

Chapter 3

Methodology and implementation of the project

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3.1. Research framework and definitions

3.1.1. Set-up of the research

IMAROM seeks to identify under which socio-economic and bio-physical conditions migration and migration remittances contribute to investments in irrigated oasis agriculture. In addition to identifying enabling conditions for the successful promotion of agricultural development, IMAROM aims to assess the ecological consequences of current changes in land and water management in oases. This is important, since increasing pressure on land and particularly water resources, as well as certain irrigation methods, might endanger the future sustainability of oasis agriculture.

Agricultural transformations seem highly differentiated across oases. The question to be addressed is what can explain this differentiation, and what is the role of migration in further understanding these processes? It is presumed that this depends on the socio-economic, political, and environmental circumstances under which the potentially enabling role of migrant remittances as a source of investment capital can be realised, and under which circumstances sustainable agricultural development can be promoted in general.

The basic framework of IMAROM was to gain insight in these enabling conditions by studying and comparing migration impact on agriculture and resource-use in eleven oases in Morocco and Tunisia showing a high degree of variation in bio-physical and socio-economic conditions. In Morocco, eight oases in the upper and lower parts of the Todgha valley (province of Ouarzazate) were selected. In Tunisia, three larger oases were selected: two in Mareth, a coastal area near Médenine, and one, Fatnassa, in the continental oasis area of Nefzaoua.

In addition to a socio-economic survey, an evaluation of the bio-physical environment of research oases was implemented to assess the quality and quantity of land and water resources, and to detect possible signs of degradation. This led to an assessment of the environmental effects of changing land and water management, as well as identification of policies which stimulate agricultural development, a more efficient use of resources and increased sustainability of desert agriculture.

Although the IMAROM project aims at comparing various oases, it had to consider intra-oasis differentiation so as to answer research questions for each oasis. Within each oasis the socio-economic survey was set up in such a way that migrants as well as non-migrants are included, in order to compare their behaviour. It is striking that most migration impact studies in general lack a systematic comparison between migrant and non-migrants, hindering the evaluation of migration impact. Non-migrants serve as a control group to assess migration impacts. Another reason to include non-migrants is that migration might also have an economic impact on them via local multiplier effects.

A second strategy was to perform intra-oasis migration impact analysis not only on an individual but also on a household level. This choice is based on theoretical insight that the family or the household, and not the individual, is the most appropriate basic decision-

making unit for migration and investments (Stark & Levhari 1982; Stark 1993; Taylor 1998). This seems particularly the case in rather traditional rural societies. Also, for the case of the Maghreb, there exists a general consensus that the household is the most appropriate management unit with regard to decisions on migration, investments and agriculture (De Mas 1990). A household level analysis is essential not only for a study of migration decisions, but also to analyse the effects of migration remittances on investment and consumption expenditures (local economic development), and how these effects reflect migration determinants.

3.1.2. Household and migration definitions

In order to guarantee synchronised data collection, it was important to elaborate a clear definition of the household. This is not evident, as many definitions exist. Particularly as regards migration, it should be clear when a migrant is still considered as a member of a household, and when not. Generally, the household is a concept based on the idea of a ‘unity’ of habitat, consumption, and sometimes production. This research focuses specifically on migrant remittances sent by household members living elsewhere. The opposite is also possible, for instance, in the case of a child studying in a big city, who receives regular payments from his family. The same applies for a migrant who just left his place of origin and has not yet found a job in his destination area. He may also rely on his family. In all these cases, there are strong financial bonds linking the migrant and the household in which he lived before departure. Although he does not live at the same place at least for part of the year, he is still very much economically attached to that household. Such persons are considered as part of the household. For the IMAROM research, the household has been defined as follows:

A group of persons who are generally but not necessarily kin, who live under the same roof and generally eat together, including persons that live during a part of the year or the entire year elsewhere, without having established their own family (wife and/or children) in that other place, and who continue to maintain regular economic relations, either by remittances sent by the migrant to his household, or by money sent by the household to the migrant (e.g. students).

Unmarried migrants (mostly sons, sometimes also daughters, working or studying elsewhere), or those who left behind their wife and children (mostly ‘household heads’ working abroad), are considered part of the household. We define them as *absent (household) members*, whereas persons who have not migrated are categorised as *present members*. The definition implies that family members who left the house with their wife, husband, or children, but who still maintain financial relations, are no longer considered as part of the household, as they have established their own independent, socio-economic unit. But as they continue to maintain their bonds, we define them as *associated non-members*. Also, families that have entirely left the oasis due to family reunification have not been counted. So, it is important to stress that the household is not analytically equivalent to the family, as not all family members are part of the same household, and a household may contain non-kin persons.

Table 3.1. Household member typology for IMAROM research

1. Lives entire year in the house?	Yes present member	No ☞ <i>question 2</i>
2. Maintains regular financial relations (at least each 3 months)	Yes ☞ <i>question 3</i>	No non-member
3. Established a family elsewhere (with wife, husband and/or children)	Yes associated non-member	No absent member

Source: De Haas and El Ghanjou 1998

A household comprised of migrant members has been classified as a *migrant household*. Households containing only internal migrants are considered as *internal migrant households*, whereas households containing at least one international migrant have been classified as *international migrants households*. So, households containing both international and internal migrants are seen as international migrant households. Households that are currently not involved in migration but are comprised of members who have been in the past and have since returned, are classified as *return migrant households*, with again a distinction between *international* and *internal* migrants, with international migrants being ‘dominant’. Households containing both current as well as returned migrants are considered as *migrant households*. Thus, actual migration is ‘dominant’ over past migration. Households lacking any past or current migration experience have been classified as *non-migrant households*.

In sum, we have defined five household migration categories, which in turn were used as the basis for the migration impact analysis. In some of the analyses to be found in this report, the number of migration categories has been reduced by only analysing the difference between households involved in international migration and those that are not. This was done on the basis of the observation that this is the most important distinction concerning income effects, as income characteristics of internal migrant households generally do not differ significantly from those of non-migrant households.

With its aim of linking socio-economic household livelihood strategies to land and water management, resource exploitation and environmental degradation, IMAROM is an inherently trans-disciplinary project. The project brings together researchers from very different scientific backgrounds. This made high demands on the careful design of the research and commitment of the researchers. The basic difficulty of working in a multidisciplinary team appeared to be the different ‘languages’ the researchers spoke, reflecting their diverging scientific and cultural backgrounds. Researchers literally lived in different realities. It cannot be expected that these kinds of obstacles can be overcome all at once. Besides, through the enhancement of communication, the integration and synergy which research offers can only be anticipated if a carefully designed research plan has been established specifying the tasks of each partner, the data has to be collected at which point of time, and how it should all be integrated. How this was done for the IMAROM project will be demonstrated in the following paragraphs.

3.2. Work packages for field data collection

3.2.1. Introduction

In the proposal phase of the project (1997), a set of five narrowly defined work packages was defined specifying the tasks of all researchers involved in the project. In the first months of the project (Spring 1998), data collection tasks specified in the description of the working

packages were further operationalised. Each of the working packages comprises a set of specific information to be collected in each of the research oases. Four of the five work packages are empirical in nature, and have been carried out by conducting fieldwork in the research oases. Together they form the elements feeding the overall analysis, the latter forming the fifth working package. In each research oasis, extensive field research has been carried out consisting of the following work packages: socio-economic surveys, integrated socio-economic interviews with peasants by plot level, a general ecological evaluation of the bio-physical environment and a survey of the agricultural and hydrological system on an oasis level (work packages I, II, III, and IV). A more detailed description of the work packages will be given in the following paragraphs.

3.2.2. Socio-economic household survey (work package I)

Work package I consisted of a socio-economic survey of households in the Moroccan and Tunisian oases under study, focusing on migration and agriculture. This survey treated the following items:

General

- (a) Demographic structure of the household;
- (b) Migration characteristics (number of household members migrated or re-migrated; migration types; 'migration history' of oases and individuals);
- (c) Education levels;
- (d) Activity patterns (men and women, including migrants);
- (e) Income characteristics (including agriculture and migration remittances);
- (f) Expenditure and investment patterns (with a distinction between agricultural and non-agricultural investments)

Agricultural exploitation

- (g) Ownership of land, water rights and cattle;
- (h) Agricultural production: harvest; dairy products; meat. Proportion commercialised/auto-consumption. Association patterns of crop production and animal husbandry;
- (i) Resource exploitation: water use, extraction methods, soil fertility maintenance.

The socio-economic survey, carried out simultaneously in Tunisia and Morocco, addressed migrant as well as non-migrant households, so as to compare their behaviour¹. The category of non-migrant households was used in the research as a control-group for the sake of the validation of the research results.

¹ Prior to their drafting in final form, the questionnaires, designed by the University of Amsterdam in collaboration with the University Mohammed V, have been tested extensively and adapted several times in the field. The latter was used by the Tunisian research team in almost the same form. Only some country-specific adaptations were made. A copy of the questionnaires has been included in the first annual report. Both in Tunisia and Morocco, the same database was used for data processing and analysis. The format for this database was developed by the University of Amsterdam.

3.2.3. Plot-level research (work package II)

Work package II was comprised of socio-economic interviews with peasants at a plot level, focusing on agricultural practices and actual land and water management. To guide the analysis, additional plot-level questionnaires were designed, including closed and open-ended questions. Items discussed with peasants included:

- (a) cropping patterns (actual land use);
- (b) intensity level of agriculture (input factors such as pesticides, fertilisers, HYVs);
- (c) irrigation methods and patterns;
- (d) land and water conservation measures by individual peasants (maintenance of irrigation systems; desalinisation measures); drainage.

Interviews were conducted among a spatialized sampling of the research population, by selecting some agricultural sectors, and by subsequently interviewing all peasants cultivating plots in that sector. Particularly at this level, the interdisciplinary nature of the research was realised by studying the interaction between socio-economic characteristics and land and water use patterns directly on the plot, through which possible migration-related divergences in agricultural practices and land and water management were detected.

3.2.4. Evaluation of the biophysical environment (work package III)

Work package III consisted of a general evaluation of the biophysical environment, aimed at assessing climate, land and water resources in the oases under study. The analysis included:

- (a) Climate assessment: analysis of mean monthly temperatures, monthly rainfall, wind speeds and directions (if possible), ETP estimation;
- (b) Assessment of water resources (water quality and quantity): evaluation of total water resources with methods for small-scale studies, including soil moisture with automatic recording sensors; water quality, in situ (pH, EC) and in the laboratory (cations and anions). For larger-scale estimations, existing models based on the relations between drainage-basin and discharge were used.
- (c) Soil degradation/desertification assessment: Mapping of land properties (soil, vegetation and land use) and estimation of their variability as a basis for the selection of plots and for the extrapolation of results from them. Identification by simple visual methods of land degradation. Soil sampling and characterisation in test sites: soil profile descriptions, particle size analysis, pH, organic matter, N, P, K, electrical conductivity, soluble ions, micro-morphology of the soil surface (for crust evaluation) and other selected horizons, water holding capacity, and erodibility assessment by simple tests in the laboratory. Hydrological behaviour of soils (infiltration and saturated hydrological conductivity) by simple field tests. Application and development of models of soil degradation (mainly physical and biological degradation, salinisation, and wind and water erosion) adapted to oasis environments.

On the ground, the sampling framework was nested and stratified at random. The distribution of a number of key soil properties, such as soil depth, texture and stoniness was based on a statistical soil-terrain model calibrated with field observations (soils) and terrain attributes derived from topography, when available. Wherever possible, SPOT-derived digital elevation models were used.

3.2.5. Oasis level survey: agricultural and irrigation systems (work package IV)

Work package IV was comprised of surveys conducted on an oasis level of water extraction and irrigation, agricultural systems and their organisational aspects. The following topics were evaluated:

- (a) Physical characteristics of the agro-hydrological infrastructure (water distribution);
- (b) Collective soil and water conservation practices (managed by traditional or modern oasis institutions, such as water users associations or traditional village communities);
- (c) Collective organisation and common law in relation to soil and water management.

Data collection for work package IV focused on the collective aspects of land and water management on an oasis level, particularly concerning the irrigation system and collective soil and water conservation practices. This data was collected through observation and open interviews.

3.2.6. Theoretical modelling (work package V)

The fifth and final work package consisted of developing a theoretical model which would serve to integrate and analyse data gathered for the first four work packages into one conceptual model, and to analyse the relationships between the variables included. The final year of the project (2000), following the completion of data collection, was dedicated to data analysis, a further elaboration of the conceptual model, as well as reporting. The data was processed using database, statistical and GIS programmes. Data from all the following work packages were integrated and hypotheses of the conceptual model (see chapter 4) evaluated. The current, final report is the result of that effort. Chapters 5-11 – containing sub-analyses per oases by the research partners – were written in such a way that they responded to general IMAROM questions. The final chapters were written with the objective of integrating, generalising data collected in the field and linking the conclusions derived from our particular research sites to general theories addressing the interaction between migration, agricultural development and ecology described in chapter 2.

3.3. Task divisions between IMAROM research partners

Five research institutions make up the IMAROM consortium. The Faculty of Environmental Sciences (Department of Geography, AGIDS research group², part of the Dutch CERES research school³) of the University of Amsterdam (UVA) is the initiator and co-ordinator of the project. The other partners are: In Morocco, the Mohammed V University (Rabat, UMV) and the Mohammed I University (Oujda, UMO); in Tunisia the Institut des Régions Arides (Médenine, Tunisia, IRA); and in Spain the Estación Experimental de Zonas Aridas (Almería, EEZA). Together, IMAROM project partners make up an multidisciplinary research consortium, providing input from the social as well as the natural sciences.

² Amsterdam Research Institute for Global Issues and Development Studies

³ Research School for Resource Studies for Development

For the fieldwork, tasks were divided up between partners as follows: the University of Amsterdam, Mohammed V University (Rabat), and the Mohammed I University (Oujda) bore joint responsibility for research in the Moroccan oases. The first two institutions were responsible for socio-economic research, the latter for biophysical research. The Institut des Régions Arides (Médenine, Tunisia, IRA) and the Estación Experimental de Zonas Aridas (Almería, Spain) were responsible for data collected in the Tunisian oases. The first partner was responsible for socio-economic, the latter for biophysical research. Data collection in the field was carried out by senior researchers and PhD students, who will prepare their theses based on IMAROM data.

3.4. Implementation of the project

3.4.1. Preparatory phase (March-August 1998)

In the first half-year of the project (March – August 1998), the research partners agreed on the joint methodology of the project and selected the research oases where the project was to be carried out. At an initial co-ordination meeting (9-11 March 1998), the project's thematic approach and working methods were further elaborated so as to guarantee the integration of the socio-economic and bio-physical portions of IMAROM research. In the first three months of the project (March-May 1998), orientation trips to Morocco and Tunisia resulted in the selection of IMAROM research oases. The primary selection criteria were a certain degree of migration as well as the existence of clear changes in agriculture and exploitation of land and water resources. Research sites were selected on the basis of a high differentiation in biophysical environment and agricultural change patterns, as variation of these circumstances within the different research sites will permit us to answer IMAROM research questions.

As research capacity was rather greater than estimated, and the oases, particularly in Morocco, were rather small, it was decided to select more than the originally intended two oases per country (see table 3.2). In Morocco, eight rather small oases in the Todgha valley (province of Ouarzazate) were selected. Within this valley can be found a high variation in biophysical environmental conditions as well as migration backgrounds. Four oases were selected in the relatively water-rich upstream part of the valley, four in the water-scarce downstream part of the valley. In Tunisia, three larger oases were selected. In the Mareth region, a coastal area close to Médenine, two oases were selected. In the continental area, in the oasis region of Nefzaoua, the oasis of Fatnassa was selected.

In the subsequent three months of the project (June-August 1998), methodologies for the four empirical work packages were further elaborated and tested in the field. In this period, the basic questionnaires for work packages I and II were elaborated. Questionnaires were framed in such a way that data collected on key issues would be similar for Morocco and Tunisia. The partners responsible for biophysical research elaborated their methodologies, sampling strategies and selected specific variables to be studied. During this period, all partners analysed literature on the research theme and on the areas where the research would be conducted. Furthermore, practical preparations were made for the fieldwork and, for some partners, personnel was selected.

Table 3.2. IMAROM research sites and number of households surveyed

<i>Name oasis</i>	<i>Country</i>	<i>Responsible partner</i>	<i>Households in survey</i>
Zaouia Sidi Abdellali	Morocco (upper Todgha valley)	UvA	123
Tikoutar	Morocco (upper Todgha valley)	UvA	105
Ait el Meskine	Morocco (lower Todgha valley)	UvA	71
Tadafelt	Morocco (lower Todgha valley)	UvA	116
Taghia	Morocco (lower Todgha valley)	UMV	70
Boutaghat	Morocco (lower Todgha valley)	UMV	85
Ichmarine	Morocco (upper Todgha valley)	UMV	66
Iâadouane	Morocco (upper Todgha valley)	UMV	116
Mareth 1	Tunisia (coastal region)	IRA	66
Mareth 2	Tunisia (coastal region)	IRA	58
Fatnassa	Tunisia (continental region)	IRA	92
Total			968

3.4.2. Data collection phase (September 1998 - February 2000)

The second half of the first project year (September, 1998 - February, 1999) was dedicated to the actual period of fieldwork take-off for work packages I, III and IV. Throughout this period, the socio-economic researchers had regular discussions with their colleagues in physical geography, hydrology and soil science in order to guarantee the integration and compatibility of their respective research efforts. However, agenda problems related to non-IMAROM activities prevented an optimal information exchange. This caused delays in some activities, particularly in the field of the biophysical research. This led to the postponement of a planned coordination meeting in February, 1999. Instead, the project co-ordinator fulfilled two coordination missions to Morocco and Tunisia in February and March, 1999. These missions were useful in speeding up research efforts, synchronising and adjusting biophysical and socio-economic research, and agreeing on the research agenda for the second project year.

The entire second year of the project (March 1999 - February 2000) was dedicated to data collection⁴. By summer, 1999, the household surveys for work package I was concluded in both Morocco and Tunisia, followed by the start of plot level research for work package II. Partners from the different teams have developed their work in close collaboration. In order to further synchronise research and guarantee comparability, the partners responsible for research in Tunisia paid a visit to the Moroccan field sites in July, 1999 (IRA) and October, 1999 (EEZA), which also provided the opportunity to organise intermediate project meetings. The second year of IMAROM was also marked by discussions of the project's conceptual model (work package V).

According to original planning, data collection on all work packages had to be completed by the end of the second project year. This objective has largely been met. However, most partners decided to collect additional data in the first half year of the last project year in order to strengthen the empirical basis of their research, or as a means of studying some interesting phenomenon uncovered during the second year's research which might offer added value for IMAROM.

⁴ For detailed descriptions of the methodologies applied in the field, questionnaires, data processing, and the problems encountered, see the Second Annual Scientific Report of IMAROM (1 March 1999 - 28 February 2000).

The second plenary IMAROM meeting took place at the Institut des Régions Arides (IRA) in Médenine Tunisia from February 9-14, 2000. At this meeting, the research partners presented and discussed the results of their research. Furthermore, the issue of theoretical modelling (work package V) was discussed on the basis of a working paper prepared by the University of Amsterdam.⁵ After some adaptations had been made, all partners agreed on a conceptual model. With the end of the data collection phase, the IMAROM project enters into its third and final phase.

3.4.3. Data analysis and reporting phase (March 2000 - February 2001)

The last project year (March 2000 - February 2001) was dedicated to data analysis, evaluating hypotheses of the theoretical model, and report writing. Following the February 2000 project meeting in Tunisia (see Annex II and the Scientific Annual Report 2000), where the first results of field data collection were discussed, the members of the research consortium dedicated most of their time to the processing and analysis of data collected in the field. Data analysis on the four empirical working packages (I-IV) have been extensively described and analysed in several IMAROM working papers series published between 1999 and 2001. Regular reporting in working papers proved to be an efficient way to systematise data analysis and present data to others at an early stage of the project.

Following discussions at the Tunisia meeting, the project co-ordinator further developed the theoretical model. It was decided not to engage in formal quantitative analysis, as reliable quantitative data was not always sufficiently available, and as some variables were inherently qualitative in nature. The first problem was partially related to the slightly different interpretation by partners of the research protocol and methodologies germane to the data to be collected, but was also related to discrepant levels of expertise and methodological-statistical capabilities among group members. The second problem was rather related to the very nature of some variables, such as ‘attitudes’ or ‘local institutions’, which are difficult to fully comprehend in quantitative terms. Other, general data on the biophysical environment was sometimes difficult to obtain due to a lack of certain background studies.

Consequently, modelling involved mainly a qualitative synthesis of the collected data. The research questions were subsequently developed into a set of hypotheses, which have been described in IMAROM working paper 4, and in chapter 4 of this report. It is particularly through this exercise that the ‘inter-disciplinary’ nature of the IMAROM project was operationalised: rather than reporting separately on the work packages, all data was integrated into this overall analysis, in which the main research questions and hypotheses of the IMAROM project were evaluated.

The last half-year of the project was devoted entirely to reporting and discussing the project results. In order to structure the chapters written by the different partners, the project co-ordinator elaborated detailed reporting guidelines during the Fall, 2000, which specified the structure of the chapters item-by-item. Whereas the working papers contain a large amount of descriptive and analytical information on the specific research sites, the contributions to the final report had to focus on the main project objectives. So, contributions to the final report had to be as targeted as possible in the interest of reaching general

⁵ De Haas, Hein (2000) “Modelling for the IMAROM project: Basic Ideas and Proposals”. IMAROM working paper series no. 4. Published in collaboration with Mongi Sghaier, Laurens Nijzink, and Leo de Haan. January 2000. Amsterdam: AGIDS (University of Amsterdam), 24 pp.

conclusions through the integration of the various data collected by the five IMAROM partners. Achieving *comparability* via *standardisation* of reporting was the main goal underlying the need to draw up these reporting guidelines.

In January 2001, the partners summarised their data analysis in the form of contributions to the final report. Their contributions have been included in this final report as individual chapters, which together form the body of the report. In these chapters, they respond to the main IMAROM research questions and hypotheses. These chapters may be considered country-level syntheses based on the fieldwork of partners systematically treating IMAROM's research questions. Working Package V analysis has resulted in an overall synthesis, forming the concluding chapter of the final report.

3.5. Problems encountered and recommendations

3.5.1. Problems related to differences in research implementation

The research plan and work packages were extensively discussed with all partners in the first half-year of the research. Nevertheless, in practice, the research was not implemented in exactly the same fashion in the different research oases. These problems were partially related to a diverging interpretations of the tasks described in the work packages and the project's research protocol (the so-called *Technical Annex*), but also to differences in time and money available between the research partners, variations in the specific characteristics of the field sites, differences in scientific backgrounds, expertise and competence.

During the project the co-ordinator partially succeeded in synchronise research efforts, by clarifying and sometimes re-negotiating the research protocol. The mutual field visits of the Tunisian and Moroccan field teams were also particularly useful in streamlining research. Unfortunately these visits took place in the second project year. It would have been better if such visits had been programmed early in the first project year, during the early implementation phase of field research.

In spite of these efforts, differences in research implementation were never totally resolved, although close contact between the research partners led to adaptations and an improved comparability of results. Although the 'technical annex', the project's research protocol, was already laid out in detail, an even more rigorous research plan, coupled with mutual visits in the first year of the research project, could have further improved synchronisation.

In particular, the biophysical research tended to diverge between the Moroccan and Tunisian sites, although this was partially due to circumstances beyond the control of individual researchers. An important factor hindering the synchronisation of biophysical research was differences in data availability for Moroccan and Tunisian oases. For Morocco, no recent detailed aerial photographs or detailed plot maps, nor detailed studies, were available, obliging the researchers to spend much time on collecting general data before entering into the detailed analysis of land and water resources. In the case of Tunisia, detailed maps were known to exist, but here the main problem was the non-accessibility of existing maps and research documents for long periods of time, as well as the poor quality of some maps. Apparently, fine studies of both study areas have been unavailable for a long time. Most of these data became available only over the course of the second year.

A preliminary study prior to the start of the project would have been useful for identifying the problem and adjusting data collection accordingly. Moreover, the research

budget and, consequently, the research capacity of the two partners appeared to be rather unequal, which also led to differences in research implementation.

Socio-economic data collection proceeded generally more smoothly, as the Tunisian field team used questionnaires and databases almost entirely identical as those developed by the Moroccan field team. This positive experience supports the idea that tight and extremely detailed research protocols greatly enhance synchronisation of research. Nevertheless, socio-economic sampling strategies were not identical, leading to some problems in data interpretation. Also, in this instance, mutual field visits to Tunisian and Moroccan sites with all participating socio-economic researchers could have resolved such a problem. In the plot level research for each work package, finally, some delays occurred due to the difficulties the researchers experienced in convincing peasants of the usefulness of a second-round of interviewing.

3.5.2. Problems related to scale

Another problem was that socio-economic researchers on the one hand, and biophysical researchers on the other, do tend to work at different spatial scales. This complicated the integration of the data from both teams on a plot-level, as was intended. Whereas the agricultural plot is a clear socio-economic spatial unit, physical geographers tend to take geomorphologic or pedological units as their research units, which do normally not coincide with plot boundaries. This problem was partially resolved by locating plots within the larger bio-physical units, but it made the intra-oasis analysis by plot-level less valuable than imagined, as most plots within an oasis were located in only one or two bio-physical units. Between oases, nevertheless, clear differences were identified.

3.5.3. Problems related to differences in data analysis and reporting

Although all partners agreed on a very detailed reporting framework, and despite prior discussions, some research partners presented and analysed data in rather different ways than was indicated in these guidelines, hindering the comparison between the different oases and countries. In addition to possible differences of interpretation in the text of the guideline, this seems also related to differences in the personal scientific orientation, experience and competencies of the researchers involved. This in turn led to diverging methods of analysis and styles of reporting. In the last months of the project the project co-ordinator dedicated much effort in commenting on some drafts, which did not fulfil the standards defined in the reporting guidelines. Again, it appeared that reports prepared by researchers who had been working together in the field were better attuned to each other's work than between researchers who had had less systematic contact. This seems to present another argument for the formation of joint research teams working together in the field, as well as mutual field visits of research teams working in different countries.

Though most data have been collected as intended and described in the work packages, the above-mentioned complications made that the data from different sites was not always fully comparable. This and a number of practical constraints explain why the initially planned formal-quantitative modelling for comparison on a project level *between* oases was not feasible. This relates particularly to the problem of data quantification (see paragraph 3.4.3.). Consequently, it was necessary to readjust the ambition of modelling to the development of a rather qualitative synthesis on a project level.

Summarising, we can conclude that the project could have been implemented more smoothly and data collection and analysis could have been more synchronised if more time had been spent on communication and, in particular, mutual field visits of researchers in the early implementation phase of the project, preferably in the first months fieldwork. Furthermore, a detailed, preliminary pre-study of available secondary data, maps, aerial photographs and satellite images, would have prevented later complications.

The elaboration of an even more rigorous research plan than previously had been the case – which has to be realistic considering the research capacity of partners and availability of data – could further have improved the quality and synchronisation of data collection. The optimum strategy would have been to organise field visits before the beginning of the project, and thereby elaborate and test methodologies in the field with all research partners present, in order to agree on a research protocol which was both tight and realistic. Unfortunately, in most projects this is impossible as, normally, no budget is available before the onset of a project. Lack of prior coordination and testing of protocols for data collection explain why research protocols are not always realistic, leading to problems during project implementation.

3.5.4. Recommendations for improved interdisciplinary research

The experience of IMAROM is partly in line with observations by De Mas (1992) in his evaluation of the interdisciplinary REDRA research project (*Ressources et Développement en Régions Arides*), implemented in the northern Moroccan Rif mountains between 1977 and 1986. The project sought to "study the interactions between population and physical environment in semi-arid conditions" (De Mas 1992:257), and has some important characteristics in common with IMAROM. For REDRA, De Mas (1992:257-267) identified three main problems. The first was the opposition between scholars oriented towards theoretical-deductive and descriptive-inductive methods. This opposition existed also within IMAROM, leading to differences in research implementation, despite the existence of a rather detailed research protocol. Differences in scientific orientation within the same disciplines led to differences in data collection, analysis and reportage. Particularly regarding the socio-economic research, the differences in approach between Anglo-Saxon and French-oriented social scientists were remarkable.

The second problem De Mas identified was related to scale. Depending on the disciplinary background, scholars tended to use different levels of analysis and time periods as the basis for their research. The third main problem in REDRA was formed by differences in research strategies and methodologies, constituting huge dividing walls between the disciplines. These two problems also played a role in IMAROM. Differences in scientific approach and data collection methodologies seemed linked to the diverging academic backgrounds of researchers. This may also explain why they could often interpret the same research protocol (i.e., the same text), in different ways.

De Mas (1992:275) stated that "individual investigators of disciplines are reluctant to readjust their own methodology and perspective... moreover, they have a preference for research themes which are current in their own discipline." Subsequently, these universal problems of interdisciplinary research are very difficult to resolve.

Elaborating on what De Mas' (1992:267, 276-277) concluded for the interdisciplinary REDRA project, which we consider to be broadly in line with the experiences of the IMAROM project, we come to the following recommendations:

1. *Researchers should be committed to the project and they should be flexible in their attitudes.* This is absolutely essential, as each interdisciplinary project implies an often difficult compromise between contending disciplines and academic traditions. Moreover, methodological adaptation is always necessary in the course of a project, and researchers should be flexible enough to do so. This of course also depends on the commitment researchers feel towards the project. Partners should not only be selected on the basis of their expertise and competence, but their proven commitment and flexibility are at least as important. It therefore seems to be an advantage to know the researchers, and, preferably to have prior joint research experience with them.
2. *The project should have a strong but communicative leader.* Maintaining a certain hierarchy within the project is absolutely essential in order to synchronise research efforts. In order to maximise commitment, however, the project co-ordinator should also be communicative, and take useful proposals from other partners seriously. Within the IMAROM project, assigning 'thematic' leaders for the different sub-researchers (working packages) and countries turned out to be useful.
3. *There should be mutual agreement on the problem statement, the research questions and a data-matrix.* Without the technical annex, in which the research tasks for each partner were described in detail and a research time-table defined, the IMAROM project would never have reached its current level of synergy. Standardisation is extremely important and useful in order to synchronise research. For example, the design of common questionnaires for the socio-economic research in Tunisia and Morocco was very useful. Also, the reporting guidelines helped to streamline analysis. However, there is still room for improvement. The research protocol could have been tighter than it was. In order to reach full comparability, it seems very useful to define a data matrix beforehand, which can be a list of variables to be collected on specified research units for each research partner. This should be done at the onset of the project, and should leave no room for confusion or misinterpretation.
4. *There should be an easy flow of communication between researchers.* Constant communication is essential. Within the IMAROM project, all aspects of research improved when the researchers had close and regular face-to-face contact. Enough money should be allocated for mutual field visits, which are more useful than formal meetings. Actually working together in the field and face-to-face contacts are more effective than contacts by e-mail or telephone, which are useful for exchanging general information and documents, but not for elaborating methodologies. Researchers should visit each other in the field in a very early stage of the project in order to test, develop and define common methodologies to be subsequently applied identically at different sites.
5. *Partners should regularly report on their data collection and analysis.* The IMAROM project co-ordinator set up a schedule for interim reporting, which meant that the partners had to submit IMAROM working papers, in which they described and analyses the data they collected until that time. This worked extremely well, as it provided as basis for publishing work at an early stage and disseminating work among a larger public. Furthermore, it enabled the co-ordinator and partners to detect lacunas and to monitor the research progress in general. Finally, the working papers formed an excellent basis for editing the final report in time.

