Pastoral Strategies as related to Community Characteristics: The Case of the Syrian Badia

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Abstract

This paper presents an up-to-date characterization of the behavioural patterns of Bedouin communities' in the steppe of Syria, in order to enhance an understanding of how rangelands are collectively used. Analysis was conducted from a community perspective as pastoral resources are exploited collectively. Based on survey data collected from 359 households and 50 Badiah communities in spring 2005, the main strategies prevailing today were identified and explained in a second step using the agro-ecological conditions and socio-economic factors in the communities. The results show a great diversity of mobility and feeding patterns as well as interconnections with other communities. This diversity is strongly explained by the community's land potential (which decreases as we move towards the dryer zones) and population densities – both indicators defining the average amount of forage resource available for a herder in his community.

1. Introduction

In Syria, as in many countries of West Asia and North Africa, due to the increasing population and rangeland degradation the pastoral system is facing important structural changes such as the sedentarization of part of the population, the modification of flock mobility patterns with motorized transportation, or the increasing reliance of flock on concentrate feeding (Vercueil et al, 2003). The ban on cultivation in the rangelands in 1995 is a public intervention, which had a strong impact on the feeding pattern of Bedouin flocks, as cropped barley was contributing around 20% to stock feeding (MAAR). Today, very little quantitative information is available on the variety of behaviors taking place in the steppe and the degree of importance of each of them. In addition, there is need for a better understanding of the differences between the structural long-term behaviors, which strongly depend on the communities' agro-ecological conditions from the less constrained decisions.

Based on survey data collected in 2005, we analyzed pastoral production strategies according to the characteristics of the communities. Environmental factors (land potential) and socio-economic characteristics (access to infrastructures, human population density, community assets) are being introduced in a model in order to address questions such as: "Are the communities that strongly depended on cultivation before the ban on cultivation in 1995 more likely to intensify their production system?" or "How are rangeland degradation and pastoral strategies interconnected?" In fact, the causal relationship between rangeland degradation processes and the pastoral production choices is very ambiguous, as land degradation and livestock holding or mobility and feeding patterns may influence each other. Before tackling this issue, we are proposing in this paper to first consider the adaptation that occurs in the pastoral production

system according to land potential. The paper describes the methodology and underlying model, and identifies and describes the main pastoral behaviors. It also presents the factors that were hypothesized as affecting pastoral strategies and discusses the results of the model estimation in.

2. Methodology

2.1. Study site

In order to improve an understanding of the pastoral system in its complexity, the International Center for Agricultural Research in the Dry Areas (ICARDA) and the Ministry of Agriculture of Syria, conducted a multilevel survey in spring 2005 in six of the seven provinces of the Syrian Badiah[1]. The Syrian rangelands, called El Badia, are defined as land with annual average rainfall below 200 mm (see Map1 in Appendix). It comprises 55% of the total land area of Syria (10.2 Mha) and is home to 900,000 to 1.5 million people, of which about 500,000 are settled (Edwards-Jones, 2003). Traditionally, a good proportion of the population would have been nomads, but after a strong decline in their number over the past 50 years, the nomads were estimated to be 10,000 in 1990, most of the Bedouins today being transhumant herders.

2.2. Data collection

The sampling method consisted of three steps: (i) twenty five 'mother communities' were randomly selected among the 125 officially censed in the steppe (see Map1 in Appendices), (ii) two communities were then randomly selected from among the communities that make up the mother community, and (iii) a household sample was taken to be the most representative of the community under three criteria (flock size, tribal sub-group and average feed cost per ewe), which consisted of a representative sample of 313 households at the Badiah level. The multiple

[1] Aleppo, Hama, Homs, Raqqa, Deir Ezzor and Damascus.

survey instruments consisted of a participative mapping of the community rangelands to locate the main types of rangeland, a characterization of the vegetation of each rangeland type, a socio-economic survey at the community level, and a household survey to collect information on livestock production and mobility strategies.

2.3. The model

We present in this paper an up-to-date characterization of the Bedouin strategies from a community perspective. Because herders share the same main input for livestock production, which is the common forage, we are interested in knowing how communities 'behave' collectively. After identifying the main strategies prevailing in the Syrian Badiah, we estimated in a second step the determinants for adopting each of them. There are four broad types of behaviors, which can influence (everything else being equal) the level of rangeland exploitation and degradation, some of which correspond to the sum of household-level decisions and others to community-level decisions.

- Livestock holding (L). Once the individual strategies are summed up, the community livestock holding is represented by the average flock size and the percentage of community members that have flocks.
- Intensification pattern (I): either through improvement of the resource (i.e., shrubs plantation) or through dependence on hand feeding, notably with the development of lamb fattening.

- Flocks mobility pattern (M). We considered the total presence of the community's animal on site and the frequency of their presence, as the rangeland is more vulnerable to overgrazing at certain periods of the year (spring).
- Linkages with outsiders (O). Because the rangeland is officially an open access resource in Syria, communities receive welcomed and unwelcomed outsider flocks on their land.

We believe that these behaviors are determined by some community characteristics, notably land potential and population density. This will determine how much of the resources will be available to every community member (RA), as well as other factors (X) such as the transaction costs, the community assets, or the governance structure. We also expect these strategies to influence each other, such as:

$$\begin{cases} L = f(I, M, O; RA, X) \\ I = f(L, M, O; RA, X) \\ M = f(L, I, O; RA, X) \\ O = f(L, I, M; RA, X) \end{cases} \qquad (1)$$

Using a linear reduced form of this system of equation, we can re-write:

$$\begin{cases} L = \alpha_l RA + \beta_l X + u_l \\ I = \alpha_i RA + \beta_i X + u_i \\ M = \alpha_m RA + \beta_m X + u_m \\ O = \alpha_o RA + \beta_o X + u_o \end{cases} \qquad (2)$$

Because this system of equations is composed of the same explanatory variables, correlation between error terms (u) can be suspected and it will be taken into account in the choice of the

estimation model. Before estimating the model, we propose to present in the next two sections, the various behavioural patterns and their determinants.

3. Pastoral behaviors

3.1. Livestock holding

One of the first pastoral strategies to consider is livestock holding. We can expect that this will vary according to the land potential, population density and the herders' traditions. Looking at the community level, two variables capture the sum of individual strategies: the percentage of households with a flock and the average flock size. Considering all the community members (migrants included), 70% of the surveyed community households own a flock. In 10 of the 50 communities, livestock holding is 100%, whereas in 10 other communities, livestock holding is less than 50%. Putting aside one exceptional community where eight members held on average 1900 heads, the average flock size in the communities is 190 heads of productive ewes; a third of the communities own less than 100 ewes on average and another one third own more than 200 heads.

3.2. Intensification patterns

3.2.1 Feeding patterns

Feeding strategies can be described based on household and community information. At the household level, we isolated herders considered to have a more intensive production system. Intensification (defined in our case as the propensity for a flock to depend on hand feeding, mostly concentrate feeds) is a relatively continuous process, and the segregation process is not obvious. Moreover, we separated as a group herders who supplement their flocks in spring when

the rangelands are most productive (called thereafter ‘intensive herders’). We then conducted a principal component analysis, adding two more variables: the percentage of households that are fattening their lambs in the community, and the average market price for the male lambs. The results (Table 1) lead to the creation of a factor (*Ifatt*), which is associated with indicators of high fattening activities and the presence of ‘intensive herders’.

3.2.2 Rangeland improvement

Another decision that has an impact on the rangeland is the acceptance to get involved in land improvement activities either by planting fodder shrubs (*Atriplex* species are the most used in the steppe) or resting the land. These activities are undertaken with the support of projects that compensate herders according to the opportunity cost of resting the land. When this strategy is chosen by the community members, they define, in collaboration with the project experts or the steppe extension services, how many hectares to improve and the location of the plantation. In 2004, 22 of the sample communities were involved in land rehabilitation activities, improving on average 10% of their land (with a minimum of 1% and a maximum of 40%).

3.3. Mobility patterns

Before the introduction of hand feeding in the mid-20th century, the mobility pattern of the pastoralists was perfectly associated with the accessibility and availability of pastoral resources (forage and water). The generalization of hand feeding and the introduction of trucks and mobile cisterns led to a change in the pattern of mobility and availability of forage. Today, we find a continuum of situations, from the case of Bedouin households who spend the entire year in their

community in the steppe to the other extreme case of staying in the cropping zone in the whole year.

In order to characterize these various strategies, we considered a long enough period to include climatic variability between years and short enough for the information to be recalled by the interviewees. In our case, the 1999–2004 period fits these criteria, with two low rainfall years (1999 and 2000), three medium years (2001, 2002 and 2004) and a very high rainfall year (2003). We then looked at the frequency with which the herders used the site and the number of months spent both at the household and community levels.

At the household level, we could identify four types of mobility strategies (Table 2).

(i) The **opportunist** herders use the community site only in years when forage is sufficiently abundant on the community pasture. Therefore, they are the herders who depend the least on community pastures. We can expect that this category was underestimated in our sample, since the year of the survey was a poor rainfall year and most of the opportunistic herders stayed in the cropping zone.

(ii) The **regular** herders use the community rangelands every year, but only for a certain period, since they regularly move between the Badiah and the cropping zone (two 'round trips' per year on average).

(iii) The **less mobiles** are herders who graze on their community rangeland every year and spent the whole year in the community at least once in the past six years.

(iv) The **immobile** herders are the settled herders who did not move from their site, even during the dry seasons and dry years.

Because the main input of livestock production is common forage (community rangelands), we expected that household strategies would be interconnected among herders of the same community. Using information on the number of households and the period of their presence on the site for each of the past six years, we built at the community level annual indicators of presence level on the site[2]. However, we could not recover the four mobility types through these community indicators. Therefore, we aggregated household categories at the community level and found that the mobility categories were strongly correlated to mobility indicators built at the community level (last section of Table 2).

In a final stage, we conducted a principal component analysis, merging community and household variables and deriving from it three main mobility indexes (Table 3).

- M1: This first factor was strongly associated with the community level indicators and can be interpreted as an index of high presence on the site.
- M2: This factor was associated with opportunistic behaviors, where communities are composed of herders who settled outside the community land and exceptionally graze on community land in good years and/or herders who settled in the community but move outside in the dry years. These behaviors are in contrast to the one that consists of grazing on the site regularly every year.

[2] Indicators = (Σ herders on site*nb months on site)/(Σ community members*12)

- M3: The last factor can be interpreted as the propensity for a community to be composed of permanent herders who would remain on the site even during dry years.

3.4. Interactions with other communities

In the 'commons' literature (Ostrom, 1990), the protection of community borders is considered as a determining factor for the success of cooperation in the management of common resources. In Syria, communities own a traditional land, which in the official context of open access regime can be relatively difficult to protect from outsiders. Nevertheless, some communities are better in doing so either because they acquired through history a strong appropriation power or because they practice irrigated cultivation (which is authorized) or illegal cultivation on rainfed land or lately through the legal planting of shrubs. This last strategy is a response to the current property regime structure in the community and is perceived as a way to exclude outsiders from community land (Ngaido, 2001). In order to characterize the nature of the links with other communities, we relied on several variables.

1. Nature of the links. Three dummy variables were built for neighboring communities, other communities in the Badiah and communities in the cropping zone. The first one taking the value 1 if it has unilateral relations of sending animals to another community, the second taking the value 1 for unilaterally receiving animals, and the last taking the value 1 if the community has a reciprocal agreement with at least one other community.
2. Indicators of outsiders' presence. Two variables indicated the level of presence of outsiders: a dummy indicating the presence of unwelcomed flocks within the past 10

years, and an estimation of the number of flocks that crossed the community land in 2004.

3. Indicators of community capacity to protect the borders. A first variable tried to answer the question: 'Can the community restrict access to unwelcome herders?' and a second one was a self-assessment of the leader's ability to easily protect the border. When crossing for both, we found some inconsistencies, which we captured in a variable called 'overestimation'.
4. Finally, we looked at the current irrigated and illegal cultivation in-situ.

These variables, which were aggregated in a principal component analysis, led to the creation of four indexes (Table 4) that can be interpreted as follows:

- O1. Presence of outsiders associated with unilateral relations (possibly flocks coming from the cropping zone).
- O2. Community self-recognized as being able to protect borders.
- O3. 'Free riders' relationship. Community flocks are sent unilaterally to other communities with no presence of outsiders in the community land.
- O4. Reciprocal relationships associated with a strong presence of flocks.

3.5. Interactions between behaviors

As expected, pastoral decisions were strongly interlinked, as we can see from the correlation matrix in Table 5. Communities with greater flock size are also the ones with opportunistic mobility pattern. Animal mobility patterns and linkages with outside communities are strongly

interconnected. Finally, intensification strategies are associated with high livestock holding, opportunistic mobility behavior vs. immobile behavior, and with reciprocal relations rather than unilateral sender relations.

4. Characteristics of communities

This section presents the factors that were hypothesized to be influencing pastoral production choices.

4.1. Land potential and human population density

The average rainfall decreases as we move from the south to the east within the steppe. Therefore, we expect that the potential conditions for livestock production would get tougher (decrease in forage productivity), and that this would be a strong factor determining the pastoral strategies. In order to capture these overall conditions, we looked at four variables:

(i) the distance between the community and the Badiah line,[3] which delimits the steppe from the cropping zone (line presented in map 1)

(ii) the potential household density (total community households per hectare)

(iii) the community land percentage that used to be cultivated in the past, and

(iv) a soil degradation indicator.[4]

[3] The Badia line is more or less equivalent to the 200 mm isohyet.

[4] Out of the three land degradation indicators defined by Tiedeman et al (2006), (i.e., indicator of soil degradation, indicator of litter movement, indicator of invader plants), soil degradation is the only one that is strongly correlated with the three variables mentioned above and we expect that it is capturing the potential land productivity instead of the current land degradation status.

These four variables were strongly correlated; the soil degradation index increases as we move away from the cropping zone, the percentage of land that was cultivated before the ban decreases, as well as the human population density. We aggregated these conditions in a single factor called *Idens* using a principal component analysis (Table 6).

4.2. Governance

Communities are represented by a leader (70% of the cases) or a representative committee (30% of the cases). In order to assess the level of leadership they exercise, we asked them if discussing and solving conflicts within the community as well as with neighboring communities was relatively difficult to accomplish, and if they had difficulties in influencing their own people. Using a principal component analysis, these indicators were aggregated to form an index of 'weak governance' (Table 7). This index is not correlated with the type of leadership exercised, meaning that the performance of leaders and committees is the same on average.

4.3. Transaction costs and assets

It was difficult to include market price in the model as we suspected them to be strongly endogenous to the pastoral strategies and notably to the mobility strategies. The choice of market to sell the lambs (and the associated prices) is made by the Bedouins and we can see the most productive ones selling their lamb in the more distant markets. Therefore, we will only include in the model the transaction costs, defined as the distance of the community to the nearest paved road and the distance to the nearest water point. Communities are located 6 km on average from both infrastructures; however, 39% and 58% of the communities have direct access to paved road and water point, respectively.

Finally, we included in the model, the community human capital, defined as the percentage of educated adults (either through public or Koranic education). On average, 44% of household heads in the communities are educated, with a median of 34%. We also considered if some community members possessed land in the cropping zone, which was the case in 11 communities only. Such land provides an exit option to livestock production or as an extra source of forage.

5. Determinants of the pastoral strategies

To enhance an understanding of the underlying factors affecting pastoral decisions, we estimated the model presented in section 3 using two alternative specifications. The first once considered the index of land potential, and the second replaced the index with the percentage of previously cultivated land, the current population density, and the distance of the community from the 'Badia line'. Since we expected the error terms to be strongly correlated between equations, we estimated the 11 equations simultaneously using seemingly unrelated regression estimation (SURE). Since the results were very similar in the two specifications, we report in Tables 8 the results of the second specification, with the coefficient and the z-statistic of the land potential index of the first specification on the first line of the table. The results are presented in the following sections, in terms of land potential and population density impact and then considering each strategy block.

5.1. Land potential and population density

The impact of the land potential and population density variables on pastoral strategies can be divided into three.

(i) A strong impact of land potential. In five out of the 11 equations, the index of land potential has a significant coefficient. As the land potential is increasing, livestock holding decreases. This result might appear surprising; however, because this land corresponded to the more cultivated and populated ones, we can consider that they are less productive than natural rangeland and the grazing competition might be tougher. In the same way, as land potential and population increase, the annual herder presence in the community land decreases (I. presence decreases). As expected, as we move deeper in the steppe, reciprocal arrangements with other communities develop and herders in the communities are more likely to follow an opportunistic type of mobility and less likely to graze regularly on the site.

(ii) Impact of the current population density only. In four other equations, the current population density alone has an impact on pastoral strategies. With a higher population density there is a lower probability for the community to be involved in range rehabilitation activities and to be unilaterally receptive to outsiders on one hand, and a higher propensity to 'officially' protect the boundaries from outsiders and be composed of settled households on the other hand.

(iii) No impact. Finally, land potential and population density has no impact on the development of fattening activities and the propensity to send unilaterally the animals to other communities.

5.2. Livestock holding and intensification

Looking simultaneously at the other results based on the four equations related to livestock holding and intensification strategies, the more the community is connected to roads and their

members educated, the greater their livestock activities: livestock holdings are higher and herders are more involved in lamb fattening and range rehabilitation. Governance and, notably, the presence of a leader has an impact on the percentage of households with sheep and the percentage of those who are fattening their lambs. Finally, a 'weak' leadership leads to a greater probability to plant shrubs on the community land.

5.3. Mobility and linkages with other communities

Besides land potential and population density, a few other variables explain mobility strategies. Surprisingly, settlement of herders is permanent in communities that were established more recently, and governance variables have impact on the three mobility strategies.

Considering the inter-linkages with other communities, the bigger the community, the greater is its ability to receive outsiders, instead of being unilateral senders of animals. The greater the distance to strategic infrastructures (road and water), the less likely it is for the community to receive outsider flocks, since their remote location is not attractive to outsiders. Land ownership in the cropping zone favors unilateral relations (sender or welcomer). Therefore, unilateral relationship does not constitute a real 'free riding' indicator as it might happen between members of the same community. Finally, a weak leadership lead to more reciprocal arrangements and less unilateral welcomers.

This study shows clearly that great variation exists in the strategies of rangeland communities in Syria vis-à-vis the use and management of their rangeland. This diversity is strongly associated to the potential resources available for each member at the community level, which is determined

by the productivity potential of the land and the population density. This result demonstrates that because the rangelands in Syria are officially openly accessible, herders do not start from the same natural capital and, therefore, exhibit strong differences in their pastoral production system. Therefore, efforts to improve rangeland management should be carefully targeted to ensure that any new systems developed takes into account the peculiarities of the communities.

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Appendices

Table 1. Fattening strategy (descriptive statistics and principal component analysis)

	Stats	PCA
	Mean	Ifat (L2)
% 'Intensive' herders*	18.4	0.589
% Hh fattening lamb	72.1	0.822
Average male lamb price	3908	0.791

*Herders complementing their flocks in spring while the

Table 2: Mobility pattern (household and community information, 1999–2004

	Opportunist	Regular	Less mobile	Immobile
Household pattern				
Number of observations	31	75	106	41
Mobility pattern 1999–2004				
Total No. of months on site in past 6 years	25.4 *	32.2 *	51.5 *	72 *
Variance of residence length	0.51 *	0.06 *	0.28 *	0 *
No. of months on site 1999 (low year)	2.8 *	4.3 *	6.7	12 *
No. of months on site 2004 (medium year)	7.8	5.9 *	9.8 *	12 *
Total No. of moves in past 6 years	4.0 *	11.7 *	6.3	0 *
Community pattern				
Representation in community (%)	13.6	23.5	32.6	11.9
Average herders presence 1999–2004[a]	0.40 *	0.43 *	0.56 *	0.59 *
Coef. var. of herders presence 1999–2004	0.66 *	0.41	0.42	0.37
Herder presence indicator 1999	0.28 *	0.30 *	0.40	0.49 *
Herder presence indicator 2004	0.52 *	0.52 *	0.68 *	0.65

** Significantly different from all other means at the 10% probability level.*

*[a] Indicator of herders presence calculated as : (Number of households with sheep *number of months spent on the site in year Y/Total number of households susceptible to use community rangeland*12)*

Table 3. Community mobility strategies (descriptive statistics and PCA)

	Stats	Principal component analysis		
	Mean	I. Presence (M1)	Opportunism (M2)	I. Immobility (M3)
Community strategy				
Average herders presence	0.515	**0.273**	0.024	0.067
Coef. var. herders presence	0.433	**-0.223**	**0.299**	-0.057
Presence indicator 1999	0.365	**0.242**	-0.040	**0.250**
Presence indicator 2000	0.620	**0.241**	0.108	-0.160
Households strategies				
Opportunistic	0.136	-0.148	**0.339**	0.318
Regular	0.235	-0.080	**-0.590**	-0.068
Less mobile	0.326	0.118	**0.293**	**-0.573**
Immobile	0.119	0.106	0.117	**0.532**

Table 4. Linkages strategies (descriptive statistics and principal component analysis)

	Stats	Principal component analysis			
	Mean	I. Welcom (O1)	I. Protect (O2)	I. Sender (O3)	I. Reciproc (O4)
Type of linkages					
Unilateral - welcomer +	0.40	**0.580**	-0.019	0.215	-0.237
Unilateral - sender +	0.34	0.180	0.068	**0.566**	0.136
Reciprocal +	0.42	-0.252	0.143	-0.007	**0.695**
Outsider presence					
Presence of unwelcomed floc	0.52	0.103	0.079	**-0.541**	0.079
Animals crossing land*	3.94	**0.228**	**-0.253**	0.069	**0.386**
Border protection					
Community can protect bord	0.20	0.002	**0.545**	-0.096	-0.122
Leader can not protect bode	0.26	0.016	**-0.553**	-0.067	-0.200
Irrigated agriculture +	0.34	**-0.451**	-0.056	0.238	0.037

* Indicator varying between 1 and 5; + Indicates dummy variables

Table 5. Correlation matrix of pastoral strategies

	L1	L2	M1	M2	M3	O1	O2	O3	O4
Livestock holding									
Average flock size (L1)									
% Hh with sheep (L2)									
Mobility									
I. Duration (M1)	0.02	0.13							
I. Opportunism (M2)	**0.35**	0.00							
I. Immobility (M3)	-0.05	0.02							
Linkage with others									
I. Welcomer (O1)	0.04	0.15	**-0.34**	-0.13	**-0.29**				
I. Protection (O2)	-0.17	-0.01	-0.18	-0.13	0.09				
I. Sender (O3)	0.09	0.02	-0.02	-0.11	**0.28**				
I. Reciprocal (O4)	0.06	-0.04	-0.19	**0.42**	-0.18				
Intensification									
I. Fattening (Ifat)	0.03	**0.29**	-0.11	0.06	-0.01	0.09	-0.03	**-0.24**	0.12
Rehabilitation (Rehab)	**0.33**	-0.04	-0.19	**0.24**	**-0.39**	0.09	-0.05	-0.13	**0.23**

In bold correlation coefficient significant at more than 90%.

Table 6. Land potential index (principal component analysis)

	Stats	**PCA**
	Mean	Idens
Distance from Badia line	43.5	-0.297
Population density*	3.3	0.358
Previous cultivation (%)	38.6	0.371
Soil degradation**	2.94	-0.335

* Households per km^2

** Indicator between 1 and 5, 5 being very degraded.

Table 7. Governance structure (descriptive statistics and principal component analysis)

	Stats	**PCA**
	Mean	I Governance
Incapacity to:		
Solve conflicts within community	10.2	0.369
Solve conflicts with neighboring community	16.3	0.412
Influence community members	12.5	0.394

Table 8a. Determinants of livestock holding and intensification strategies (SURE estimation).

	Livestock holding				Intensification			
	Average flock size (L1)		% hh with sheep (L2)		Range rehabilitation (I1)		I. fattening (I2)	
	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat
Land potential and density								
Index of land potential (model1)	-297.6	-3.42 **	-0.533	-3.27 **	-0.452	-1.28	0.074	0.12
% Previous cropland	-170.9	-3.14 **	-0.193	-1.73 *	-0.080	-0.36	0.143	0.35
Current population density	-762.7	-1.43	-1.841	-1.69 *	-5.560	-2.55 **	-3.146	-0.79
Distance to the badia line	0.498	1.20	0.000	0.16	0.000	0.23	-0.002	-0.67
Community characteristics								
Community size	-0.392	-1.39	0.000	-0.56	0.001	0.68	0.003	1.52
Years of establishment	-0.791	-1.13	0.000	-0.20	0.006	2.00 **	-0.005	-0.91
Transaction costs								
Distance to paved road	-2.007	-1.78 *	-0.005	-1.96 **	0.003	0.66	-0.017	-2.00 **
Distance to water point	-1.221	-0.70	0.004	1.11	-0.001	-0.12	-0.011	-0.82
Assets								
Education	116.7	1.68 *	0.006	0.05	0.465	1.63 *	0.786	1.52 *
Land in cropping zone +	80.5	1.89 *	-0.020	-0.22	-0.069	-0.39	0.152	0.48
Governance								
Leader +	10.6	0.28	0.156	2.04 **	0.036	0.24	0.676	2.43 **
Index of weak leadership	-43.9	-0.72	-0.006	-0.05	0.428	1.71 *	-0.078	-0.17
Constant	273.7	3.50 **	0.747	4.66 **	-0.140	-0.44	-0.418	-0.72
R2		0.45		0.35		0.26		0.36
Chi2 stat p-value:		0.000		0.007		0.113		0.005

Table 8b. Determinants of mobility strategies (SURE estimation).

	I. Presence (M1)		I. Opportunisme (M2)		I.Immobility (M3)	
	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat
Land potential and density						
Index of land potential (model1)	-1.503	-2.38 **	-2.171	-3.61 **	0.874	1.30
% Previous cropland	-0.003	-0.01	-1.013	-2.62 **	0.185	0.43
Current population density	-11.065	-2.76 **	-4.878	-1.29	9.938	2.36 **
Distance to the badia line	0.002	0.49	0.005	1.70 *	0.002	0.50
Community characteristics						
Community size	-0.002	-0.79	-0.001	-0.39	0.001	0.38
Years of establishment	0.002	0.44	-0.001	-0.15	-0.013	-2.38 **
Transaction costs						
Distance to paved road	-0.002	-0.20	0.006	0.70	-0.013	-1.42
Distance to water point	-0.005	-0.38	-0.018	-1.50	0.019	1.37
Assets						
Education	0.689	1.32	0.397	0.80	0.210	0.38
Land in cropping zone +	-0.291	-0.91	-0.310	-1.03	-0.023	-0.07
Governance						
Leader +	-0.186	-0.66	-0.517	-1.95 *	0.112	0.38
Index of weak leadership	0.728	1.59 *	0.133	0.31	-0.800	-1.66 *
Constant	0.051	0.09	0.637	1.15	0.305	0.49
R2		0.21		0.36		0.31
Chi2 stat p-value:		0.355		0.005		0.029

Table 8c. Determinants of linkages strategies (SURE estimation).

	I. Unilateral welcomer (O1)		I. border protection (O2)		I. unilateral sender (O3)		I. reciprocal unwanted (O4)	
	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat
Land potential and density								
Index of land potential (model1)	0.076	0.11	0.577	0.86	-0.213	-0.32	-1.520	-2.51 **
% Previous cropland	0.156	0.34	-0.568	-1.41	-0.560	-1.30	-0.593	-1.50
Current population density	-7.874	-1.75 *	13.521	3.43 **	5.812	1.38	1.397	0.36
Distance to the badia line	-0.004	-1.19	-0.001	-0.25	0.003	0.77	0.006	2.12 **
Community characteristics								
Community size	0.001	0.50	0.003	1.33	-0.004	-1.82 *	0.005	2.47 **
Years of establishment	-0.002	-0.29	0.005	0.91	-0.002	-0.40	-0.005	-1.07
Transaction costs								
Distance to paved road	0.001	0.07	-0.001	-0.16	0.022	2.42 **	0.000	-0.05
Distance to water point	0.013	0.91	0.046	3.60 **	0.005	0.36	-0.018	-1.42
Assets								
Education	-0.405	-0.69	0.554	1.08	-0.589	-1.07	0.020	0.04
Land in cropping zone +	0.728	2.03 **	-0.099	-0.31	0.807	2.40 **	0.334	1.08
Governance								
Leader +	0.043	0.14	0.054	0.19	-0.091	-0.31	-0.256	-0.94
Index of weak leadership	-0.950	-1.84 *	0.348	0.77	-0.063	-0.13	0.844	1.91 *
Constant	0.332	0.50	-1.109	-1.92 *	0.375	0.61	0.061	0.11
R2		0.23		0.42		0.32		0.42
Chi2 stat p-value:		0.231		0.000		0.019		0.000

Map 1. Rangeland 'mother communities' and the Badiah line of Syria.