

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

A thesis
submitted in partial fulfilment
of the requirements for the Degree of
Master of Applied Science
at
Lincoln University

by
N.T. Pérez Izadi

Lincoln University

2000

Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of

M.Appl.Sci.

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

By N. T. Pérez Izadi

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. This uncertainty is in part due to the variation in definitions, paradigms and goals of development. The concept of development has evolved from rapid economic growth to a more holistic view which encompasses eradication of poverty and fostering of sustainability, participation and empowerment.

Using participatory research, the case study evaluated 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.

ACKNOWLEDGEMENTS

Doy gracias primero a Dios por haber provisto los medios, asegurado el camino y haberme guiado para realizar esta investigación. A mis padres y mi familia cuyo amor y apoyo son la motivación que me permite seguir adelante.

Este trabajo de investigación no hubiera sido posible sin la ayuda del Dr. Hugo Velasco Molina, su gran deseo de servir a las gentes más necesitadas del sur de Nuevo León fue reflejado en el constante apoyo que se dio a esta investigación desde su inicio. Agradezco de todo corazón su cooperación. Así mismo, ofrezco un apreciado reconocimiento al Ing. Francisco Espinoza por su participación en esta investigación. Un sincero agradecimiento al Dr. Jesús Velasco quien me brindó los contactos del proyecto ‘Agua y Vida’.

Doy las gracias a la familia Pérez Cruz por su generosa hospitalidad durante mi estancia en el ejido de San Felipe. Muchas gracias a Doña Carmelita por sus atenciones y cuidados. Un muy apreciado agradecimiento a Sandra, María de Jesús y Armandina por su amistad y colaboración en la investigación. Doy reconocimiento al Comisariado de San Felipe por su dedicada participación en el diseño e implementación del trabajo de campo.

Mis más sincero agradecimiento a las gentes del ejido de San Felipe que participaron en la investigación comunitaria. Mi desempeño fue más la de un facilitador, mientras que ellos son realmente los autores de esta tesis. Mi más apreciado reconocimiento a las siguientes personas:

- | | | |
|----------------------------------|------------------------------|----------------------------|
| ▪ Roberto Pérez Montoya | ▪ Jesús Pérez Medellín | ▪ Juan José Pérez Medellín |
| ▪ Francisco Pérez Montoya | ▪ José Guadalupe Pérez Cruz | ▪ Damacio Cruz Montoya |
| ▪ Luis Rodríguez Cruz | ▪ José Luis Rodríguez Pérez | ▪ Efraín Pérez Salinas |
| ▪ Ascensión Pérez Montoya | ▪ Carmela Cruz Montoya | ▪ Francisca Eguía Trejo |
| ▪ Ma. del Socorro González Ortiz | ▪ Simona Medellín de León | ▪ Vicenta Gaytán Torres |
| ▪ Enriqueta Carrizales Iracheta | ▪ Florentina Ruiz Trejo | ▪ Berta Salinas García |
| ▪ Guadalupe Iracheta Hernández | ▪ María Iracheta | ▪ Silvestre Pérez Medellín |
| ▪ Simón Pérez Medellín | ▪ Alejandro Rodríguez García | ▪ Ruben Pérez Salinas |
| ▪ Rufino Pérez Salinas | ▪ Roberto Pérez Cruz | ▪ Armandina Pérez Cruz |
| ▪ Ma. de Jesús Pérez Cruz | ▪ Sandra Pérez Cruz | ▪ Teresa Cordero |

My gratitude and appreciation to Mandy Cahn for her continued support and guidance during my research. Many thanks to Keith Morrison whose input and time was very valuable for my research. Thanks to the staff and my special gratitude to Nancy Dobrochowski and Chris Ma’auga for their helpful assistance in the edition of this thesis.

I offer a special and heartfelt thanks to my husband Behzad. For his loving support and patience throughout my thesis research. I am truly thankful to my family, to my father, my brother and my aunt Ruth that help me and support me during field research in Mexico. My sincere gratitude to the Roe family, Rocha Munive Family, Ali Hurtado and Sahar Haei who hosted me during my travel. Likewise to my friends, all over the world, thank you.

Financial assistance from Lincoln University and the NZODA (New Zealand Overseas Development Agency) enabled this research to be undertaken and is gratefully acknowledged. Special acknowledgments to the University of Nur in Bolivia, to Fernando Dick and his staff for their guidance in the application of the participatory approach in this research.

I would like to acknowledge my mother (deceased) who has been a source of courage and motivation and always will be. My deep appreciation and gratitude for all her love and guidance.

CONTENTS

ABSTRACT.....	II
ACKNOWLEDGEMENTS.....	IV
CONTENTS.....	VI
LIST OF TABLES	X
LIST OF FIGURES	XI
ABBREVIATIONS AND ACRONYMS	XII
CHAPTER ONE: INTRODUCTION	1
1.1 BACKGROUND	1
1.2 RESEARCH OBJECTIVES	1
1.3 THESIS STRUCTURE	2
CHAPTER TWO: LITERATURE REVIEW	3
2.1 INTRODUCTION.....	3
2.2 DEFINING DEVELOPMENT.....	3
2.2.1 <i>History</i>	3
2.2.2 <i>Paradigms</i>	5
2.3 POVERTY	8
2.4 SUSTAINABILITY	12
2.4.1 <i>DFID Sustainable Livelihoods Framework</i>	14
2.4.1.1 Vulnerability Context.....	14
2.4.1.2 Livelihood Assets.....	14
2.4.1.3 Transforming Structures and Processes	15
2.4.1.4 Livelihood Strategies	15
2.4.1.5 Livelihood Outcomes.....	15
2.5 PARTICIPATION.....	15
2.5.1 <i>Approaches to Participation</i>	15
2.5.2 <i>Participation and Inclusiveness</i>	17
2.5.3 <i>Types of Participation</i>	17
2.6 SUMMARY	19
CHAPTER THREE: RESEARCH METHODS AND DESIGN.....	21
3.1 INTRODUCTION.....	21
3.2 METHODOLOGY.....	21
3.3 DIMENSIONS OF THE RESEARCH.....	23
3.3.1 <i>Purpose for Study: Exploratory Research</i>	23
3.3.2 <i>Use of Study: Participatory Action Research and Evaluation</i>	24
3.3.2.1 Participatory Action Research.....	24
3.3.2.2 Evaluation	25
3.3.3 <i>Time Dimension in Research: Case Study</i>	27
3.3.4 <i>Data Collection Technique: Participatory Rural Appraisal</i>	27
3.4 RESEARCH DESIGN	29
3.4.1 <i>First Phase: Participation of the Stakeholders in the Design of the Research</i>	30
3.4.2 <i>Second Phase: Collection of the Secondary Data</i>	31
3.4.3 <i>Third Phase: Community Participatory Research</i>	31
3.4.4 <i>Fourth Phase: Community Action Plan</i>	35
3.4.5 <i>Fifth Phase: Semi-structured Interviews</i>	35
3.4.6 <i>Methods</i>	35
3.4.6.1 Semi-structured Interview.....	35
3.4.6.2 Focus Group.....	36
3.4.6.3 Mapping.....	36
3.4.6.4 Transect Walks	36
3.4.6.5 Time Line.....	36
3.4.6.6 Ranking, Scoring and Matrices	36
3.4.6.7 Venn Diagrams	37
3.4.6.8 Flow Diagrams.....	37
3.4.6.9 Daily Schedule.....	37

3.4.6.10 Brainstorming, Observation and Informal Discussions	37
3.5 CONSTRAINTS	37
3.6 SUMMARY	38
CHAPTER FOUR: BACKGROUND TO THE CASE STUDY	40
4.1 INTRODUCTION	40
4.2 MEXICAN AGRICULTURAL SECTOR	40
4.3 LAND REFORM	41
4.4 MEXICAN SEMI-ARID AND ARID REGION	42
4.5 WATER HARVESTING TECHNIQUES	43
4.5.1 Run-off Agriculture	44
4.5.2 Run-off Storage	45
4.5.3 Mexican Rainwater Harvesting Techniques	45
4.6 PROJECT 'WATER AND LIFE'	46
4.7 EJIDO OF SAN FELIPE	49
4.7.1 Doctor Arroyo	49
4.7.2 San Felipe	50
4.7.2.1 Human Water Consumption	51
4.7.2.2 Vegetable Garden Production	52
4.7.2.3 Manual Irrigation of the Peach Orchard	52
4.7.2.4 First-Aid Kit	53
4.8 SUMMARY	53
CHAPTER FIVE: RESEARCH RESULTS	55
5.1 INTRODUCTION	55
5.2 SEMI-STRUCTURED INTERVIEW	55
5.3 COMMUNITY PARTICIPATORY RESEARCH	57
5.3.1 Mapping	57
5.3.2 Time Line	59
5.3.3 Matrix Scoring for Poverty Analysis	60
5.3.3.1 Household	61
5.3.3.2 Livestock	61
5.3.3.3 Transport	62
5.3.3.4 Sources of Work	62
5.3.4 Matrix Scoring for Productive Activity Analysis	62
5.3.4.1 Seasonal Harvesting	63
5.3.4.2 Water	63
5.3.4.3 Money	64
5.3.4.4 Human Consumption	64
5.3.4.5 Work	65
5.3.4.6 Seasonal Rainfall	65
5.3.4.7 Risk	65
5.3.4.8 Overall Results	65
5.3.5 Sustainability of Project Benefits	66
5.3.5.1 Vegetable Garden	66
5.3.5.2 Plum and Peach Orchard	66
5.3.5.3 Solar Module	66
5.3.5.4 Knowledge for New Constructions	67
5.3.5.5 Overall	67
5.3.6 Income and Expenditure Analysis	67
5.3.6.1 Farming Costs and Transport	67
5.3.6.2 Health	68
5.3.6.3 Coping with Expenses	68
5.3.7 Food Consumption Analysis	68
5.3.7.1 Project Food Handout	69
5.3.7.2 Rainfed Agriculture	69
5.3.8 Household Water Consumption and Sources of water	69
5.3.8.1 Vegetable Cistern	69
5.3.8.2 Solar Module Silt Trap	70
5.3.9 Local Products	70
5.3.10 Local Product Links and Problems	71
5.3.11 Transect Walk	72
5.3.12 Daily Schedule	76
5.3.13 Benefits of the Project	76
5.3.14 Impact of the Project	77
5.3.15 Youth Group Discussion	78
5.4 COMMUNITY ACTION PLAN	79

5.4.1 Women's Participation in the Vegetable Garden	79
5.5 INFORMAL DISCUSSIONS	79
5.5.1 Meeting with the Commission and the Coordinator Assistant.....	79
5.5.2 Santa Ana highway construction	80
5.5.3 Migration.....	80
5.6 OBSERVATIONS	80
5.7 SUMMARY	81
CHAPTER SIX: DISCUSSION.....	82
6.1 INTRODUCTION.....	82
6.2 SUSTAINABLE LIVELIHOODS ANALYSIS –SAN FELIPE.....	82
6.2.1 Vulnerability Context.....	82
6.2.1.1 Government Trends	83
6.2.1.2 Seasonal Price, Produce and Employment	84
6.2.1.3 Erratic Rainfall and Droughts	84
6.2.1.4 Hails, Eclipses, and Hoar Frosts	85
6.2.1.5 Coyotes	86
6.2.2 Livelihood Resources.....	86
6.2.2.1 Human Capital	86
6.2.2.2 Social Capital.....	86
6.2.2.3 Natural Capital.....	87
6.2.2.4 Physical Capital	89
6.2.2.5 Financial Capital.....	89
6.2.3 Institutions and Organisations.....	90
6.2.4 Livelihood Strategies	91
6.2.4.1 Rainfed Agriculture	91
6.2.4.2 Livestock.....	92
6.2.4.3 Ixtle Extraction	92
6.2.4.4 Migration	92
6.2.4.5 Pen Animals and Native Crops	93
6.2.4.6 Fruit Orchards.....	93
6.2.4.7 Vegetable Garden.....	94
6.2.4.8 Occasional Jobs.....	94
6.2.5 Livelihood Outcomes	94
6.3 EVALUATION OF THE 'WATER AND LIFE' PROJECT	95
6.3.1 Relevance.....	95
6.3.1.1 Subsistence.....	96
6.3.1.2 Protection.....	97
6.3.1.3 Understanding and Creation.....	98
6.3.1.4 Participation and Freedom	99
6.3.1.5 Identity and Affection	100
6.3.2 Impact.....	100
6.3.3 Sustainability of Project Benefits.....	101
6.4 SUMMARY	102
CHAPTER SEVEN: CONCLUSIONS	103
7.1 INTRODUCTION.....	103
7.2 SUSTAINABLE LIVELIHOODS	103
7.3 EVALUATION OF THE PROJECT 'WATER AND LIFE'	104
7.3.1 Achievements	105
7.3.2 Problems.....	105
7.4 RECOMMENDATIONS FOR THE PROJECT 'WATER AND LIFE'	107
7.5 LESSONS LEARNT	108
REFERENCES.....	110
APPENDICES	
Appendix 1: Arid and Semi-arid Zones in Mexico	118
Appendix 2: Rainwater Harvesting System --Vecar Type	119
Appendix 3: Run-off Solar Module and Vegetable Garden.....	120
Appendix 4: Microcatchment System for Peach Orchard.....	121
Appendix 5: Rainwater Harvesting System --Lt Type	122
Appendix 6: Miscellaneous Outputs of the Project 'Water and Life'	123
Appendix 7: Map of Nuevo Leon.....	124
Appendix 8: 'Water and Life' Project Records.....	125
Appendix 9: Features of San Felipe.....	127
Appendix 10: Sources of Water in San Felipe.....	128

Appendix 11: Benefit Sustainability Analysis..... 129
Appendix 12: Expenditure Analysis 130
Appendix 13: Food and Water Consumption Analysis..... 131
Appendix 14: Local Products..... 133
Appendix 15: Women’s Daily Schedule 134
Appendix 16: Action Plan 135
Appendix 17: Transect Walk (video included)

LIST OF TABLES

<i>Table 1: Things and People Paradigm.....</i>	<i>6</i>
<i>Table 2: The Evolution of Thinking about Poverty</i>	<i>8</i>
<i>Table 3: Classification of Consumption Patterns</i>	<i>9</i>
<i>Table 4: Types of Satisfiers</i>	<i>11</i>
<i>Table 5: Participatory Approaches.....</i>	<i>16</i>
<i>Table 6: A Typology of Participation.....</i>	<i>19</i>
<i>Table 7: Research Approaches</i>	<i>22</i>
<i>Table 8: Dimension of the Research</i>	<i>23</i>
<i>Table 9: General Assumptions in PAR.....</i>	<i>25</i>
<i>Table 10: PRA Common Techniques.....</i>	<i>29</i>
<i>Table 11: Stakeholder Analysis.....</i>	<i>30</i>
<i>Table 12: Secondary Data.....</i>	<i>31</i>
<i>Table 13: Community Participatory Research Design.....</i>	<i>32</i>
<i>Table 14: Participatory Techniques for the Community Research</i>	<i>34</i>
<i>Table 15: Additional Participatory Techniques.....</i>	<i>35</i>
<i>Table 16: Arid and Semi-arid Zones Characteristics.....</i>	<i>42</i>
<i>Table 17: Techniques to Improve Soil Surface Impermeability</i>	<i>45</i>
<i>Table 18: Main Project's Outputs in San Felipe.....</i>	<i>47</i>
<i>Table 19: Efficiency of the Microcatchment System</i>	<i>53</i>
<i>Table 20: Highlights of the Interview with Doctor Arroyo's Mayor.....</i>	<i>55</i>
<i>Table 21: Highlights of the Interview with the Project's Coordinator.....</i>	<i>56</i>
<i>Table 22: Highlights of the Interview with the Assistant coordinator.....</i>	<i>57</i>
<i>Table 23: Mapping Group Discussion</i>	<i>59</i>
<i>Table 24: Time Line Group Discussion</i>	<i>60</i>
<i>Table 25: Matrix Scoring for Poverty Analysis.....</i>	<i>61</i>
<i>Table 26: Matrix Scoring for Productive Activity Analysis.....</i>	<i>63</i>
<i>Table 27: Basic Food Consumption.....</i>	<i>69</i>
<i>Table 28: Household Water Consumption and Water Sources.....</i>	<i>70</i>
<i>Table 29: Preference Ranking of Local Products</i>	<i>70</i>
<i>Table 30: Livestock</i>	<i>72</i>
<i>Table 31: Mezquite Picking.....</i>	<i>72</i>
<i>Table 32: Rainfed Agriculture.....</i>	<i>73</i>
<i>Table 33: Ixtle Extraction</i>	<i>74</i>
<i>Table 34: Peach Orchard.....</i>	<i>74</i>
<i>Table 35: Rainwater Harvesting System for the Peach Orchard.....</i>	<i>74</i>
<i>Table 36: Other Activities</i>	<i>75</i>
<i>Table 37: Women's Productive Activities</i>	<i>75</i>
<i>Table 38: Households</i>	<i>76</i>
<i>Table 39: Benefits of the Project.....</i>	<i>77</i>
<i>Table 40: Impact of the Project.....</i>	<i>78</i>
<i>Table 41: Water Resource Management.....</i>	<i>88</i>

LIST OF FIGURES

<i>Figure 1: Sustainable Livelihoods Framework</i>	14
<i>Figure 2: Rainwater Harvesting Concept</i>	44
<i>Figure 3: Project Stakeholder Analysis</i>	48
<i>Figure 4: Rainfall Patterns</i>	51
<i>Figure 5: Vegetable Garden Production Patterns</i>	52
<i>Figure 6: Medicine Consumption</i>	53
<i>Figure 7: Map of San Felipe</i>	58
<i>Figure 8: Time Line</i>	60
<i>Figure 9: Flow Chart of Local Product Links and Problems</i>	71

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
DICONSA	Distribuidora e Impulsora Comercial Conasupo S.A de C.V Government-controlled commodity distributor
FIRCO	Fideicomiso de Riesgo Compartido
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
SEDESOL	Secretaria de Desarrollo Social Secretariat for Social Development
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 THESIS 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. Chapter six discusses the research results using the DFID sustainable livelihoods framework and Max-Neef human scale development approach. Finally, chapter seven 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 History

The concept of development is broad and varied. Authors and organisations differ in their definitions, and paradigms have shifted through time. Regan (1996) describes four dominant approaches to development that have evolved over the last half of the 20th century:

1. Rapid economic growth. Emphasis is 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. Importance is placed on industry rather than agriculture, urban growth instead of rural growth, and the promotion of consumption and personal wealth before social or collective well-being.
2. Development as structural change. 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.
3. Development as liberation. Emphasis is 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.
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. The inclusion gender, culture and environment awareness has enhanced the seeking of justice and liberation by development endeavours.

In the post-World War II period (1950s to 1970s), the dominant concept of development was economic growth. Development was defined as "... rapid and sustained rise in the real output per head and attendant shifts in the technological, economic and demographic characteristics of society" (Regan, 1996, p.12). It was assumed that if Gross National Product (GNP) or Gross Domestic Product (GDP) grew, then the well-being of each person would inevitably rise also (Regan, 1996).

Economists and engineers from Government agencies and multilateral organisations focused on capital and technology intensive strategies to promote growth (Chambers,1995; UNDP, 1999b). 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).

The concept of development as structural change emerged in the mid 1970s when the inherent capacities and knowledge systems of rural and urban public were recognised. This approach advocated more inclusive and participatory procedures for policy making and project planning, and focused on grassroots actions (UNDP, 1999b). As the 1980s drew to a close, there emerged acknowledgment of, and commitment to, project activities that accounted for not only economic factors, but also for environmental protection, sustainable development, participation and institution building (Cernea, 1991). This acknowledgment is shown clearly in the World Bank's agenda for development in the 21st century:

We recognize that there is more to living standards than is typically captured in GDP accounting. Improvements in education or health are not just means to an end of increased output, but are ends in themselves. Growth by itself does not ensure that the fruits will be equitably shared. We recognize the costs, both to individuals and to society, of economic insecurity. We no longer take for granted our environment—and we recognize that in the struggle to increase GDP, the air in many developing country cities became so polluted as to make them almost unlivable. We know that cutting down an irreplaceable hardwood forest provides an increase in measured GDP that is probably not sustainable. (Stiglitz, 1999, p. 3).

The development as liberation approach emerged at the time of the democratisation movements of the late 1980s and early 1990s in Africa, Latin America and Eastern Europe. This approach expanded the scope and meaning of participation and empowerment. This movement saw the re-emergence of civil society not only as a political force but also as

complementing the state and market in promoting development activities. Thus, participation denoted the active involvement of a significant number of persons in situations or actions which enhance their well-being (UNDP, 1999b). A definition of development that encompasses the concepts of this approach is from the United Nations Development Programme (UNDP):

This is development that not only generates economic growth but distributes its benefits equitably; that regenerates the environment rather than destroying it; that empowers people rather than marginalizing them. It is development that gives priority to the poor, that enlarges their choices and opportunities, and that provides for their participation in events and decisions that shape their lives. It is development that is pro-poor, pro-nature, pro-jobs, pro-democracy, pro-women, and pro-children. Development gives people the choice to live a long and healthy life, to be educated, and to have a decent standard of living. And development provides other choices too – political freedom, human rights and self-respect. (Speth, 1994, p. 2)

This definition also demonstrates an explicit inclusion of gender, culture and development issues. Nowadays, it is no longer possible for development strategies to ignore the gender, environmental or cultural dimensions of various policies (Regan, 1996).

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 Paradigms

Chambers (1995) describes a major shift in the paradigm of development that could arguably be explained as a change from a vision ‘centred in things’ to a new one ‘centred in people’ (Table 1). 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.

Table 1: Things and People Paradigm

Point of departure and reference	Things	People
Mode	Blueprint	Process
Keyword	Planning	Participation
Goals	Pre-set, closed	Evolving, open
Decision-making	Centralised	Decentralised
Analytical assumptions	Reductionist	Systems, holistic
Methods	Standardised	Diverse
Rules	Universal	Local
Technology	Fixed package	Varied basket
Professionals' interactions with clients	Motivating, controlling	Enabling, empowering
Clients seen as	Beneficiaries	Actors, partners
Force flow	Supply-push	Demand-pull
Outputs	Uniform, infrastructure	Diverse, capabilities
Planning and action	Top-down	Bottom-up

Source: Chambers, 1995

Although the people-centred paradigm has become more influential, still the top-down reality prevails as the dominant paradigm, especially in practical endeavours. The development theory has changed, but institutions, technology, values, attitudes and behaviour remain the same. For instance, Lynch (1997) points out that, although participation enjoys increasing support throughout the development community, some agencies simply use the terminology to fulfil official development agency requirements and are not consciously adopting participatory methodologies.

Chambers (1997) identifies four forces that hinder the transformation of development theory into practice, and thus jeopardise the success of development programmes:

1. 'Normal professionalism'. The concepts, values, methods and behaviour dominant in professions, which seek and value controlled conditions and universal truths.
2. 'Normal bureaucracy'. The concepts, values, procedures and behaviour dominant in bureaucracies, with their tendencies to centralise, standardise and control.
3. 'Normal careers'. Successful careers promote in professionals a location, lifestyle, work pressures, and power status that isolate them from field realities.
4. 'Normal teaching'. Normal professionalism is reproduced, transferring knowledge from the teacher 'who knows', to the pupil 'who is ignorant'.

Similarly, Ekins (1992) describes three immensely powerful forces that are causing and maintaining the current cyclical crises of poverty, war, ecological destruction, and denial of human rights:

1. 'Scientism'. Which attempts to monopolise the definition of knowledge and devalues the ideas, experience and accumulated wisdom of the majority of humankind.
2. 'Developmentalism'. Where consumption and accumulation are defined as major goals for all countries.
3. 'Statism'. Where the nation-state is the ultimately legitimate form of political authority and exercises omnipotence over the life of its governed subjects.

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).

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).

The mission statements of The World Bank and the UNDP reflect accurately the addressing of these needs:

The UNDP mission is to help countries in their efforts to achieve sustainable human development by assisting them to build their capacity to design and carry out development programmes in poverty eradication, employment creation and sustainable livelihoods, the empowerment of women and the protection and regeneration of the environment, giving first priority to poverty eradication. (UNDP, 1999a, p.1).

The World Bank is a development institution whose goal is to reduce poverty by promoting sustainable economic growth in its client countries. Development is a long-term process which ultimately involves the transformation of whole societies. It is about getting economic and financial policies right. But it is also about empowering the people, building the roads, writing the laws, recognizing the women, educating the girls, eliminating the corruption, protecting the environment, inoculating the children - and much, much more. Development is about putting all the component parts in place - balanced economic and social programs. (The World Bank, 1999, p.1).

Poverty, environmental degradation and denial of human rights have been identified as the main development problems of the world. A more people-centred approach to these problems promotes goals such as sustainable livelihoods, local participation, empowerment, and emancipation of women and children. These goals address the needs of justice, sustainability and inclusiveness described by Korten (1990).

These problems and goals form the conceptual framework for this research. That is, successful development will be judged by means of its effectiveness in reducing poverty, environmental degradation, and improving the humans right status of different groups and communities by addressing the needs of justice, sustainability and inclusiveness. These issues are developed in the following sections.

2.3 POVERTY

Poverty has been defined in many different ways. Kanbur 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 2, this broadening changes remarkably the thinking about measurements and strategies to reduce poverty.

Table 2: 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 Kanbur and Squire, 1999

Despite the broadening of the concept of poverty, poverty lines are still very much a feature of the measurement of poverty (Kanbur and Squire, 1999). Although this measurement offers a narrow perspective of poverty as income and consumption, it shows the interactions between growth in national income and changes in the gap between rich and poor. The most recent World Development Report on poverty reports that of the 5.6 billion people living in the world, 1.1 billion live in a state of poverty¹ (The World Bank, 1990). Women suffer disproportionately, representing 70% of all poverty stricken people, followed closely by the elderly. Although urban poverty continues to grow, the rural poor

¹ Defined as having an income level of \$ 370 USD or less paid per year. The amounts are in 1985 purchasing power parity – PPP– dollars. (World Bank, 1990).

still represent more than 80% of the total poor. In recent years, poverty in developed countries has also grown (World Bank, 1990).

The 1998 Human Development Report highlights the inequality that the world faces. The report states that although world consumption has expanded at an unprecedented pace over the 20th century, with private and public consumption expenditures reaching \$24 trillion in 1998, inequalities in consumption are stark. Globally, the 20% of the world's people in the highest-income countries account for 86% of total private consumption expenditures while the poorest 20% account for a minuscule 1.3 %. The report suggests that today's trend of consumption is undermining the environmental resource base and it is exacerbating inequalities (UNDP, 1998).

Patterns of consumption can be classified in three different classes: over-consumers, sustainers and excluded (Table 3). Referring to this classification, Korten (1996, p. 20-21) describes today's trend of consumption as "...the tragedy of nearly fifty years of economic growth and national development. Rather than building societies that create a good life for sustainers and bring the excluded into the sustainer class, we have followed the path of converting sustainers into over-consumers and pushing many of those in the sustainer class into the excluded class".

Table 3: Classification of Consumption Patterns

Over-consumers 1.1 billion > US \$7 500 per capita	Sustainers 3.3 billion US \$700 – 7 500 per capita	Excluded 1.1 billion <US \$700 per capita
Travel by car and air	Travel by bicycle and public surface transport	Travel by foot, maybe donkey
Eat high fat, high calory meat-based diets	Eat healthy diets of grains, vegetables and some meat	Eat nutritionally inadequate diets
Drink bottled water and soft drinks	Drink clean water plus some tea and coffee	Drink contaminated water
Use throwaway products and discard substantial wastes	Use unpacked goods and durable and recycle wastes	Use local biomass and produce negligible wastes
Live in spacious, climate controlled, single family homes	Live in modest naturally ventilated homes, with extended or multiple families	Live in rudimentary shelters or in the open. Usually lack secure tenure
Maintain image conscious wardrobe	Wear functional clothing	Wear second hand clothing or scraps

Source: based on Durning, 1991; cited in Korten, 1996.

A broader approach of poverty is 'human scale development' described by Max-Neef (1991). 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's (1991) main postulates and propositions are as follows:

- Development is about people and not about objects.
- Fundamental human needs are finite, few and classifiable.
- Fundamental human needs are the same in all cultures and in all historical periods. What changes, both over time and through cultures, is the way or means by which the needs are satisfied ('satisfiers').
- Needs are satisfied within three contexts: with regard to oneself; with regard to the social group; and with regard to the environment.
- Any fundamental need that is not adequately satisfied reveals a human poverty. Each poverty generates pathologies.
- Up to the present treatments for individual and small group pathologies have been developed.
- Today, there is a dramatic increase in collective pathologies for which treatments have proved ineffectual.
- The understanding of these collective pathologies requires transdisciplinary research and action.

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 development can be said to require not only material means but also spiritual aspects, as expressed by the World Faiths Development Dialogue (1999, p.1):

It is only on the basis of those characteristics known generally as ‘virtues’ that a truly ‘developed’ society can be achieved. Thus moral and spiritual education – the teaching of the values embedded in those virtues – is the vital pre-requisite for development. On its own, academic or technical education does not ensure that knowledge and skills will be used in the best possible way for the common good.

The World Faiths Development Dialogue (1999) describes poverty as 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 (Table 3). 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 (Table 4). 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.

Table 4: Types of Satisfiers

Type of satisfier	Example	Addressed need	Destroyed or inhibited need	Enhanced need
Destroyer	War	Protection	Subsistence, affection, participation and freedom.	
Pseudo	Exploitation of natural resources	Subsistence		
Inhibiting	Commercial television	Idleness	Understanding, creation and identity	
Singular	Food charity	Subsistence		
Synergic	Preventive medicine	Protection		Understanding, participation and subsistence

Source: adapted from Max-Neef, 1991

For example, Korten (1996, p. 17) criticises the policy of many development programmes of creating new jobs, where often these jobs produce things that are damaging to the world in order for people to obtain money to purchase things that are often not needed:

The point is that our real need is not for more jobs – it is to assure everyone a meaningful and adequate means of livelihood – which is well within the means of nearly every society on the planet that chooses to do so. It calls for very different policy actions, however, than for job creation. Rather than focusing on policies that increase the economic strength of corporations, it requires a focus on policies that empower localities and strengthen the bonds of family and community.

Traditional approaches to development have fostered consumerism. Nowadays, excessive consumption damages the environment and generates gross inequalities (UNDP, 1998; Korten, 1996). Consumption should be shared, strengthening, socially responsible and sustainable (UNDP, 1998). Consumption relates to satisfiers and not to needs. Needs are finite and the same (disregarding time and cultures), and there is a need to look for synergic, sustainable satisfiers to fulfil those needs. Poverty is not only a problem of the ‘third world’, ‘developed’ countries also suffer from ‘poverties’ that should be combated.

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 which 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 this sense, sustainability refers to the nature of the ways in which a living is made or livelihood secured (Loubser, 1996). It implies (UNDP, 1999c):

1. The ability to cope with and recover from shocks and stresses.
2. Economic effectiveness, or the use of minimal inputs to generate a given amount of output.
3. Ecological integrity, ensuring the livelihood activities do not irreversibly degrade natural resources within a given ecosystem.
4. Social equity, which suggests that promotion of livelihood opportunities for one group should not foreclose options for other groups, either now or in the future.

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).

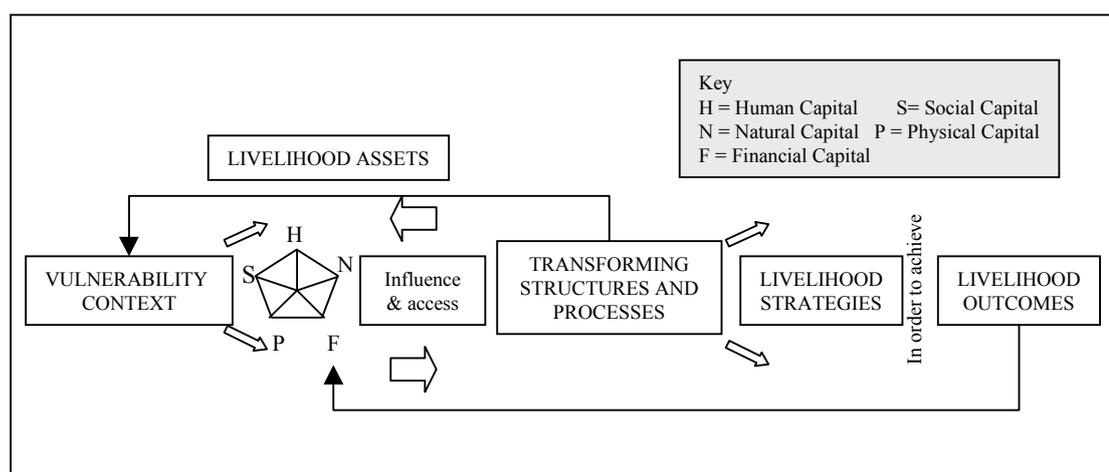
An example of a framework based on the concept of sustainable livelihoods is described below.

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

2.5.1 Approaches to 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). 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). Some of the current participatory approaches are mentioned in Table 5.

Table 5: Participatory Approaches

AEA	Agroecosystem Analysis
BA	Beneficiary Assessment
DELTA	Development Education Leadership Teams
D&D	Diagnosis and Design
DRP	Diagnóstico Rural Participativo
FPR	Farmer Participatory Research
FSR	Farming Systems Research
GRAAP	Groupe de recherche et d'appui pour l'auto-promotion paysanne
MARP	Méthode Accéléré de Recherche Participative
PALM	Participatory Analysis and Learning Methods
PAR	Participatory Action Research
PD	Process Documentation
PRA	Participatory Rural Appraisal
PRAP	Participatory Rural Appraisal and Planning
PRM	Participatory Research Methods
PTD	Participatory Technology Development
RA	Rapid Appraisal
RAAKS	Rapid Assessment of Agricultural Knowledge Systems
RAP	Rapid Assessment Procedures
RAT	Rapid Assessment Techniques
RCA	Rapid Catchment Analysis
REA	Rapid Ethnographic Assessment
RFA	Rapid Food Security Assessment
RMA	Rapid Multi-perspective Appraisal
ROA	Rapid Organisational Assessment
RRA	Rapid Rural Appraisal
SB	Samuhik Brahman (Joint Trek)
TFD	Theatre for Development
TFT	Training for Transformation

Source: Cornwall, Guijt and Welbourn, 1993; cited in Chambers, 1995

As shown in Table 5, many approaches have been documented and some of them overlap. Authors differ in the way they group the approaches. Chambers (1995) groups the approaches into three families:

1. Participation of farmers in agricultural research and extension, for example, farming systems research.
2. Participatory management of local natural resources, for example, joint forest management, irrigation management, and watershed management.
3. Approaches derived from applied social anthropology, agro-ecosystems analysis, farming systems research, participatory research and rapid rural appraisal. For example, participatory rural appraisal.

In contrast, Rennie and Singh (1996) identified four main types of participatory research methods:

1. The participant observer.
2. Rapid rural appraisal.
3. Participatory rural appraisal.
4. Participatory action research.

2.5.2 Participation and Inclusiveness

Despite the multitude of participatory approaches which 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.

2.5.3 Types of Participation

Participation can be 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. Development projects apply different types of participation, as shown in Table 6, some of which could fall into ‘pseudo-participation’ (e.g. ‘passive participation’). Types 1-4 use participation as a means, and although these types of participation could aid disempowered people, collaboration is not primarily undertaken for the purpose of enhancing the inclusiveness of all segments of society. Only the last two types, ‘interactive participation’ and ‘self-mobilisation’, could be classified as ‘participation as an end’, where the aim is to empower local people. Most of the participatory approaches used in development at the moment are ‘participation as a means’(Nelson and Wright, 1995). However, it is important that development practitioners and researchers use higher levels of participation to create long-lasting processes that enhance inclusiveness and empowerment.

Table 6: A Typology of Participation

Typology	Characteristics of each type
1. Passive participation	People participate by being told what is going to happen or has already happened. It is an unilateral announcement by an administration or project management without listening to people's responses. The information being shared belongs only to external professionals.
2. Participation in information giving	People participate by answering questions posed by extractive researchers using questionnaire surveys or similar approaches. People do not have opportunity to influence proceedings, as the findings of the research are neither shared nor checked for accuracy.
3. Participation by consultation	People participate by being consulted, and external people listen to views. These external professionals define both problems and solutions, and may modify these in the light of people's responses. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to take on board people's views.
4. Participation for material incentives	People participate by providing resources, for example labour, in return for food, cash or other material incentives. Much on-farm research falls in this category, as farmers provide the fields but are not involved in the experimentation or the process learning. It is very common to see this called participation, yet people have no stake in prolonging activities when the incentives end.
5. Functional participation	People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organisation. Such involvement does not tend to be at early stages of project cycles or planning, but rather after major discussion has taken place. These institutions tend to be dependent on external initiators and facilitators, but may become self-dependent.
6. Interactive participation	People participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple perspectives and make use of systematic and structured learning processes. These groups take control over local decisions, and so people have a stake in maintaining structures or practices.
7. Self-mobilisation	People participate by taking initiatives independent of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Such self-initiated mobilisation and collective action may or may not challenge existing inequitable distributions of wealth and power.

Source: Pretty (1994), adapted for Adnan et al (1992); cited in Pretty et al (1995)

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. Factors that hinder development projects occurring as they should were considered throughout the chapter. 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 offers a rationale for the research methods and design.

3.2 METHODOLOGY

Contemporary development seeks to solve the crises of poverty, environmental degradation, and denial of human rights through a people-centred approach (The World Bank, 1999; UNDP, 1999a; Chambers, 1995; Ekins, 1992; Korten, 1990). For instance, the recent ‘sustainable livelihoods’ approach highlights the complexity of the rural community and the importance of participatory approaches for planning, analysing, monitoring, and evaluating development projects (UNDP, 1999d; Chambers, 1995; DFID, 1999; IISD, 1999a).

For this research to be carried out in agreement with the contemporary trends of development, it is crucial to select congruent research approach and methods. As already mentioned, one of the major obstacles for the implementation of a more people-centred approach in development practice is ‘normal professionalism’ or ‘scientism’. Normal professionalism includes the concepts, values, methods and behaviour dominant in professions that attempt to monopolise the definition of knowledge and devalue the ideas, experience and accumulated wisdom of the majority of humankind (Chambers, 1997; Ekins, 1992). A participatory approach is needed in order to avoid the obstacle of normal professionalism and take into account the knowledge and experience of the community involved.

In social science, there are several approaches to research such as positivism, critical rationalism, interpretivism, critical theory, realism, structuration theory and feminism (Blaikie, 1993). Generally, as shown in Table 7, they can be integrated in five major research approaches (Neuman, 1997):

1. Positive social science.
2. Interpretive social science.
3. Critical social science.
4. Feminist research.
5. Post-modern research

Table 7: Research Approaches

Approach	Definition
Positive Social Science	Organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity.
Interpretive Social Science	The systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understanding and interpretation of how people create and maintain their social worlds.
Critical Social Science	Critical process of enquiry that goes beyond surface illusions to uncover the real structures in the material world in order to help people change conditions and build a better world for themselves.
Feminist Research	<p>Characteristics:</p> <ul style="list-style-type: none"> • Advocacy of a feminist value and perspective. • Rejection of sexism in assumptions, concepts, and research questions. • Creation of empathic connections between the researcher and those he or she studies. • Sensitivity to how relations of gender and power permeate all spheres of social life. • Incorporation of the researcher's personal feelings and experiences into the research process. • Flexibility in choosing research techniques and crossing boundaries between academic fields. • Recognition of the emotional and mutual-dependence dimensions in human experience. • Action-oriented research that seeks to facilitate personal and societal change.
Post-modern Research	<p>Characteristics:</p> <ul style="list-style-type: none"> • Rejection of all ideologies and organised belief systems, including all social theory. • Strong reliance on intuition, imagination, personal experience, and emotion. • Sense of meaninglessness and pessimism, belief that the world will never improve. • Extreme subjectivity in which there is no distinction between the mental and the external world. • Ardent relativism in which there are infinite interpretations, none superior to another. • Espousal of diversity, chaos, and complexity that is constantly changing. • Rejection of studying the past or different places since only the here and now is relevant. • Belief that causality cannot be studied because life is too complex and rapidly changing. • Assertion that research can never truly represent what occurs in the social world.

Source: based on Neuman, 1997

Critical social science and feminist research seem to be most congruent with the contemporary development discourse. Critical social science and feminist research are approaches clearly reflected in ‘participatory research’, which is becoming commonly used in development endeavours (UNDP, 1999d; Chambers, 1997; The World Bank, 1996; Pretty et al, 1995).

3.3 DIMENSIONS OF THE RESEARCH

Rarely are approaches used in a research pure types. Commonly research reflects a combination of two or more approaches. Research can be classified into dimensions as a way to simplify its conduction and to assure an appropriate design. According to Neuman (1997), there are four dimensions of social research:

1. The purpose for study.
2. The use of study.
3. The time dimension in research.
4. The data collection technique.

Table 8 shows the dimensions selected to conduct this research. A detailed description of these four dimensions is presented in the following sections.

Table 8: Dimension of the Research

Purpose for Study	Use of Study	Time in Study	Data collection technique
Exploratory	Applied: Participatory Action Research/ Evaluation	Case study	Qualitative data: Participatory Rural Appraisal

3.3.1 Purpose for Study: Exploratory Research

According to Neuman (1997) there are three main purposes of social science:

1. Exploratory research. Explores a new topic.
2. Descriptive research. Describes a social phenomenon.
3. Explanatory research. Explain why something occurs.

In this case, the research is exploring a new topic, thus it is exploratory research. It is also, to a lesser extent, descriptive. Descriptive and exploratory research are similar and blur together in practice (Neuman, 1997). The main objective of the research is to determine whether sustainable livelihoods in San Felipe have been achieved and how the project

‘Water and Life’, implemented in this community, has affected their livelihoods. The concept ‘sustainable livelihoods’ is relatively new, appearing in the 1990’s (UNDP, 1999c; DFID, 1999; IISD, 1999a; Agenda 21, 1992). Little has been written on it, and information available is more empirical than academic. The community of San Felipe has not been researched before and only statistical census information is available. Moreover, the project implemented in the area has been developed empirically, indicators of development were not set and the project has only monitored technical indicators to evaluate the efficiency of the systems constructed.

As described by Neuman (1997), exploratory research rarely yields definitive answers and it is difficult to conduct because there are few guidelines to follow. It requires creativity, open mindedness, and flexibility. Qualitative data is frequently used.

3.3.2 Use of Study: Participatory Action Research and Evaluation

This type of research is applied, seeking to solve specific problems. For applied research, the emphasis is on seeking the solution to a specific problem for a limited setting (Neuman, 1997). Action research, social impact assessment, and evaluation research are some of the major types of applied research (Neuman, 1997). Action research and, to a lesser extent evaluation, are the two types that were selected for this research.

3.3.2.1 Participatory Action Research

The term ‘participatory action research’ (PAR) is an umbrella term that includes several traditions of theory and practice. The main assumptions drawn from the various traditions of PAR are presented in Table 9. The major thrust of PAR is to generate knowledge on desired changes in specific, often unique, situations where the creation of generalised knowledge that is unattached to particular circumstances is of secondary importance (Deshler and Ewert, 1995). Although there are variations, PAR can generally be defined in the following terms:

...participatory action research (PAR) is defined as a process of systematic inquiry, in which those who are experiencing a problematic situation in a community or workplace participate collaboratively with trained researchers as subjects, in deciding the focus of knowledge generation, in collecting and analyzing information, and in taking action to manage, improve, or solve their problem situation. (Deshler and Ewert, 1995, p. 1)

Table 9: General Assumptions in PAR

Assumptions	Description
Common Values	<ul style="list-style-type: none"> • The democratisation of knowledge production and use. • Ethical fairness in the benefits of the knowledge production and use. • An ecological stance toward society and nature. • Appreciation of the capacity of humans to reflect, learn, and change. • A commitment to non-violent social change.
Ownership	<ul style="list-style-type: none"> • Community's ownership of the focus of research. <p>To make this ownership possible the community's participation and their sharing of experience and knowledge is needed.</p>
Commitment to Action	<ul style="list-style-type: none"> • Commitment by researchers and community participants to individual, social, technical, or cultural actions consequent to the learning acquired through research. • Explicit and evident use of the research findings and implications for action.
Participants' Role	<ul style="list-style-type: none"> • Community participants engage in all stages of the research process. • Reduce barriers to participation, especially for those who have been excluded or under-represented in the past.
External Researcher Role	<ul style="list-style-type: none"> • The researcher contributes expertise when needed as a participant in the process.
The Scope of the Research	<ul style="list-style-type: none"> • Holistic
Learning about Research	<ul style="list-style-type: none"> • To allow and encourage the community to learn about research methods and knowledge generation so that further inquiry can be undertaken without dependence upon external research expertise.
Research Methods	<ul style="list-style-type: none"> • Flexibility or change in research methods and focus, as necessary.
Benefits	<ul style="list-style-type: none"> • To benefit the community. • Risks are acknowledged and shared among trained researchers and the community.
Resolution of Differences	<ul style="list-style-type: none"> • Differences between researchers and community participants regarding all stages of research are to be acknowledged, negotiated at the outset, or resolved through a fair and open process.

Source: adapted from Deshler and Ewert, 1995

3.3.2.2 Evaluation

Part of the research entails the evaluation of the project 'Water and Life'. According to Stephen (1990), evaluation research answers the questions of:

1. Relevance. Does the project address the needs of the community?
2. Efficiency. Is the project using the resources wisely?
3. Effectiveness. Are the desired results achieved?
4. Impact. To what extent have the project activities brought about changes for the betterment of individuals and/or the community?

This research concentrates on determining the project's relevance to and impact on the livelihoods of San Felipe and to a lesser extent efficiency and effectiveness.

To answer the above questions, there are different types of evaluation research that can be used. The one selected for this research is 'Participatory Evaluation' (PE), which draws from various participatory research traditions: PAR, Participatory Learning and Action, Rapid Rural Appraisal, PRA and many others (Estrella and Gaventa, 1998). It was an externally-led evaluation, that is, it was organised and initiated externally and conducted by an individual having no direct involvement or interest in the outcome of the project.

Estrella and Gaventa (1998) explain that the first and most critical stage in PE is to establish a framework for its process, including the identification of objectives and indicators. It requires a lengthy process of negotiation, contestation, and collaborative decision-making among various stakeholders. There is an increasing awareness that local people should be involved in determining these indicators (UNDP, 1999d; Estrella and Gaventa, 1998; Stephen, 1990). Estrella and Gaventa (1998) stress the need to first establish objectives as a key step before indicators are defined. Although indicators are important, there are suggestions that indicators are not very useful in the monitoring and evaluation of certain processes, such as participation, and that less structured and more flexible means are needed to evaluate qualitative change such as impact and relevance (UNDP, 1999d). No participatory process was used in the 'Water and Life' project to establish objectives, and there was insufficient information about the needs and strengths of the community to determine indicators that would fairly reflect the community's own perspective of reality.

Due to the limitations of time and scope and lack of previous indicators, this research used less structured and more flexible means to evaluate how the project 'Water and Life' affected the livelihoods of the community of San Felipe. The sustainable livelihoods framework and Max-Neef's human scale development framework, described in the literature review, were used to determine the relevance and impact of the project in San Felipe. Because it is exploratory research, the intention is not to give a definitive answer but rather to explore issues such as whether the community of San Felipe have sustainable livelihoods, the impact of the project on their livelihoods and to identify the lessons learnt. The intention is also to provide the stakeholders with an integrated and holistic framework from which will they be motivated to set objectives and indicators for further monitoring and evaluation.

3.3.3 Time Dimension in Research: Case Study

According to Neuman (1997), different types of social research give different treatment to time. Some studies give a snapshot of a single, fixed time point which is analysed in detail. Other studies provide a moving picture where events, people, or social relations are analysed over periods of time. This research focuses on a single case in a specific geographic region during a three month period. This treatment of time is known as case study, which usually involves qualitative methods (Neuman, 1997).

A case study is “ an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 1994, p. 13). For the purpose of this research and in congruence with contemporary development, it is essential to cover contextual conditions to be able to use the sustainable livelihoods analysis and Max-Neef’s scale development framework. Due to the limitation of time, which was constrained to three months, and because this research was committed to action, it was decided to employ a single-case design.

3.3.4 Data Collection Technique: Participatory Rural Appraisal

According to Neuman (1997), data collection techniques are grouped in two categories: 1) quantitative, collecting data in the form of numbers; and 2) qualitative, collecting data in the form of words or pictures. Because of the purpose, use, and time treatment of the research, it was decided to carry out qualitative research. PRA methods and techniques were selected to carry out this research.

As Chambers (1996) describes, PRA is a growing family of approaches and methods to enable local people to make their own appraisal, analysis, plans, monitoring, and evaluation of projects. Its normative ideas have been drawn from the PAR stream (Chambers, 1997). Ford and Lelo (1991, p. 7) give a PRA definition for the rural area context:

PRA is a field based methodology that mobilises communities. It enables multi-sector teams to join with village leaders to gather data, rank village needs and priorities, and on the basis of this draw up a village resource management plan. The plan becomes the basis for action in the community and enables local institutions, government agents, and NGOs to cooperate.

According to the World Bank (1996), PRA evolved from Rapid Rural Appraisal (RRA), in response to the perceived problems of outsiders missing or miscommunicating with local people in the context of development work. The difference between RRA and PRA is that in RRA the analysis is done mainly by the outsiders; while, PRA empowers a process of analysis and action by local people.

The World Bank (1996) describes the following issues as the key tenets of PRA:

1. Participation, where local people's input into PRA activities is essential to its value as a research and planning method.
2. Teamwork, where it is important to have a well-balanced team that represents the diversity of socioeconomic, cultural, gender, and generational perspectives.
3. Flexibility, where the combination of techniques depend on such variables as the size and skill mix of PRA team, the time and resources available, and the topic and location of the work.
4. Optimal ignorance, PRA work intends to gather just enough information to make the necessary recommendations and decisions.
5. Triangulation, to ensure that information is valid and reliable, the rule of thumb is that at least three sources must be consulted or techniques must be used to investigate the same topics.

A typical PRA activity involves a team of people working for two or three weeks on workshops, discussions, analyses and fieldwork. Chambers (1992) highlights that any PRA practice has three foundations:

1. Methods. PRA methods emphasise group discussion and diagramming by rural people where outsiders' behaviour, attitudes and interactions with the locals is very important. A summary of the most common types of techniques and tools used in PRA are listed in Table 10.
2. Behaviour and attitudes. "The major problem in development is not 'them'- local people, the poor and marginalised, but 'us'- the outsider professionals" (Kumar, 1996, p. 3). To facilitate PRA, the practitioner's behaviour and attitudes matter more than the methods (Chambers, 1997). At the South-South workshop of Attitudes and Behaviour in PRA, 23 PRA experts concluded that PRA stresses in particular the following outsiders' personal behaviour and attitudes: 1) self-critical awareness of one's behaviour, biases and shortcomings; 2) commitment to the poor, weaker and vulnerable; 3) respecting others; 4) not interrupting, not lecturing, but being a good, active listener; 5) not hiding, but embracing error; 6) 'handing over the stick', meaning passing the initiative and responsibility to others; 7) 'they can do it', meaning empowering others through confidence in their capabilities; 8) open-ended flexibility to make space for the priorities of the poor (Kumar, 1996).
3. Sharing. In normal surveys and questionnaires the information is private and unknown to the local people. In PRA, information should be visible and publicly owned and

verified by participants. Participants should be able to command and alter data collected with confidence – it belongs to them.

Table 10: PRA Common Techniques

• Secondary data review	• Diagramming
• Direct observations, including wandering around	• Wealth ranking
• DIY (do-it-yourself), taking part in activities	• Ranking and scoring
• Key informants	• Quantification
• Semi-structured interview	• Ethno-histories and trend analysis
• Group interviews and discussions	• Time lines (chronologies of events)
• Sequences of interviews	• Stories, portraits and case studies
• Key indicators	• Team management and interactions
• Workshops and brainstorming	• Key probes
• Transects and group walks	• Short simple questionnaires
• Mapping, modelling and aerial photographs	• Rapid report writing in the field

Source: Chambers, 1992

The literature reports other techniques such as seasonal calendars, seasonal disease calendars and Venn diagrams. Cornwall (1997) comments that the use of participatory theatre, video and other art forms can stimulate and sustain community participation in the development process. Mapping, modelling and seasonal calendars illustrate the increasing use of visual techniques in agricultural PRA. Traditional games have also been used in a PRA context. As Mosse (1994) affirms, there is no list or fixed set of PRA methods. The range of methods used in PRA is large, overlaps with ‘conventional’ research tools, and is constantly expanding as new techniques are tried.

PRA is a response to the need of identifying the community’s problems in a quick, effective and inexpensive way. PRA has developed the widest set of techniques to involve different stakeholders (UNDP, 1999d; Chambers, 1997). It is now practised in at least 130 countries (Pretty et al, 1995). The approach for this research is participatory, based on PAR and PRA, reflecting critical social science and feminist research.

3.4 RESEARCH DESIGN

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 (17 June-18 July).
2. Collection of the secondary data (17 June-18 July).
3. Community participatory research (25 July-1 August).
4. Community Action Plan (10–13 August).
5. Semi-structured interviews (19-31 August).

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

3.4.1 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 11.

Table 11: 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.

3.4.2 Second Phase: Collection of the Secondary Data

Secondary data was collected and its purpose is shown in Table 12. 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 12: 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.

3.4.3 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, that is on 17 and 18 July (Table 13). 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 13: 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 13). 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 13). 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 13). 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 14. 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 (Appendix 17). 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 13).

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 14: 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	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. 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.
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-unity	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)

3.4.4 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.

3.4.5 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 15.

Table 15: Additional Participatory Techniques

Technique	Informant	Purpose
Semi-structured interview	Coordinator of the project	Obtain background information about the region and the project 'Water and Life'.
	Assistant coordinator of the project	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.

3.4.6 Methods

3.4.6.1 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).

3.4.6.2 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).

3.4.6.3 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).

3.4.6.4 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.

3.4.6.5 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).

3.4.6.6 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.

3.4.6.7 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).

3.4.6.8 Flow Diagrams

Flow diagrams are graphical representations of processes or 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).

3.4.6.9 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.

3.4.6.10 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).

3.5 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 field work. 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.

3.6 SUMMARY

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 design of the research was developed in 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.

The research was constrained by factors such as time, seasonal bias and uncertainty as to what would be able to be achieved.

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 Commission². The Agrarian Law regulates the creation and operation of the ejidos and communities (CEC, 1995).

Yates (1981) explains that when a land grant is made to a group of people who have organised themselves into an ejido, the elected government body calls to an assembly all the male ejido members, known as 'ejidatarios'. At the assembly, it is decided what the area of actual or potential crop land is, and this area is divided into plots and distributed amongst the male members. The remaining land, that is the pasture, woodland, and other areas, remains in the communal ownership of the ejido. The members have the right to graze their animals on the pasture and to cut firewood in the forest.

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

² 'Comisariado'.

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.

4.3 LAND REFORM

The election of Carlos Salinas de Gortari as national President in 1988 initiated a process of privatisation in Mexico's financial and industrial sectors. In January of 1992, Article 27 of the Mexican Constitution was amended to facilitate the modernisation of Mexican agriculture. Gutierrez (1996) points out that this reform officially declared the end of the distribution of private land to landless peasants, which started after the revolution in 1917 and was carried out in the 1930s by President Lazaro Cardenas (1934-1940). This land reform was subsided dramatically in the 1940s and 1950s, and experienced a resurgence in the 1960s and 1970s. Under this old system the Mexican government carried out a massive redistribution of land by which half of the arable land of the country was transferred into ejidos.

Before the 1992 reform of the land law, the ejido land was not constituted as property but as a right for individuals or groups to work the land. As explained by Gutierrez (1996), under the old system, it was illegal to rent or sell the individual land parcels. No private investor was allowed to own or co-own an agricultural enterprise with ejido members. The change in the agrarian law in 1992 basically consisted of the abolition of such restrictions over rents and sales of ejidos. That is, the land was put back into the market as a commodity.

Price subsidies for farmers were also eliminated and substituted in 1994 by a direct aid programme for agriculture called PROCAMPO. PROCAMPO has compensated the producers who became negatively affected by the commercial liberalisation of Mexican agriculture. 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).

4.4 MEXICAN SEMI-ARID AND ARID REGION

The Secretariat for Social Development (SEDESOL) has under its jurisdiction a National Commission for the Arid Zones (CONAZA). As reported by CONAZA (1999a), arid and semi-arid regions cover nearly 52% of the land area of Mexico (Appendix 1). The main characteristics of the Mexican arid and semi-arid regions are described in Table 16.

Table 16: 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

CONAZA's task is based on four goals that include actions and projects directed to improve the living conditions and to guarantee the survival of the most deprived communities (CONAZA, 1999b):

1. Providing a basic social infrastructure. CONAZA works to construct the necessary infrastructure for impounding, storing and distributing drinking water such as construction and rehabilitation of drinking water systems, cistern constructions, and also the construction of rural roads, the improvement of houses and others. It also provides needy communities with water in tank trucks through the 'Aquarium Plan', which operates in agreement with the Ministry of National Defence.
2. Diversifying agricultural and cattle-production. Some of the specific actions in this regard are implementation of technical irrigation systems, prickly pear orchards, aloe orchards, fruit tree orchards, genetic improvement of goats and sheep livestock and others.
3. Fostering the control of desertification. CONAZA is promoting the plantation and reforestation with drought resistant native and introduced plant species. That will provide alternative sources of income for the population.
4. Supporting production for self sufficiency. CONAZA intends to improve the self sufficiency of basic grains by constructing and rehabilitating infrastructures that allow the communities to ensure production. Some of the initiatives are cattle sharecropping units and horticultural orchards.

It is important to highlight that although 'Aquarium Plan' was initiated as an emergency measure it has become a permanent programme in those communities currently unable to trap water resources (CONAZA, 1999c). This plan is likely to continue. The goal of the Aquarium Plan to 1999 was to distribute 1.5 millions of m³ of water (CONAZA, 1999c).

Another project under SEDESOL is a government-controlled commodity distributor called DICONSA. Its goal is to supply isolated communities with basic products at the lowest price possible (DICONSA, 1999). The distribution company is organised by the benefit communities. Most of ejidos have a company store from DICONSA.

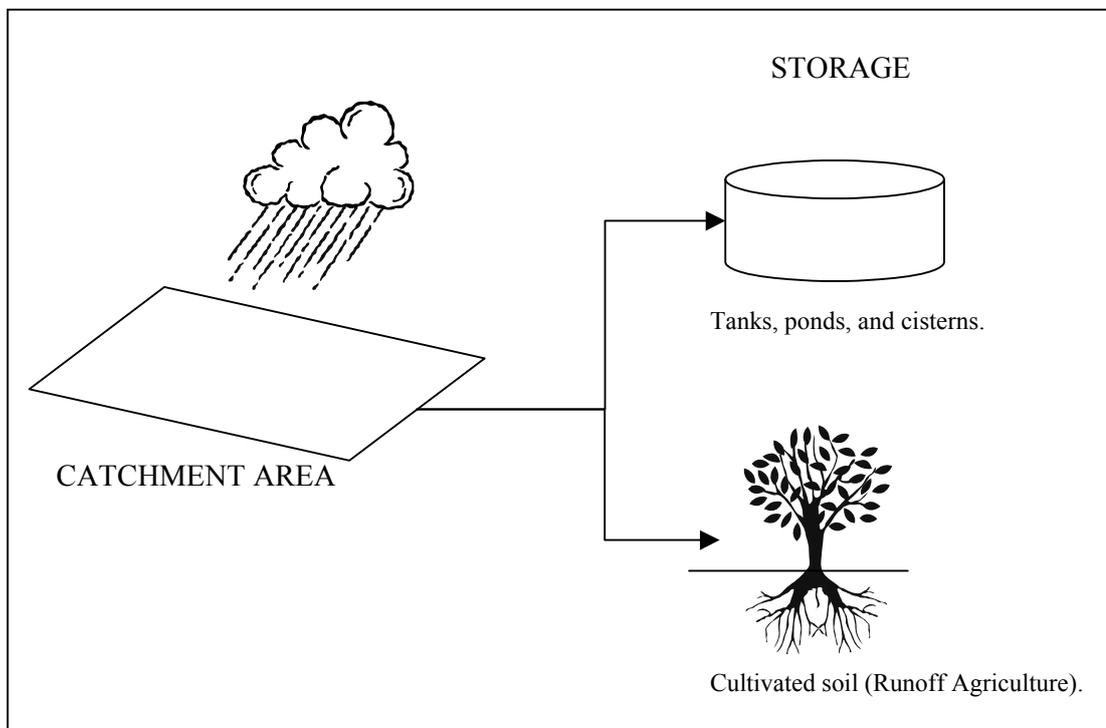
4.5 WATER HARVESTING TECHNIQUES

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

4.5.1 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.

4.5.2 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 (Table 17). 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 crop land percolation losses (Advisory Committee on Technology Innovation, 1974).

Table 17: Techniques to Improve Soil Surface Impermeability

Principle	Specific Technique
Land Alteration	<ul style="list-style-type: none"> • Ditches • Rock walls • Rocks and vegetation cleaning • Compacting soil surface
Soil Chemical Treatment	<ul style="list-style-type: none"> • Sodium salts • Silicones • Latex • Asphalt • Wax
Soil Covers	<ul style="list-style-type: none"> • Plastic sheets • Butyl rubber • Metal foil • Plastic films covered with gravel

Source: Adapted from Advisory Committee on Technology Innovation, 1974

4.5.3 Mexican Rainwater Harvesting Techniques

In 1975, a research project was undertaken by two Mexican universities³ in the southern semi-arid area of Nuevo Leon, to investigate the application of rainwater harvesting technologies for human, livestock and dry farming use. After 1977, this research was sponsored by CONAZA (Velasco-Molina and Carmona-Ruiz, 1984).

From 1975 to 1976, eight rainwater harvesting systems were built in one of the ejidos of the municipality of ‘Doctor Arroyo’. The eight systems were evaluated and after a period of five years, their rainwater harvesting efficiency ranged from 45.7% to 80.6%. According to the research results, the water from the rainwater harvesting systems was five

³ ITESM and UANL

to 11 times cheaper than the water transported in trucks by the 'Aquarium Plan' (Velasco-Molina and Carmona-Ruiz, 1984).

As a result of the five years of research, the 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).

4.6 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, although the film covering the catchment and the cistern area had deteriorated. Farmers narrated that in some other ejidos the Vecar system was so deteriorated that the steel sheet was gone and trees were growing in the middle of the cistern. 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 18. Photos of the different project activities are included in Appendix 2 to Appendix 6.

Table 18: Main Project's Outputs in San Felipe

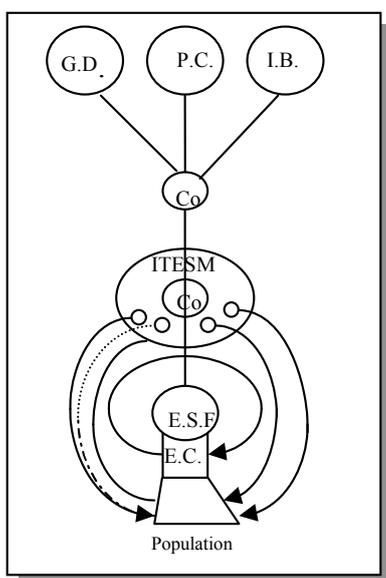
Technology	Description	Local Use	Date
Rainwater Harvesting System. (Vecar type)	<ul style="list-style-type: none"> • 2,100 m² run-off catchment using polyethylene film, 0.010 “ thick, covered with gravel. • Storage cistern of 500,000 L capacity. <ul style="list-style-type: none"> • Chlorosulphonate polyethylene 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 are: 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	Second hand collects that are donated to the community. Some business sponsor goods (i.e. chickens). <ul style="list-style-type: none"> • Chickens. • Bicycles. • Clothing. • Christmas gifts. • Candies. • Others. 	Personal use and consumption.	

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

The project has been implemented by this single university researcher who will be referred to as the coordinator of the project 'Water and Life'. Only since February, 1999, has he employed an assistant. During this research, the coordinator of the project 'Water and Life' was asked to explain the different stakeholders involved in the project through a Venn diagram (Figure 3).

Figure 3: Project Stakeholder Analysis



G.D. : Government Donors

P.C. : Private Commercial Sponsorship

I.B. : Individual Benefactors

ITESM : Monterrey Institute of Technology

Co : Coordinator of the Project 'Water and Life'

E.S.F. : Ejido of San Felipe

E.C. : Ejido's Commission

The coordinator acquires economic resources from the government donors, private commercial sponsors, and personal benefactors. For instance, a well renowned multinational cement company sponsored the construction of the latest rainwater harvesting system (Lt type) which costed \$230,000.00 pesos. SEDESOL, a government secretariat, supported this project's construction with some building materials.

The project also depends on the good will of individuals with enough economic resources to give significant donations. For example, an individual benefactor donated all the furniture and materials for the kindergarten.

As the project is coordinated by the university the funding must be transferred through the university. Once the funds have been transferred, the coordinator allocates the funds in the different constructions and activities implemented in San Felipe. He first informs the Commission of San Felipe how these funds are going to be used in the ejido and explains to the community what the purposes of the constructions and activities are.

Teachers, employees, and students from the university also aid the ejido of San Felipe. The aid consists of goods such as toys, bicycles and secondhand clothes. The university has donated some furniture. The university halls have donated old bedding in good condition and clothes that are left by the students. These people are represented in the Venn diagram (Figure 3) as small circles inside the university circle.

4.7 EJIDO OF SAN FELIPE

4.7.1 Doctor Arroyo

San Felipe is one of the 106 ejidos of Doctor Arroyo municipality and is situated in the state of Nuevo Leon (Appendix 7). 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 sector⁴, 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

⁴ Agriculture, livestock, silviculture, hunting and fishing.

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).

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 dependant on ponds and aljibes. Also, the underground water has a very high saline concentration⁵ and cannot be used for human consumption and sometimes not even for livestock consumption (Velazco-Molina and Carmona-Ruiz, 1984).

4.7.2 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).

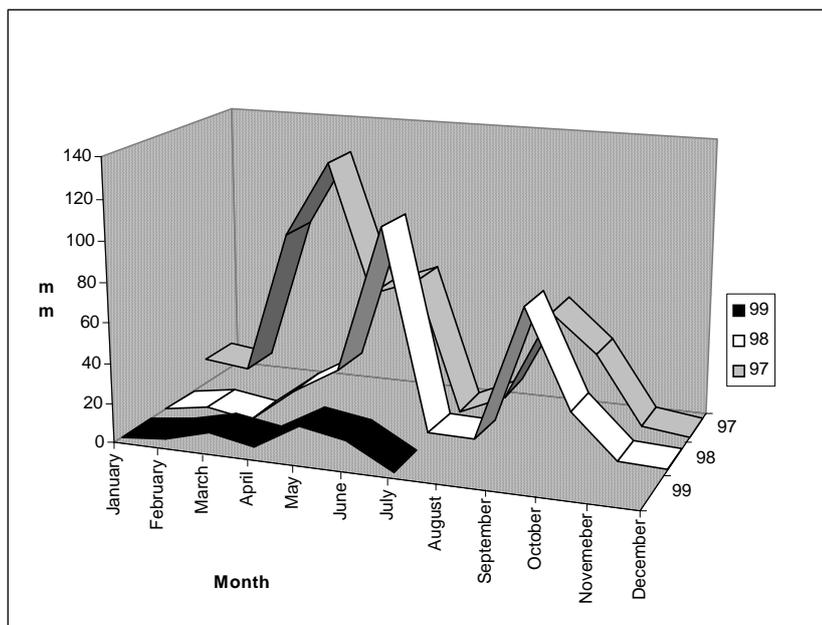
As in Doctor Arroyo, rainfall in San Felipe is minimal and its patterns are inherently erratic. Since the project ‘Water and Life’ started in 1996, two rain gauges have been installed in San Felipe. The records are presented in Appendix 8.

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 4 shows clearly that last year’s rainfall does not follow the former years pluvial patterns.

⁵ An electric conductivity of 3336 µMHOS/cm at 25 C.

Figure 4: Rainfall Patterns



Source: Project records from the peach orchard rain gauge

4.7.2.1 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 cistern. It was agreed that it would be used only for drinking, cooking and occasional bathing.

Water consumption is monitored by the project (Appendix 8). For this purpose a local woman was appointed to supply the water from the cistern and to record consumption. Water is collected twice a week, Wednesday and Sunday mornings. Women are responsible for fetching the water for the household. Four women have wheelbarrows to transport the water to their houses while the rest fetch the water by hand, carrying buckets of 20 L. The physical assets to transport the water affects the consumption. For example from May to July, MCC has consumed 5,190 L while MTC has consumed 2,000 L. The

former woman has a wheelbarrow and barrels in which to store the water while MTC does not (Appendix 8).

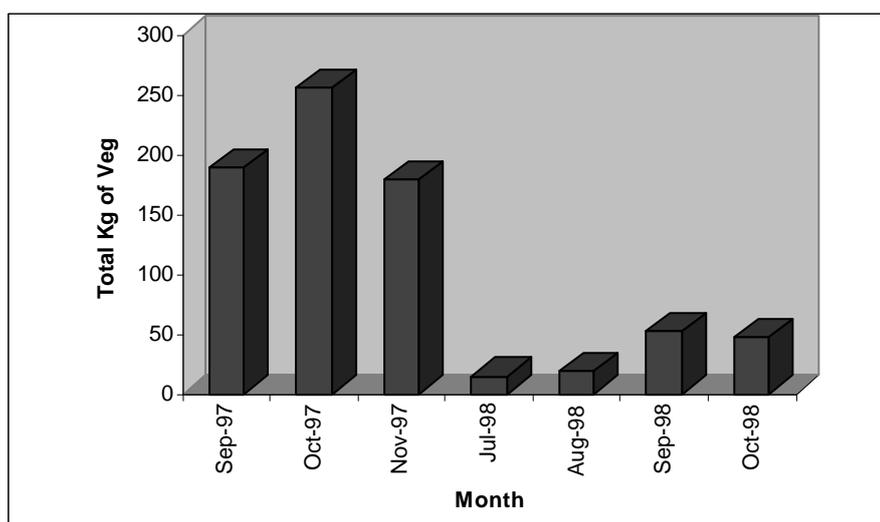
From the period May to July the project has provided 45,006 L. A household consumes an average of 1,220 L each month (Appendix 8).

4.7.2.2 Vegetable Garden Production

The project has been recording the production of the vegetable garden (Appendix 8). First production dates from September 1997. Production has been shared out to the ejidatarios who are only men of 17 years old or more. There are 21 ejidatarios in total, six of them are unmarried men and one is an elderly man.

As shown in Figure 5, vegetable garden production fell dramatically after November 1997. Production virtually ceased in November 1998.

Figure 5: Vegetable Garden Production Patterns



Source: Project Records

4.7.2.3 Manual Irrigation of the Peach Orchard

The microcatchment system forces rainfall from a larger than a normal area to irrigate the tree. However, in times of severe drought the microcatchment system will not prevent the tree from reaching its 'permanent wilting point' and therefore needs to be combined with manual irrigation of the orchard. The water for the manual irrigation is obtained from the rainwater harvesting system (Vecar type), which is the same that is used for human consumption and the vegetable garden. As shown in Table 19, manual irrigation was scarcely needed in the first three years of the project.

Table 19: Efficiency of the Microcatchment System

Year	Manual Irrigation (%)	Microcatchment Irrigation (%)
1996	8.3	91.7
1997	0.43	99.57
1998	2.68	97.32

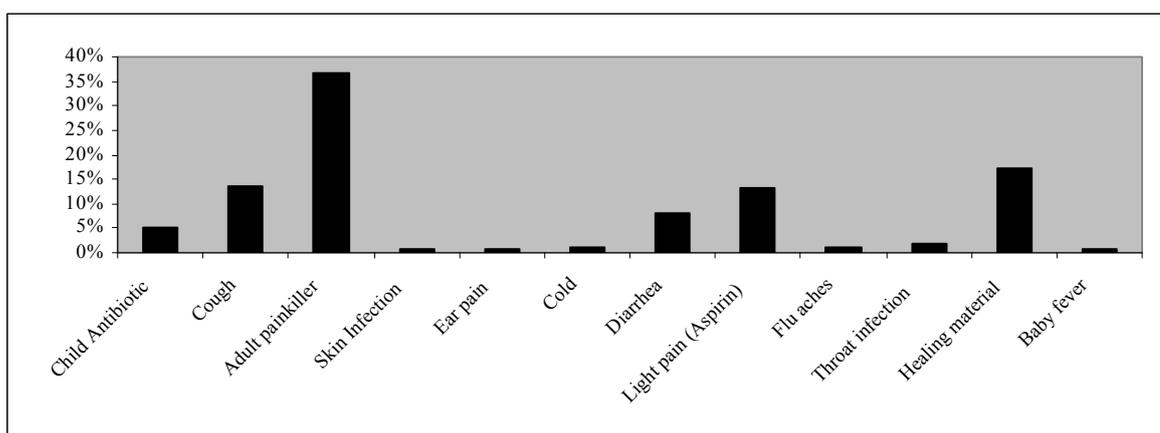
Source: Project Records

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.

4.7.2.4 First-Aid Kit

The medicine supply started in November 1998. The first load was free to the community while following supplies have been paid for by the community. The project provides 33 different medicines as well as healing material. A local woman is in charge of selling the medicine to the community and recording consumption (Figure 6). When some of the medicines run out of stock, she approaches the coordinator of the project with a list of medicines and the money to cover their cost. The coordinator provides the medicine on his next visit.

Figure 6: Medicine Consumption



Source: Local woman's records, April 27th-August 10th 1999

4.8 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

This chapter presents the results obtained from semi-structured interviews, participatory community research, the community action plan, informal discussions and observations. The PRA techniques used to obtain results in this chapter were mapping, time line, matrix scoring for poverty analysis, matrix scoring for productive analysis, matrix analysis of project's benefits, matrix analysis for income and expenditure, matrix analysis for water and food consumption, preference ranking of local products, flow diagram, transect walk and women's daily schedule. Only those results that are directly relevant to the research objectives appear in this chapter. Other related results are included in Appendix 8 to Appendix 16.

5.2 SEMI-STRUCTURED INTERVIEW

Three stakeholders were interviewed individually: 1) the Mayor of Doctor Arroyo's municipality; 2) the coordinator of the project 'Water and Life'; and 3) the assistant coordinator of the project 'Water and life'. The highlights of the interviews are presented in Table 22, Table 21, and Table 20.

Table 20: Highlights of the Interview with Doctor Arroyo's Mayor

Themes	Detailed description
Main problems of the municipality	Doctor Arroyo is the poorest municipality of the state of Nuevo Leon. One of the major problems is the lack of water.
Measures taken	Construction of wells and 'aljibes'. Land conversion from grain to pasture. \$4 million pesos has been invested for this. It is a major attempt to motivate the farmers to change from crop agriculture to livestock.
Sustainability	One of the major shortcoming of all projects is the lack of continuity. It is important to pull them down from the desk to reality. The projects should not be paternalistic.
San Felipe and the project 'Water and Life'	San Felipe was the poorest ejido in the municipality, but since the project started it is not anymore. The Mayor thinks that it is a good project. However, he believes it is too large an amount of money to invest in such a small population. The Mayor is not willing to fund constructions in the ejido of San Felipe. However, the Mayor is willing to fund the project 'Water and Life' with \$1 million pesos to replicate the rainwater harvesting systems in several other ejidos (e.g. San Ramon with 685 inhabitants).
Others	San Felipe's ejidatarios have asked the Mayor to donate a tractor to the community. San Felipe is not a priority since it is already aided by the project.

Table 21: Highlights of the Interview with the Project's Coordinator

Themes	Detailed description
Expected impact of the project	To design simple rainwater harvesting systems that will allow the peasants from the Mexican semi-arid region to harvest water for human consumption, livestock consumption, and food production.
San Felipe's ideal vocation	Nature dictates that the main vocation of San Felipe should be focused on silviculture and pastoral agriculture. Silvicultural yields native plants such as 'lechuguilla', 'viznaga', 'mezquite', nopal, and palm. Mezquite and dates are fruits rich in polysaccharides excellent for animal feedstock. They should dedicate to pastoral agriculture due to the potential of having a 1,200 ha grazing land with 800 to 1,000 goats or sheep, preferably goats. The goat is an animal able to survive in the most adverse conditions. Maintenance of livestock and pasture could be achieved by constructing three rainwater harvesting systems of 500,000 L and fencing the ejido's perimeter (30 km).
Fruit orchards and vegetable garden	The peach and the plum orchards are intended for self consumption, the community using fresh fruit for two months and the women conserving the rest for the winter. Some of the fruits could be processed into jam and sold. The vegetable garden is only a 'small backyard' to produce chilli, onion, tomatoes, and lettuce for households' consumption.
Rainfed agriculture	Rainfed agriculture is not possible. In reality rainfed agriculture in the semi-arid region is a fruitless activity that maintains farmers in misery always hoping that next year they will obtain a harvest. Generally, over a period of 10 years they harvest only three or four years. The maize and beans that they collect last no more than four months in a good year.
Participation of the community	The local people have learnt to build the systems. There is sincerity and legality between the coordinator and the community. The people have not been ordered to carry out activities. The ideas have been suggested and their purposes explained. The coordinator has visited San Felipe every fortnight since the project started in 1996. The community has seen the punctuality of the visits and the continuity of his assistance to the ejido; thus, the response from the community has been positive. The community has realised, little by little, that the benefits are not the poor salaries earned from the construction but the benefits are at mid- and long-term.
Eclipse	The peach orchard production is going to be extremely low this year because of the drought. However, farmers blame the loss of harvest on the eclipse.
Concerns	What is going to happen when the project finishes?

Table 22: Highlights of the Interview with the Assistant coordinator

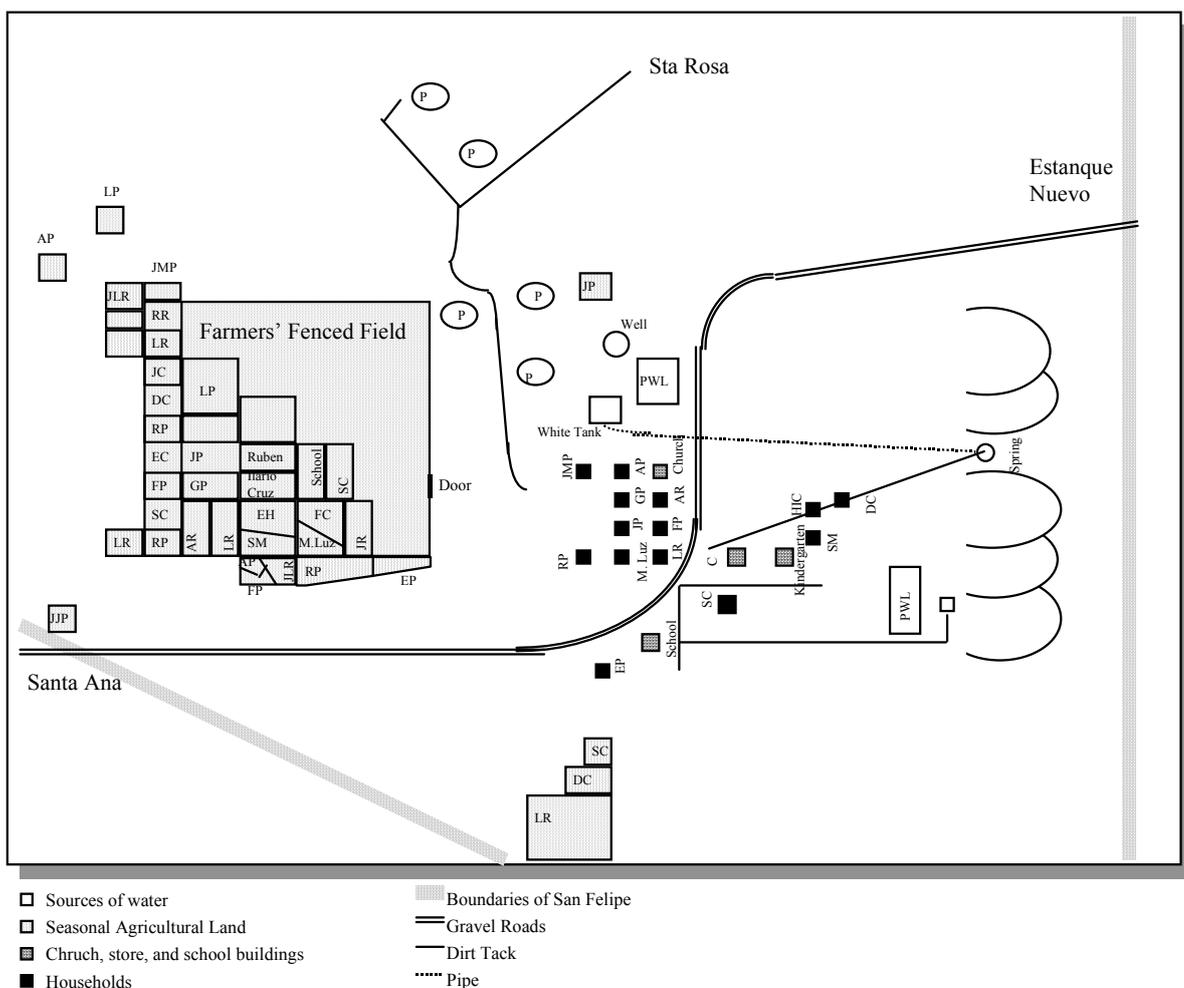
Themes	Detailed description
Participation of the community	The people of San Felipe have been wholly committed to the project. The way the people have given themselves is not because of the payment. They are not only working, they are also learning consciously. They know that everything that is built is for them.
Key people in San Felipe	The key people are the president and the treasurer of the Commission.
Priority needs	The main need is for them to have a dignified place in which to live. The assistant coordinator has the idea of providing the families with house catchments instead of providing a community roof catchment. The project provides the roof, and the locals build the walls. In this way they can satisfy the need for a house and water at the same time.
What would happen if the project finishes?	Any project should have a start and an end. An ending of the project at this moment would be rough. Although it is necessary to set a conclusion time for the project because that ejido is theirs. If the coordinator of the project leaves at this moment there will be instability because there are situations that are not defined yet and they should have been defined before.

5.3 COMMUNITY PARTICIPATORY RESEARCH

5.3.1 Mapping

Group 1 was asked to draw a map of San Felipe. (Figure 7) is an adaptation of the original drawing. Specific areas, roads, tracks, and boundaries have been differentiated for a better description of the place. Although this differentiation was not visually represented, participants described it orally. Photos of different features of San Felipe are presented in Appendix 9 and Appendix 10.

Figure 7: Map of San Felipe



PWL : project 'Water and Life' orchards, vegetable garden and buildings C : company store P : pond Other Initials : represent local names

Santa Ana, Sta Rosa, and Estanque Nuevo : neighbouring ejidos

The initials for the agricultural land and the households represent the names of the ejidatarios of the community; the only exception is 'M. Luz' who is a widow. One important feature of the parcels is that they are fenced. During the mapping, discussion occurred on the sources of water and the problems that happened during the drought (Table 23).

Table 23: Mapping Group Discussion

Water sources	<p>White Tank. The water from the spring is pumped down by a solar pump. This solar pump is not part of the project 'Water and Life'. During this year, particularly in recent months, it ran out of water completely. There was not enough water to pump from the spring to the tank. Previously people consumed spring water, but it was not enough and they needed to drink from the cistern allocated to vegetable garden.</p> <p>Vegetable garden cistern (rainwater harvesting system Vecar type). The vegetable garden cistern has been built for 21 years. Up to 1996, water was drunk from there. When the project started the cistern was repaired and the water allocated for the vegetable garden. It has been used for the vegetable garden and human consumption. At the moment this is used more for human consumption than for the garden.</p> <p>Ponds. Ponds are for livestock consumption.</p> <p>Well. Its saline concentration is too high even for livestock consumption. Is not used.</p>
Problems and needs	<p>During the drought, there was not enough water to give to some 15-20 cows. Some of them needed to drink once every three days. People who have a vehicle went to 'Santa Ana', 'Santa Rosa', 'San Pablo' to bring barrels of waters.</p> <p>Farmers want to have animals but there is no water to give them. It would be good to have one or two cisterns for livestock.</p> <p>'Roof Catchment' is a rainwater harvesting system made of stainless steel. It is a future construction of the project 'Water and Life', and will be an ideal support. People will be able to consume water more comfortably and it will be possible to produce vegetables.</p>
Other issues	<p>The water from the vegetable cistern is considered to be cleaner than water from the spring.</p> <p>A small amount of money is paid to the people for the manual irrigation of the peach orchard.</p>

5.3.2 Time Line

Group 1 was asked to describe the most relevant events that had happened in San Felipe (Figure 8). Most of the discussion concentrated on the other projects that have been implemented in San Felipe and their major outcomes. Special emphasis was given to the failure of former projects (Table 24).

Figure 8: Time Line

17 June, 1935	<ul style="list-style-type: none"> • San Felipe was founded.
1962	<ul style="list-style-type: none"> • Gravel roads was built.
1964	<ul style="list-style-type: none"> • Primary school was founded.
1972	<ul style="list-style-type: none"> • First rainwater harvesting system (Vecar type) was built by the coordinator of the project ‘Water and Life’. • The company store was built.
1975	<ul style="list-style-type: none"> • Rabbit breeding project was started.
1980	<ul style="list-style-type: none"> • Contour ridging and maize plantation project was implemented by FIRCO. • 11 December. Ejido’s land was extended.
1985	<ul style="list-style-type: none"> • Orchard plantation of 500 pistachios was established.
1994	<ul style="list-style-type: none"> • PROCAMPO was started.
1996	<ul style="list-style-type: none"> • Project ‘Water and Life’ was started. • January. 1972’s cistern was repaired. • April. Peach orchard was established. • April. Run-off solar module and vegetable garden were established.
4 March, 1998	<ul style="list-style-type: none"> • Electricity was installed.
1999	<ul style="list-style-type: none"> • The rainwater harvesting system (Lt type) construction for the peach orchard was started.

Table 24: Time Line Group Discussion

PROCAMPO Agriculture Direct Aid Programme	For rainfed agriculture the farmers first plough the land and then they wait until it rains to sow the maize. Plant growth and harvest are dependent on several rains. PROCAMPO is a national programme that aided indulgently the first year with \$300.00 pesos. However, now, if there is no maize harvest the programme does not give the aid support, no matter how much money, time and work the farmer has invested for ploughing and sowing. PROCAMPO is not a benefit; it is only enough to cover the costs and sometimes not even that.
Project Failure	The pistachio orchard failed because there was no water for its irrigation. During the rabbit project, the rabbits’ food was supplied by the project in exchange for rabbits. When the programme was finished it was necessary to extract ‘ixtle’ to buy their food and it was not affordable. They ate the rabbits.

5.3.3 Matrix Scoring for Poverty Analysis

Group 1 analysed poverty using a matrix scoring exercise. First the group selected the criteria to measure poverty or wealth. The participants identified household, livestock, transport and sources of work as the criteria. The group decided not to include income because “the more we earn the more we spend; the only way is through sources of work”. They also remarked, “We do not need money; we need knowledge. If they give us \$100.00 pesos we spend it. If they give us a knowledge we can make ourselves some money”.

Then families were scored according to the quality and quantity of their household, livestock, transport and sources of work. Low numbers represent lesser poverty while higher numbers greater poverty (Table 25). Family No. 9 was identified as the poorest of San Felipe.

Table 25: 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'

5.3.3.1 Household

Families were scored depending on whether or not houses have a latrine, the number of rooms, and whether the houses have a concrete floor or a dirt floor. Major priority was given to the latrine. Only two houses have latrines: PM and PC. The number of members was also taken into account. Highest points were given to the RIP family (No. 7) because they do not have a house of their own, they live with MGL (No. 15). Lowest points were given to the PC family (No. 4) because they have a latrine, one big kitchen and two spacious rooms, all of them with concrete floors.

5.3.3.2 Livestock

Families were scored according to the number of livestock they had. The possession of goats or cows was given the priority. High scores were given for those who only had labouring animals such as donkeys, mules, and horses. Those who were scored 15, RIP

(No. 7), PCo (No. 9), PGa (No. 11), and CR (No. 12) do not have any animals. However, it was pointed out that to be wealthy one needs to have around 50-60 cows, or 200 goats. In San Felipe those who have livestock have four or five cows or 40-50 goats. It is for survival rather than as a business.

5.3.3.3 Transport

Common vehicles in the area are vans and motorcycles. PC and PCa families have both one van and one motorcycle (PCa's motorcycle does not work). PI, RIP, RI, and CM have a motorcycle. The rest do not have any vehicle.

5.3.3.4 Sources of Work

The participants highlighted the importance of a steady source of work, which at the moment they do not have. The group decided to include the types of work that the families did as well as the scoring. They identified six current activities: 1) picking mezquite; 2) ixtle extraction; 3) working in the project 'Water and Life'; 4) working as staff in the project 'Water and Life'; 5) working as an employee in the company store; and 6) working in the USA.

The project hires the local people for the construction of the rainwater harvesting systems, the manual irrigation of the peach orchard and other activities. Also, during the project's implementation, some of the local people were trained to build these systems and learnt skills such as levelling surfaces. Payment is low at around \$25.00-\$30.00 pesos a day and employment is irregular depending on the project's workload. Only PC and PE have an steady job with the project and are paid regularly. However, payment remains low. Almost all men work in the project, however they do more than one single activity. Those who are dependant on the project as their only source of work were scored with the highest points after the elderly MGS and MGL who do not have any work.

The company store hires one person, RI. The advantage of this work over the project is that it is regular. Ixtle extraction is the traditional source of work of the region. Those few men who are very skilled at it can gain more money than working at the project. Picking mezquite is a better source of money, however it is seasonal.

Migrating to the USA to work was identified by all as the best source of work. Migrating to the USA, although illegal, is a very popular option for coping with debts and needs.

5.3.4 Matrix Scoring for Productive Activity Analysis

Group 1 was asked to list the different productive activities carried out in San Felipe. Different criteria were determined for scoring the activities (Table 26). Activities that

were considered better were scored with low marks and the activities with bad performance were scored with high marks.

Table 26: 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

5.3.4.1 Seasonal Harvesting

Some of the activities cannot be done during the whole year. Peaches, plumbs, mezquite, cabuche, dates, nopal and its fruit produce only one month a year. Goats breed twice a year. Farmers see this as a shortcoming because benefits do not last for the whole year. The activities that are not scored are not dependant on season and are considered better activities. Rainfed agriculture was not scored because it depends on the rainfall and not on a specific month of the year.

5.3.4.2 Water

As water is a scarce resource, the amount of water needed is a key criteria into analysing the activities. Due to the conditions of the region, the less water required the more feasible

the activity is. The project's orchard and vegetable garden were scored with low marks because the water for those activities is secured. The peach orchard, although it has the microcatchment, still needs manual irrigation. At the moment that the rainwater system is completed, this activity could also be scored as one because it will not need further manual irrigation. Vegetable garden is scored as two because the cistern is used at the moment for human consumption and the vegetable production has diminished. Animals and the construction of the cistern are the activities that consume more water than the rest of the activities. The rainfed agriculture, ixtle extraction, mezquite, dates, cabuche, nopal and its fruit are not irrigated and would not be irrigated even if they had the water. However, their production is dependent on water.

5.3.4.3 Money

The vegetable garden, the rainfed agriculture, the mares, donkeys, mules, nopal and its fruits are activities that do not generate any income. Mares, donkeys and mules are labouring animals, and the rest of the activities are destined for self consumption. The group decided that these activities were not applicable; however they have been scored as five to show the negative aspect of not generating money. The orchards, goats and cows were scored low because they are activities that generate more money. However, orchards have still not produced.

Major discussion occurred over whether the construction of the cistern should be scored lower marks than the other seasonal activities such as dates, mezquite and cabuche. Some participants argued that the fact should be taken into account that besides the payment given for building the cistern, the rainwater harvesting system belongs to the community. It was mentioned that some of the farmers would rather pick mezquite during the season than work in the construction because they earned more money that way. In the end the picking of mezquite, dates and cabuche was considered better and scored lower.

Ixtle extraction raised discussion, too, because income depends on the skill to extract the plant. Some people could extract 6 Kg while others only 0.5 Kg a day. That gives a range of \$60.00-\$5.00 pesos a day. Therefore, some of the participants earned more in the construction of the cistern while others earned more in the ixtle extraction. Finally, both activities were scored the same.

5.3.4.4 Human Consumption

As with the previous criteria, some of the activities were not applicable such as ixtle which is an inedible fibre. Mares, donkeys and mules are dedicated to labour and not for consumption. Mezquite and dates are products suitable for cattle as well as for humans, but farmers would rather sell them.

Although orchards have not produced yet they were scored as the best activities together with the vegetable garden. Goats scored well not so much due to their meat but because they produce milk. Rainfed agriculture was scored four because if it does not rain it does not produce anything in the whole year. Cows were considered the worst activity for human consumption because they rarely are eaten or milked.

5.3.4.5 Work

The construction of the rainwater harvesting system, the vegetable garden, the rainfed agriculture and goats were considered activities that require intense work and constant care. Participants pointed out the difference between cows and goats: the former are checked only once every 15 days while goats need to be grazed daily.

5.3.4.6 Seasonal Rainfall

The only activities that were considered dependant on the rain were the rainfed agriculture and the native products. However, it was highlighted that although droughts affect the native products there is always some production. In contrast, droughts do make agricultural endeavours completely unfruitful.

5.3.4.7 Risk

Project's activities were scored as the least risky, although it was highlighted that orchards run the risk of hail, hoar frost or eclipses. It was pointed out that this year, peach harvest was lost because of the eclipse that damaged the flower. However, lack of water was considered the major risk, therefore those activities that had their source of water secured were considered the least risky. Rainfed agriculture was considered the most risky activity followed by the animals. Participants remarked that if animals had their water secured there would not be risk.

5.3.4.8 Overall Results

Rainfed agriculture resulted as the worst activity on the basis of the criteria identified. However, all ejidatarios are engaged in this activity and supporters of it. The participants explained that they sow at the moment not for the grain but for the pasture. With one or two rains the maize can grow one meter and it becomes pasture for a cow or a horse. They take the risk to sow because they do not have money to buy food for their animals. Although they need to invest more work they do not need to invest much money. Rainfed agriculture is also a tradition left by their grandparents. They do it because they need to but also as a tradition. Farmers hope to fence the ejido to grow pasture. If there is pasture they do not need to sow. However, they do not have any place to grow the pasture.

Although at the moment the work for the project is very hard they realise that it has future benefits. There will be peaches and vegetables for their children and they will be able to sell some of the fruits to buy some clothing and have a better life. “Now is only work and work, but in the future, if God permits, we are going to benefit from it.”

5.3.5 Sustainability of Project Benefits

Group 1 was asked to list the aspects of the different project activities that they could continue without any external support (Appendix 11). Participants were asked to highlight also the activities that they cannot continue by themselves.

5.3.5.1 Vegetable Garden

The project does not pay the farmers to look after the garden. This kind of work is commonly called ‘faena’. When participants were asked who was in charge of the vegetable garden the answer was: “We agreed that the community is in charge but at the moment only the treasurer and the president of San Felipe Commission⁶ contribute.” The president commented that he was not trained to take care of the garden, he only waters and fertilises. Five men of the community have been trained. Seeds are given by the project but it was explained that they could buy seeds if it were necessary. Participants suggested that the ejidatarios need to take care of the vegetable garden, which has not been done.

5.3.5.2 Plum and Peach Orchard

The farmers have not pruned the trees and the project does not want them to because they are not well trained. The project has hired externals to prune the trees. The project sends the chemical sprays and the quantity that needs to be applied and farmers carry out the spraying. If the project was not there they would not know the price, source, quantity and type of the sprays. As the cistern is not completed manual irrigation of the peach orchard is necessary but not sustainable. The manual irrigation is not a faena and the project pays for it.

5.3.5.3 Solar Module

Recently the solar pump did not work and the community did not have the knowledge to repair it, neither was it known who else could fix it. The project repaired the pump.

The impermeable film of the rainwater harvesting system has a guarantee of 25 to 30 years. However, it is unlikely the community will be able to afford to replace the film.

⁶ The two men who have a staff job in the project (Table 25).

5.3.5.4 Knowledge for New Constructions

Two of the farmers have been trained in topography by the coordinator of the project. They can effectively trace and level a surface. One of them, the treasurer of the Commission, knows how to measure the rainfall from the rain gauge and monitors the level of the cisterns from the Vecar system and the solar module. He could train other people for the vegetable garden, and he is able to copy old constructions.

5.3.5.5 Overall

Participants explained that the relationship between them and the project is like a sports team. They have the desire to work and the project provides the means to do the work. They remarked that the coordinator of the project is a very responsible and reliable person that comes every fortnight and pays regularly the salaries for the work. Participants pointed out that if the coordinator came every month or two the constructions would never be done. One participant explained:

They used to pay us \$8.00 pesos, and other ranches and even the municipality Mayor used to say that we were stupid. Is too little. But we could see that the construction was going to stay with us... In other ranches they want to earn \$50.00 or \$60.00 pesos. There it is very difficult to organise, I guarantee you that in other ranches they do not work as we do. Because they are wealthy people, are they going to earn \$15.00? They have means to earn \$50.00 or \$60.00 or even more.

5.3.6 Income and Expenditure Analysis

Group 2 was asked to list their sources of income and the areas of expenditure (Appendix 12). Participants commented that there is no regular income beside the jobs offered by the project. In need, people go to extract ixtle and they earn around \$10.00-\$20.00 pesos per day extracting. The following main areas of expenditure were identified: food, farming costs, education, electricity, transport, health and clothing.

The expenditure ranged from \$9,500.00 pesos/year to \$30,400.00 pesos/year. Money is mainly spent on farming costs and transport. It was not possible to determine a fixed amount for health because expenses vary greatly depending in its severity. Only one of the participants has spent \$6,600.00 pesos/year on education because four of his children are studying at secondary school and high school which is not accessible in San Felipe and thus requires payment for accommodation and food outside the ejido.

5.3.6.1 Farming Costs and Transport

Money is invested in rainfed agriculture and livestock, in the range of \$2,500.00 to \$10,000.00 pesos per family. Main costs for transport are made to travel to Matehuala (the nearest city to San Felipe) and Monterrey (one of the largest cities of Mexico) and expenditure in petrol (for those who have van or motorcycle).

5.3.6.2 Health

There is a clinic in Santa Ana. There are doctors but no medicine; the visit costs \$5.00 pesos. The medicine is bought in Matehuala. As well as the expense of the medicine there are travel and food costs. For severe operations they need to go to Monterrey or San Luis. In this case they do not need to pay for travel and food only but also for staying in the city.

5.3.6.3 Coping with Expenses

The \$30.00 pesos per day earned in the project is only for daily subsistence. For other expenses farmers purchase on credit, they ask friends and relatives for personal loans, they migrate to work or they sell an animal.

In regard to rainfed agriculture, farmers purchase a tractor on credit with the hope that the national project PROCAMPO will support them with aid money. For example, one of the participants ploughed 16 ha and invested \$10,000.00 pesos which he obtained on credit. So far PROCAMPO has always provided aid money. However, this year the participant doubts whether PROCAMPO will support him because it has not rained and he has not been able to sow.

To migrate for work one can pay a debt of \$200.00-\$300.00 pesos. There are expenses of travel, accommodation, and food thus savings are little. Some of the men migrate to other ejidos which have large plantations (e.g. potatoes) and work as labourers. Others go to Monterrey to work as employees and others pass the border illegally to work in the USA.

To pay back debts of \$5,000.00-\$10,000.00 pesos it is necessary to sell animals. A goat can be sold for \$300.00 pesos.

One of the participants is dedicated to ixtle extraction. He used to make ropes, scourers, clotheslines, and other products out of ixtle. He still pays for the education of the younger children to study at secondary and high schools in other ejidos. Now he receives support from some of his sons that have already finished high school and are working in Monterrey.

5.3.7 Food Consumption Analysis

Groups 3 and 4 were asked to list the basic products they use for food and the amount they spend (Appendix 13). The basic foods are oil, maize, beans, corn flour, rice, pasta, sugar, coffee, potatoes, salt, wheat flour, lard, eggs, tinned tuna, soft drink, species, chilli, tomatoes, and onion. Only one of the women makes cheese from goat milk. Soap, although it is not a food, is also a common need in the household.

Table 27 shows the average weekly consumption of a household of six or seven members. It includes those foods that are consumed by the majority of the households. The most

important foods consumed by all households are: corn flour or maize to make ‘tortillas’, beans and oil.

Table 27: 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

5.3.7.1 Project Food Handout

Participants commented that since the project began, San Felipe has run out of hunger; women seldom need to buy pasta or rice in the company store. Now they only buy oil when it finishes and spices for the pasta and rice. People do not need to go to extract ixtle any more. Generally, food that is needed is bought on credit at the company store.

5.3.7.2 Rainfed Agriculture

Despite maize being a staple food it has to be purchased. There has not been a maize harvest for many years although maize is planted each year. It costs \$20.00-\$30.00 for 5 Kg of maize to sow and despite hard work the maize does not grow. A participant explained: “The maize does not grow, not even with the work that one does, only one gets tired and for nothing”.

5.3.8 Household Water Consumption and Sources of water

Groups 3 and 4 were asked about the water expenses in the household (Appendix 13). Group 3 reported a water consumption that ranged from 200 L/week to 480 L/ week. To confirm this information Group 4 was asked to be more detailed in the description and list the household water consumption and the sources of water (Appendix 13). An average consumption of 1,318 L/week was reported, including water for drinking and cooking of 378 L/week (Table 28). Women reported five sources of water: 1) pond; 2) spring; 3) vegetable cistern (Vecar type); 4) solar module silt trap; and 5) barrels (Table 28).

5.3.8.1 Vegetable Cistern

The water from the vegetable cistern (rainwater harvesting system –Vecar type) is restricted by the project for drinking, cooking and bathing, and occasionally to wash dishes and clothes. During the drought there was the need to climb with the donkeys up to the

spring because there was not enough water for it to be pumped to the white tank. For around four months they really struggled to give water to their animals. They took them to the spring every third or fourth day because there was not enough for all the animals. One family lost 8 cows in two months.

Table 28: Household Water Consumption and Water Sources

Use	Litres/week	Source	Use	Litres/week	Source
Drinking	224	3	Cooking	154	3
Bathing	104	2,4,3,5	Washing dishes	126	4,2,3
Washing clothes	228	2,4,1,5,3	Mopping/wetting floor	182	2,4,1
Watering pen animals	210	1,2,4	Watering house plants	90	2,4,1

1. Pond
 2. Spring (white tank)
 3. Vegetable cistern (Wednesday and Sunday only)
 4. Solar Module Silt Trap (blue tank, little tank)
 5. Barrels.

5.3.8.2 Solar Module Silt Trap

During June it rained lightly; water catchment in the solar module was so little that most of it accumulated in the silt trap. The women started using the water from the silt trap during July for different purposes. It is commonly called the ‘blue tank’ or ‘little tank’. The water from the silt trap run out in one month. The coordinator was unaware of the uncontrolled use of the silt trap.

5.3.9 Local Products

Groups 3 and 4 were asked to list the local products that they usually consume. After brainstorming, the women ranked the products according to their preferences. A list of all the local products is in Appendix 14. Table 29 represent an integrated summary of the ranking of Groups 3 and 4.

Table 29: Preference Ranking of Local Products

Chickens/chicks/egg	++++++	Maize	++++
Pig	++++	Prickly pear	++++
Nopal	+++	Cabucho	+++
Palm Flower	+++	Turkeys	+++
Peach	+++		

For group 3, maize was very important because it is used for human consumption and to feed chickens and pigs. No maize has been harvested in the last seven years. Pigs are very important because women obtain from it lard, crackling and the meat. There is no money to buy them; most of the women who have one or two pigs have received them as a gift. Chickens are also very important because they obtain from them eggs, chicks and meat.

Women cannot keep many chickens because there is no money to buy maize for them. Also, they do not have wire fencing for the chickens' pen.

For Group 4, palm flowers, prickly pears, peaches, chickens and turkeys were considered the most important products. It is important to take into account that none of the participants of this group has pigs and that two of the participants do not have chickens. Group 4 highlighted as a major problem the coyote that kills the chickens, turkeys, and goats.

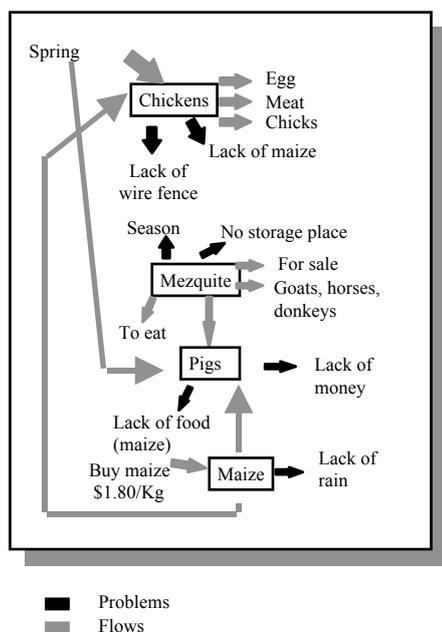
Women mentioned the desire to learn how to make conserves. One of the women pointed out that in other ejidos some trainers come and teach the women how to make soap, cookies and other goods.

The project 'Water and Life' has given chickens to the women. Most of the women have benefited from them, and only a few have lost them all or sold them. Some of the women have bought more chickens by their own endeavours, but these chickens tend to be of a very low quality. They have not grown and they do not produce eggs.

5.3.10 Local Product Links and Problems

After the local products were ranked and the most important ones were identified, Group 3 was asked to illustrate the links and problems of the different products. Gray arrows represent links while black arrows represent problems (Figure 9).

Figure 9: Flow Chart of Local Product Links and Problems



5.3.11 Transect Walk

Groups 2, 3 and 4 did transect walks where they showed different aspects of San Felipe. Routes and houses can be traced using the map illustrated in Figure 7. Some parts of the transect walk have been recorded in video (Appendix 17). Group 2 decided to show the different activities carried out in the community. First they went to LR house to show the livestock activities. LR has the largest herd of goats, at LR's home participants described their livestock activities (Table 30).

Table 30: Livestock

Name	Discussion
DC	His father had animals, but he did not. There is lack of pasture and water. The situation in the ejido is very difficult.
LR	He has 20 goats and 90 that are share farmed. Shared animals is a common practice in the region. Farmers take care of the animals, graze them and give them water. Owners and farmers share a 50:50 split of the offspring. The farmer has all rights to the milk. If it does not rain the animals die of thirst. One needs to struggle to find them some water. During the drought there were four months with absolutely no water. There was a need to bring the water in carts from Estanque Nuevo. Seven goats and 15 kids died.
EPS	He is very poor and has not been able to get any animals.
APM	He has 10 cows, two or three donkeys, and two horses. During the drought seven cows died. Animals are used for money emergencies.
JLRP	He has two or three share farmed cows. He struggled very much during the drought as he needed to take them up to the spring.

After the discussion, Group 2 went to the farmer's fenced field and showed DC's plot (Figure 7). Mezquite trees which are not in a fenced area do not have fruit because animals eat the fruit. DC has some trees in his plot. The mezquite season was at its peak at the time of the research. Farmers described the activity and highlighted their concerns (Table 31).

Table 31: Mezquite Picking

Name	Discussion
DC	At the moment he is picking the mezquite. He will collect around one tonne. He has not found any buyer yet. If the buyer does not come he needs to go and find one, and he does not know how much he will be paid. Farmers have discussed this matter with the supervisor of the company store. Hopefully the company store will buy it.
JLRP	He also has some trees in his plot. They must be picked one by one because the buyer does not want them to have stones. "To earn \$20.00 pesos we need to fill two sacks that is 40 Kg. And the \$20.00 pesos are only for 1 L of oil and 1 Kg of beans. We take the whole day to pick 60 Kg, because we need it clean. If not, they do not buy it".
APM	The community has 2000 ha. It has mezquites that could give fruit but animals from neighbouring communities eat the fruit. There is no one who markets the mezquite.

The next place visited was LR's plot, which is near to DC's (Figure 2). Most of plots were already ploughed and farmers were waiting for the rain to come. Participants described the activity and pointed out concerns and problems (Table 32).

Table 32: Rainfed Agriculture

Name	Discussion
DC	There is no yoke for ploughing, but there are tractors that can be rented. Almost nobody has a yoke. 1967 was the only year that they had a real harvest. Three years have passed where they harvest only enough to last only one month. Now the plots have been ploughed but they have not been sown because of lack of rain. By 4 October frosts will start. If it rains now farmers will harvest pasture only for the animal. He invested \$5,000.00 pesos.
LR	Rainfed agriculture is very eventual. Rarely is there a harvest. But there is not anything else to do so one needs to risk it. He prepared his plot in December, and he has been waiting for the rain. His plot has contour ridges. He has a yoke. "One cultivates with the hope to see whether one can harvest some maize or at least some pasture for the animals. So one does not need to buy and also to sell to the friends...Last time I harvested was three years ago; now I almost do not harvest anything only one third of pasture". Also they keep cultivating their plots because they are committed to PROCAMPO to work a fixed amount of land. He is committed to work 16 ha. If one does not work all the land it becomes a problem, and they cannot get the money for all the land.
EPS	He has not cultivated because he does not have a yoke.
APM	He has 3 to 4 ha cultivated, some areas have been irrigated. "We are not earning what we are investing. It does not correspond with the work. We do it to see whether next year we harvest. We do not earn even a cent from the harvest neither from the work; we do not earn the investment. It consumes time, it requires money, and does not give anything". For the agriculture PROCAMPO gives some money. However, one needs to struggle a lot; PROCAMPO do not give the aid so easily. Farmers need to have maize grown at a certain height to receive the money.
RPM	Due to the drought, there is an aid of \$72.00 pesos/ha for those farmers that are registered in PROCAMPO. PROCAMPO is supporting a maximum of 5 ha.

After visiting the farmer's fenced field, the next activity was the ixtle extraction. One of the participants, DC, has dedicated all his life to the ixtle extraction and has given education to his 12 children with it. The 'lechuguilla', which is the plant that the ixtle is extracted from, grows wild in the hills and mountains. Group 2 took the path from the school that leads to the peach orchard and the rainwater harvesting system under construction. The orchard and system is represented in the map as squares near the mounts with the initials 'PWL' (Figure 7). DC gave a demonstration of the extraction of ixtle. The main points of the discussion are described in Table 33.

Table 33: Ixtle Extraction

Name	Discussion
DC	He extracts 4 Kg/day. Before buyers used to pay \$1.50 pesos for it, then \$2.50 pesos, then \$4.00 pesos, then \$7.00 pesos. Now they are paying \$9.95 pesos/Kg. The company store buys the ixtle. To earn \$40.00 pesos one needs to go all day to the hills from 9 a.m. to 5 p.m.
JLRP	He is very bad at extracting ixtle. He can only extract 2.5 to 3 Kg/day.
LR	He only extracts ixtle when there is need and there is no other option.
APM	He cannot extract any more. He is 70 years old.

After the demonstration, Group 2 continued their transect to the peach orchard. This year the first harvest was expected, former years, production has been minimal because the trees were less than three years old. Comments and discussion are described in Table 34.

Table 34: Peach Orchard

Name	Discussion
LR	Water is not the only requirement to make the orchard produce. The peach orchard has several enemies: the eclipses, hail and hoar frosts. The orchard has been irrigated and there have been light rainfalls, but this year there was no harvest because of the eclipse. The eclipse is a phenomenon that burns all the tender part of the plant. When this occurs, during that year, the plant does not grow. Thus, during this year there is not going to be much fertility in the tree.
JLRP	This year the flowers dried because of the eclipse, besides that the drought was very heavy. Farmers needed to bring water in carts, that is why the rainwater harvesting system is being built.

From the orchard, Group 2 moved to the harvesting system that is under construction. Advances on the system were shown. Highlights of the discussion are presented in Table 35.

Table 35: Rainwater Harvesting System for the Peach Orchard

Name	Discussion
FPM	The salary to work on the system construction is \$25.00 pesos/ day. They do it with the purpose of giving a security to the peach orchard. Work at the moment is by list because they only employ three people per day. When there is work all come.

Other comments expressed during the transect that do not relate to specific locations but are relevant to the study are presented in Table 36.

Table 36: Other Activities

Name	Discussion
DMC	“I gave secondary and high school education to my family because I see the situation here is very difficult”.
APM	There is a palm forest in the ejido. That palm forests can produce around 20 tonnes of dates. The season is in August, and buyers purchase the dates very cheaply. If the ejido was fenced this would protect the mezquites and the dates. Cabuche is another local fruit that is sold at \$7.00/Kg. The coordinator of the project thought it would be good to make a cabuche orchard.

Groups 3 and 4, which are women’s groups, carried out the transects through their households. In San Felipe’s map, the houses are represented in black (Figure 7). Women showed their animal pens, house rooms and kitchens. Main highlights of the transect are presented in Table 37 and Table 38.

Table 37: Women’s Productive Activities

Name	Discussion
SML	She has two pigs. She feeds them with food left over and mezquite. The pigs are not for breeding but for eating. A piglet costs \$150 pesos. A pig costs \$400.00 pesos. She has 10 chickens and one rooster. Sometimes they escape from the pen and the coyote catches them.
FET	She has two rabbits. She feeds them with cabbage leaves, alfalfa and grass.
CCM	She has nine chickens and 16 chicks. She feeds them with leftover and maize. She had some ducks but the coyote killed them. She also had a pig but she killed it for her daughter’s birthday party.
ECI	She has one pig. She feeds it with leftovers and maize.
GIH	She has chickens, turkeys and goats. She uses the goat’s milk to produce cheese.
MI	She has chickens and turkeys. The chickens were given by the coordinator of the project.

Table 38: Households

Name	Discussion
SML	They do not have concrete floor in her house, and do not have money to concrete it. Three of her sons and their wives live with them and do not have houses. They live in very cramped conditions.
FET	Their house is only one room.
SGO	They live in a room from her father-in-law's house. They do not have money to build a house.
CCM	They have two rooms, one kitchen, one latrine, one fridge, one gas stove, one washing machine, one van, and one motorbike.
EC	They live in house that has one room and a little kitchen.
FRT	They have two houses. One of the houses was the parent-in-laws house but now they use it to store mezquite.
MI	The house where they live is not theirs. It is property of MLM. It has two rooms and one kitchen.
VGT	Two small rooms. One is made of adobe like the other ones but the other is made out of sticks.
BSG	Two small rooms. One made out of adobe and the other made out of mud.
TC	One tiny room and one tiny kitchen.

5.3.12 Daily Schedule

Group 3 listed the normal activities of their day (Appendix 15). On Wednesday and Sunday mornings they collect the water from the vegetable cistern. The schedule of participants differ.

Women stated that they do not normally participate in the project. However, they pointed out that they do participate in preparing the lunch box for their husbands and sons that go to work in the project constructions. Last year women worked in the constructions only once. They worked for one month in the peach orchard sweeping with brooms, cleaning, taking stones, and weeding. They were paid and worked from 12 p.m. to 3 p.m. Women expressed the opinion that working in the project did not overload them.

5.3.13 Benefits of the Project

Group 3 was asked to brainstorm the different benefits of the project. Benefits are outlined in Table 39.

Table 39: Benefits of the Project

- Monthly food handout
- Clothing
- Vegetables (cabbage, broccoli, cauliflower)
- Dishes
- Shoes
- Toys
- Bicycles
- Candies
- Piñatas (for new year, and child's day)
- Water bottles
- Sheets, towels, pillow cases
- Medicines/ First aid kit
- Water from the cisterns
- Vegetable garden
- Peaches

Women discussed the medicines, the cisterns and the vegetable garden. Women highlighted the importance of the first aid kit. They expressed the opinion that everybody had benefited from it. Now they do not need to go to Matchuala unless there is a serious disease.

Before there was any cistern in San Felipe, people needed to bring the water from the spring with donkeys during droughts. They struggled using clay pots that sometimes broke before arriving home. When it rained they drank from the ponds because the spring was very far away. They needed to drink and wash from the ponds even if sometimes the water was green and contaminated with animal urine. Some of the women stressed the need for a rainwater harvesting system for human consumption. They were concerned that there was not going to be enough water for the vegetable garden.

Women do not decide what to plant in the vegetable garden. The president and the treasurer make these decisions. One of the women did not like the radish that was planted once. They did not know how to cook some of the vegetables, like the broccoli, and they asked the coordinator of the project how to cook them. The vegetables they like most are cabbage, silver beet, zucchini, and tomatoes. The peach orchard produced a small coup last year which was divided and distributed.

5.3.14 Impact of the Project

Group 4 was asked to brainstorm their impressions about San Felipe before and after the project 'Water and Life' (Table 40).

Table 40: 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

Women pointed out the dependency on ixtle extraction before the project implementation. They stated that families were very poor before the project. If they did not extract ixtle they could not eat. Women commented that if the food handouts, clothes and other goods were not provided by the project they would need to go back to ixtle extraction. With ixtle extraction they can just afford to eat. As long as there is other work available people do not go to extract ixtle.

5.3.15 Youth Group Discussion

The youth of San Felipe were gathered to discuss their hopes and visions for their future lives. Most of the young men perceived the project ‘Water and Life’ as a source of work. None of the young men has been formally trained and they have only participated with their labour. Only two of them saw the project as more than a job. The two saw the orchards and systems as a future benefit for their lives and were keen to learn how to maintain them.

There were three young women in the group, all of whom have education above secondary school. One of the girls does not want to stay in San Felipe because she does not like it. The other two want to be teachers. They can possibly live in San Felipe but this depends on where are they appointed to work. One of them is the kindergarten teacher, and also she is in charge of monitoring the first-aid kit. Another girl has studied as a nurse. She monitors the water consumption from the vegetable cistern (Vecar type) and takes care of the healing of injuries.

The ejido has only kindergarten and primary school education. When youth want to study at secondary school they need to study in Santa Ana, and to study at the high school they need to go to other ejidos such as ‘El Cedral’.

5.4 COMMUNITY ACTION PLAN

The auxiliary judge, the president and the treasurer of the Commission met to prepare an action plan. First they determined which of the problems identified in the community research could be solved without any external help by the local authorities. After some consultation they determined that the problems found in the vegetable garden and in the plum orchard could be addressed by the San Felipe Commission.

The community is supposed to take care of the vegetable garden and the plum orchard. The project no longer pays the farmers to work in these two activities. Although all farmers are supposed to be responsible, only a few are taking care of vegetable garden and the plum orchard. Authorities determined that they can solve this problem by themselves and prepared an action plan (Appendix 16).

First the authorities listed the activities required in the vegetable garden and the plum orchard. These activities need to be done as 'faenas', which means that they would not be paid. To appoint the 'faenas' they decided to call an assembly at the company store, any day from 19th to 26 August.

When the Commission was asked what were going to be the policies for the repartition of the orchards, they answered that it will not be their task. Commissions last only three years, and former officials cannot be re-elected. A new Commission will be elected by February 2000.

The Commission decided to gather the ejidatarios outside the company store because they did not have an official meeting place. The community could use the school buildings only with permission of the teachers who are the ones who have a key. At the time the children were on holidays and the primary teacher did not live in San Felipe. The auxiliary judge commented that a meeting place was needed.

5.4.1 Women's Participation in the Vegetable Garden

Days later after this plan was elaborated some women commented that women should take care of the vegetable garden instead of men because women "develop more affection for the plants." This idea was expressed to the president of the Commission. It was suggested to assign faenas to women instead of men at the assembly meeting. The president agreed.

5.5 INFORMAL DISCUSSIONS

5.5.1 Meeting with the Commission and the Coordinator Assistant

Some important people from government and NGOs visited the ejido to see the project 'Water and Life'. Due to their high potential as donors for the project the assistant

coordinator and the Commission had a former meeting to decide what they would ask the donors if the opportunity arose. The three main priorities of the coordinator of the project were:

1. Roof Catchment.
2. Three rainwater harvesting systems for animal consumption.
3. Fencing the 30 Km of the ejido's perimeter.

The assistant coordinator had another opinion. He suggested asking for a house catchment instead of the community roof catchment. The roof catchment requires a budget of \$800,000.00 pesos while the house catchment requires a budget of \$40,000.00 pesos. In the case of house catchments, it is the individuals who will be responsible for the water management and not the community, and also house catchments will provide housing to all the families.

The treasurer of the Commission appeared to be agree with the coordinator's priorities. He commented that the ejidatarios have asked him before for a system for animal consumption but the coordinator told them to wait.

During the visit, the treasurer reported that the vegetable cistern (Vecar type) was at 1/2 of its capacity while the plum cistern (solar module) was at 2/3 of its capacity.

5.5.2 Santa Ana highway construction

A temporary job was offered to men in San Felipe to build a highway in Santa Ana. They pay \$75.00 pesos/8 hours. This kind of job requires very intense work. That is one of the reasons why so many pain killers are consumed from the first-aid kit.

5.5.3 Migration

To cross the border, people pay a person (called a 'coyote') to pass them illegally. Coyotes ask for around \$700.00 USD. People usually return with a new leather jacket and some money that is spent in less than three months. Most of the young men would like to cross the border.

If it was not for the water of the vegetable cistern, most of the families would be forced to migrate.

5.6 OBSERVATIONS

There is public transport (a bus) from Santa Ana to Amaro twice every Tuesday. To travel to the nearest cities, Matehuala or Monterrey, people take the bus from Santa Ana. It costs \$50.00 pesos to go to Matehuala and \$226.00 pesos to go to Monterrey.

There is no phone in San Felipe. The nearest phone is in Estanque Nuevo and Santa Ana. Electricity is mainly used for lighting, radio and TV. Electricity is not used for refrigeration, except for one household and the company store. For cooking, wood from the range land is collected by men.

The kindergarten was built as a prototype of a house for the semi-arid regions. It is planned to spend around \$3,000.00 USD to install solar energy into the building.

During the field research, the mezquite season started. At the beginning there was no market for it, however people kept picking it although they were running out of storage room. Eventually the company store and one of the members of the community, RP, started buying it at \$0.90 pesos/Kg. RP has his own van, and he can go and sell the mezquite at \$1.00 pesos/Kg. There was not enough room for storage, not even in the cooperative.

The two families that have transport use the vans to irrigate their plots for rainfed agriculture. Those who have barrels or big containers and wheelbarrows are able to transport and store more water than the other families that do not have those assets.

5.7 SUMMARY

This chapter presents relevant information about the livelihoods and people's needs of San Felipe. Inhabitants of San Felipe revealed important issues about the role of the project 'Water and Life' in their community which differed to some extent from the perception of other stakeholders of the community. The use of varied PRA techniques with different stakeholders and gender groups allowed the triangulation of the results. Further discussion of the results is presented in the next chapter.

CHAPTER SIX: DISCUSSION

6.1 INTRODUCTION

To evaluate the effect of the project ‘Water and Life’ the discussion 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).

6.2 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.

6.2.1 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.

6.2.1.1 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 SEDESOL and PROCAMPO are set up to assist the marginal areas through direct aid. For instance, the 'Aquarium Plan' of CONAZA is artificially maintaining subsistence in ejidos that do not have a permanent source of water. Moreover, 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 more strict 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 (Table 32). 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 (Table 20).

The ejido's policy of electing a new Commission every three years without having the opportunity to re-elect members could be an obstacle for the continuity and implementation of new projects. 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 2000, and this change could affect the outcomes of the project especially in the organisation of 'faenas'.

6.2.1.2 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 (Table 26). 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 (Table 26). 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 due to its uncertainty it is considered the most risky and the worst of all productive activities (Table 26). Rainfed agriculture provides part of the staple food, maize and beans, but is so vulnerable that these crops are normally purchased.

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 most steady 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.

6.2.1.3 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 (Table 22).

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 (Table 21). 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.

6.2.1.4 Hails, Eclipses, and Hoar Frosts

Orchards were ranked as the productive activities with least risk because they have the water secured. 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 (Table 34). 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 (Table 21). 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 burns 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.

6.2.1.5 Coyotes

The breeding of pen animals is very vulnerable at the moment because women 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 9).

6.2.2 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.

6.2.2.1 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.

6.2.2.2 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.

6.2.2.3 Natural Capital

San Felipe has a variety of natural resources that could be combined to achieve successful livelihood strategies. 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 7). Another system with a storage cistern for 166,000 L is in the process of being constructed.

As shown in Table 41, 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, as was the case of the silt trap from the solar module. However, those sources that are unconstrained run out fast and are in need of better management.

Table 41: 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

Land is another natural resource. Every ejidatario has his own plot which he is responsible for cultivating (see farmers' fenced field in Figure 7). 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 21).

6.2.2.4 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 to judge the degree of poverty of a family (Table 25), are very limited, especially transport.

The community has a gravel road that connects the ejido with Santa Ana and Estanque Nuevo (Figure 7). 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 (Table 38). Only two houses have latrines, which is the household's major priority (Table 25).

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.

6.2.2.5 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.

6.2.3 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.

6.2.4 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 25 and Table 26). All of these strategies have failed to reduce the vulnerability or to improve the food security of the ejido.

6.2.4.1 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 26) 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 (Table 27). 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.

6.2.4.2 Livestock

The handling of cattle is carried out by men. Cows and goats are ranked as the 4th and 5th best activities in San Felipe respectively (Table 26). 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.

6.2.4.3 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 26). 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 (Table 40). The youth of San Felipe did not mention ixtle extraction as a source of income.

6.2.4.4 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 25). 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.

6.2.4.5 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. 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 29). 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 27). 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.

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 26). Major shortcomings are that these products are seasonal, and that there is no 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.

6.2.4.6 Fruit Orchards

According to the coordinator of the project, the fruit orchards are mainly to provide food for the households of San Felipe (Table 21). However, farmers hope that the orchards will become an income-earning source (Table 26). 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.

6.2.4.7 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.

6.2.4.8 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 25).

Other occasional jobs, such as the highway construction in Santa Ana, 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.

6.2.5 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 (Table 40). 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.

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.

6.3 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.

6.3.1 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 (Table 25).

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.

6.3.1.1 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. However, farmers explained that these activities would not be irrigated even if there was water available (Table 26).

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 (Table 23). 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 (Table 28).

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 (Table 23).

The main household food needs are purchased or provided by the project. As shown in Table 27, the staple food is beans, maize, corn flour, wheat flour, rice, pasta, potatoes, eggs, lard, oil, chilli, 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 29).

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.

6.3.1.2 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. Types of medicines are shown in Figure 6.

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 7) 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 (Table 22). 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 (Table 25), although major priority was given to the latrines.

6.3.1.3 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.

6.3.1.4 Participation and Freedom

According to Pretty's (1994) typology of participation, San Felipe has participated by consultation and for material incentives. 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.

6.3.1.5 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 26). 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.

6.3.2 Impact

As mention 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 26).

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.

6.3.3 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 2000, 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.

6.4 SUMMARY

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 SEVEN: CONCLUSIONS

7.1 INTRODUCTION

This chapter presents the conclusions drawn from the discussion. This chapter draws together separate conclusions for the sustainable livelihoods analysis and the evaluation of the project 'Water and Life'. 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.

7.2 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 agro-forestry 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.

7.3 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'.

7.3.1 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.

7.3.2 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 an 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.

7.4 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.

7.5 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.
- Blaikie, N. (1993). *Approaches to social enquiry*. Cambridge: Polity Press.
- 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. (1996). Introductory notes. *Institute of Development Studies*[online], 2 screens. Available: <http://www.ids.ac.uk/prs/intro.html>[1998, 30 March].
- Chambers, R. (1997). *Whose reality counts? Putting the first last*. London: Intermediate Technology Publications.
- CONAZA(Ed.). (1999a, 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].
- CONAZA (Ed.). (1999b, October –last updated). *Outlines* [Homepage of CONAZA/SEDESOL, National Secretariat of Mexico], [Online]. Available: <http://www.sedesol.gob.mx/html2/conaza/accion.htm> [2000, February 14].
- CONAZA (Ed.). (1999c, October –last updated). *Aquarium Plan* [Homepage of CONAZA/SEDESOL, National Secretariat of Mexico], [Online]. Available: <http://www.sedesol.gob.mx/html2/conaza/acuario.htm> [2000, February 14].
- Cornwall, A. (1997). Performance and participation: An overview. *PLA Notes International Institute for Environment and Development*, (29), 23-28. Abstract from: SilverPlatter, CAB Abstracts 1990-1991, AN 971912769.
- 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).
- Deshler, D. and Ewert, M. (1995). Participatory Action Research: Traditions and major assumptions. *Participatory Development Resource Centre* [online], 8 screens. Available: <http://www.oac.uoguelph.ca/~pi/pdrc/articles/article.1>[1999, 15 April].
- 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].
- DICONSA (Ed.). (1999, November –last updated). *Que es DICONSA* [Homepage of SEDESOL, National Secretariat of Mexico], [Online]. Available: <http://www.sedesol.gob.mx/diconsa/quees.htm> [2000, February 14].
- Ekins, P. (1992). *A new world order: Grassroots movement for global change*. London: Routledge.
- Estrella, M. and Gaventa, J. (1998). *Who counts reality? Participatory monitoring and evaluation: a literature review*. Brighton: IDS.
- 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/httoc.htm#I0> [2000, February 12].
- Ford, R. and Lelo, F. (1991). Listening to village leaders in Kakuyuni Location. *Forest, Trees and People Newsletter*, (13), 7-13.
- 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. (1999a). *Communities & livelihoods* [Homepage of IISDnet, The International Institute for Sustainable Development], [Online]. Available:
<http://iisd1.iisd.ca/communities.htm> [2000, 4 January].

- IISD. (1999b). *Arid and semi-arid lands: Characteristics and importance* [Homepage of IISDnet, The International Institute for Sustainable Development], [Online]. Available: <http://iisd1.iisd.ca/casl/ASALProjectDetails/ASAL.htm> [1999, 11 September]
- INEGI. (1995). *Dr. Arroyo, Estado de Nuevo León: Cuaderno estadístico municipal*. Mexico: Instituto Nacional de Estadística, Geografía e Informática.
- INEGI. (1990). *XI Censo nacional de población y vivienda 1990*. 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.
- Kumar, S.(Ed.)(1996). *South-south workshop on PRA: attitudes and behaviour, Bangalore and Madurai, 1-10 July 1996*. India: ACTIONAID India and SPEECH.
- 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.

- Lynch, J.H. (1997). *Participatory development – does the practice support the rhetoric?*. Unpublished dissertation, Lincoln University, Lincoln, New Zealand.
- 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.
- Mosse, D. (1994). Authority, gender and knowledge: Theoretical reflections on the practice of participatory rural appraisal. *Development and Change*, 25, 497-526.
- Nelson, N. and Wright, S. (1995). Participation and power. In N. Nelson and S. Wright (Eds.), *Power and participatory development: Theory and practice*. London: Intermediate Technology Publications.
- Neuman, W.L. (1997). *Social research methods: Qualitative and quantitative approaches* (3rd ed.). MA, U.S.A.: Ally & Bacon.
- 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.

- Seymour-Rolls, K. and Hughes, I. (1998). Participatory action research: Getting the job done. *Action Research Electronic Reader* [Online], 5 screens. Available: <http://www.behs.cchs.usyd.edu.au/arow/Reader/rseymour.htm> [1999, 1 December].
- 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.
- Speth, J.G. (1994). Statement of UNDP, Mr. James Gustave Speth. *United Nations Information Network* [Online], 4 screens. Available: <http://www.undp.org/popin/icpd/conference/una/940906211820.html> [1999, 30 December].
- Stephens, A. (1990). *Participatory monitoring and evaluation*. Bangkok: Craftsman Press.
- Stiglitz, J. (1997). An agenda for development in the twenty-first century: Keynote address to the ninth Annual Bank Conference on Development Economics (ABCDE). *The World Bank Group* [Online], 13 screens. Available: <http://www.worldbank.org/html/extrd/extme/jssp043097.htm> [1999, 30 December].
- 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 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. (1995). *Proyecto "Agua y Vida": Agua de sobrevivencia, agricultura sostenible y empleo de la energía solar para mejorar el nivel de vida en los semidesiertos mexicanos*. Monterrey, N.L., Mexico : Proposal for funding .
- 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.
- World Bank. (1990). *World Development Report 1990: Poverty*. Washington, D.C.: Oxford University Press.
- World Bank. (1996). *The World Bank participation sourcebook*. Washington, D.C.: Environmentally Sustainable Development.
- World Bank. (1999). *Overview* [Homepage of The World Bank Group], [Online]. Available: <http://www.worldbank.org/html/extdr/about/why.htm> [1999, 30 December].
- World Faiths Development Dialogue. (1999). A different perspective on development and poverty: Comment on the World Development Report 2000. *The World Development Report on Poverty* [Online], 14 screens. Available: <http://www.worldbank.org/poverty/wdrpoverty/faiths/comment.pdf> [1999, 21 December].
- Yates, P.L. (1981). *Mexico's agricultural dilemma*. Arizona : The University of Arizona Press.
- Yin, R. K. (1994). *Case study research: Design and methods*. USA: Sage Publications.
- 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/pr/intro.htm> [2000, February 29].

Appendix 1: Arid and Semi-arid Zones in Mexico

Appendix 2: Rainwater Harvesting System --Vecar Type

Appendix 3: Run-off Solar Module and Vegetable Garden

Appendix 4: Microcatchment System for Peach Orchard

Appendix 5: Rainwater Harvesting System --Lt Type

Appendix 6: Miscellaneous Outputs of the Project ‘Water and Life’

Appendix 7: Map of Nuevo Leon

Appendix 8: 'Water and Life' Project Records

Table 1: San Felipe Rainfall 1996-1999

Month	1996 (mm)	1997 (mm)	1998 (mm)	1999 (mm)
January	---	13	0	0
February	---	10.2	3.4	2.5
March	---	84	0	8.1
April	---	123	17	3.8
May	---	57	30.4	16.6
June	---	66.2	103.8	12.6
July	---	0	4.2	0
August	---	10.4	3.5	---
September	54.9	56.1	71.2	---
October	0	37.3	22.6	---
November	6.5	3	1	---
December	0	0	0	---
Total	61.4	460	257.1	43.6

Source: Project records from the peach orchard rain gauge

Table 2: Water Consumption from the Rainwater Harvesting System (Vecar type)

Name	May (L)	June (L)	July (L)
1. MI	2000	1540	840
2. SM	2026	1360	760
3. FE	1660	1360	560
4. PI	1220	1020	380
5. MSG	1220	1020	380
6. FR	995	680	415
7. HS	1915	1285	720
8. GI	1930	1990	1175
9. VG	1665	1545	640
10. MTC	640	740	620
11. MCC	1990	1920	1280
12. EC	1740	1410	1220
13. MLM	270	75	---
14. SMM	130	50	---
15. FC	60	---	---
16. Project's Bulls	160	400	---
Total	19621	16395	8990

Source: Local woman's records

Table 3: Vegetable Garden Production

Month	Vegetables	Kg	No. of beneficiaries	Total Kg/month
Sep-97	Cabbage	189	all	189
Oct-97	Silver Beet	162	all	256
	Lettuce	94	all	
Nov-97	Zucchini	179	all	179
Jul-98	Silver Beet	12	17	15
	Zucchini	3	17	
Aug-98	Silver Beet	15	17	18.4
	Tomatoes	3.4	4	
Sep-98	Silver Beet	6	2	53.3
	Tomatoes	22.5	15	
	Zucchini	17.3	14	
	Beet Root	6	10	
	Melon	1.5	14	
Oct-98	Silver Beet	15	14	47.1
	Zucchini	7.3	4	
	Tomatoes	16	21	
	Broccoli	8	21	
	Pea	0.8	21	

Source: Project records

Table 4: Manual Irrigation of the Peach Orchard

Month	1996 L/tree	1997 L/tree	1998 L/tree	1999 L/tree
Jan	----	0	0	0
Feb	----	0	0	0
Mar	----	0	38	76
Apr	----	0	38	50
May	----	0	0	104
Jun	38	0	0	50
Jul	19	0	0	50
Aug	19	38	38	----
Sep	0	38	38	----
Oct	0	0	0	----
Nov	0	0	38	----
Dec	19	0	38	----
Total	95	76	228	330

Source: Project records

Appendix 9: Features of San Felipe

Figure 1: Gravel Road to San Felipe



Figure 2: San Felipe Community



Figure 3: Typical House



Figure 4: Company Store



Figure 5: Company Store



Figure 6: Primary School (1) and Old Kindergarten (2)



Appendix 10: Sources of Water in San Felipe

Figure 1: Pond



Figure 2: White Tank



Figure 3: Spring

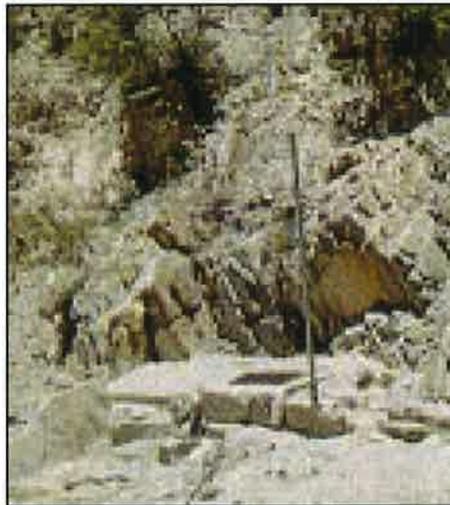


Figure 4: Solar Cell for the Spring



Appendix 11: Benefit Sustainability Analysis

Activities of the Project 'Water and Life'	Sustainable	Not Sustainable
Vegetable Garden	<ul style="list-style-type: none"> • Irrigation • Preparation of plots • Preparation of seedbeds • Sowing and transplantation of seeds • Fertiliser application (mezquite twigs) • Training 	<ul style="list-style-type: none"> • Composting • To invite the 'ejidatarios'
Plum Orchard	<ul style="list-style-type: none"> • Irrigation • Hoeing and weeding • Applying fertiliser • Fumigant application 	<ul style="list-style-type: none"> • Spraying (type, quantity, preparation, where, etc) • Pruning
Solar module	<ul style="list-style-type: none"> • Maintenance 	<ul style="list-style-type: none"> • Knowledge about the solar system and the pump. Technical assistance • Economic Resources. 25-30 years
Rainwater Harvesting System for the Vegetable Garden	<ul style="list-style-type: none"> • Maintenance 	<ul style="list-style-type: none"> • How to change the tap washers
Peach Orchard	<ul style="list-style-type: none"> • Weeding and hoeing • Applying fertiliser • Form microcatchment 	<ul style="list-style-type: none"> • Spraying • Pruning • Irrigation
Rainwater Harvesting System for the Peach Orchard		<ul style="list-style-type: none"> • Maintenance • Economic Resources • Training
Kindergarten	<ul style="list-style-type: none"> • Pave the fence 	<ul style="list-style-type: none"> • Solar system • Furniture • Rainfall gauge • Training for maintenance
Knowledge for new constructions	<ul style="list-style-type: none"> • Clearance • Fence • Trace and leveling • Form microcatchments • Plantation • Replicate former constructions 	<ul style="list-style-type: none"> • Economic Resources • Materials • Plants • Labour • Transport

Appendix 12: Expenditure Analysis

Criteria	DC	JLR	EP	LR	AP
Food	\$30/DAY	\$30/DAY	\$25/DAY	\$50/DAY	\$30/DAY
Cost	\$5000/year	\$2500/year	---	\$10000/year	\$8000/year
Education	\$5800/year + \$200xson/year	---	---	\$100/year	---
Electricity	\$21-36/ 2 months	\$25-50/ 2 months	---	\$30-60/ 2 months	\$21-22/ 2 months
Transport	\$50/month \$226/ 3 months a year	\$60/month	\$50/3 times a year	\$300/year	\$600/year
Health	---	---	---	---	---
Clothing	\$300/year	\$1000/year	\$300/year	\$1500/year	\$2000/year
Total	\$24 500/year	\$15 4000/year	\$9 500/year	\$30 400/year	\$21 600/year

Appendix 13: Food and Water Consumption Analysis

Table 1: Food and Water Consumption, Weekly Consumption (Group 3)

Family	Members	Oil L	Maize Kg	Beans Kg	Corn Flour Kg	Rice Kg	Soap Kg	Pasta (bag)
Pca	6	2	8	2	7	1	1	
PC	6	2	3	2	8	1	1	4
PG							0.5	
PM	19	4	49	10.5		2	0.5 6 persons	15
PE							0.5	

Family	Members	Sugar Kg	Coffee Jar	Potato Kg	Salt Kg	Chilli Tomato Onion	Wheat Flour Kg	Lard Kg	Water L
Pca	6	1		2	1/mont h	4 cans 1 Kg 1 Kg	2	1	200
PC	6	5	1	3	1/mont h	0.5 Kg 1Kg 0.5 Kg			400
PG									
PM	19	4	1	2	1/mont h	0.5 Kg 0.5 Kg 0.5 Kg	4	1	480
PE									

Table 2: Food Consumption (Group 4)

Family	Member	Beans Kg	Rice Kg	Pasta bags	Eggs Kg	Tinned Tuna	Potato Kg	Oil L	Chilli Tomato Onion	Salt (bag) Spice (box)
RI	7	1 /day	1 /week	3 /week	2 /week	5/ week	3/week	2/ wee k	0.5/week 1 /week 0.25/ week	1/week 1/day
PGa	6	0.5/day	0.5 /day	3 /week	2 /week		1/week	1/ wee k	0.5/week 0.5/week	1/2 week 2/week
CR	4	2/week	1/15 days	2/week		1/ week	1/week	1/w eek	0.2/week 0.5/week	1/3 weeks 2/week
RIP	7	0.5/day	1/week	4/week	6/week	1/ week	1/week	1/ wee k	0.5/week 0.5/week 0.5/week	1/ 2 weeks 2/week
PS	4	3/week	1/week	4 or 5/week	4 eggs/ day		2/week	2/ wee k	0.5/week 0.5/week 0.5/week	1/week 3/week

Family	Members	Sugar Kg	Corn Flour Kg	Wheat Flour Kg	Lard Kg	soft Drink	Coffee Jar	Cheese	Soap Kg
RI	7	1/week	3/day	8/week	1/week	3/day	1/week	1/day	1/2week
PGa	6		2/day	2/week	1/2week	1/day			0.5/week
CR	4	1/week	1.5/day	1/day		3/day	1/15 days		0.5/week
RIP	7		6/week	9/week	1/week	5/day			0.5/week
PS	4	1/week	2/day	2/week	0.5/week	2/day			0.5/week

Table 3: Household Water Consumption and Water Sources

Family	Drink	Wash Clothes	Bathing	Cooking	Animals	Plants	Wash Dishes	Mop/wet floor
RI	2b/day 3	8b/2 times a week 1,2,4	6b/week 2,4	1b/day 3	2b/day 1,2,4	1b/day 1,2,4	1b/day 2,3,4	1b/day 1,2,4
PGa	1b/day 3	3b/2 times a week 1,2,5	3b/2 times a week 5,2,3	1b/day 3		0.5b/day 2	0.5b/day 3	2b/day 1,2
CR	1b/day 3	7b/2 times a week 4,2	3b/2 times a week 4,2,3	0.5 b/day 3			1b/day 4,2	0.5b/day 4,2
RIP	2b/day 3	8b/2 times a week 4,2	5b/week 4,2,3	1b/day 3	1 b/day 1,2,4	1b every 3 rd day 4,2	1b/day 4,2	1b/day 4,2,1
PS	2b/day 3	5b/week 4,2,3	3b/week 4,2,3	2 b/day 3			1b/day 4,2,3	2b/day 4,2,1

1. Pond; 2. Spring (white tank); 3. Vegetable cistern (Wednesday and Sunday only); 4. Solar Module Silt Trap (blue tank, little tank); 5. Barrels.
b: bucket (bucket is 20 L).

Appendix 14: Local Products

Group 3
Quelites
Nopal ++
Palm Flower
Cabuche +
Squash Flower
Squash ++
Prickly Pear ++
Dates
Mezquite ++
Alicoche
Limas
Corn/Peas/Green Beans
Maize + + + + +
Milk
Cheese
Chickens/chicks/eggs + + + +
Pig + + + + +
Rabbits +
Turkeys
Ducks
Goats +
Quiotes

Group 4
Cabuche ++
Palm Flower + + +
Quelites ++
Nopal ++
Prickly Pear + + +
Peach + + +
Cuijas +
Alicoche +
Mezquite
Milk +
Chickens/chicks/eggs + + +
Turkey + + +
Pig
Goats +
Corn
Zucchini

Appendix 15: Women's Daily Schedule

Alternative 1		Alternative 2	
7.00	Prepare breakfast	Make	Feed the chickens
	Wash dishes	'tortillas'	Prepare breakfast
	Milk the goats		Cook beans
	Prepare breakfast	Weave	Wash dishes
	Make 'tortillas'		Clean beans
10.00	Wash dishes		Prepare lunch
11.00	Clean		Clean room
			Make jellies and ice pops
12.00	Prepare the lunchbox		Wash clothes
1.00	Prepare lunch		Prepare lunch
	Wash clothes		
3.00	Lunch		
4.00			Feed the animals
	Bring water from the tank		
	Wash clothes		
	Stay in the room		
	Prepare dinner		
8.00	Dinner		
9.00			Chat/ Watch TV.
11.00	Sleep		

Appendix 16: Action Plan

Activities to be done	Plan
<p>Vegetable Garden</p> <ol style="list-style-type: none"> 1. Prepare plot 2. Apply compost 3. Prepare seedbed 4. Sow and transplant 5. Irrigate 6. Hoe and weed 7. Check plagues <p>Plum Orchard</p> <ol style="list-style-type: none"> 1. Weed 2. Irrigate 3. Fertilise 4. Hoe 	<p>How?</p> <p>Appoint ‘faenas’ Call the ‘ejidatarios’ to an assembly meeting to appoint the ‘faenas’ and determine:</p> <ul style="list-style-type: none"> • How many people • How often <p>When?</p> <p>Assembly will be organised during the 19 –22 August</p> <p>Where?</p> <p>Company store</p>