvesting systems. This water is available only for the project and neglects human consumption needs and traditional activities. None of the systems is permanently allocated to human consumption providing it only as an emergency measure. People have been drinking from the spring which is considered of lower quality. Rainfed agriculture and livestock have not benefited from the increase of water in the community.

Women have only passive participation in the project. As a result of the community's traditional organisations and institutions, women are completely excluded from the decision-making. The vegetable garden is a strategy to provide food for the community. Although women are the ones who prepare the food, at the moment it is men who decide what to plant and the vegetables are shared between the ejidatarios. Moreover, women were not trained for the vegetable garden, only men.

Orchards and the vegetable garden do not provide staple foods and cannot be considered as strategies for on-going food security. Orchards potentially could be a income generating strategy which could be used to purchase the staple food. However, San Felipe has very few physical assets that support successful orcharding. There is a high possibility that a considerable amount of the harvest could be lost due to post-harvesting problems such as lack of proper storage, lack of an infrastructure for distribution and lack of a set market. In addition, orcharding is very risky due to frosts, hails and eclipses. Conserves could be a strategy to reduce losses. However, it is uncertain that the households will have the capacity to obtain the flasks and ingredients to prepare their own conserves, or have a market for conserves. The other shortcoming is the lack of a 'savings' culture in the community. Seasonal income is spent immediately and will not ensure food security for the remaining months.

Young men have not been trained in the project. Two of the systems will not last more than 30 years, which means that the benefits of these systems will disappear if the next generations have not been trained and do not have the means to obtain the economic resources to maintain the irrigation system.

Also only a few key ejidatarios have taken responsibility of doing the faenas required for the vegetable garden and the plum orchard. The Commission has not assigned the faenas for the vegetable garden and the orchards. Only paid work is undertaken by all the ejidatarios.

The project is unlikely to be replicated in other ejidos due to its high investment of money and the need for high social capital to implement it.

6.4 RECOMMENDATIONS FOR THE PROJECT 'WATER AND LIFE'

It is recommended that:

1. The project addresses the need of human water consumption with the rainwater harvesting systems available. The rainwater harvesting systems should be used not only as a coping measure, but as a strategy to address this essential need of San Felipe. The water of the highest quality available should be given to people first.

2. The women be given responsibility for the vegetable garden. The vegetable garden provides a learning environment where women could be trained in technical and management skills. These activities could foster the formation of a women's local organisation that has a voice at the ejido's assembly meetings. Eventually, this organisation could have a wider influence in the community and increase women's full participation in the development of San Felipe.
3. The kindergarten, after school hours, is used as a meeting place for the community, the Commission and the assembly, and future local organisations. The key of the kindergarten needs to be available to other responsible members of the community besides the teacher.
4. A combination of the different assets available in San Felipe are experimented with to improve livelihood strategies and outcomes. For example: grow pasture in the fenced plots; grow maize and beans in the vegetable garden; investigate the feasibility of integrating the fruit trees, mezquite or palms with crops; use water from the Vecar system for human consumption and the spring for the vegetable garden; diversify the use of the water from orchard cisterns to other strategies such as livestock. The project should not concentrate its efforts on increasing new assets while the former ones have not been effectively used and have not reduced the vulnerability nor improved the food security of the community.
5. The project encourages more participation by beneficiaries in project decision-making to empower people and to foster a sense of ownership and responsibility.
6. The project encourages self sufficiency and discourages dependency to enhance sustainability by:
 - Improving networks and connections for the supply of medicines and establishment of plum and peach markets.
 - Stopping the food handouts strategy that is creating a false sense of security, leading to livelihood strategies such as ixtle extraction to disappear and hindering the creation of sustainable livelihood strategies.
7. A time for the completion of the project in San Felipe is determined so that the community is aware of their responsibility and can work towards self sufficiency in maintaining the systems provided by the project.
8. The project, together with the people of San Felipe, sets clear objectives and indicators for monitoring and evaluating the project in the future.

6.5 LESSONS LEARNT

Some general lessons can be learnt from this case study that can be applied to other development endeavours in Mexico and elsewhere. The more specific lessons are described first, ending with most general lessons.

1. Livelihood structures of the semi-arid region of Mexico are likely to be complex, usually integrating limited assets in diverse livelihood strategies to reduce the risks associated with living near subsistence. There is an urgent need to reduce vulnerability and improve food security in the communities. An increase in assets does not necessarily improve the livelihood strategies and therefore does not assure a reduction in vulnerability or an improvement in food security.
2. Water is an essential asset for the Mexican semi-arid regions, however an increase of this natural capital is not enough on its own to reduce vulnerability or improve food security. There are a number of other essential ingredients. Water management is equally important. Income was demonstrated to be another very important asset in San Felipe. It was evident that an increase in income is not enough, because the seasonality

of the income-earning opportunities means that money is not always available. Lack of a saving culture in a region where there is no regular sources of work or steady stream of income makes the community vulnerable. What is required are productive activities that assure food security or provide a regular income. Changing to a saving culture is a long term solution that requires skills, training and the improvement of physical and financial assets.

3. Organisations and policies have a direct impact on the level of participation and access to assets of the different groups of a community. Therefore, to increase the participation of women it is important to formalise a base organisation that participates in the decision-making of an ejido. The national laws may hinder the participation of women as all required structures and processes of the ejido are developed by the ejidatarios.
4. It is important to increase the networks and connections of the local organisations with the wider institutions. If not, ejidos and similar small communities will be dependent on outsiders as intermediaries. This, as demonstrated in this case study, limits communities to a range of choices and goals that do not agree with the ejido's perception of reality, formulated by inaccessible agencies.
5. Women's full participation is essential to achieve a reduction in vulnerability, especially an improvement in food security. Women need to have a voice in the decision-making both in development projects and the community, especially on matters regarding food production, consumption and preparation. Otherwise, because of the different role that women and men play in a community, women's and children's needs may be neglected and remain unaddressed.
6. Participation should be used to empower people, and not as a tool for outsiders to accomplish an aim. If not, real poverty reduction and sustainable development will not be achieved. People become dependent on aid, as has happened in San Felipe. Inhabitants feel impotent to build or repair rainwater harvesting systems or cultivate new orchards, and are replacing traditional livelihoods (e.g. ixtle) with temporary income measures. The community is not capable of maintaining and enhancing the assets implemented by the project and the benefits are likely to fade.
7. Development endeavours should integrate poverty reduction strategies, sustainability, participation and empowerment processes as part of their general outcomes. Negative impacts or failure to achieve development goals could easily happen if there is not a holistic view of the processes by which people achieve their livelihoods and consideration of how the project will impact on the whole community.
8. The DFID sustainable livelihoods framework and Max-Neef human scale development approach are two complementary models that can be used to effectively provide a holistic view of the strengths and needs of a community. Using these models as a basis, stakeholders will be able to plan, implement and monitor relevant development projects that assist the community to achieve sustainable livelihoods.

REFERENCES

- Advisory Committee on Technology Innovation. (1974). *More water for arid lands*. Washington, D.C.: National Academy of Sciences.
- Agenda 21, *United Nations Conference on Environment and Development*. (1992).
- Bahá'í International Community. (1995). *The prosperity of humankind*. Haifa: Bahá'í International Community Office of Public Information.
- Brock, K. (1999). Implementing a sustainable livelihoods framework for policy-directed research: Reflections from practice in Mali. *IDS Working Papers* [Online], 24 screens. Available: <http://www.ids.ac.uk/ids/publicat/wp/wp90.pdf> [2000, January 13].
- Canadian Embassy in Mexico. (1997). *Trade action plan for Mexico: Agriculture and Agri-food* [Homepage of Canadian Embassy of Mexico], [Online]. Available: http://www.canada.org.mx/trade/english/cib_agri.htm [1998, 30 March].
- CEC (Ed.). (1995, 01 October –last updated). *Summary of environmental law in Mexico* [Homepage of Commission for Environmental Conservation, Canada, Mexico and the United States], [Online]. Available: <http://www.cec.org/infobases/law/Data.CFM?Country=Mexico&Language=English&unique=150.0> [2000, February 8].
- Cernea, M.M. (Ed.). (1991). *Putting people first: Sociological variables in rural development* (2nd ed.). Washington, D.C.: Oxford University Press.
- Chambers, R. (1992). Participatory rural appraisals: Past, present and future. *Forest, Trees and People Newsletter*, (15/16), 4-9.
- Chambers, R. (1995). Paradigm shift and the practice of participatory research and development. In N. Nelson and S. Wright (Eds.), *Power and participatory development: Theory and practice*. London : Intermediate Technology Publications.
- Chambers, R. (1997). *Whose reality counts? Putting the first last*. London: Intermediate Technology Publications.
- CONAZA(Ed.). (1999, October –last updated). *Arid zones (social and economical diagnosis)* [Homepage of CONAZA/SEDESOL, National Secretariat of Mexico], [Online]. Available: <http://www.sedesol.gob.mx/html2/conaza/zonasari.htm> [2000, February 14].
- de Negri, B. et al. (1998). *Empowering communities: Participatory techniques for community-based programme development. Volume 2: Participant's Handbook*. Nairobi: The Centre for African Family Studies (CAFS).
- DFID. (1997). *Eliminating world poverty: A challenge of the 21st century* [Homepage of the Department for International Development of the United Kingdom], [Online]. Available: <http://www.dfid.gov.uk/public/what/engwptxt.html> [1999, 19 December].
- DFID. (1999). Sustainable livelihoods guidance sheets. *Institute of Development Studies, Sussex* [Online], 36 screens. Available: <http://www.ids.susx.ac.uk/livelihoods/pdf/section1.pdf>[1999, 21 December].
- Ekins, P. (1992). *A new world order: Grassroots movement for global change*. London: Routledge.
- FAO (Ed.). (2000). *Food-based dietary guidelines* [Homepage of Food and Agriculture Organisation of the United Nations], [Online]. Available: <http://www.fao.org/es/esn/fbdg/htoc.htm#I0> [2000, February 12].
- Gutierrez, J.J. (1996). The new law is not ours: Local level response to agrarian reform in Mexico. *The ANTHAP Working papers* [Online], 5 screens. Available: <http://anthap.oakland.edu/papers/gutierrez96/contents.html> [1998, 30 March].
- Hoon, P., Singh, N., and Wanmali, S.S. (1997). Sustainable livelihoods: Concepts, principles and approaches to indicator development: A draft discussion paper.

- Sustainable Livelihoods (SL) Documents* [Online], 28 screens. Available: http://www.undp.org/sl/Documents/Indicators_and_eval/SL%20concepts/sl_concepts_principles_and_approaches_to_indicator_development.htm [1999, 20 December].
- IISD. (1999). *Communities & livelihoods* [Homepage of IISDnet, The International Institute for Sustainable Development], [Online]. Available: <http://iisd1.iisd.ca/communities.htm> [2000, 4 January].
- INEGI. (1995). *Dr. Arroyo, Estado de Nuevo León: Cuaderno estadístico municipal*. Mexico: Instituto Nacional de Estadística, Geografía e Informática.
- ITESM. (1996). *Mission of the Monterrey Institute of Technology University System*. Monterrey, N.L.: Instituto Tecnológico y de Estudios Superiores de Monterrey.
- Jones, C. (1996). *PRA tools and techniques pack*. Brighton: IDS.
- Korten, D.C. (1990). *Getting to the 21st century: Voluntary action and the global agenda*. Connecticut: Kumarian Press.
- Korten, D.C. (1996). Sustainable livelihoods: A foundation of just and sustainable societies. *Report of 1994-95 SID/PIED workshops on civil society and sustainable livelihoods held in Asia, Sub-saharan Africa, Latin America and North America*. Rome: Society for International Development and Center for Respect of Life and Environment.
- Kunbar, R. and Squire, L. (1999). The evolution of thinking about poverty: Exploring the interactions. *World Bank Poverty Net* [Online], 39 screens. Available: www.worldbank.org/poverty/wdrpoverty/evolut.pdf [1999, 21 December].
- Loubser, J. (1996). Sustainable livelihoods: A conceptual exploration. *Report of 1994-95 SID/PIED workshops on civil society and sustainable livelihoods held in Asia, Sub-saharan Africa, Latin America and North America*. Rome: Society for International Development and Center for Respect of Life and Environment.
- Martinez, J.C. et al. (1999). *Programa de apoyo al PROCAMPO*. Mexico: SAGAR and SHCP.
- Max-Neef, M.A. (1991). *Human scale development: conception, application and further reflections*. New York: Apex Press.
- Pretty, J.N. et al. (1995). *Participatory learning & action: A trainer's guide*. London: IIED.
- Regan, C. (Ed). (1996). *75 25 Development in an increasingly unequal world*. Birmingham: Development Education Centre.
- Rennie, J.K. and Singh, N.C. (1996). *Participatory research for sustainable livelihoods: A guidebook for field projects*. Manitoba: IIED.
- Rietbergen-McCracken, J. and Narayan, D. (1998). *Participation and social assessment: Tools and techniques*. Washington, D.C.: The World Bank.
- Rocheleau, D. and Slocum, R. (1995). Participation in context: Key questions. In R. Slocum et al (Eds.), *Power, process and participation – Tools for change*. London: Intermediate Technology Publications.
- Selener, D. (1997). *Participatory action research and social change*. New York: The Cornell Participatory Action Research Network.
- Siegert, K. (1995). Gathering the rains. *Ceres*, 27(6), 35-38.
- Singh, N.C. and Strickland, R. (1994). *Sustainability, poverty and policy adjustment: From legacy to vision*. Manitoba: IISD.
- Smith, S.E. (1997). Participatory action-research within the global context. In S.E. Smith and D.G. Willms (Eds.), *Nurtured by knowledge: Learning to do participatory action-research*. New York: the Apex Press.
- The Earth Council. (1999). *What is sustainable development?* [Homepage of The Earth Council], [Online]. Available: <http://www.ecouncil.ac.cr/rio/susdevelopment.htm> [2000, 4 January].
- The World Bank. (1996). *The World Bank participation sourcebook*. Washington, D.C.: Environmentally Sustainable Development.

- The World Bank. (1999). *Overview* [Homepage of The World Bank Group], [Online]. Available: <http://www.worldbank.org/html/extdr/about/why.htm> [1999, 30 December].
- The World Commission on Environment and Development. (1987). *Our common future*. Great Britain: Oxford University Press.
- UNDP. (1998). Human Development Report 1998: Overview. *Human Development Report* [Online], 8 screens. Available: <http://www.undp.org/hdro/e98over.htm> [1999, December 6].
- UNDP. (1999a). *Mission Statement*. [Homepage of United Nations Development Programme], [Online]. Available: <http://www.undp.org/info/discover/mission.html> [1999, 30 December].
- UNDP. (1999b). Participatory assessment and planning for sustainable livelihoods. *Sustainable Livelihoods (SL) Documents* [Online], 16 screens. Available: http://www.undp.org/sl/Documents/Strategy_papers/Participatory_Assessment_for_SLSW.htm/PAPSL.htm [1999, December 6].
- UNDP. (1999c). Sustainable livelihoods concept paper. *Sustainable Livelihoods (SL) Documents* [Online], 5 screens. Available: http://www.undp.org/sl/Documents/Strategy_papers/Participatory_Assessment_for_SLSW.htm/PAPSL.htm [1999, December 6].
- UNDP. (1999d). Empowering people: A guide to participation. *Sustainable Livelihoods (SL) Documents* [Online]. Available: <http://www.undp.org/sl/Documents/Manuals/Empowering/toc.htm> [1999, December 21].
- Velasco-Molina, H.A. (1999, May 05). Letter to Nina Perez.
- Velasco-Molina, H.A. and Carmona-Ruiz, G.C. (1984). *Cosecha de agua de lluvia en el altiplano semidesertico de Mexico*. Mexico: El Programa Nacional para el Desarrollo de los Plásticos en la Agricultura Proyecto PEMEX-CIQA.
- Wilson, P.N. and Thompson, G.D. (1993). Common Property and Uncertainty: Compensating Coalitions by Mexico's Pastoral Ejidatarios. *Economic Development and Cultural Change*, 41(2), 299-318.
- Young, D. and Hinton, R. (1996). An introduction to participatory techniques. *Agriculture and Natural Resources Series* [Online], 2 screens. Available: <http://www.vso.org.uk/pubs/wpapers/prai/intro.htm> [2000, February 29].