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in the oases of Morocco and Tunisia**

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Summary

Oases in the Maghreb have been fundamentally transformed over the the past century following their gradual integration into both the state's political structure and the capitalist market economy. International migration in particular, it seems, has increased the income of many oasis households, decreasing their dependence on agriculture and enabling a greater diversity of economic activities. Such changes have, of course, led to important transformations in the agricultural realm, although there is widespread controversy over the nature of these changes and the role of migration in them. Some authors, for example, claim that migration has contributed positively to agricultural development. Most, however, see it as responsible for the demise of oasis agriculture. The IMAROM research project (1998-2001) - whose main findings are presented in this paper - was able to explore these issues through multidisciplinary fieldwork in Moroccan (Todgha valley) and Tunisian (Mareth, Fatnassa) oases.

It is concluded, in contrast to the prevalent pessimistic views, that oasis agriculture in the Maghreb is not in fact declining but undergoing a spatially differentiated transformation. Several oases are indeed suffering from the phasing-out of traditional irrigation systems, but the majority are more intensively cultivated than half a century ago, and the total irrigated surface has been extended significantly. However, this has put increasing stress on water resources and may threaten the long-term viability of oasis agriculture. Migration, it was also concluded, has generally contributed to agricultural transformation in a positive way as international migrant households often show a relatively high willingness to invest in agriculture. Nevertheless, the development potential of migration has not yet been fully realised due to a number of social, economic, legal, institutional, and infrastructural obstacles.

Author

Hein de Haas is a researcher at the Centre for International Development Issues Nijmegen (cidin), University of Nijmegen (The Netherlands). He studied human geography at the University of Amsterdam and has been involved in research on migration and development in Morocco and Tunisia since 1993. Between 1998 and 2001, the author coordinated the IMAROM (Interaction between Migration, Land and Water Management and Resource Exploitation in the Oases of the Maghreb) project on behalf of the agids research institute, University of Amsterdam. In recent years he has conducted extensive fieldwork in Morocco.

1. Introduction

Oasis agriculture in the Maghreb¹ has witnessed some important transformations in the past decades which cannot be understood in isolation to the fundamental socio-economic and political changes that have occurred throughout the 20th century. The political integration of oases into the structure of modern nation-states and national and international capitalist-economic contexts - as well as the concomitant demise of traditional economic and socio-ethnic relations - have provoked a reorientation of peasant households. Previously, there was an almost complete dependence on subsistence agriculture but today there is a greater diversification of activities in which non-agricultural cash income plays an increasing role. International migration in particular, it seems, has increased the income of most oasis households, in turn decreasing dependence on agriculture and enabling the growing diversification of economic activities of oasis households.

Although it seems societal changes have triggered agricultural transformations, the very nature of these transformations as well as their underlying causes and consequences are unclear and widely contested. Oasis agriculture receives little attention in literature on agriculture in the Maghreb. Most existing studies on oases in the Maghreb are monodisciplinary and purely descriptive, and seem to operate in a theoretical void. With the exception of some studies (in particular Bencherifa & Popp 1990, Bencherifa 1991; 1993), they tend to focus on one particular aspect of oasis systems, and fail to comprehend the complex relationships and feedback mechanisms between the various transformations in the cultural, social, economic, and agricultural domains.

This paper presents the main findings of the IMAROM project (Interaction between Migration, Land and Water Management and Resource Exploitation in the Oases of the Maghreb) which was conducted over a three-year period from 1 March 1998 to 1 March 2001.² The IMAROM project was initiated and co-ordinated by the University of Amsterdam (the Netherlands). In addition to the University of Amsterdam, four other research institutions in

¹ Morocco, Algeria, and Tunisia. Field research was only carried out in Tunisia and Morocco. Nevertheless, studies on Algerian oases have been included in the literature analysis.

² The IMAROM project was funded by the INCO-DC programme of DGXII of the European Commission (IC18-CT97-0134). The complete scientific findings of the project have been compiled in: De Haas, Hein (ed.) (2001) *Migration*,

Spain, Tunisia, and Morocco participated in the project.³ Together, the IMAROM project partners comprised a multidisciplinary research consortium, providing input from the social as well as the natural sciences.

The IMAROM project tried to fill at least some of the gaps in knowledge concerning transforming oasis systems in the Maghreb. It focused on the impact of migration and the concomitant socio-economic and political changes on agriculture and natural resource exploitation. IMAROM also aimed to increase understanding of the high degree of spatial differentiation. Finally, IMAROM aimed to assess the ecological consequences of current changes in land and water management of oases.

The research consisted of a review of the relevant subject literature and field work analysing socio-economic, agricultural, and environmental developments in a number of oases located in southern Morocco and Tunisia. Eleven research sites were selected, showing a high degree of variation in bio-physical and socio-economic conditions. In Morocco, eight small 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 (see map).

Within each oasis, a household survey was conducted. The survey was set up so that migrant households (differentiating between international, internal and returned migrants) as well as non-migrant households were included - the latter serving as a control group to assess migration impacts. Semi-structured interviews were conducted with peasants on land and water management on the agricultural plot. An evaluation of the bio-physical environment of research oases was implemented to assess the quality and quantity of land and water resources available and to detect possible signs of degradation. At the oasis level the (collective) agro-hydrological systems were studied, including the functioning of village institutions responsible for land and water management.

In the following paragraphs, we will present the main findings of the IMAROM project.

agricultural transformations and natural resource exploitation in the oases of Morocco and Tunisia. Final scientific report IMAROM research project. Amsterdam: University of Amsterdam.

³ In Morocco, participating institutions included the Université Mohammed V (Rabat) and the Université Mohammed I (Oujda); in Tunisia the Institut des Régions Arides (Médenine); and in Spain the Estación Experimental de Zonas Aridas (CSIC, Almería). In its final stage, the project received support of the CIDIN of the University of Nijmegen (the Netherlands).

First, we will offer an overview of existing views in the literature on migration and agricultural transformations in the Maghreb's oases. Subsequently, the main conclusions of the IMAROM research will be presented (for a full account, see De Haas 2001). We should, of course, be careful to generalise on the basis of research conducted in only eleven oases. The main aims of this study are, however, to identify the nature of the main agricultural transformations currently occurring in the Maghreb's oases, to discuss the way and extent to which they are related and triggered by migration, and to identify the principal contextual factors explaining the spatial heterogeneity of agricultural transformations.

Map: IMAROM research sites

2. Oasis agriculture in a changing political-economic context

2.1. Typology of traditional oases

In the arid zones of the Maghreb population settlements and agriculture have traditionally been concentrated in areas where water availability is relatively reliable. Over many centuries, inhabitants of these regions developed sophisticated techniques to capture surface water or to extract groundwater, and to exploit these water resources for irrigated agriculture. In this way oases – defined as agricultural areas in arid environments where agriculture is normally not possible without irrigation – emerged. Oases were important agricultural production centres in generally unproductive environments. They were also trading centres linking distant regions and had a crucial military and political importance. Depending on the specific natural environment in which they are located, the water sources they use, and the irrigation techniques employed, several traditional oasis types can be distinguished. Although many different typologies exist in the literature, a general typology based on water sources seems most appropriate. We have distinguished the following three traditional oasis types: river, groundwater and spring oases.

Most large-scale *river oases* are located along perennial or semi-perennial rivers, whose surface water resources are directly tapped for irrigation in fields that are normally located on their fertile sediments, either on the banks of the rivers, or on alluvial plains or deltas. In agricultural terms, such river oasis systems are relatively prosperous, thanks to a usually guaranteed flow of water and regularly occurring floods which bring down fine sediments to the fields, thereby maintaining soil fertility. River oases in the Maghreb are small compared to the huge oasis systems of the Nile and Mesopotamia. They are most prevalent in Morocco and Algeria at the southern and eastern foot of the relatively humid Atlas mountains where several small and medium sized rivers drain into the desert. These Saharan fringes suffer less from aridity due to the rainwater they receive from the mountains (Kassah 1998:95).

The most famous of these river oases are the Drâa and Tafilalt-Ziz basins in Morocco, but some smaller-scale river oasis systems exist, such as the Dadès and the Todgha basin. Typical for river oasis systems is the existence of a large number of different oasis villages, located on the banks of the river and following it like a green ribbon through the desert land. Traditionally, irrigation there takes place through several small-scale dams which channel surface river water

into complex irrigation systems consisting of a hierarchy of primary, secondary, and tertiary irrigation channels, which in turn lead water to the fields by gravity alone. The only type of irrigation practised in traditional oases is flood basin irrigation where the plots are entirely submerged.

Apart from river oases, numerous relatively small-scale *groundwater oases* exist throughout the Maghreb, located in areas where groundwater is close enough to the surface to be tapped. These types of oases are generally insular. Groundwater is extracted via intricate techniques, either by using animal traction (e.g. the *nouria*), or by using techniques tapping underground water sources by digging underground tunnels (a technique known by different terms: *khetaras*, *qanats* or *foggaras*).⁴ The social and labour costs of tapping this groundwater are generally very high (Clouet & Dollé 1998:86), and demand a high degree of organisation at community level. In certain oases, however, especially in Algeria, groundwater is so close to the surface that cultivation of date palms is possible without any irrigation. Since the water resources of these isolated oases are generally less abundant and reliable than those of large-scale river oasis systems, agriculture is often less intensive and more sensitive to changes in water tables induced by drought or pumping.

Spring oases, the third oasis type, are located in immediate proximity to small, local springs. Such springs have generally very limited flows which tend to be highly variable and sometimes only flow during part of the year, they are also sensitive to drought and most of these oases are of the insular type. The difference compared to the second type of oasis is that no elaborate techniques are required to tap water here and these spring oases are less labour intensive than the second type. Many Tunisian oases, such as those of Jérid, Nafzaoua, Gafsa, and Gabes can be classified as spring oases (Kassah 1998: 96), but they can be found in other parts of the Maghreb as well, such as in the Moroccan Bani-region (De Haas 1998).

Although the general classification distinguishing river, groundwater, and spring oases seems valid, it should be stressed that these are 'ideal' types, and that a combination of different water-gaining techniques is often found. For example, several oases located in the relatively

⁴ A *khattara* is an ancient water extraction technique originating from present-day Iran, but which has spread over the entire Middle East and North Africa. A *khattara* consists of a number of wells linked by an underground tunnel. This tunnel conducts the water originating from an underground source further downstream. Since the slope of the tunnel is always smaller than that of the terrain above, the tunnel comes to the surface after several kilometres' distance,

water-scarce downstream parts of river basins compensate for water shortages by employing additional techniques to extract groundwater, such as *khettaras*. Most oases are located in alluvial plains or river valleys and occasional floods are an important additional source of irrigation water. As will be discussed in subsequent paragraphs, motor pumps have become an important new alternative technique to overcome problems related to water scarcity in virtually all oases of the Maghreb. This has been fundamentally changing the technological base of oasis agriculture in the course of the last century.

2.2. Main characteristics of traditional oasis agriculture

Despite the large variety of oasis types most traditional oases have a number of characteristics in common. The maintenance of intricate irrigation systems has traditionally demanded high labour inputs while the scarceness of natural resources, high population pressure, and the need for diversification and risk-spreading has also often meant the cultivation of two or even three vegetation layers. The upper layer is generally that of the date palm - itself the very symbol and pillar of oasis agriculture. The second layer consists of smaller fruit trees bearing figs, almonds, olives, and pomegranates. The third and lowest layer consists of annual crops such as cereals (barley, wheat, sorghum), alfalfa (the main fodder crop) and diverse vegetables. As a result of patterns of land-tenure inheritance and high population densities, plots tend to be very small.

In reality - depending on natural resource availability, the techniques employed and climatic conditions - a high diversity of oasis production systems in fact exist. The above-mentioned 'ideal' type of triple-layered oasis agriculture is generally found only in oases with relatively abundant and reliable water resources, typically in river oases with relatively stable water resources (Larbi 1989: 18). In ecologically more marginal spring or groundwater oases, extraction techniques, where water supply is limited and less reliable, or where land degradation occurs, the second layer of fruit trees and sometimes also the third layer of annual crops is completely absent. Oases located at high altitudes are a special case as the cold conditions mean date palms - which require a hot desert climate - do not thrive. Particularly in Morocco, oases like those located in the upper Dadès valley consist only of fruit trees and a layer of annual crops

after which it serves the purposes of irrigation and domestic use.

(Aït Hamza 1995, Rijbroek 1997).

Traditional oasis systems are dependent on a symbiosis between animal husbandry and tillage. Animal husbandry is one of the principal elements of traditional oasis agriculture which is highly dependent on the utilisation of manure for the maintenance of soil fertility (cf. Tisserand 1990:237). In ‘exchange,’ the oasis system produces fodder to feed the animals. In addition to maintaining soil fertility, animals also play an important role in transport, water extraction and ploughing.

In the past there was a strong economic and political interdependency between the sedentary oasis population and nomadic desert inhabitants. The latter often extorted protection agreements from sedentary populations, forcing them to pay tribute in exchange for defending them from other nomadic groups. Nomads and semi-nomads also exchanged products with sedentary oasis inhabitants, thereby complementing their respective livelihoods. In contrast to what is commonly believed, however, the distinction between nomadic and sedentary life was not always very sharp (De Haas & El Ghanjou 2000). In many oases, inhabitants were also active in nomadic activities for at least part of the year. Indeed, throughout the history of the Maghreb nomadic groups have settled in existent oases or created new ones, becoming partly or entirely sedentary in the process (Ensel 1999, Hart 1981).

Oases are further characterised by a generally high degree of ‘collectivity’ of land and water management. The maintenance of irrigation systems and agriculture itself is highly labour intensive and dependent on the availability of cheap labour. A strong ethnic hierarchy was fundamental to the functioning of traditional oasis systems (cf. Beaumont 1989:126) whereby cheap labour was generally provided by slaves, serfs or sharecroppers from ethnically inferior groups such as the *‘abid* or *haratin* (cf. Ensel 1999) It seems, therefore, no coincidence that oasis societies have been typically marked by sharp divisions and hierarchical relations between different ethnic groups. A high level of collective organisation at community level⁵ was also required to guarantee adequate distribution of irrigation water among several individuals, villages and tribal groups usually living together in the same oasis, as well as the maintenance of the irrigation system. The latter often requires collective action to which the entire oasis community was obliged to participate (Ouhajjou 1996).

⁵ Normally, this was the traditional village (or tribal) ‘council’, or *jemâa* in Arabic.

2.3. Changing political-economic and migratory context of the 20th century

Oases are anthropogenic agricultural systems par excellence. Consequently, oasis agriculture cannot be seen in isolation to the social, economic, and political contexts that have shaped these intensive agricultural production environments. The late 19th and 20th centuries brought many fundamental changes to oasis societies in the Maghreb. Beginning with the French colonial expansion (Algeria in 1830, Tunisia in 1883, Morocco in 1912), these regions were gradually integrated into a modern, central state as well as the national and international market economy. These developments also coincided with the creation of modern infrastructure linking oases with the new colonial capitals. Simultaneously, traditional caravan trade along routes linking oases with distant regions across the Sahara witnessed a rapid decline. The demise of nomadism led to the subsequent sedentarisation of most nomads in or at the fringes of oases.

These processes, which have continued in the post-colonial era, created important income earning opportunities outside agriculture for oasis peasants, sharecroppers and slaves, especially through migration towards large towns and foreign countries. This was to fundamentally change the entire economic fabric of oasis society, thereby triggering transformation in the local social, political and agricultural realms. In the past century, rural areas in the Maghreb have witnessed a mass emigration of their people to urban centres within their own countries as well as to Europe and the Arab oil countries. Recent studies also suggest that migration is generally strongest in the regions that are relatively disadvantaged in terms of ecological conditions, such as aridity (Bencherifa 1991:125-6, Michalak 1997).

Migration from these marginal regions to urban centres started almost immediately after colonisation, and has persisted ever since (Bellakhdar 1990:167; Heinemeijer 1960:95). This is particularly the case for oases where the high demographic growth, the limited means of subsistence and the rigid ethnic hierarchies all seem to have further propelled migration. International migration started in colonial times but has gained full momentum since the 1960s. with France being the primary destination for people of almost all oases. Countries such as the Netherlands and Belgium (for Moroccans) have also been important destinations while Spain and Italy have grown in relative importance since the 1980s.

Within the whole complex of socio-economic and political transformations, migration is

prominent not only because of its magnitude, but also because of its profound impact on the daily life of most oasis families and on social relations within oasis society. Its impact is deeply felt in the social, cultural, economic and agricultural domains. It is particularly through the experience of migration that abstract processes of ‘integration in the modern state and market economy’ or ‘globalisation’ are concretely manifested for oasis inhabitants. Migration and the growing importance of local non-agricultural labour markets have created increasing opportunities to gain a higher income outside agriculture. In most countries of the Middle East and North Africa it seems migration has offered “a clear avenue of upward mobility for those able to migrate” (Richards & Waterbury 1990:396). In oases, this has resulted in the (partial) socio-economic emancipation of the formerly inferior groups and contributed to the partial breakdown or even reversal of the traditional ethnic hierarchies (Bellakhdar et al 1992:169, Büchner 1990:27) and, hence, the traditional institutions regulating land and water management (De Haas 1998, Otte 2000).

The (post) colonial era also coincided with the intrusion of the modern state and its institutions which now play an increasingly important role in oasis agriculture. In both Algeria and Morocco, the state has constructed large-scale dams in the upstream parts of some of the larger oasis river basins, aiming to regulate water flows, prevent flood damage and stock water for irrigation during dry periods. In Morocco, two large dams were constructed in 1971 on the Ziz River, and in 1972 on the Drâa River. In the Algerian Sahara, one dam was constructed on the Guir River in 1965, and another in Foum El Kherza on the Aurès (Kassah 1998:97-98). Several other smaller dams exist in all of the Maghreb’s other countries. The success of such dams seems only partial as sediment accumulation has often reduced their capacity and there seem to be increased problems of soil salinisation. Moreover, the absence of regular floods has had a negative effect on soil fertility.

In Tunisia, the state has pursued a specific policy to rehabilitate the oases that were suffering from water shortages by establishing central drillings, modernising and increasing efficiency of irrigation and drainage systems, reorganising the ancient oases and promoting the cultivation of crops (in particular dates) for the export market. In particular the Algerian and Tunisian states have actively promoted the creation of new agricultural areas outside the traditional oases (Kassah 1998). Despite these efforts, some smaller oases, especially in Morocco, remain largely untouched by the state.

3. The differentiated impact of migration on oasis systems

3.1. The dominant pessimistic scenario

The literature on migration and agricultural development in the Mediterranean - and in the Maghreb in particular - seems almost unanimous in its conclusion that migration has provoked the stagnation or even decline of agriculture and the local economy in ecologically 'marginal' places such as oases and mountain areas. The argument is generally as follows: As migrant remittances and other external, non-agricultural sources of income have become the most important revenue source for oasis households, agriculture has become a supplementary source of income and of secondary interest. The lack of economic interest and agricultural labourers (who have migrated), has meant land cultivation is now less intensive, and some fields are even being abandoned, heralding the general decline of oases. Moreover, traditional agriculture has often become the subject of strong aversion, particularly among the rural youth.

Migrant remittances, the argument continues, are mainly used for the construction of opulent houses, the purchase of 'unnecessary' luxury goods and other investments evaluated as 'non-productive'. So-called productive investments in, for example, agriculture or industry, are very limited. In many instances, migrant households are even withdrawing from productive activities, in or outside agriculture. In the case where traditionally intensive oasis agriculture persists or investments occur, it mainly concerns an 'economically non-viable' form, often described as 'ritual' (De Mas 1990) or 'sentimental' (Bencherifa 1991). Moreover, the high consumption levels of international migrants in particular is leading to local price inflation, rendering the life of non-migrants more expensive. Therefore, the expected positive impact of migration on development in the regions of departure is modest. In fact, more often migration is negatively contributing to the 'development of underdevelopment' (cf. Heinemeijer et al. 1977, Kagermeier 1997, Lebon 1984, Lazaar 1987, for other Mediterranean countries see for example Almeida 1973, Heckmann 1985, Rhoades 1978, 1979).

The breakdown of extended families, the erosion of the traditional ethnic hierarchies and the concomitant disintegration of the power of traditional village institutions (such as the so-called *jemâa*) responsible for the maintenance of the hydrological infrastructure, and migration-

induced labour shortages are undermining the enforcement of common law and the willingness to carry out collective water and soil conservation measures (Charoy & Torrent 1990: 229; De Haas 1998; De Mas & Kruithof 1992: 122; Aït Hamza 1999, Kerbout 1990). The general neglect and deterioration of land and water management is also leading to the breakdown of the agricultural infrastructure, particularly vital irrigation systems. This means land degradation and desertification, further decreasing agricultural productivity and leading to an ‘unhealthy’ dependence on external revenues.

This view also corresponds with the ‘pessimistic’ theories which used to dominate much of the broader scientific debate on migration-development linkages in the past decades.⁶ These tended to interpret migration as one aspect of capitalist penetration which is ruining stable peasant societies, undermining their economies, and uprooting their populations. Migration is put in a strongly negative light as an expression of increasing dependency on global political-economic systems dominated by the Western powers. Migration is a consequence of capitalist penetration that undermines the local economy by depriving communities of their most valuable commodity – their labour force, further increasing dependence on the outside world. In a process known as ‘cumulative causation’ (Myrdal 1957) “international migration tends to sustain itself in ways that make additional movement progressively more likely” (Massey et al. 1998:45). In this way, the vicious circle continues, with migration creating an unfavourable situation in the sending areas, causing yet more migration.

Theories that view capitalist penetration and its concomitant phenomena such as migration not only as detrimental to the economies of underdeveloped countries but also as central to the very causes of underdevelopment – instead of paths towards development – are strongly inspired by the work of historical-structuralists such as Andre Gunder Frank (1969) and other frontrunners of the ‘dependency’ school. Another exponent of the historical-structural school of thought is the world-systems theory of Emmanuel Wallerstein (1974, 1980). These historical-structuralist views both perceive migration as a natural consequence of disruptions and dislocations that are intrinsic to the process of capitalist accumulation and the inclusion of ‘peripheral’ areas into the world system. These pessimist views were particularly influential in the 1970s and 1980s when they clearly dominated more optimistic ‘developmentalist’ views, and they still dominate much of the debate on migration and development in the Maghreb today.

⁶ For an extensive overview of the migration and development debate, see Massey et al. 1998.

3.2. Towards a non-deterministic approach concerning migration and development

A growing number of recent studies, mostly dating from the 1990s, have challenged these determinist and pessimistic views on migration and development. They have demonstrated that in several rural areas of the Maghreb, including various oases, peasants have invested considerably in the development of agriculture and other local economic activities. After a period which was characterised by relative stagnation and the crisis of traditional oasis systems during the 1960s and 1970s, there seems to have been a revival of oasis agriculture since at least the 1980s, a development that seems to have further accelerated in the 1990s.

In contrast to unilaterally pessimistic or optimistic views, it becomes more and more clear that, instead of an overall decline, a spatially differentiated agricultural transformation is taking place in which traditional forms of oasis agriculture are partly transformed into new forms. These transformations may concern cropping patterns but also pertain to technical change. Motor pumps, for example, are increasingly being introduced in addition to modern agricultural techniques such as new irrigation methods, the use of fertilisers and pesticides and the introduction of new crop varieties. In some oases, such changes are taking place rapidly but in most oases agricultural change is taking place slowly or methods have remained largely traditional.

Migrants, especially those who have moved abroad, seem to play an important and innovative role in this process. Clearly, migration has the potential to play a positive role by enabling investments through migration remittances (Aït Hamza 1987; Bencherifa & Popp 1990; Bencherifa & Refass 1994; Bisson 1990, 1991; Bou Ali 1990; Clouet & Dollé 1998; De Haas 1998, 1999; Dubost & Moguedet 1998; Ferry & Toutain 1990: 262; Nasr 1999; Popp 1999; Skouri 1990; Kassah 1998). Thus, so-called 'capitalist penetration' has apparently not uniformly resulted in further marginalisation vis-à-vis the 'core' or 'development of underdevelopment'.

The shift in the debate on migration and agricultural development in the Maghreb - from a 'pessimistic' to a more pluralist view in which various development responses are possible, and which recognises the fundamental complexity of migration-development linkages - seems at least a reflection of a paradigm shift in the general debate on the effects of migration in sending areas.

In recent years, however, more and more scholars are challenging the determinism of unilaterally pessimistic (or optimistic) views. This criticism has originated mainly from insights gained from the 'new economics of labour migration'-theory (NELM).

It was Stark (1978) who revitalised academic thinking on migration from the developing world by placing the behaviour of individual migrants in a wider societal context and by considering not the individual but the family or the *household* as the most appropriate basic decision-making unit (cf. Taylor 1999). This new approach models migration as a risk-sharing behaviour of families. Better than individuals, households seem able to diversify their resources like labour in order to minimise risks to the family income. A key insight is that people, that is, households, act not only to maximise income but also to minimise and spread risks (Stark and Levhari 1982). This approach allows for integrating factors other than individual income maximisation to influence migration decision-making. Migration is perceived as a household response to income risk - migrant remittances provide an 'income insurance' for households of origin (Lucas and Stark 1985:902).

Besides providing a relatively stable income, this new approach places the household in imperfect credit (capital) and risk (insurance) markets that prevail in most developing countries (Stark 1978, 1991; Taylor 1986, 1999; Taylor and Watt 1996). Such markets are often weakly developed and difficult to access for non-elite groups. In such a situation, migration can be a strategy to overcome various market constraints, thereby enabling households to invest in productive activities and to improve their livelihoods, facilitating the transition from familial to commercial production (Stark 1980).

Taylor et al. (1996:1) argue that "prior work has been unduly pessimistic about the prospects for development as a result of international migration, largely because it failed to take into account the complex, often indirect ways that migration and remittances influence the economic status of households and the communities that contain them". Consumption as well as investments in sectors like education and housing may, under certain circumstances, play a very positive role in economic development and should therefore be included in analyses on migration and development (Taylor 1999).

A major fault of most of the literature on migration and development is that it attempts to separate causes and effects of migration. Both, in fact, are two sides of the same coin. As Taylor (1999:63-64) argues, this is unfortunate, since the factors influencing migration decisions are also

likely to shape the development outcomes in sending areas. In fact, migration is an integral part of “that whole process of change that is implied in the term ‘development’” (Skeldon 1997:3). The process of economic, political and social change has enabled increasing mobility and migration from the oases, but it has also had a distinct impact on the development process itself.

Another crucial point is that although the impact of migration is potentially high it does not determine the nature and direction of change as such. The central assumption should be that *migration enables the withdrawal from agriculture (and other local economic activities) as well as the intensification of agriculture to varying degrees* (De Haas 1998). Migration research therefore needs a theoretical perspective in which the strongly contextual character of migration impact takes a central position. However, it should be stressed that the fundamental uniqueness of local responses should not be an excuse to be content with the assertion that each local variation is unique, nor should it be used to avoid looking for generalisations. This will certainly “lead us down the sterile path of relativism and return us to an exceptionalism that was all too common in geography in the past” (Skeldon 1997:13).

The challenge for migration researchers is to deal with this spatial diversity and to discern regularities in the complex realities of migration and development interactions. Systematic research and comparison should “help us make sense of social structures and processes that never recur in the same form, yet express common principles of causality” (Tilly 1984:146, cited in Skeldon 1997:13). Unravelling such principles determining the spatial heterogeneity of the interaction between migration and transforming oasis agriculture is the aim of the following analysis.

4. Trends of agricultural transformation

4.1. Introduction

The agricultural transformation taking place in the Maghreb’s oases is made up of several underlying trends. The co-existence of these trends may appear contradictory at first sight, but they are, in fact, part of the same general development, and may even take place simultaneously within the same oases. On the basis of the IMAROM oasis studies (and supported by a review of

the literature) we identified the following, parallel, trends: (1) persistence as well as (2) the decline of traditional oases; (3) ‘vertical’ intensification⁷, modernisation and increasing motor pumping in traditional oases; (4) ‘horizontal’ intensification through new agricultural extensions in the desert, solely based on motor pumping; and (5) changes in animal husbandry. We equally identified more (6) general changes in cropping patterns. Jointly, these different and parallel trends shape what we may call the ‘agricultural transformations’ of oasis systems. In the following paragraphs, we will first describe these trends and attempt to determine under which (environmental as well as socio-economic) circumstances certain trends prevail.

4.2. Persistence of traditional systems in water-rich oases

In several of the oases under scrutiny, traditional forms of agriculture are more or less continuing, demonstrating the high persistence of oasis systems seen in other studies too (cf. Bencherifa & Popp 1990). Traditional agriculture is particularly persistent in oases (e.g. in the upper Todgha valley) where surface waters are relatively abundant year-round and can easily be tapped. In such water-rich oases the organisational demands and labour necessary for tapping water resources are lower than in the case of the labour-intensive, underground *khattara* systems, which are, moreover, vulnerable to fluctuations in the water table. The persistence of largely traditional forms of oasis agriculture is the general pattern we see in the upstream parts of most river oases and water-rich spring oases (Bencherifa 1991, 1993; De Haas 1999), which are particularly numerous in Morocco (Ziz, Drâa, Dadès, Todgha).

In these oases, agricultural change remains mostly limited to changing cropping patterns, particularly as witnessed by the increasing importance of fodder crops, such as alfalfa, and certain fruit trees, and the decreasing importance of cereals. In most traditional oases, agricultural innovation and the mechanisation of agriculture is hampered by the high complexity of ancient and collective agricultural structures, extremely small plot sizes and the dispersion of plots. The

⁷ This paper distinguishes two types of intensification. ‘Vertical intensification’ refers to (in situ) intensification of agricultural production on arable land that is already under cultivation within the traditional oases, enabling higher yields on the same surface through higher inputs of labour and capital-related factors (e.g., water pumps, high-tech irrigation techniques, fertilizers, pesticides, insecticides, HYV seeds). ‘Horizontal intensification’ refers to the

continuity of agriculture is often guaranteed by a new agricultural division of labour in which female labour is becoming increasingly important. Since able-bodied men are often absent or have other local occupations outside agriculture, gender roles in agriculture seem to be changing.

From the IMAROM research it appeared scarcity of land resources are, in fact, a more important obstacle to agricultural development than scarcity of water resources. As many water-rich oases are located in upstream valleys, hemmed in between mountains, virtually all arable land has been already intensively exploited. Here, neither 'horizontal' nor 'vertical' intensification of agriculture is possible, making these 'mountainlocked' oases extremely uninteresting for agricultural investments. This explains why many of the people in these oases buy land in other, sometimes distant regions.

4.3. Decline of traditional systems in water-scarce oases

In the oases under scrutiny, large-scale abandonment of land is very limited. Small-scale abandon does sometimes occur under the effect of migration due to labour shortages, but is mostly a temporary phenomenon. The large-scale, long-term abandonment caused by a lack of agricultural labour - which in the literature has frequently been presumed to be a negative consequence of migration - has not been detected. Nevertheless, in some relatively water-scarce oases (such as the research sites located in the lower Todgha valley), agriculture tends to become less intensive, with some fields even abandoned. In these cases often only one vegetation layer of date palms or fruit trees is maintained and water-demanding annual crops are largely absent. This partial retreat from agriculture is generally related to a lack of water resources. Such local 'water crises' do not have a direct climatic background, but are mostly closely related to organisational problems at collective community level, which often lead to deteriorating maintenance and the general decline of the traditional agro-hydrological infrastructure, such as dams, *khettaras*, and irrigation channels.

This seems to reflect a general pattern in certain water-scarce oases of the Maghreb where limited natural water resources can only be exploited by utilising labour-intensive water extraction techniques which seem to pose an obstacle to the persistence of traditional oasis

extension of the agricultural surface through the exploitation of previously barren areas outside the traditional oases.

agriculture. This is particularly the case for traditional *khattara* systems which used to form the basis for traditional gravity irrigation in many oases, especially in Algeria and Morocco. These *khattara* systems are very labour-intensive and require a good social organisation to guarantee their maintenance. The fact that traditional social organisation has been undermined partly explains why most traditional *khattara* systems are now breaking down today (cf. Dubost & Moguedet 1998; De Haas & El Ghanjou 2000).

Collective management of the traditional agro-hydrological infrastructure by traditional village institutions in oases clearly seems in crisis throughout the Maghreb. Collective management was a precondition for the development and maintenance of complex and laborious water extraction and irrigation systems, and the allocation of land and water resources among many peasants using one single water source. Traditional oasis systems were based on the mobilisation of cheap labour which was possible through the existence of rigid socio-ethnic hierarchies. Strong communal organisation was also necessary to enforce common law, settle conflicts and defend the oasis from raiding nomads and the populations of neighbouring oases.

In the current, rapidly transforming oasis societies traditional institutions for communal land and water management are increasing obstacles to agricultural development. Whereas oasis society has changed fundamentally in all its domains, the agro-hydrological infrastructure as well the traditional village institutions responsible for land and water management in several oases are largely based on the historical characteristics of oasis society. Moreover, the high complexity of land tenure and irrigation systems and small plot sites constitute a major obstacle for agricultural development. The increasing importance of non-agricultural sources of (cash) income, the integration into the market economy, the decline of the feudal socio-ethnic relations and rising individualism have all at least partly eroded communal land and water management.

The incongruity between the 'inherited' physical structures and institutions on the one hand, and the fundamentally altered social and economic structures on the other is important when trying to explain the crisis of traditional water extraction and irrigation systems, especially if the latter are labour-intensive. The ancient institutions are increasingly losing the effective power to enforce common law, and, for instance, to punish 'free riding' peasants who refuse to contribute to the collective maintenance of the irrigation systems. This often leads to the partial or total breakdown of those systems which in turn often drastically reduces water availability for agriculture through traditional sources. Due to the desiccation of traditional, collectively managed

water sources, poorer peasants lacking the capital to invest in individual, motorised pumping are being forced to partially or entirely withdraw from agriculture.

In several water-scarce oases, poor households tend to reduce cultivation if possibilities for replacing traditional water extraction by mechanised water pumping are seriously limited. Such limitations do occur if water tables are too deep to be exploited by individual peasants or if the groundwater is too saline. This trend towards decline and abandonment has been witnessed in a small number of oases in the lower Todgha valley in Morocco where traditional *khettaras* have collapsed, water resources are scarce, and the populations weakly involved in international migration and are, therefore, poor. More generally, such decline seems common in many relatively marginal oases in the Maghreb. However, in the Tunisian research oases, where traditional land and water management has almost entirely disappeared, such developments seem less frequent since the state has often intervened through the creation of central water pumps to guarantee water provision.

4.4. 'Vertical' intensification and the shift towards pumping in water-scarce oases

Many oases are witnessing a shift from traditional water extraction techniques towards mechanised water pumping. This shift has generally been propelled by the decline of the collectively managed agro-hydrological infrastructure, the increasing demand for water needed for agricultural intensification and the growing individualisation of the agricultural enterprise in general. The boom in mechanised water pumping is a development not only in all water-scarce oases under scrutiny, but in the Maghreb's oases in general.

In the Moroccan oases studied, this shift is entirely the result of investments by individual peasants. In the general absence of (successful) state intervention, the change towards motor pumping can only be made if peasants have sufficient financial means.⁸ This explains why we are mainly seeing this shift in those oases with many (international) migrants. In many cases, however, peasants use a combination of traditional and modern water sources. In some of these

⁸ It should be mentioned, however, that the Moroccan state is more actively intervening in the water management of the larger oasis areas, notably the Drâa and Tafilalt, mainly by constructing large dams. Nevertheless, its general level of involvement in oasis agriculture is lower as compared to the Tunisian state

oases, traditional *khettaras* are still functioning but their flow has often declined. In traditionally water-scarce oases, mechanised tapping of underground water resources allows peasants to ‘vertically’ intensify their agriculture. Thanks to motor pumping, peasants are able to cultivate all their fields and annual crops throughout the year on at least part of their plots, instead of only in the cool winter season as was traditionally the case in water-scarce oases. The increasing use of fertilisers and pesticides is another indication of such ‘vertical’ intensification of agriculture.

The rise of motorpumping seems to further undermine the willingness to participate in the maintenance of the traditional agro-hydrological infrastructure and to obey the common law. This can lead to the desiccation of the *khettaras* and natural sources on which the traditional systems rely. There is, therefore, a vicious circle which is eroding the willingness to maintain these traditional systems and increasing the momentum towards motor pumping. However, the decline of traditional systems is certainly not inevitable. In the Moroccan Todgha valley, for instance, some *khettaras* have been successfully preserved by relatively simple technical interventions.

In all the Tunisian oases under study (Mareth I and II, Fatnassa) and in one Moroccan oasis of the lower Todgha (Aït El Meskine) traditional water extraction methods have been totally replaced by mechanised motor pumping. The poorest households in the water-scarce oases of the lower Todgha - where many *khettaras* are breaking down and water tables are falling through pumping - are increasingly being forced to withdraw partially or entirely from agriculture as a result of such capital-related water access problems. In contrast to Morocco, the Tunisian state has established collective village pumps and created modern water users’ associations, aimed at replacing the ‘obsolete’ traditional village council (*jemâa*). Despite many organisational problems, this development has at least guaranteed water provision to poorer households not able to make investments themselves. Nevertheless, the water provided by the central drillings in Tunisia is generally insufficient, in particular in the inland oases of Fatnassa. This also explains why in Tunisia many peasants have installed additional private motor pumps.

4.5. ‘Horizontal’ intensification: extensions in the desert

A final trend is the intensification and extension of oasis agriculture through the creation of new agricultural extensions in the desert, which almost entirely rely on mechanised motor pumping. It

is striking that peasants often seem to prefer to invest in new, until recently barren, areas outside the traditional oases where constraints with respect to water availability, water distribution, fragmented land property and collective regulations do not play a role (cf. Bencherifa 1991, 1993). Although this development started in colonial times, it has rapidly increased since the 1960s and 1970s, gaining full momentum in the 1980s and 1990s. New agricultural extensions can be found in all the Tunisian oases under scrutiny and in the oases of the lower Todgha where sufficient uncultivated arable land outside the traditional oases is available. Besides new extensions adjacent to the old oases, completely new agricultural zones have been developed as well, such as Mareth II in Tunisia and the Ghallil plain in the lower Todgha. As is the case for ‘vertical’ intensification, this agricultural extension movement seems a general development, taking place in many oases of the Maghreb.

The Tunisian state has actively promoted the creation of new agricultural areas outside the traditional oases. The development of agricultural extensions often coincides with the mechanisation and partial modernisation of agricultural techniques (increasing use of machines, fertilisers and pesticides), and a growing orientation towards a limited number of ‘cash crops’ such as dates or almonds, which are sometimes for export (in particular Tunisian dates), but mostly for the local markets. Oases that are in proximity to large population centres seem in particular to benefit from increasing urban demand.

Extensions only occur, however, if local geomorphologic conditions allow so – which is, for example, not the case in oases located in narrow valleys – and if sufficient water for irrigation is available. The first condition can hardly be influenced by man and is more or less absolute. The second condition can be fulfilled in two ways. First, peasants themselves can dig wells and pump water. In this case, they need sufficient capital in order to be able to invest in equipment. The second way is water tapping through the establishment of central drillings created by the state and the parallel creation of water users’ associations, responsible for the distribution of water. In this case the state carries the financial risk of the investments and the water is available at relatively low costs compared to individual pumping. This also allows poorer households, who do not have the money or cannot afford the risk to pump water individually, to get access to ‘pumped’ water.

These developments challenge the pessimistic visions on oasis agriculture and prove that many peasants are willing to invest in agriculture. Motor pumps are increasingly being

introduced as well as modern agricultural techniques, such as new irrigation methods (e.g. concrete canals, piped water, trickle irrigation), tractors, harvesters, the use of fertilisers and pesticides, and the introduction of new crop varieties. This seems to coincide with a parallel trend of increased market-oriented cropping to the detriment of subsistence farming. Although the rise of modern, pumping-based oasis agriculture has been identified throughout the Maghreb, the development seems more advanced in Tunisia and Algeria than in Morocco. This is perhaps, according to Bisson (1991), related to the latter country's lower level of economic development.

Oasis households without a substantial, stable income outside agriculture cannot normally afford to invest in digging a well and purchasing a motor pump. The costs and risks of such an enterprise are high. In Morocco it seems primarily peasants involved in international migration are able to make such investments. In Algerian oases, many oasis dwellers earn relatively high incomes as internal migrant workers in the oil industry, which, in turn, enables them to invest in agriculture and motor pumps (Bisson 1990:290). In Tunisia the general standard of living is higher than in Morocco, and more non-migrants also seem more able to invest.

Other factors might also play a role in explaining the lagging modernisation of oasis agriculture in Morocco. In Tunisia and Algeria, the state seems more active in establishing central drilling sites that tap fossil groundwater for urban and agricultural uses. This has further accelerated the decline of traditional oasis systems but increased water availability for agriculture. State-initiated central drillings for agricultural use are rare in Moroccan oases. Another possible factor is that Moroccan oases are generally endowed with far more abundant water resources than in Algeria and Tunisia (Zaimeche 1992), making such interventions less necessary, and allowing the persistence of traditional forms of agriculture in water-rich river and spring oases.

4.6. Cropping patterns and animal husbandry

The importance of animal husbandry - particularly cows - seems to be increasing for sedentary oasis populations. However, the evidence is scattered and mostly originates from research in Moroccan oases. Some studies suggest a relationship between this phenomenon and migration (Aït Hamza 1995; Bencherifa 1991; De Haas 1998). Livestock numbers, especially cows, have

significantly increased in oases and nowadays peasants are buying more and more exotic, imported cow breeds. In most cases, dairy products are destined for self-consumption, but an increasing number of peasants envisage trading their livestock and market dairy products. The development of urban centres near oasis areas seems to create growing markets for meat and dairy products.

Two underlying factors appear to act upon this development. Firstly, the presumed 'feminisation' (Bencherifa 1991, Steinmann 1993a+b, but, interestingly, questioned by Van Rooij 2000) of the agricultural work force, which, in part, is largely due to out-migration and the general reorientation of men to other activities, has probably encouraged animal husbandry. Considering the prevailing, rigid labour division, domestic livestock-breeding is an activity that can be carried out entirely by women and children. Women are also allowed to harvest the alfalfa, which serves as fodder. Second, livestock-breeding can be carried out individually, independently from the agro-hydrological structures on which traditional agriculture strongly depends (Bencherifa 1991, see further Steinman 1993a and 1993b, De Haas 1998). Most households possessing several cows cannot produce enough fodder for their own fields, and therefore purchase large quantities of fodder. Also in this domain, the importance of the market seems increasing.

These developments coincide with changing cropping patterns. In most oases the cultivation of alfalfa has gained ground at the cost of other crops. In particular, cereals now seem less important - a clear indicator that agriculture is losing its objective of self-sufficiency. Besides alfalfa, there is also a tendency to concentrate on the cultivation of dates (particularly in the Tunisian oases under scrutiny) and on almonds (in the Moroccan research oases), which are largely destined for the market.

4.7. Ecological consequences of agricultural transformations

In much of the subject literature, a (partial) withdrawal from oasis agriculture is often associated with environmental degradation. In several water-scarce, peripherally located oases with generally poor populations, peasants have tended to partially withdraw from agriculture, leading in some cases to the breakdown of traditional irrigation systems, sand encroachment, erosion and

increasing problems of soil salinity due to a lack of irrigation. However, decreasing intensity levels of oasis agriculture (e.g. increasing fallow, less maintenance, cultivation of less labour-intensive crops) can nevertheless coincide with preservation of the 'ecological potential' (Bencherifa 1993) and the IMAROM research confirmed that land degradation in such circumstances is by no means inevitable. Furthermore, total abandonment of oasis agriculture - as often supposed by the subject literature - is rather rare and mostly limited to oases where natural water resources are very scarce and populations too poor to invest in motor pumping in conjunction with a non-interfering state. It is, therefore, only in particular oases with many poor non-migrant or exclusively internal migrant households that a partial withdrawal from agriculture is common. However, even in this case, total abandonment is rare.

It is, in fact, soil salinity which seems the most immediate threat to oasis agriculture - especially in those oases where there is an intensification of agriculture and which are more water demanding. If salts are not leached out of the system, soil salinity builds up. Soil salinity is variable, and its degree depends essentially on the following factors: (a) soil management and tillage: no-tilled and poorly tilled plots present a clear surface salinity; (b) irrigation water: where irrigation water is saline there is a continuous input of salts by irrigation; and (c) drainage and the depth of the water table. Soil salinity and soil sodicity seem to be on the rise due to increasing irrigation and the lack of drainage in some oases. Pumping may, through various mechanisms, lead to the deterioration of the chemical quality of water. In combination with changed irrigation methods, lack of drainage and water-logging problems, this might cause land degradation via sodification and salinisation (Côté 1998, Fassi 1992: 52-53; Skouri 1990: 332). Shallow water tables are the main causes of salinity and to lower the water table is essential to desalinise the soil as efficient drainage reduces salt concentration. Consequently, this problem can be avoided or solved through proper land and water management.

The intensification of agriculture puts increasing stress on water resources and this may threaten the long-term sustainability of oasis agriculture. In many oases, the growing need for irrigation water may lead to an increasing scarcity of water resources and increased costs for water extraction. In general, the digging of new wells takes place in a chaotic way. It is a process which operates in a power vacuum as it not or only partly controlled by the state or the traditional village institutions. The risk of the over-exploitation of water resources is apparent and poses a potential environmental threat. In many areas throughout the Maghreb, excessive pumping of

water for agricultural and urban-industrial or touristic use has resulted in falling water tables (Zaimeche 1992:91-92, Kassah 1999, Bennadji et al. 1998, Côté 1998). It is an urgent question whether current agricultural developments are ecologically sustainable, and how future water crises can be prevented. If the anarchic boom in water pumping remains uncontrolled the increasing stress on water resources may in the end lead to a resource crisis. Government intervention, hydrological research and control on pumping, seem necessary.

4.8. Overview

The abovementioned trends seem to take place at the same time but to different degrees. The decline of traditional forms of agriculture may operate simultaneously with the rise of relatively ‘modern’ forms of agriculture, and both processes tend to reinforce each other. For example, mechanised pumping may lead to reduced water flows in *khettaras*, thereby further undermining traditional oasis agriculture already suffering from organisational problems (cf. Dubost & Moguedet 1998). Both processes, ie the decline of traditional agriculture and the rise of pumping, can operate at the same location (i.e. transformation of the ancient oases) or in different places (extensions outside the traditional oases, decline of traditional oasis). Nevertheless, a strong decline of traditional agriculture is not necessarily accompanied by the rise of new forms of agriculture. Similarly, the persistence of traditional forms of agriculture can coincide with a rise of motor pump-based agriculture in deserts surrounding the ancient oasis.

In most oases, ‘modernisation’ is a slow or only partial process. One of the first signs of such a transformation is the introduction of motor pumps - often followed by the gradual introduction of fertilisers, pesticides, new crop varieties, changing horticultural and irrigation techniques as well as cropping patterns. Cropping patterns tend to change towards increasing concentration on a small number of crops. Although these changes are taking place rather slowly and are even absent in some oases, an increasing number of peasants are producing specifically for markets. In Morocco, oasis agriculture still has a far more traditional character and tends to be less capital-intensive than in Tunisia. Several oases in Morocco, such as in the water-abundant but land-scarce upper Todgha valley, are seeing levels of agricultural exploitation stagnate in the absence of substantial investments. In the Moroccan oases, traditional ‘gravity irrigation’ (river

or *khattara* irrigation) is still important, although traditional irrigation systems are clearly on the decline, causing severe problems in water-scarce oases with poor populations. Here, we are seeing the worst problems of agricultural decline and land degradation.

In general, oasis agriculture has proved to be persistent, largely confirming the hypothesis put forward by Bencherifa and Popp (1990). It is clear that oasis agriculture in the Maghreb is not disappearing but undergoing a gradual, though highly differentiated, transformation across locales. Although several oases are suffering from serious water scarcity due to the demise of traditional irrigation system, oases are generally more intensively cultivated than half a century ago, and the total irrigated surface has been extended significantly over the same period.

5. The role of migration in agricultural transformations

5.1. The role of migration

International and internal migration has been a permanent and dominant phenomenon in most oases of the Maghreb throughout the 20th century. It seems, in particular, that international migration has had the most profound impact on oasis society. In the IMAROM research oases, 39 per cent of the households on average were involved in international migration. Nevertheless, the variation is high, with percentages on oasis level varying between 21 and 61 per cent. Such intense migration has had a profound socio-cultural impact on the research oases. The regular return of the migrant 'role models' - and exposure to their success and considerably higher wealth - have contributed to high material and social aspiration levels among the younger generations. It has also led to the development of a 'culture of migration', in which migration is identified with success and where most adolescents aspire to leave the oasis.

Indeed, migration remains the chief way to 'success' for the unemployed youth of the oases. Higher aspirations, better education, access to international media - indeed the whole process of 'opening up' seems to have led to an increased emphasis on migration and more disaffection vis-à-vis traditional agriculture among many youngsters. Migration also seems to have accelerated the erosion of ancient socio-ethnic and religious hierarchies as well as the role of old community institutions regulating village life and managing the agro-hydrological

infrastructure.

The research revealed the importance of international migration for the contemporary oasis economy. Migration remittances constitute one of the most important sources of cash income. In all research oases, international migrant households have incomes that are on average almost twice nonmigrant households (see table 1). The bulk of remittances originate from international migration, a much smaller part from internal migration. Internal migrant households do not differ significantly from nonmigrant households as far as their income is concerned.

Migration in general and international migration in particular have contributed to the economic development of the oases and urban centres in their vicinity. In addition to the usual investments in housing, many international migrants invest in coffee-houses, restaurants and hotels, as well as in the retail, handicrafts and transport sectors. Migrants' investments in the construction of new houses and other small-scale enterprises also trickle down into the local economy through the creation of local employment and income for poorer non-migrant families. Through these indirect income effects migration seems to have a certain stimulating effect on the whole village and regional economy. International migration in particular, but also other sources of non-agricultural income, have contributed to a considerable increase in mean household incomes and a general improvement in living standards.

The IMAROM research suggests that international migrant households - 'returnees' in particular - play an important role in agricultural transformations by providing the necessary revenues for investments. They seem particularly important in the first phase of the introduction of new techniques or cropping patterns as they can afford the risks and costs of such investments. In later phases such innovations tend to spread through a large part of the population, including many non-migrants. Remittances have generally enabled the purchase of the first individual motor pumps, the purchase of land, agricultural equipment, fruit trees, seeds, and fertilisers. Many non-migrants who make such investments are financially aided by family members involved in international migration.

Table 1 Mean monthly cash household income in €⁹

⁹ The following exchange rates have been used for the conversions in €: Moroccan Dirham 9.8278; Tunisian Dinar 1.2833.

Mean household income per months in Euro	International Migrants (including returned migrants)	Non-migrants and internal migrants	Total
Todgha I ¹⁰	512.0 (n=169)	238.2 (n=246)	349.7 (n=415)
Todgha II	544.3 (n=132)	248.4 (n=205)	364.3 (n=337)
Mareth 1	536.1 (n= 22)	310.0 (n= 39)	391.5 (n= 61)
Mareth 2	528.8 (n= 23)	239.8 (n= 34)	356.4 (n= 57)
Fatnassa	440.0 (n= 25)	234.0 (n= 67)	290.0 (n= 92)
Total	521.1 (n=371)	246.1 (n=591)	352.2 (n=962)

Source: IMAROM fieldwork

However, table 2 shows that there are important differences between Morocco and Tunisia in this respect. Two clear trends emerge concerning agricultural investments. First, the mean agricultural investments per households tend to be far higher in Tunisia than in Morocco. Although the data from both countries may not be perfectly comparable due to differences in research methodology implementation (investments have initially been recorded over different time periods), the differences nevertheless appear very clear. This perhaps reflects better agricultural investment conditions in Tunisia, and, possibly, higher incomes, although on this point the data seem too shaky to come to a firm conclusion.

Second, international migrant households tend to invest higher sums than nonmigrant households in all oases except Mareth, where the difference is only small. As with other income and investment variables, the differential between migrants and nonmigrants tends to be higher in Morocco than in Tunisia. In the Moroccan oases, migrants invest four to five times more (on average) than nonmigrants in agriculture. This challenges the prevalent views in migration literature which suggest that migration leads to a withdrawal of local economic activities, in particular in agriculture. On the other hand, if we compare expenses on farming equipment in Tunisia, we observe clear anomalies from the trends observed in Morocco. In Fatnassa, international migrants invest ‘only’ two times more, and in Mareth there is hardly any difference at all.

Apparently, there are less obstacles to agricultural investments for nonmigrants in

¹⁰ Todgha I are the four oasis villages studied by the University of Amsterdam; Todgha II are the four oasis villages studied by the University Mohammed V Rabat.

Tunisia. This might be because investments seem less risky than in Morocco where access to water resources is less certain and more expensive. Summarising, we can state that investments by migrants play a significant role in agricultural transformations. However, we should remain cautious about generalisations of behaviour of migrant versus nonmigrant households: investors and noninvestors can be found in both categories.

Table 2. Agricultural investments and migration (purchase land, pumps, other equipment, and plantations) in € (1994-1998)

	International Migrants (including returned migrants)	Non-migrants and internal migrants	Total
Morocco I	897 (n=163)	136 (n=243)	442 (n=406)
Morocco II	517 (n=132)	123 (n=205)	277 (n=337)
Mareth	2,413 (n=30)	2,283 (n=35)	2,343 (n=65)
Fatnassa	2,330 (n=25)	1,264 (n=58)	1,585 (n=83)
Total	986 (n=350)	391 (n=541)	625 (n=891)

Source: IMAROM fieldwork

It should be stressed that not all international migrants are investors in agriculture. Some migrants have actually retreated from agriculture, especially if they decided not to return to their home village. In such cases they generally entrust their land to (poorer) family members or sharecroppers. This explains why migration-induced abandonment of land is a limited and normally only temporary phenomenon. With the diffusion of new techniques and the advent of some nonmigratory local employment opportunities, the proportion of nonmigrant households investing in agriculture seems to have increased over the past decades. This might also explain why the investment differential between international migrants and nonmigrants is relatively small or absent in the Tunisian oases.

The installation of a motor pump, well digging and land purchase involve costs and risks that many poorer nonmigrants or internal migrant households cannot generally afford. This is especially the case in the Moroccan research oases where the state has not intervened to install central wells, forcing peasants to install private motorpumps. Through the shift to motor pumping, the management crisis which affected many traditional oasis systems has generally not

led to large-scale abandonment of land caused by water shortages. Although some particular (mostly peripheral, poor and water-scarce) oases seem in decline, in most oases migration – through the investment of remittances – has contributed to the intensification and extension of oasis agriculture during the 20th century.

5.2. Migration as dimension of general political-economic transformations

The IMAROM research demonstrated that international migration can be an important agent of economic and agricultural change. The research results confirm the hypothesis that people do not only migrate to escape from poverty, to survive, or to live in luxury, but also to accumulate sufficient capital to invest in diverse economic enterprises (Stark 1991, Taylor 1999), among which agriculture plays an important role. Migration, therefore, can indeed be seen as a household strategy to overcome the constraints of a largely absent capital and insurance market for small peasants. International migration in particular generates sufficiently high and stable incomes, allowing households to invest in agriculture and other economic sectors.

Despite its profound influence, however, it would be erroneous to depict migration as the only cause of agricultural transformations. The role of migration is much more complex and should not be considered in isolation to its wider context. The current shifts in cropping patterns and the rise of motor pumping cannot be attributed to migration alone but are closely related to general transformations in the environmental, political, economic and social realms which have created a fundamentally different environment for agricultural production. As the migration impact is mediated by such contextual factors, migration-development linkages are fundamentally complex.

In the course of the 20th century, oases have become increasingly integrated into modern state structures and the national and international market economy. This also coincided with the decline of ancient economic systems based on largely self-sufficient subsistence agriculture, the exchange between nomads and sedentary peasants, and long-distance trans-Saharan trade. The development of infrastructure and the dramatic increase in mobility has also increasingly linked oases to the rapidly developing national economic centres, mostly located in the coastal regions. Ancient trade networks - which were much more inland-oriented - and tribal relations have

crumbled, whereas the economic importance of migration and local non-agricultural activities, and the importance of the money economy in general, have increased dramatically. Besides the growing importance of non-agricultural income, the average size of agricultural plots has severely decreased due to the rapid population growth over the past century.

For most oasis households the current agricultural production is insufficient to sustain even an extremely basic livelihood. Simultaneously, social and material aspirations have increased significantly. Both the increased importance of non-agricultural sources of cash income and the decreasing size of agricultural exploitations have led to the decreased relative economic importance of agriculture. Nowadays, only a small minority of poor oasis households depends on subsistence agriculture alone. Despite the general trend towards diversification, agriculture remains one of the most important local economic activities and an important source of income in cash or in nature.

Oasis agriculture is witnessing important changes which can partially be attributed to the same general economic processes of market integration and income diversification. The increasing wealth and the growing importance of non-agricultural cash income has created a situation in which the former necessity to produce a large variety of products to satisfy the demands of own consumption, no longer exists. In other words, *subsistence agriculture has lost its former imperative of self-sufficiency*. The integration into national and international markets has led to the increasing relevance of comparative advantages for agricultural production. This pushes peasant households to cultivate those products which they find either the most convenient in terms of labour input or the most productive, as other crops can now often be bought on the market of better quality and at more competitive prices with the money earned outside agriculture.

Moreover, technical innovations, in particular mechanised pumping, have changed the conditions under which oasis agriculture is possible. As peasants are released from the obligation to be agriculturally self-sufficient, they now have a 'freer choice' to 'specialise' in certain products. Peasants seem to specialise in crops that are relatively well adapted to local production factors such as the available labour, gender roles, climatic factors, and specific soil and water characteristics. There is also a tendency to specialise on a smaller number of crops, and a growing number of peasants are partially producing for regional, national or even international markets.

6. Conclusion

The research largely confirmed the premises of the new economics of labour migration that international migration should not only be seen as a household strategy aimed at spreading and minimising income risks - it also helps overcome capital constraints on local investments. In general, migrant households tend to invest more in the local economy - agricultural and non-agricultural sectors alike - than nonmigrants. However, although this is mainly valid for international migration internal migrants seem rather similar to nonmigrants in income and expenditure patterns. It should also be noted that in one Tunisian research oasis (Mareth) international migrant households tended to invest only slightly more than nonmigrants.

The diversity of agriculture in the research oases confirmed that a broad range of local development responses to migration are possible. Furthermore, migration should not only be perceived as the cause of agricultural transformations but also as the response of peasant households to new opportunities to gain a higher income elsewhere. This has been increasingly facilitated by the development of modern infrastructure, migrant networks and increasing integration into both national and international economic and social networks. In its turn, migration might enable further changes in the societies of origin. In addition to its distinct social and cultural impact, migrant remittances play an important role enabling households to invest in the local economy. In this view, migration is not only a factor explaining change - it is an integral part of the changes itself and may enable further changes.

The research results suggest that international migrants are particularly important in the first phase of the introduction of new agricultural techniques or cropping patterns as they can most afford the risks and costs of such investments. It should be mentioned, however, that some wealthier non-migrants also form part of this group of 'early adopters'. In later phases, such 'innovations' tend to 'diffuse' over a large part of the population, including many (poorer) non-migrants. The hypothesis that the spatial impact of migration is highly differentiated seems particularly important. The extent to which the above-described transformations occur differs considerably from oasis to oasis, and ranges from almost complete abandonment to a high degree

of investments and dynamism.

Although migration remittances play a potentially important role in enabling agricultural, *migration does not determine the nature and direction of changes as such, as its impact is indirect and mediated by other factors.* This stresses the fundamental context-sensitivity of development responses to migration. Theoretically, migration enables the abandonment of agriculture as well as investments in agriculture. The extent to which migration remittances are invested in the local economy and to which specific activities such investments are allocated, depends on the specific local socio-cultural, economic, political, and geographical circumstances, which can form obstacles or, instead, incentives to investment. Variations in these contextual variables explain geographically varying transformation patterns.

By comparing diverging agricultural developments in eleven different oases in Morocco and Tunisia, we identified three principal factors explaining the spatial heterogeneity of agricultural transformations. The *economic position of individual oasis households* is the first factor of importance, as it determines their potential ability to invest in agriculture. Oasis agriculture has a modest tendency to become more capitalised. This exemplifies the important role international migration - as one of the main providers of cash income - often plays in initiating and accelerating agricultural transformations. However, it is not migration as such but income which is the principal discriminatory factor enabling agricultural investments. Several nonmigrant households which have wealth comparable to migrant households also invest in agriculture.

Sufficient income is a necessary, but not exclusive, condition for investment in agriculture. The local bio-physical environment (climate, land and water resources) can also be a (dis) incentive to agricultural investment and local climatic variations have a clear influence on the nature of specialising cropping patterns. Surprisingly, *scarcity of land resources* is generally a bigger obstacle than scarcity of water resources and can be an absolute obstacle to investment in agriculture, especially in 'mountainlocked' upstream river oases. Although scarcity of water resources is not an absolute obstacle (at least in the short term) it can lead to agricultural decline and even abandon if households are too poor to invest in pumping, or the state does not intervene to guarantee collective, cheap access to water (such as in several Tunisian oases). The quality of land and water resources are less absolute obstacles to agricultural development, provided that their quality is acceptable. Oasis systems have traditionally been able to cope with salinity and

sodicity problems, but bad management or abandonment might further increase these problems in the future.

The national political-economic context - including the role of the state - forms the third main factor determining agricultural transformations. The general level of economic development, the integration of oases into national and international markets and the development of infrastructure (which decides the relative isolation of the oases) all determine general investment conditions. Furthermore, the effectiveness of state intervention (e.g., subsidies on water saving methods; organisation of water distribution and pumping; introduction of crops; fiscal measures stimulating investments; market structure) determines the risks and profitability of agricultural investments and seems to have a clear impact on the tendency of households to invest. These conditions seem at least slightly better in Tunisian oases than in their Moroccan counterparts, which might partly explain why Tunisian peasants tend to invest more frequently.

This research demonstrated the fundamental complexity of agricultural transformation currently taking place in the oases of the Maghreb, and the equally complex connections between these transformations on the one hand and international migration on the other. The potential impact of migration on agricultural development is high, but this impact is mediated by various other contextual variables which ultimately define the investment conditions. Although migration has certainly contributed to agricultural transformations in the Maghreb, it is also clear that its potential has not yet been fully realised due to a number of social, economic, institutional, legal and infrastructural problems. Moreover, the complexity of (fragmented) land tenure and water distribution systems sometimes leads to the decline of agriculture and the wasting of valuable water resources. These problems are partly related to the decreasing effectiveness of institutions regulating land and water management. Often they are only partly, or not even at all, replaced by state institutions which then leads to a power vacuum and legal insecurity concerning land possession. Furthermore, intervention seems necessary to ensure the rapid increase in water pumping does not undermine future oasis agriculture.

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