

Social Network and Vulnerability: A Clear Link in Bedouin Society (Egypt)

Véronique Alary¹ · Samir Messad² · Ibrahim Daoud³ · Adel Aboul-Naga⁴ ·
Mona Abdelzaher Osman⁴ · Pascal Bonnet² · Jean-François Tourrand²

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Abstract In the last 60 years, the livelihoods of agro-pastoral and pastoral families in the arid and semi-arid zones in North Africa and the Middle East have undergone major changes caused by significant incentives to adopt a sedentary lifestyle and the increasing intensity of drought events. Such changes have also been influenced by land reclamation projects accompanied by the construction of reservoirs and dikes in the dry lands as well as the extension of irrigation canals in the desert in the Coastal Zone of the Western Desert, Egypt. To understand the changes in the traditional social organization of this desert society, and how these social changes have affected families' ability to adapt to external shocks such as the recent 15-year drought, we developed a typological approach to investigate the link between family livelihoods and social capital in Bedouin society. We showed a clear link between physical assets (mainly land and animals), the nature and intensity of social links within the traditional society, and level of education. The analysis revealed also some new wealth accumulation processes in link with the socio-political influence of urban zones and the increasing level of education in the zone.

Keywords Social capital · Livelihood · Typology · Bedouin · Egypt

Introduction

The Mediterranean basin is expected to become a 'hot spot' of climate change in which temperature and rainfall will be particularly affected (Christensen *et al.* 2007). In the southern Mediterranean area, many studies have attempted to understand the various coping strategies for drought, underlining the significant contribution of livestock production to reduce vulnerability, improve livelihoods, and increase food security (Glenn 1988; Alary *et al.* 2012). However, the decline in the transhumant way of life in the majority of these countries and the transformation of pastoral systems into sedentary agriculture have increased human and animal pressure on these fragile ecosystems, with significant impacts on the adaptive capacity of these new systems caused by external shocks. These transformations have also generated new social arrangements inducing a redistribution of wealth and power with inevitable effects on the entire social organization of traditional societies.

These various pressures (such as climate change, human pressure, and social change) question the capacity of traditional Bedouin society in the Coastal Zone of the Western Desert (CZWD) of Egypt to adapt to external shocks, which in turn requires more systemic approaches to account for the multitude of factors involved. Our objective was to investigate the links between the traditional tribal organization (considered as a social capital) and livelihood patterns. To address heterogeneity at the local scale, we attempted to identify typical livelihood patterns in each agro-climatic zone of our study area by using factorial and cluster analysis. As social capital is difficult to measure (Vincent 2007), we based our survey on a set

✉ Véronique Alary
veronique.alary@cirad.fr

¹ CIRAD/ICARDA, Cairo, Egypt

² CIRAD, Montpellier, France

³ Matruh Governorate, Matruh, Egypt

⁴ APRI/ARC, Dokki, Cairo, Egypt

of indicator attributes to reflect the different dimensions of social networks as a good proxy of social capital.

In the following section, we summarize the basic definition and concept of capital asset and social capital. In the third and fourth section, we describe the two study areas and the methods used. The paper concludes with a review of the different livelihood profiles and their links with social capital.

Conceptual Background

The livelihood approach, which highlights the links between assets and the options people have in practice to pursue alternative activities required for a means of living, has been the subject of increasing interest in recent times. This approach provides a dynamic way of examining the reciprocal effects of external shocks and capital assets at the household or community level and their interactive impact on the institutional environment (Chambers and Conway 1992; Ellis 2000). Assets may be described as stocks of capital or resources that can be used directly, or indirectly, to generate the means of survival of the household (Ellis 2000). However, the roles of institutions are difficult and complex to analyze (Scoones 2009). This role refers to governance that can be described as the processes of interaction and decision making among the actors involved in a collective problem; the vitality of interactions and their outputs can be approached in terms of social capital that can be determined by the study of the social network. Indeed, a social network is characterized by the structure, nature, and intensity of the ties within a community and it gives a measure of the ability to act collectively (Adger 2003; Woolcock and Narayan 2000). However, the relationships within the community and their mutual commitments result from a certain degree of trust, reciprocity, and emotional involvement (Putnam 1993). The literature has mainly focused on trust as a good proxy for reciprocal ties. In this study, the degree of trust described the perceptions of trustworthiness and trustfulness that farmers grant to tribal representatives.

The second critical factors are education and experience, as observed by many authors (Ellis and Ndoe 2003; Chambers 2006). According to Putnam (1993), education is also a factor of social participation in the sense that education can act to enlarge the social network. In our study, we consider education to be part of human capital because education is mainly accumulated at the level of the family.

As vulnerability is the product of a large number of factors at different scales, we have to deal with a complex construct that calls for an organized data-driven approach to indicators and for a system of classification of indicators to understand their relative role in the functioning of adaptation. Some authors have designed integrative indicators to quantify the underlying processes and compare relevant attributes at the household or administrative level (e.g., O'Brien *et al.* 2004;

Hahn *et al.* 2009). In the same way, Vincent (2007) developed an aggregate index of adaptive capacities to assess the ability of rural households to deal with changing water availability related to climate change. In his study, the author identified ties of kin and friendship as important determinants of adaptive capacity. Due to merging these indicators into a final index, it is not possible to analyze the specific contribution of this social component to a household's entire adaptive capacity.

Alternative approaches, such as a systemic approach based on the effects of different types of interactions among the elements of the system (in this study, family), make it possible to investigate the structure space spanned by selected vulnerability indicators (Sietz *et al.* 2012; Eakin 2005). The clustering analysis is appropriate to reveal typical patterns of attributes for the units being investigated. This approach also enables using a large number of indicators, and the non-aggregation of these indicators preserves the heterogeneity of the contribution of indicators in the study area.

Case Study

The CZWD extends over 450 km from Borg el Arab to El-Saloum. It is an arid zone with less than 150–200 mm annual rainfall. The zone can be divided into six agro-ecological strips. The first strip, which extends from the coast to 5 km inland, is the most fertile zone where orchards and vegetables are cultivated in the delta of the *wadi*. This strip is subject to the highest demographic pressure as a result of urbanization and the development of tourism. The second strip, which extends 5 km to 15 km from the coast, is characterized by an agro-pastoral system including orchards on wadi land, barley on the escarpments of the wadi, and flocks of small ruminants on the upper plateau. This zone has 100–140 mm annual rainfall and soil fertility is poor; the land has been the target of rural development projects focused on water management (e.g., dikes, reservoirs, rehabilitation of Roman cisterns). The four other strips starting 15 km from the coast up to the desert comprise arid and extremely arid zones with less than 100 mm annual rainfall where grazing and the nomadic system prevail (Bonnet *et al.* 2014). In this paper, we focused on the two strips located closest to the coast where social changes combined with climatic changes represent the biggest challenge.

With the implementation of reservoirs and dikes in the upstream part of the wadi, the study zone saw an incredible development of plantings in the wadi area (strip 2). Today, the orchards are a key component of Bedouin farming systems in these zones. However, the increasing number of orchards has created new social tensions as a result of increasing pressure on land in the parts of the wadi located further upstream. Moreover, plantings have been the first outward manifestation of private ownership by 'marking the territory'. And, the social tensions inherent to the power structure and the rules of

access to resources that are managed at the tribal level have possibly exacerbated the land inequities in this new land use.

The Bedouin society in the CZWD comprises six main tribes, all belonging to the Awlad Ali, the ancestral tribe that arrived from the Arabian Peninsula around 950 AD (Altorki and Cole 2006) and spread from eastern Libya to western Egypt in the 18th century. Figure 1 shows the geographical repartition of the six tribes (Fig. 1). Each tribe is divided into sub-tribes or lineages (around 45 lineages) comprising different families called *bayt* (meaning ‘house’). In each center (equivalent of a district), each tribe is represented by an *umda* who is in charge of the interests of the tribe at the governorate level and by the *shaykh*, the traditional representative of the tribe. This traditional social organization plays an important role particularly in land-use distribution and land-use conflicts (notably external conflicts with private speculators, the state or army), relationships with the governorate and central government, territorial leadership, and the bridal system (marriage) (Alary *et al.* 2014b). Besides, tribes can contribute to the cost of important (and expensive) social events such as funerals, accidents, and marriage, as well as to the cost of migration.

The social network also includes the managers of development projects who control access to the irrigation infrastructure (reservoirs and dikes) and extension services for the supply of seeds and animal feed. All interventions by administrative or non-governmental organizations in the zone are subject to tribal approval. Hoffet *et al.* (2012) reported on the role played by tribal organization in water management projects, determining who will benefit from such projects.

In the CZWD, two types of family can be distinguished as economically dependent units: the nuclear family and the extended family. Here, the term ‘extended family’ refers to more than two generations or siblings who share the same physical assets (land and livestock) and financial assets (credit and non-agricultural income). In these families, the heads of household

are under the authority of the family head for all economic and social decisions within and outside the family. Following the recent 15-year drought (1995–2010), some extended families have decided to separate into nuclear families with their own productive assets. The main reasons given were family tensions exacerbated by the economic crisis, the need for independence (departure of a brother or son to a town to earn his own living), or lack of assets to survive the drought. This questions the adaptive capacity of extended family faced of extreme shocks but also the capacity to survive for the new families.

Methods

Our survey was conducted along a west–east transect from Sidi Barani (approximately 100 km from El-Saloum on the Libyan border) to Borg El Arab (60 km from Alexandria). The study area includes five centers (Fig. 2). The families were selected along a north–south gradient from the coast to the desert. Despite difficulties of access, all interviews were conducted in situ.

Two main tools were used to gather the data for this study: open interviews with local leaders and key informants, and structured interviews with individual families. The aim of the open interviews was to gather qualitative data on Bedouin society, its organization, relations with Egyptian society as a whole and with the administration, and their perception of social and economic changes in the study area and beyond.

The structured interviews with families were based on a questionnaire comprising five components related to the family, the land and cropping system, the structure and management of livestock, the nature of the link and degree of trust between the family and the main representatives at the community level and their perception of changes in climate,

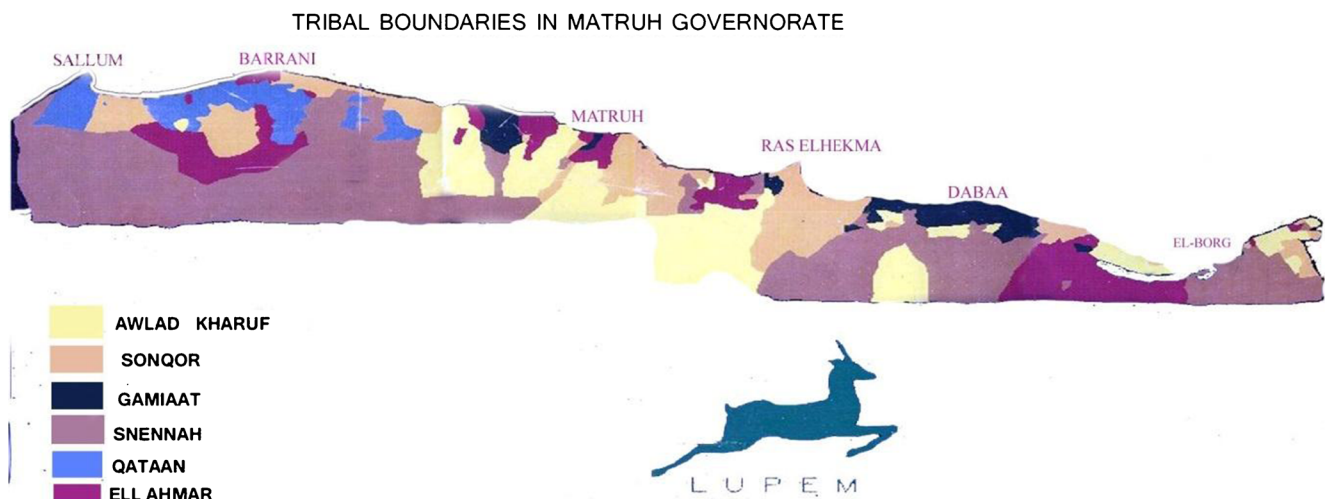


Fig. 1 Tribal land allocation in Matrouh governorate (Source: carried out by Land Use Planning and Environmental Monitoring project (LUPEM), cited by El Miniawy *et al.* 1990)

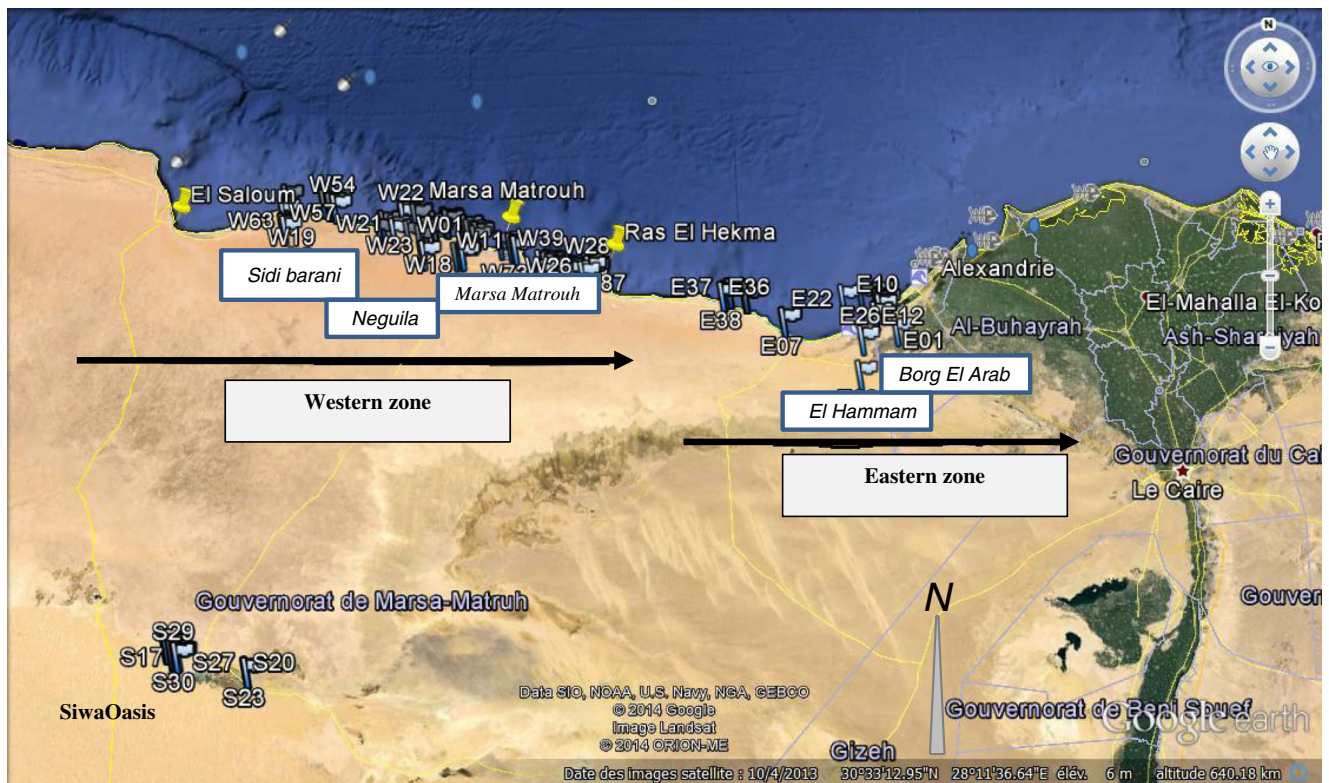


Fig. 2 Map of the 5 districts in the 2 agro-climatic zones (West and East) of the coastal zone of Western desert (Egypt) (From Google Earth 2011)

productivity and social relations. Our data refer to the 2010–2011 agricultural campaign. The collected data were checked for consistency in range and for a logical link between variables.

In the analysis, we distinguished two zones: (1) the dry rainfed zone (west zone) that extends from Ras El Hekma to Sidi Barani—the families in this zone face major climatic risks in addition to urbanization in Marsa Matrouh; (2) the zone in the new reclaimed lands (east zone) that extends from El-Hammam to Borg El Arab, where the climatic risk for agriculture is lower with regard to the canal irrigation. In our sample, 95 families were interviewed in the west zone and 31 families in the east zone.

To choose the most appropriate indicator attributes of vulnerability, we referred to both deductive and inductive approaches. First, based on a review of the literature on vulnerability, we selected the main indicators that are appropriate in the case study according to our open interviews. The indicator attributes are the physical assets such as the amount of land in ownership, livestock assets, education level, type of housing, and non-agricultural income. Second, based on open interviews with key informants, we have included indicator attributes that are particular to our local case study. All the attributes are listed in Table 1.

We assumed that tribal governance is the driving force behind the adaptive capacity to external shocks such as drought. First, we considered three main categories of

institutions: (i) the traditional tribal society, by focusing on the links with the umda and shaykh, the two representative entities in the tribe; (ii) the extension service as representative of public service in this zone, and (iii) the Matrouh Resource Management (MRMP) Project as representative of a non-governmental project up to the 2000s, to become a governmental research station. For each entity, six attributes were taken into consideration: the family's tribe, the physical distance between the institutional representatives and the head of the family, the nature of the link (ties through the family, through a relative or a friend, or no direct ties), the frequency of contact, the expected benefits of the link (expectations), and the degree of trust (no trust, weak, moderate, or strong trust). We added also the quantity of loans among close friends, relatives, or traders to account for the extension of the social network within and beyond the community.

For the analysis, in the first step, we used a method based on multiple factor analysis (MFA) similar to that described in Alary *et al.* (2014a) and restricted for our two studied zones. In the present study, our purpose was to show whether specific links exist between the family livelihood profiles in given localities and social capital, which, in turn, would explain the different types of coping strategies. For that, the second step of the analysis was classifying the families on the basis of the summaries obtained with the MFA to understand the role of social functioning at the regional level. For each family, the MFA calculated a series of scores that expressed similarities

Table 1 Attributes chosen to illustrate each type of capital assets (adapted from Alary *et al.* 2014a)

Type of assets	Key variables
Human capital	Age of the head of family; Extended family; Total number of persons in the family; Men able to work; Members of family who are shepherds; percent of off-farm jobs; Television (Yes/no); Mobile phone (Yes/no); Level of education of the head of family; percentage of educated adults (attended at least primary school); Son left home
Land capital	Rainfed area; Wadi area; Pastureland areas; Irrigated land (for eastern zone); Number of trees (Fig, Olive, Palm); Total area per household; Total cultivated area per household
Livestock capital	Total no. of ewes and does; Total head of cattle; Total head of camel; Vaccination coverage; The rate of internal parasites; The rate of external parasites; The average feed supplementation (kg/day/animal); Changes in the size of the sheep, goat and camel herd between 1995 and 2012
Housing	Roof made of concrete (Yes/no); Electricity (Yes/no); Water (1. Network, 2. Reservoir, 3. Nothing); Car (Yes/no); Refrigerator (Yes/no)
Off farm activities and income	% income from livestock in total income; % income from livestock in agricultural income; Net income per household; net income per capita; Cash income per household; % off farm income in total income; Occasional job (Yes/No); Government job (Yes/No); Number of off farm jobs in the family;
Social capital	Tribe ownership; Link with the head of the <i>bayr</i> ¹ (same family, no); Distance to Umda, Distance to Shaykh (km); Trust in Umda, Trust in Shaykh, Trust in development project (weak/strong); Relationships with Umda, Relationships with Shaykh (Family/relation; Problem, no contact); Frequency of contact with Umda; Frequency of contact with Shaykh; Frequency of contact with agricultural extension service, Frequency of contact with development project (None; Rare; Frequent); Benefits from agricultural extension service (Yes/No); Benefits from development project (1. Settlement, 2. Reservoir, 3. Well, 4. Dams, 5.); Loan from friends/relatives (Yes/No); Loan from trader (Yes/No)

and differences between families. These scores were used to construct a hierarchy of partitions based on agglomerative hierarchical classification (Manly 1994). All calculations were performed using R software (R core team 2012) and the additional package *ade4* (Thioulouse *et al.* 1997). Applied to the North West Coastal Zone, this approach resulted in four clusters per zone.

Key Finding

The Role of Social Capital in the Western Rainfed Zone

In the west zone, i.e., from Ras el Hekma to Sidi Barani, the cluster analysis distinguished four family profiles. The first profile (profile 1) corresponded to farmers with no formal education. The Snena tribe was the prominent tribe in this profile, mainly located in the south or in the second strip (5–15 km from the coast). These families had neither a concrete house nor electricity. Their social ties with the tribal representatives (umda or shaykh) or with development projects (such as the MRMP project) were very weak. The cultivated land was less than 5 *feddans* i.e., 2.5 ha (1 *feddan* is equivalent to 0.42 ha) of cultivated land of which less than 3 *feddans* were in the wadi area (< 40 trees). Their flock consisted of 25–100 ewes. Twenty-one percent of the families owned a small herd of camels (from 2 to 11 animals). These farmers depended to a great extent on rainfall and on the productivity of the rangeland that provided feed for their animals for more than 4 months per year.

Profile 4 resembled profile 1 in terms of land assets (less than 5 *feddans* of cultivated land with 3 *feddans* located in the wadi area). However, unlike profile 1, these farmers planted orchards (40–120 trees) and reduced their flock to less than 25 ewes and 10 female goats, with a minimum of animal care (only one vaccination). Half of this group belonged to the Awlad Kharuf tribe and lived in Matrouh. All families had strong and frequent contact with the shaykh because of their proximity to the town, Marsa Matrouh, which also facilitated access to loans from close relatives. However, they had received little benefit from the MRMP project.

These two profiles, characterized by low levels of physical assets (land or/and animals), have developed two different coping strategies: profile 1 continued to keep a large herd of different species (including camels) because of their mobility, and profile 4 invested in orchards in the wadi area. Faced with external shocks such as the recent drought, the farmers under profile 1 were obliged to use family members for external jobs that offered no social recognition, whereas the families of profile 4 received social support from their tribe.

Profile 2 corresponded to families with a basic level of education; in 2011, more than 20 % of the adult members of the families had a primary school certificate. These families had frequent contact with the shaykh and some contact with the MRMP project. More than 50 % lived close to Marsa Matrouh in a concrete house. They owned 5–15 *feddans* (i.e., 2–6 ha) of land and had planted more than 400 trees (olive or fig trees). They had considerably reduced the size of their flock by selling between 50 % and 70 % of their animals, as a result of the recent 15-year drought. They had

10–25 female goats, mainly for family milk consumption and between 40 and 100 sheep. In 2010–2011, their income from livestock did not exceed 20 % of the total family income. Because of their educational level, 41 % of the governmental jobs in our sample were held by members in this group.

Profile 3 corresponded to extended families with more than 25 members; in 2011, approximately 20 % of the male members had work. More than five men worked off the farm. The family heads had frequent and regular contact and strong ties with the MRMP project technicians, which explained the increased planting of orchards. These families, comprising two to three households, shared all their productive assets. Their physical assets were quite large: more than 30 feddans (i.e., more than 12 ha) of land including more than one-third in the wadi area. Their flocks were the largest with more than 100 ewes (an average of 327 sheep), around 56 goats, and more than 15 camels. As their herds grazed their own land in addition to collective land, they only needed to purchase 50 kg of feed per head per year.

So, profiles 2 and 3 can be distinguished by their orientation. Profile 2 focused on orchards in parallel with governmental jobs, whereas in response to the high demands of a large family, profile 3 continued livestock production in addition to planting orchards.

In this high climatic risk zone, three correlated external factors can explain the degree of vulnerability of farmers during the recent 15-year drought: the distance to the nearest town, education level, and access to development projects. It is clear that being located near a town together with a higher level of education made it easier for family members to find off-farm jobs, mainly in administration, which facilitated access to new social networks such as international or national development projects. Figure 3 shows that profiles 2 and 3, with the highest educational levels, received more income from non-agricultural activities, mainly governmental jobs. Profile 2 had moderate tribal ties but solid governmental and non-governmental ties and profile 3 had strong ties both within and outside its tribe. In this zone, the term ‘private job’ refers to employment in local businesses or in international legal or illegal trade, mainly with Libya. And the majority of such trade is practiced by Bedouin families (profile 3) who are integrated in traditional society.

Of the two profiles (profiles 1 and 4) characterized with fewer assets, only members within profile 1 (with its weak tribal ties) were obliged to accept occasional jobs as shepherds or agricultural laborers to survive, whereas those in profile 4 benefited from donations or social support provided by their own tribe, mainly the Awlad Kharuf tribe, which is the dominant tribe in the zone.

Except for profile 3, all the interviewed farmers reported they had reduced their flock by 60–70 % during the recent 15-year drought. They did so because they were unable to feed their animals and they needed cash for family expenses. Some

open interviews were conducted in 2012, the first good climatic year after the drought, and revealed that families had subsequently reinvested in livestock. Thus, livestock continues to be a major capital asset even after the recent drought event. Currently, the orientation taken by profiles 2 and 4 (especially with the expansion of orchards) classifies livestock activity as a non-strategic remunerative activity in normal climatic years.

Although the level of education increases opportunities outside of agriculture, it does not necessarily ensure access to well-paid jobs; it mainly favors access to permanent jobs in the public administration. Such governmental jobs can facilitate access to further resources or inputs including concentrates or seeds via the social network. The combination of education and social capital is therefore indispensable for access to resources and opportunities.

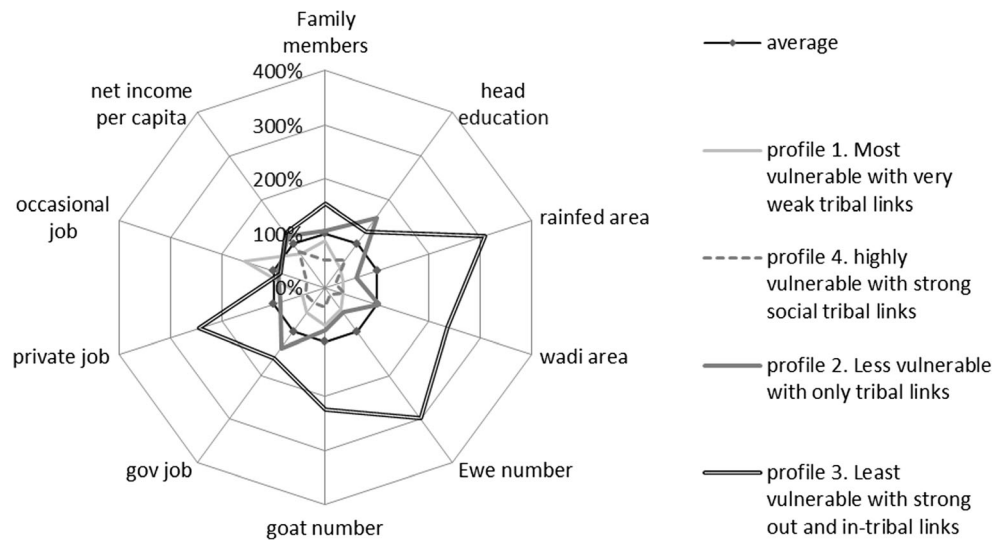
Rural Development and Traditional Social Networks in the Eastern Zone

In the eastern zone, the cluster analysis distinguished four farmer profiles. Profile 1 corresponded to the type of extended families belonging to the two main tribes of farmers surveyed in this region: Awlad Kharuf and Sengor. This group is close to Borg El Arab city. They have invested in their flocks during the last 10 years and, in 2011, the flocks contained around 190 sheep and 20 goats and provided 60–90 % of total family income. These families are Bedouin families who were ousted from their land during the land reclamation and they had to purchase their land (what they considered to be their own land) from private owners. Half of the purchased land is now irrigated.

Profile 2 corresponded to families with more than 25 members. These families maintained strong traditional social ties with the Awlad Karuf or Snena tribes in the west. They were able to diversify their agricultural activities because of the high proportion of irrigated land they owned. On average, farmers in this group cultivated 44 feddans under irrigation (i.e., 18 ha). Their herd contained an average of 310 sheep, 30 goats, and 6 cattle. They continued to practice seasonal transhumance (between 1 and 8 months). In 2011, their main source of income was crops and livestock. Off-farm jobs provided no more than 20 % of total family income. This group was mainly located in the El Hammam region.

Profile 3 corresponded to small- or medium-sized families (with less than 25 members) that relied exclusively on crops and livestock. These families (two-thirds belonged to the Sengor tribe) distanced themselves from the representatives of their tribe even though the representatives were located less than 30 km away. Except for one farmer, the average size of the flock was approximately 40–60 sheep. They have stopped keeping goats because of the shortage of land; they owned only 3 feddans (i.e., 1.3 ha), of which 1.5 feddans were

Fig. 3 Vulnerable profiles in the West from Ras el Hekma to Sidi Barani. Legend: the term ‘gov job’ refers to governmental jobs; the term ‘private job’ refers to employment in local businesses or in international legal or illegal trade, mainly with Libya; and the terms ‘occasional jobs’ refers to daily jobs in agriculture or building sector or temporary job of shepherd



irrigated in 2011. Moreover, these farmers underwent serious water shortages in 2011.

Profile 4 corresponded to families with few physical assets. They had no basic infrastructure such as electricity and could not afford to invest in a concrete house. Furthermore, their livestock had decreased in recent years because of the drought and a lack of canal water. They cultivated 2 feddans, only one of which was irrigated. Their flock comprised 20 sheep, 10 goats, and a single cow for milk. These farmers are located in the extreme western part of the newly reclaimed land and received little benefit from the irrigation canal.

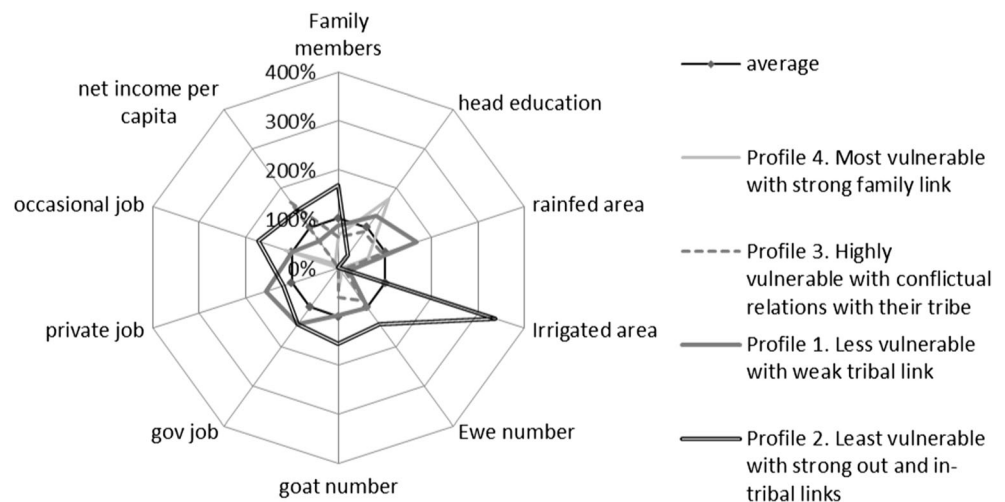
First, contrary to our expectations in this zone, where the government has introduced a canal-based irrigation system, livestock is the main factor that differentiated the farmers (see Fig. 4). This is because of the strict regulation of access to these lands, which are located beyond the social sphere of the region, and also to the land regulation policy based on the allocation of a 5-feddan plot of land per household. However, profile 2 shows that strong internal and traditional ties can facilitate the extension of land access. In this context, livestock had been the

target of considerable investment by farmers even though they had access to water from the irrigation canal. Furthermore, these farmers can practice a relatively long seasonal transhumance, which reduced the cost of feed because of the proximity of agricultural land with more available crop residues.

Second, unlike the western region, the physical proximity of the tribal representatives in this region did not guarantee a tight tribal network. Furthermore, shaykh or umda were not always members of the best-endowed families. This social configuration results from the proximity of urban zones (such as Borg el Arab or Alexandria) and new economic and political influences that can open up different opportunities through new social organizations other than the traditional tribal community.

Finally, unlike the dry western zone, diversification towards non-agricultural jobs has not occurred despite the proximity of big towns. There are several explanations for this phenomenon: the low average level of education in the Bedouin community in this zone compared with that of families originating from the Nile delta, strong competition as a result of the population density in this zone, and the

Fig. 4 Vulnerable profiles in the Eastern zone (El Hammam to Borg El-Arab). Legend: the term ‘gov job’ refers to governmental jobs; the term ‘private job’ refers to employment in local businesses or in international legal or illegal trade, mainly with Libya; and the terms ‘occasional jobs’ refers to daily jobs in agriculture or building sector or temporary job of shepherd



considerable agricultural diversification (irrigated cash crops, sheep, goat, cattle raising) that requires family labor on the farm.

The major distinguishing feature in this region has been the construction of the canal, which influenced the development of livestock activities. Unlike the Nile Delta zone where large ruminants dominate, as soon as they have access to land in this specific area at the border of the desert the Bedouin prefer to invest in sheep.

Discussion and Conclusion

In this traditional hierarchical society, we observed a clear link between physical assets (mainly land and animals), the nature and intensity of social links within the traditional society, and level of education (Table 2). Only people who have built relationships within their tribe have really benefited from the social and economic development of their zone. Thus, the profiles considered ‘the least vulnerable’ in our sample and in the two zones had the largest physical and social assets, and these two types of assets were shown to be interdependent. In the west, a higher educational level led to greater responsibility within the tribe; this facilitated access not only to physical resources but also to other social networks. Similarly, the families considered ‘the most vulnerable’ no longer had any social ties inside or outside the tribe, nor did they have the minimum educational level required to benefit from non-agricultural opportunities. As a result, when external shocks occurred, the members of those families were obliged to take occasional jobs as shepherds or as agricultural laborers in the two zones.

However, the profiles ‘less vulnerable’ and ‘highly vulnerable’ differ between the two zones. In the west, thanks to their higher levels of education, they had access to permanent mainly governmental jobs that secured their livelihood. They had also maintained good relationships within the tribe, unlike in the eastern zone where they had achieved a high level of agricultural diversification because of irrigation. The ‘highly vulnerable’ families had similar physical assets to the ‘most vulnerable’ families in the two zones. However, because of their traditional social network, those in the west can count on social support during a crisis. In contrast, those in the east relied on their livestock to help them survive periods of external shocks better than the most vulnerable.

Because of the prerogatives of the tribes in Bedouin society concerning access to resources, their links with the representatives (umda or shaykh) are a major factor in the accumulation of wealth (physical assets) and in reducing the effect of shocks (financial assets). In our sample, the least vulnerable in the west only reduced their flock by 36 % during the recent 15-year drought, compared with double this number in the other profiles. This confirms the important role of social capital in access to resources such as common grazing land.

Moreover, by controlling migration, the representatives of the tribes maintained the control of key opportunities to accumulate wealth. Only a higher level of education acted to offset a lack of ties in traditional society. The recognition of education by traditional society as a valuable indicator of social reputation is recent and starts to change the social pattern.

These results confirm that the adaptive capacities are embedded in human and social capital, leading to two main recommendations: first, the education access in all the area is a key factor to avoid reproducing the vulnerable profiles between generations, and second, policy makers need to consider traditional tribal organization as an institutional body with its own social rules and also as social security in the zone, not just as a source of competition or even conflict vis-à-vis official institutions.

The results showed also that the scission of extended families occurs mainly in families with internal social tensions. In most cases, young married people wanted more freedom and access to education for their children. This trend has been encouraged by the rapid urbanization of Marsa Matrouh in the past 15 years (Bonnet *et al.* 2014). Thus, if the nature and volume of the family’s initial endowments have exacerbated tensions because of a lack of money to cover the specific needs of youth, it is not the only factor. This scission has also meant new family arrangements between father and sons or brothers living outside the family farming system (as the investments and confiage of animals to the farm unit), that reinforce social security in different locations.

However, the choice of attributes based on social capital can be discussed. First, in our study, the answers of the family heads were possibly influenced by the presence of community members during the interviews. They were also obviously influenced by the recent events that affected the community or interviewee. A recent conflict over land left unsolved can immediately change a farmer’s perception of his traditional community. Nevertheless, the main trends of these relationships analyzed according to zone and profile confirmed the observations we made during the interviews. Second, social capital was determined via two indicators: social network (nature, distance, frequency, and reasons of contact) and the degree of trust in the different entities. Although the reasons for contact are frequently the same (the need to solve a problem, conflicts over land, a family event), frequency of contact is seen to be tightly linked to the distance and relationships (filiation or alliance). We observed that the most pertinent attributes to distinguish the profiles were, in the west, the degree of trust and the frequency of contact with tribal representatives and, in the east, the relationships and distance with the shaykh. This reveals the importance of socio-geographical factors for the understanding of the role of social capital.

In summary, our study showed that different family profiles (defined by various levels of assets and social capital) relate to different strategies to deal with external shocks (see Table 2).

Table 2 Description of each vulnerable profile according to capital asset, major sources of risks and their main responses to risks in the Coastal Zone of Western Desert (Egypt)^a

Clusters	Human asset	Land asset	Livestock asset	Non-agricultural jobs	Social asset	Monetary poverty	Major sources of risk	How do households respond?
West								
Most vulnerable (profile 1)	x	xx	xx	x	x	xx	Drought and its impact on pastureland (reduction of plants and shrubs)	Livestock mobility and animal transaction
Highly vulnerable (profile 4)	xx	xx	xx	xx	xxx	xx	Drought; Economic or political instability	Diversification in cash crops (Fig and Olive) thanks to strong internal and external family bonds Belonging to dominant tribe: Awlad Ali Ahmar
Less vulnerable (profile 2)	xxxx	xxx	xxx	xxx	xxx	xxx	Drought; Economic activity in Marsa Matrouh	Invest in education for diversification out of agriculture thanks to the proximity of the city Marsa Matrouh
Least vulnerable (profile 3)	xxx	xxxx	xxxx	xxxx	xxxx	xxx	Drought; Trading activities and business with Libya	Strong family bonds Dominant tribe in their area: Sengor and Ali Ahmar
East								
Most vulnerable (profile 4)	-	x	x	x	-	x	Land access; Irrigation system; Drought	Reduction of assets (livestock); Look for occasional jobs
Highly vulnerable (profile 3)	-	x	xx	-	x	xxxx	Land access; Irrigation system	Fewer assets to offset problem of irrigation
Less vulnerable (profile 1)	-	xx	xxx	xxx	x	xx	Land access	High agricultural diversification with development of livestock activities Permanent off farm jobs
Least vulnerable (profile 2)	x	xxxx	xxxx	xx	xxxx	xxx	Economic price	Develop integrated livestock-crop system based on land diversification

^a number of x according to the contribution measured by test value (Morineau 1984) of the theme for each farm type. The test value is a descriptive statistic which facilitates the description of the classes of a partition by an indicator and it is extended here for several groups of indicators (themes). For the case of nominal variables, the test value measures for each modality the difference of proportion in the sub-sample related to the group and the whole sample. If this difference is large, it means that the modality has an important contribution to the characterization of the group

The factorial analysis combined with cluster analysis enabled us to identify the profiles of adaptive capacities. From a methodological point of view, the main advantage of the cluster analysis based on MFA was to avoid making assumptions a priori about the main adaptive capacities represented by assets, and thus preserve the variety of roles of the different attributes for one type of asset. In this way, the identification of low or high vulnerability rested entirely on the empirical manifestation of the factor values. This study stresses the role and importance of the attributes of social capital. It would be interesting to combine this approach with the on-going developing approaches of social networks to investigate how the interacting social and technical-economic systems move towards more resilient systems when faced with external shocks.

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