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Current Social and Rangeland Access Trends among Pastoralists in the Western Algerian Steppe

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Abstract: In the western Algerian steppe, the public authorities have carried out actions aimed at rural development (agricultural development programs) and combating desertification (grazing reserves) to counter the significant and rapid loss of vegetation cover of pastures by overgrazing, and the consequent impacts on local livelihoods. In the Rogassa area, these actions have impacted land tenure and the ancestral and collective way of land use and access. These changes have caused transformations in lifestyle and pasture management. This research aims to characterize how such changes are affecting local pastoralists and what their perceptions are about them. A selective sampling of 150 agropastoral households was carried out by interviewing their heads, analyzing socioeconomic, land tenure and government perception variables. Most agropastoralists access land under tribal tenure, conditioned by local social structures. Pastures are prevailingly perceived by pastoralists as insufficient, and the perception of grazing reserves is largely negative. Pastoralists are worried about land degradation and declining grazing lands, and are looking for solutions and alternatives. However, state interventions have been uncoordinated and have not considered their customary land rights. The generalized awareness of environmental deterioration points to the need for better communication and intervention strategies to be developed by authorities in the future that involve the inhabitants of these lands.

Keywords: rangeland access; land degradation; agropastoralists; land tenure; pastoral society; livelihood transformation; development programs

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1. Introduction

Since the 1960s and 1970s, developing countries have often put policies and pastoral development initiatives in place that focus on the sedentarization of pastoral communities, on the redistribution of land tenure rights through nationalization, and/or the privatization of land [1,2]. However, since the 1990s, several research works [3–5] have shown that human societies had for centuries succeeded in coming up with pragmatic cooperation institutions that avoid overexploitation of environmental resources. Dynamic socio-ecological systems are efficiently managed through common pool resources (hereafter, CPRs). In the management of CPRs, individuals face a coordination problem of social dilemmas that risk incurring the unsustainable use of resources up to their depletion point [6,7] Such social dilemmas can be solved through the coordination of individuals if they communicate among themselves and monitor the resource state [8]. Access to CPRs is limited either by

posing difficulties to its use (excludability), or by facilitating the appropriation of some resources by some users that cancels the possible use by later users (subtractability, [5]). The management of CPRs determines their sustainability and is shaped by both the resource itself and its community of users, including their social relationships and the established rules for its use [8–10].

Access and circulation in open spaces is the original form of occupation of territories [11,12], generalized in the whole Mediterranean basin because of high environmental, social, and economic sustainability [13]. It derived from relations maintained with public authorities, and from various agreements between communities on the delimitations of territories with shifting limits and structured by herd movements [1,14–16]. In the Maghreb, pastoralist land was under customary land tenure. The legitimacy of the control and the rules of use of rangelands by the different tribes were dictated by their demographic, political and military strength. Governance was determined by customary institutions constituted by politico-religious elites (notables, Imams) who led, through assemblies ("*Djama'a*"), the communities they belonged to [17]. Collective land was shared between nomadic families, groups of nomads and tribes, where membership, Muslim law and customs determined the modalities of appropriation, exploitation, and inheritance [18]. Nomadic pastoralists practiced transhumance all year round in search of pastures over vast pastoral areas subjected to common use [1]. These community-based management methods implemented by pre-colonial Maghreb pastoral societies allowed an efficient exploitation of natural resources, as described by Diana Davis in her work on "the environmental myths of French colonization in the Maghreb" [3]. According to Cassimirri [19] "*There is growing recognition of the importance of indigenous peoples' knowledge in ensuring the ecological and socio-economic sustainability of natural resources*". Traditional Ecological Knowledge (TEK) has become embraced by conservationists, and has been characterized as a source for rethinking human relationships with their environment [20,21].

The traditional pastoralist CPRs of the Algerian steppe were managed by Arabic tribes [1], while Berber-managed pastoralist CPRs (including *igoudlane*, plural of *agdal*; [22]) are mainly located in Maghrebi mountains. Arabic tribal organizations originating from historical and social relationships are mutating today. In other countries, such as Mongolia [23], Morocco and Tunisia [15,24], or Sudan [24], the tribal framework and the organization of customary practices still make it possible to ensure pastoral management despite conflicts and overexploitation of natural resources. In Algeria, however, the upheaval of pastoral spaces linked to specific socio-economic and political dynamics is remarkable [14–16,25,26]. The modernization process, initiated during the French occupation (1830–1962), and the liberal-inspired agricultural reforms, combined with the introduction of new technical paradigms (modern equipment), have severely affected the rural social relations (customs and traditions, extent of crops, and exclusion of pastoralists) [16]. The most evident outcomes of these dynamics are the deconstruction and marginalization of customary organizations, the abandonment of nomadic lifestyles, the decline of traditional pastoralism associated with agricultural intensification, and widespread land degradation in the rangelands.

The process of the sedentarization of pastoral communities started during the French occupation. In recent decades this was accompanied by an informal appropriation of land, supported by land laws enacted since the 1980s. A significant rural exodus toward cities and rapid urbanization is also ongoing, following the great droughts and insecurity derived political unrest in the 1990s. Since the beginning of the 2000s a partial conversion to agriculture of the pastoral areas is evident in several places. The area cultivated in the steppe has more than tripled since the 1970s, rising from about 1 million hectares to more than 3 million hectares [1]. State subsidies nurtured by hydrocarbon revenues are poured into these areas as part of a food security and poverty reduction policy aiming for red meat being available at affordable prices, based on a discourse of equality of access to resources for all social groups.

In the West Algerian steppe of El Bayadh, these changes have resulted in significant shifts in land management and in occupation patterns [27]. Those have been amplified by the more than seven-fold increase in population in between 1966 and 2018 (from about 47,500 to more than 330,000 inhabitants), and by more than a four-fold increase in sheep and goat numbers (the main livestock in the El Bayadh region and the steppe, from 623,000 to over 2,500,000 heads). Confronted with an intensive and predatory exploitation exceeding the regeneration capacities of the plant cover in the steppe (about 15 million hectares) and with widespread land clearing [17,26,27], the public authorities have formulated actions aimed at protecting specific species such as halfah grass (*Stipa tenacissima*) and white wormwood (*Artemisia herba-alba*). The measurements carried out since the 1970s on the phytomass of these two species, and of perennial species in general, show a spectacular decline [27]. Operations aimed at creating ecologically protected enclaves (grazing reserves, pastoral planting) since the 2000s have triggered the appropriation of tens of thousands of hectares of collective rangelands in El Bayadh. As a result, many agropastoralists have often found themselves deprived and sometimes excluded from the use of pastoral lands previously accessible, being confined to smaller spaces. Other agropastoralists, and even groups of city dwellers, have taken advantage of the subsidies provided by development programs since the 2000s. These programs promote the cultivation of land, assisted also by Law 108 of February 2011 that gives right to concession over large areas of land. A situation of competition in the appropriation of land has generated new strategies (negotiations, circumvention, alliances). This process is framed in the dwindling durability of CPRs, and the shrinking ability of individuals for coordination in social dilemmas, given the ongoing modernization of competitive societies, which experience changes in individual preferences, social norms, customs, and views, through changing human interactions [8,28].

This article aims to study the transition experimented by pastoralist CPRs through pressures to introduce less collaborative, more competitive settings, and its consequences for on social, economic, and environmental sustainability. For this goal, we characterize the social and economic situation of pastoralists and analyze recent transformations on rangeland access and use in the Rogassa area (wilaya of El Bayadh), one of the main pastoral areas in western Algeria and one of the last areas with a relatively good steppe vegetation cover in Algeria. We base our study on interviews conducted with local agropastoralists.

2. Materials and Methods

2.1. Study Area

The study was conducted in the Rogassa *daria* (second-level political division, equivalent to, e.g., Canadian counties) in El Bayadh *wilaya* (first-level political division, equivalent to, e.g., Canadian provinces), Algeria (Figure 1).

The area has a human population of ca. 24,000 people and a sheep and goat herd of more than 550,000 heads. It has one of the most important halfah grasslands of the Algerian steppe, very sought after by agropastoralists of neighboring counties (Tiaret, Saida, Djelfa). The local Arabic tribe "Ouled Ziad" is one of the most important and influential of western Algeria.

Recent as well as older research in the area confirms a particularly advanced degradation level in the rangelands [27]. To tackle it, and to cope with the significant increase in animal numbers throughout the El Bayadh region, the State has subjected a great part (ca. 40%) to a grazing reserve regime. It consists of a total prohibition of grazing by livestock for several years to facilitate pasture recovery. The reserves are then leased every year for spring (months of April and May) and fall (from 15 November to 15 December) grazing, with a fixed animal load equivalent to two sheep/ha, determined since the creation of the defenses. The local tribes have priority in the rental, which is fixed at the price of DZD/ha 1000 (eq. to USD 7.5) for each season. It is one of the most important actions undertaken at the national level, or even in North Africa, regarding the combating of desertification. Furthermore, many pastoralists and investors have profited from policies encouraging the development of communal areas (subsidies for drilling, equipment purchase, etc.) and have

been offered the right to the land concession by appropriating the common rangelands. Some have also appropriated land, taking advantage of these policies and of the absence of pastoralists with grazing rights, who belong to the same tribe but migrated to cities in the 1990s and early 2000s due to the drought and deteriorating security situation. During this period, the sheep and goat numbers fell by about a quarter, from about 1,788,000 to about 1,365,000 heads. Much of the rangelands were therefore officially appropriated by the State (decrees of the prefect, establishing the creation of grazing reserve) and part of the remaining land was redistributed between the actors. In Rogassa county, the rural exodus movement reached its peak during the 1990s–early 2000s, but its impetus continued with the reduction in rangeland access when reserves were established from 2001 on. The herders had no other alternative to avoid capital loss than to gradually increase quantities of fodder to feed their herds. This made the costs of herding difficult to support, especially for small breeders [25], many of whom have migrated to the city in search of other jobs. This movement is so important that the sedentary population of the city of Rogassa has grown from just 40 people recorded in 1968 to more than 7000 today. Such concrete dynamics and such important changes in the land regime made us choose Rogassa county for our research.

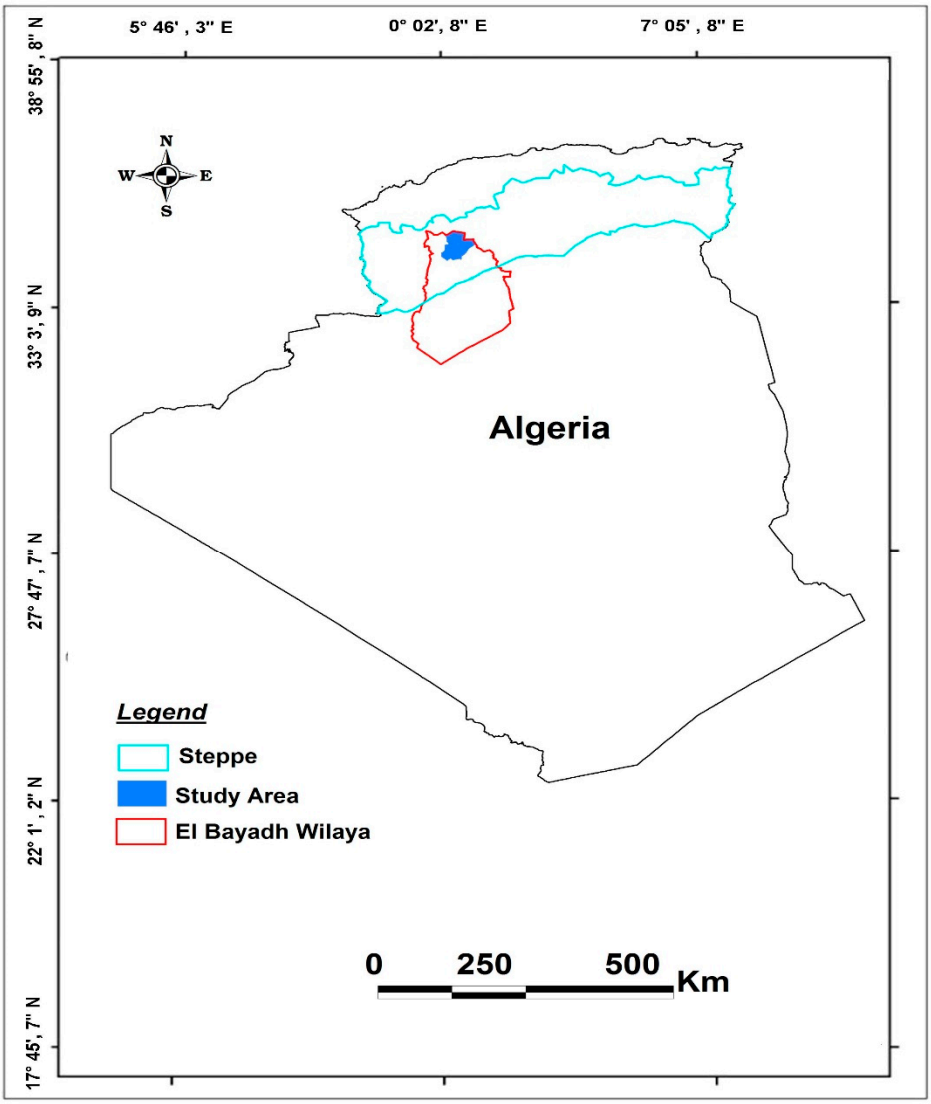

Figure 1. Localization of the study area.

2.2. Data Collection

Due to the lack of official socio-economic data on the local population, on the real occupation of the space, and on the share of natural resources, our approach aimed to capture economic, social, and environmental dimensions by a selective sampling of 150 agropastoralist householders (all male). A first pilot interview in Arabic language was tested in a prospective visit. The interviews and the field observations were carried out from November 2019 to September 2020, with an interruption between mid-March and July 2020 due to COVID19. During this research, we adopted a non-probability, predefined and reasoned sampling [29]. Fieldwork was carried out with the help of trained Master's students, some of whom lived in the study area.

The considered variables included: (i) a group of variables that characterized each household socially and economically: education level and local nativeness of the householder, living standard, degree of dependency on livestock, size of the herd, and its composition; (ii) variables describing the land situation under which they were operating, namely: type of land tenure under which their herd accessed lands, distance to grazing reserves established by the State, and degree of sufficiency of the accessed rangelands—including the reasons why they were insufficient, in the case they were considered so; and (iii) variables describing the perception of the political and social environment surrounding the exploitation of pastures: effect of farming and agricultural programs on grazing activity, beneficial character of agricultural programs, opinion on the interest or disinterest of the government in local pastoralism, perceived facilities for practicing pastoralism, and perceived inequalities in land access. Further descriptive questions included details about insufficiency of pastures, and the interest of government in preserving pastoralism in the area.

2.3. Data Analysis

We rationalized a set of relationships between variables to potentially explain or reflect the underlying social, economic and political patterns in the area. We then conducted statistical analyses to assess correlations between some key variables. Many of the analyzed variables were semi-quantitative, i.e., categorical variables with order, and they were transformed into rank variables to allow for ordinal regression analyses (Table 1).

Table 1. Values for the assigned ranks of semi-quantitative variables.

Variable Group	Question in Interview	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8
Socio-Economic	Education level	analphabet	Quranic school	Primary	Middle	Secondary	Academic	n.a.	n.a.
	Local nativeness (year starting residence in Rogassa county)	2011–2020	2001–2010	1991–2000	1981–1990	1971–1980	1961–1970	1950–1960	Born in the area
	Living standard	weak	average	good	n.a.	n.a.	n.a.	n.a.	n.a.
	Dependency on livestock (primary, secondary or additional livelihood activity, numbered in order	other	agriculture	Agriculture and livestock farming	livestock farming	n.a.	n.a.	n.a.	n.a.
Access to land	Type of land tenure	not owner	renting	concession	tribal	landowner	n.a.	n.a.	n.a.
	Distance to reserves	inside the reserve	close-0 to 5 km	5 to 10 km	far from the reserve	n.a.	n.a.	n.a.	n.a.
	Rangeland sufficiency	not enough	rather ok	enough	n.a.	n.a.	n.a.	n.a.	n.a.
Perception of political and social environment	Farming activity and agricultural programs affecting grazing activity	no	rather	yes	n.a.	n.a.	n.a.	n.a.	n.a.

We consider herd size to be a key metric for the wealth of livestock keepers. It potentially conditions power relationships while also expressing entrepreneurial success—therefore being a potential source of explanation for socio-economic patterns. We also considered education level to play a role, because of the increased opportunities it brings for diversification in pastoral settings [30]. As householders would be reluctant to give exact herd size numbers, the options for responding to the questionnaire gave ranges of livestock heads (intervals of 50 for sheep and camels, and of 5 for goats and cattle). The mean value of the answered range for each animal was transformed into Livestock Units (1 camel or cow = 10 sheep or goats) and added to the values for other animals in the herd to come up with a herd size value. The Shannon index [31] was used to evaluate the diversity of the herd in each household.

Grazing reserves constitute the main action of the government to assure the sustainability of pasture use. We were therefore interested in assessing not only the acceptance of grazing reserves, but also on analyzing how they would condition a positive or negative perception of the herders' livelihood. We therefore tested herders' perceptions of sufficiency of pasture against distance to reserves, as well as against factors that are related to underlying power structures: wealth (quantified through herd size) and type of land access, which can reveal whether traditional land access gives any advantage of access to better preserved rangelands. We also hypothesized that the potential dissatisfaction with the grazing reserve program may lead to a negative perception of government actions in general, being higher when close to the grazing reserves. Finally, we wanted to evaluate if the cases of positive perceptions of government interest were related to subsidies promoting conversion into crop agriculture, or if they were related to other livestock investments. Interest of government and beneficial character of agricultural programs were evaluated through yes/no responses.

The relationships between herd size as dependent variable and other covariates were assessed with generalized linear models (GLM) with a log-link function and gamma distribution. As Gamma distribution has probability 0 at value zero, we added a small constant of 10^{-6} to be able to model respondents with no livestock. When the response variable was binary ("yes"/"no"), we used a GLM with a logit function and binomial distribution. For models of other response socio-economic variables recorded as categorical variables with order, we modelled them with Ordinal Logistic Regression (OLR). All analyses were conducted with R version 4.0.2 [32]. Further graphic description provided detail for explaining rangeland insufficiency (at both the personal and collective level) and reasons for perceiving a favorable or unfavorable attitude of the government towards the preservation of pastoralism in the area.

3. Results

3.1. Social and Economic Characterization

Herd size was positively correlated with the degree of nativeness to the Rogassa area (parameter estimate = 0.172, t = 3.35, p-value = 0.001), meaning that people of local origin were more likely to have larger amounts of livestock. This association was further nuanced with the degree of education among natives but not among "outsiders"; natives with low education had more livestock than those natives with high education, while "outsiders" showed no significant effect (interaction estimate = −0.082, t = −2.13, p-value = 0.035; Figure 2A).

A tendency was observed for herd size to be correlated with the degree of dependency on livestock, with a cross-interaction with the education level (Dependency estimate = 0.183, t = 1.801, p-value = 0.074; Education and Dependency interaction estimate = −0.132, t = −1.859, p-value = 0.065). Householders with large dependency on livestock and a low education level—being the majority in the interviewed population, which may be impacting on the ability of data to reach the statistical significance level—would therefore tend to have larger herds than those highly dependent on livestock but with higher education levels. Conversely, among householders with lower dependency on livestock, those less

educated would have smaller herds—while the more educated would have larger herds (Figure 2B).

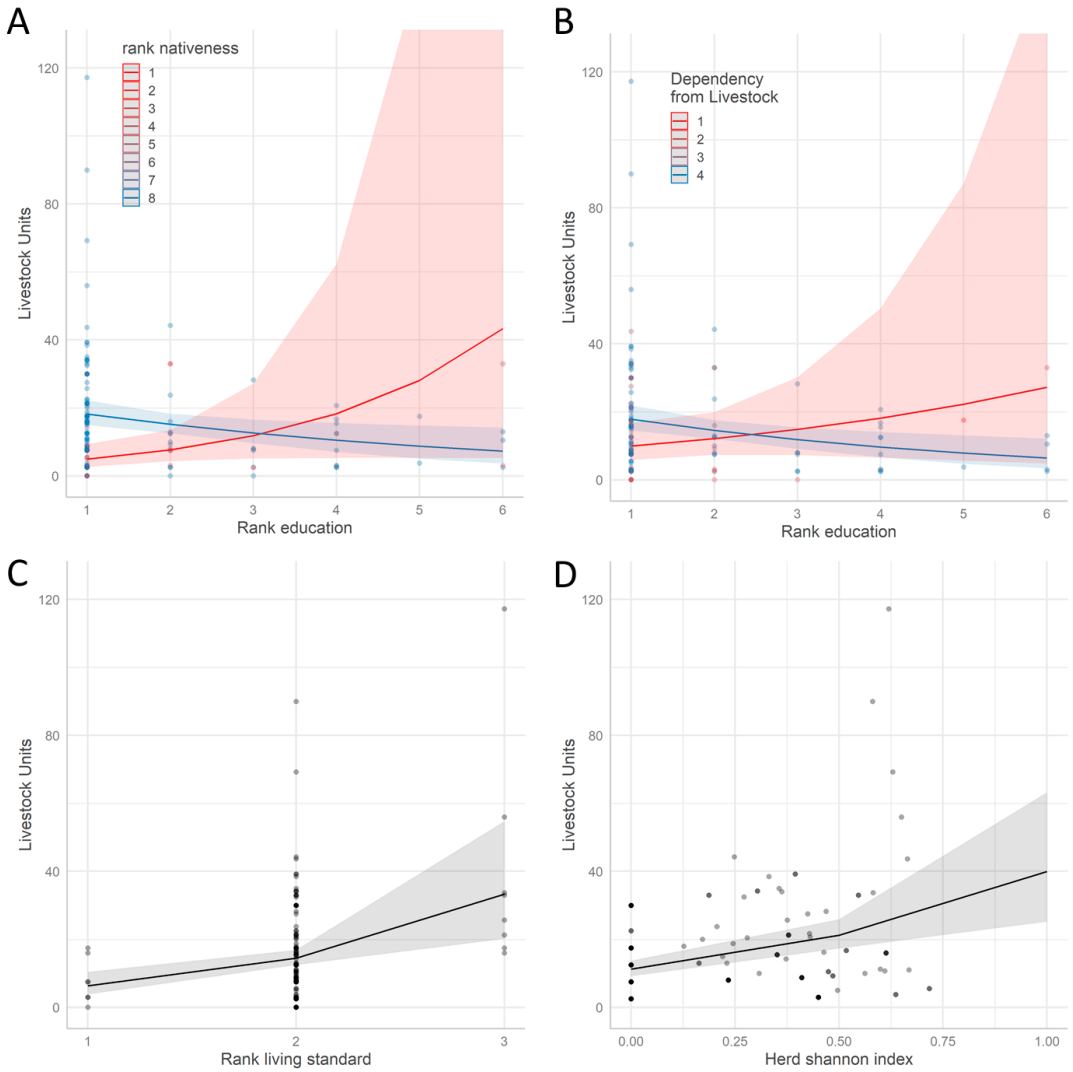

Figure 2. Results for the correlations of socio-economic variables. (**A**) Correlation of herd size and education, with crossed effects from the degree of nativeness to the study area. (**B**) Correlation of herd size with education, with crossed effects from the degree of dependency from livestock. Education and dependency correlation is only marginally significant. (**C**) Correlation of herd size with the self-identified living standard. (**D**) Correlation of herd size with herd diversity, measured through the Shannon diversity index. For equivalences of rank variables see Table 1. Shaded areas correspond to 95% confidence intervals.

Herd size was also positively correlated with living standard (estimate = 0.83, t = 3.406, *p*-value < 0.001; Figure 2C), showing that the herd size reflects the wealth of households adequately despite lower education levels observed above.

Herd size was also positively correlated with herd diversity (estimate = 1.267, t = 4.264, *p*-value < 0.001; Figure 2D), showing that wealthier herders adopt diversification strategies while poorer herders are choosing more conservative strategies.

3.2. Rangeland Access

The interviews revealed that pastures in the area are prevailingly perceived not to be sufficient (Figure 3).

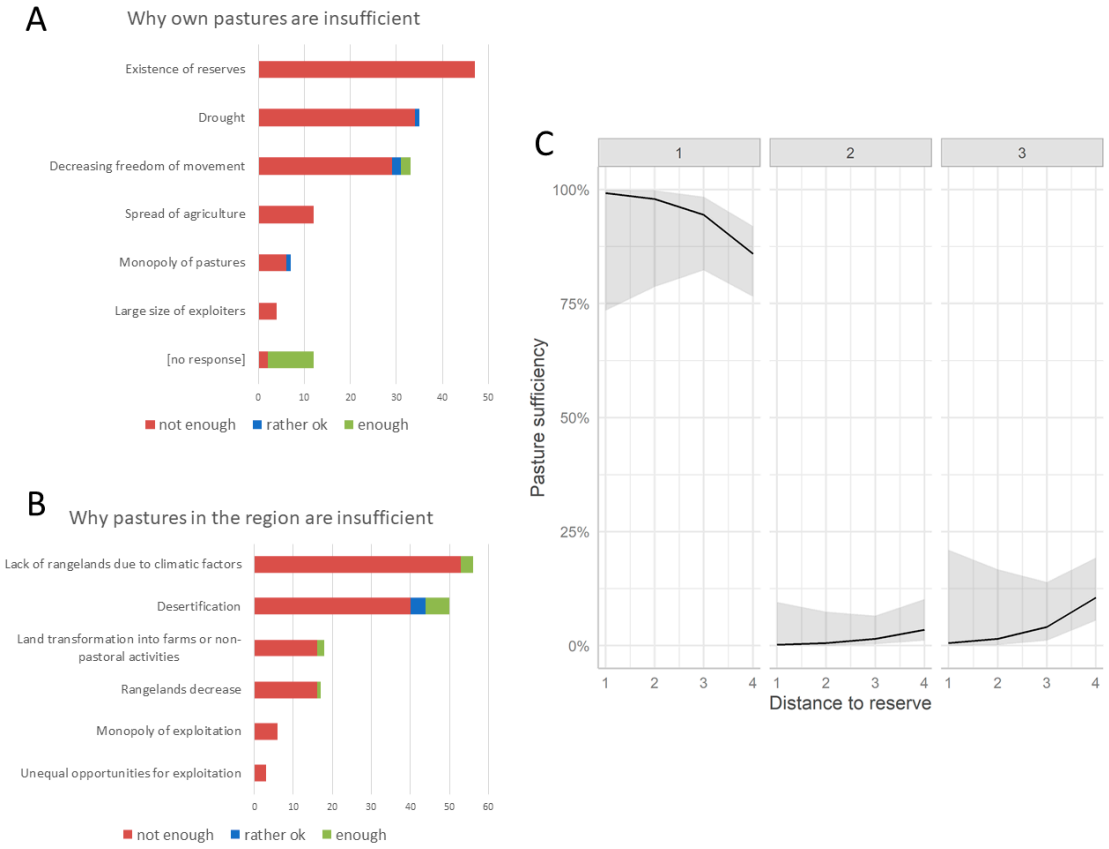

Figure 3. Impact of grazing reserves on land-related perceptions of local householders. (**A**) Reasons given for insufficiency of pastures at the household level, according to the level of sufficiency expressed. (**B**) Reasons given for insufficiency of pastures at the regional level, according to the level of sufficiency expressed at the household scale. (**C**) Likelihood (only marginally significant) of responses to pasture sufficiency at the household level (1 = not enough; 2 = rather ok; 3 = enough) according to the distance of the household to the reserves (see Table 1 for distance values at each rank). Shaded area corresponds to the 95% confidence interval.

Of the interviewed agropastoralists, 83% access land under tribal tenure, 10% land concession, 4% do not own land, 3% own land, and 2% rent land. The degree with which householders perceived rangeland resources to be sufficient was not correlated with type of land access (estimate = 0.253, t = 0.572, p-value = 0.567). The distance from protected grazing land did not influence the perception of sufficiency either, although a marginal statistical effect was observed (estimate = 1.022, t = 1.72, p-value = 0.085), mainly related to a more positive perception in the areas more distant from grazing reserves (Figure 3C). No significant effect of herd size (estimate = −0.02, t = −0.877, p-value = 0.38) or education level (estimate = 0.07, t = 0.354, p-value = 0.723) was observed on the distance to reserves, showing no displacement of disempowered households to the vicinity of the reserves.

When examining the reasons for pastures being perceived as insufficient for their own herd the dominant reason is related to the grazing reserves, either because of being blamed directly or because of complaining about the hurdles to movement (Figure 3A). When changing the analysis scale from a personal to a regional one, however, rangeland degradation factors become dominant (Figure 3B).

3.3. Sociopolitical Perceptions

Presented with the question "Do you think that the government is interested to preserve pastoral activity in your area?", most respondents expressed a negative response (Figure 4).

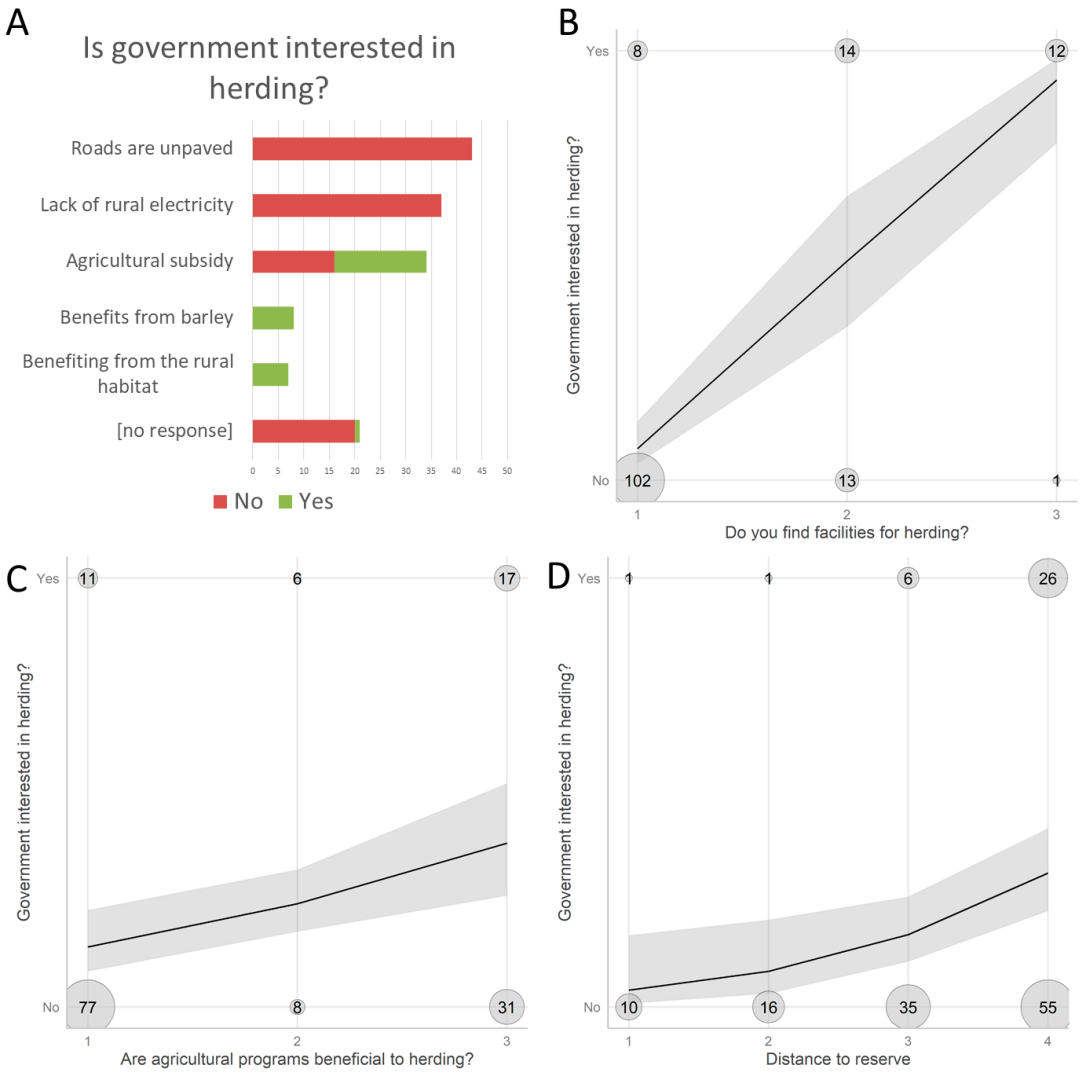

Figure 4. Trends and correlation results for the perception of government's interest on herding at the household level. (**A**) Reasons given for negative (red) or positive (green) perceptions of pastures at the household level. (**B**) Correlation between negative/positive perceptions of the interest of government and perceptions of existing facilities. (**C**) Correlation between negative/positive perceptions of the interest of government and perceptions of existing agricultural programs. (**D**) Correlation between negative/positive perceptions of the interest of government and the distance of the pastures grazed to the grazing reserves established by the government. For (**B**–**D**), see Table 1 for values at each rank. Shaded areas correspond to 95% confidence intervals.

They related most of such responses to the lack of services, such as roads or electricity (Figure 4A). The responses of interviewed household heads in Rogassa showed a correlation with "Do you find facilities for practicing your activity?" (estimate = 2.572, z = 5.964, p-value < 0.001). Among the few households who thought the government showed interest, they did generally find facilities (Figure 4B). Their positive responses to government interest related to subsidies and provision of barley as supplementary fodder (Figure 4A).

The same responses to the government's perceived interest were also correlated with the response to "In your opinion, are agricultural programs beneficial to grazing activity in the county" (estimate = 0.731, z = 3.022, p-value = 0.003). If the impression of the government's interest was positive, there was a tendency to perceive the agricultural programs as positive too (Figure 4C)—the latter related to the subsidies and fodder provision mentioned above.

The responses to that same question were also correlated with the distance to the grazing reserves (estimate = 0.842, z = 2.106, p-value = 0.035; Figure 4D). Almost all respondents

that were positive about the government's interest grazed the areas more distant from the grazing reserves, showing a very negative attitude towards the government's action if the activities of the respondent were constrained by the grazing reserves.

The responses to the question "Do you think that there are groups that have priorities in exploiting pastures in the area" were not correlated with the distance to the grazing reserves (estimate = 0.247, t = 1.311, *p*-value = 0.19). The negative attitude towards the establishment of the reserves seems therefore not to be related to the attribution of privileges to selected groups, even if a handful of respondents had identified such issues (Figure 3A,B). As a matter of fact, most respondents (64%) do not think there are privileged households in the area.

4. Discussion

The households with larger livestock herds in Rogassa, and consequently better living standards, are those with a more established presence in the area but, at the same time, those which have the lowest education levels. This points to locals, "natives", having acquired customary rights over land use that allow for keeping larger herds, whereas family members that go away to study are probably losing such "rights". The trend for some among the more educated, less rooted householders to diversify more into agriculture and achieve higher capital (measured in terms of herd size and living standard) is also explained by such a customary rights setting, exemplified by the high degree of land accessed under tribal land tenure. Conceding land for cultivation, as per Law 108/2011, is probably also aggravating the rift between local pastoralists and "outsider" crop farmers. On the other hand, the pastoralist profession has become very painful and difficult due to frequent droughts and widespread land degradation, and due to the collapse of the purchasing power of the Algerian consumer [33]. In addition, and in spite of the opportunities it provides for pastoralists [34], an inadequate deployment of Information and Communication Technologies (ICTs) discourages young people from exercising this profession, especially when it comes to a mobile lifestyle in a tent without electricity and with poor telephone network coverage [34]. Among interviewed herders, 90% of them are moving herds around nearby rangelands. Faced with this reality, some parents prefer not to educate all children, so that some stay with them and take over the herd. In any case, choosing an economic pathway that does not compete with established livestock keepers is likely to give better economic opportunities in the medium term for those that have abandoned the local community for studying.

The troubles for outsiders trying to thrive on livestock can be interpreted as access to pasture being controlled by tribal and local rulings (as happens elsewhere: [35]), so the entry of an "outsider" into that system is difficult and, for well-positioned stakeholders, it is rather worth investing into crop agriculture. In the case of local, established (wealthy) householders, their efforts go more into herd diversification, which may be considered as a risky strategy (as it is not undertaken by poorer herders) but convenient in the long term. The path of livestock diversification in the area goes first towards goats but then towards the acquisition of larger stock (mainly cattle; Figure 5).

While in some cases herd strategy has been observed to respond to changing environmental conditions [36], the Algerian steppe offers conditions that are stable to some degree, where sheep herds maximize the exploitation of pastures [1]. The accumulation of larger stock may therefore be a response to capital accumulation strategies in the form of stock described for pastoralist systems in general [37].

Grazing reserves are overwhelmingly seen as a problem for the profitability of livestock keeping in Rogassa county (Figure 3A). This was a generalized perception that worsened in close proximity to the reserves and was neither influenced by the type of land access householders enjoyed, nor by their level of wealth. Only 2% of herders interviewed claim to have rented reserves, which shows that most of them prefer to take advantage of these reserves illegally, i.e., for free. In the worst case scenario they pay the fine applied per hectare (about DZD/ha 1000; eq. to USD 7.5), which is equal to the rental price. The

sanctions to be applied in the event of non-compliance with the laws are not dissuasive, meaning that they do not lead to sustainable management of collective rangelands [4,5]. Indeed, during a prospecting and verification mission carried out in spring 2021 by various state services, it was observed that the violations are almost generalized and only a third of the grazing reserves were respected. The coercive approach adopted by the public authorities in the application of agricultural programs, without real participation by the different stakeholders, drives negative perceptions and the refusal of herders to comply [18,38], in line with other examples of the defiance theory for coercive environmental enforcement [39]. According to Groppo [40], to be appropriate and sustainable, to be effectively implemented and to be effective, development projects and programs must be participatory and freely negotiated. In any case, vegetation status in the Rogassa area monitored since the establishment of grazing reserves [27] shows that the perennial vegetation cover is still relatively more conserved within reserves than in unprotected rangelands, including in the areas which are illegally trespassed. Departing from a similar initial condition, vegetation in grazing reserves show a more positive evolution along the years [41], including better recovery from disturbances such as severe droughts [17]. A possible explanation is that herds are routinely expelled by the authorities, giving time for the pastures to recover, and protecting them against overgrazing. The frequent complaint by agropastoralists of grazing reserves having been established in the areas with best plant growth potential or best pre-existing plant condition seems hence less likely.

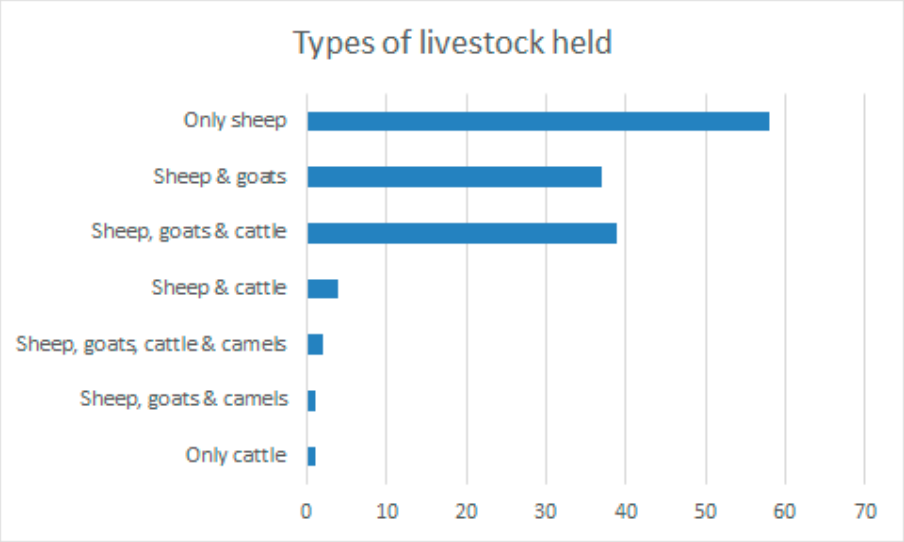

Figure 5. Combination of livestock species in the households' herds, by frequency of households.

A different perception arises when enlarging the scale of analysis, with different types of land degradation identified as the main regional problem. This is a positive note for the grazing reserve program. Firstly, it does not seem to be creating social tensions, as there is a prevalent view of equality on the access to grazing resources. Secondly, a better communication campaign could explain the reasons for establishing grazing reserves and contain any animosity that arises against the government's actions for sustainability. Judging by the limiting factors identified above, the reasons for insufficient access to pastures at the individual level seem to be more related to social relationships and acquired rights inside the community. Most of the positive appreciation that respondents have for government actions is related to the provision of fodder, or to subsidies that contribute to fodder production. Subsidies are allocated to appropriate collective pastoral spaces and to practice an additional activity (usually barley cultivation for fodder), to obtain rural housing and to have access to better living infrastructures (electricity, appliances). Ten per cent of the interviewed herders have acquired the concession title or started the procedure, which implies higher investment in on-site fodder production. Such investments, however,

are counterproductive for the conservation of halfah grasslands, as the provision of barley as fodder is tightly related to land degradation in the whole Algerian Steppe region [42]. It therefore becomes clear that an alternative structuring of governmental support to pastoralists and to the economic development of the steppe must be designed to make it coherent with sustainability objectives. Achieving these development objectives requires the optimized use of the fragile resources of the steppes, taking into account the specific constraints of the livestock system being practiced [43]. The outcomes of direct help measures must be found useful by local herders, but at the same time must not contribute to regional degradation. Thus far, the minority who think that agricultural programs are good identify them with an interest from the government, and they also find facilities to exploit the rangelands. This shows that intervention programs do translate into an improved perception by pastoralists, so it is worth innovating to come up with win–win solutions.

Transdisciplinary methods are recommendable that involve pastoralists not only in the approval but also in the formulation of innovative interventions, and that use a multi-sectorial approach conjugating environmental, social, and economic interests [44].

5. Conclusions

This study shows that to cope with insufficient pasture to feed herds, less educated households with large livestock herds, educated households, and foreign investors with little or no land, try to take advantage of state aid programs to cultivate the land, feed their herds, acquire land concessions, and thus increase their capital. The implementation of an environment-oriented policy to deal with the degradation of rangelands has established reserves and contributed to partly preserve and restore the natural vegetation. This has happened despite the droughts and overgrazing of the past and despite the weaknesses in the implementation of the grazing reserve program—with no consideration of the risks of overexploitation of rangelands due to the standardization of stocking rate in the reserves and the increasing feed supplementation with barley. However, the following underlying degradation factors are not being tackled: (1) the high use of fodder by pastoralists, and (2) the lack of acceptance for grazing reserves by pastoralists, who have always expressed their opposition to this project and ignore the restrictions when possible, even if they are also concerned about land degradation and reduction in pasture. This is of little surprise, given that state interventions took place in the absence of coordination with pastoralists and consideration of their customary land rights. The process of modernization of pastoralism conducted by the Algerian state has been accompanied by a deconstruction of the traditional community organization, which had efficiently managed the steppe rangelands through a common pool resource system. This led to the emergence of individual and competitive farming methods that degrade the steppe's pastures, in line with worldwide trends for CPRs [28].

Wrongly conceived investments, or insufficiently accepted interventions on pastoral livestock, erode the attractiveness and future viability of pastoralist livelihoods, potentially leading to a future collapse [44]. The rural exodus is resulting in a new form of peri-urbanization in Rogassa following the need for schooling and access to public services (health, market, leisure, etc.). Adequate consideration of investment frameworks could, however, improve the results of intervention policies in the future [2] and guarantee the persistence of pastoralist livelihoods and their associated services in the future. The consideration of best practices for pastoralist land tenure [45] offers a good set of tools to implement land restoration strategies that involve the inhabitants of such lands.

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