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Social strategies to access land influence crop diversity in northwestern Morocco

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Abstract

1. Much evidence supports the ecological and agronomic benefits of diversity, of both crops and environments, for building resilience and sustainability in agroecosystems. Farmers' knowledge about crop diversity is well-documented, but aside from studies on how farmers exchange seeds and knowledge through networks, the interactions of social factors and the diversity of crops and cultivated environments have been mainly overlooked. One factor receiving attention is farmers' access to land, but in only one of its dimensions, the security of access. Here we address the different strategies by which farmers gain access to land. How does the plurality of modes of access to land influence crop choices, and thereby crop diversity? How does this plurality influence the range of environments available to individual farmers for cultivating crop diversity?
2. Analysing data from 51 interviews with farmers and 312 plots in agrosilvopastoral systems in northwestern Morocco, we described eight different modes of access. Each mode offers different opportunities and constraints concerning the kind of crops that can be grown on the plot. We found that an increase in the number of modes of access to land increases the crop diversity of farmers' holdings, regardless of the total area each farmer cultivates. Accessing additional plots contributed to both environmental heterogeneity and to crop diversity of farms.
3. In striving to gain access to land and to grow diverse crops, farmers are motivated by their notion of what it means to be a 'real farmer', that is, the relation to their identity. Farmers mobilize not only their economic power but also their social relationships to gain access to plots of land. Their choices are also based on their relationships to tree crops such as olive, which are economic and cultural key-stone species, as well as markers of land ownership and control.
4. Multiple modes of access to land characterize many smallholder farming systems, which support a large fraction of the world's population. Recognizing diverse social practices of access to land that allow farmers to continue to mobilize multiple

Yildiz Aumeeruddy-Thomas and Delphine Renard share last authorship.

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modes of access can increase resilience against unpredictable events and help maintain sustainable agroecosystems.

KEYWORDS

access to land, agrobiodiversity, farmers' practices, social organization

1 | INTRODUCTION

Abundant empirical evidence suggests that greater biodiversity can support more resilient and sustainable agriculture and food systems (Altieri, 1999; Lin, 2011; Massawe et al., 2016; Zimmerer & de Haan, 2017). Greater wild and/or domesticated biodiversity (hereafter agrobiodiversity) notably enhances yield and its stability, disease and pest resistance, nutrient cycling and human nutrition (Beillouin et al., 2019; Renard & Tilman, 2021). Much attention has focused on the ecological and agronomic benefits conferred by agrobiodiversity. In contrast, the social factors that come into play in determining the level and distribution of agrobiodiversity, especially the diversity of crops, are less studied. Agrobiodiversity is indeed managed by people through a corpus of knowledge and practices (FAO, 2019), and farmers' decisions underpin its patterns (Pimbert, 2017; Pimbert & Borrini-Feyerabend, 2019). For example, seed exchanges through farmers' social networks shape the dynamics of crop diversity, from species richness to intraspecific genetic diversity (Leclerc & Coppens d'Eeckenbrugge, 2012) and from the level of the individual farm up to several villages (Zimmerer, 2003).

Access to land is another important social component related to crop diversity (Mackenzie, 2003). Smallholder farmers manage not only a diverse portfolio of crops (Ricciardi et al., 2018), but also make use of a diversity of environmental conditions at the field level (Félix et al., 2018; Mariel et al., 2021). Access to plots of land follows complex and multiple modes (Saïdou et al., 2007; Turner & Moumouni, 2019), including inheritance, sharecropping, rent and through community management. Gradients of land use and associated rights depend on farmers' social status, gender, age, origin and power (Cote, 2011; Mackenzie, 2003).

In many countries, smallholder farmers' access to land has experienced profound changes following colonization and decolonization processes, agrarian reform policies, liberalization of land markets and changes in inheritance rights (Clover & Eriksen, 2009; Ducourtieux et al., 2005; Mwangi, 2006). These transformations tended to increase inequity, notably among women and migrants, in access to land (Frankema, 2006; Hausermann et al., 2018). In fact, the coexistence of customary and legal tenure systems is not always compatible. Fights for land rights are now central to farmer movements across the world (Léger-Bosch et al., 2020; United Nations, 2018) because these rights are not always secured in the face of economic interests (Cotula et al., 2008; Dell'Angelo et al., 2017; Michon et al., 2000). Under these circumstances, farmers must mobilize diverse strategies to secure their access to land (Gray, 2005; Gray & Kevane, 2001; Place & Otsuka, 2010).

The few studies linking land access to crop diversity have compared cropping and practices, and their sustainability, between two broad categories of access, permanent and temporary (Awanyo, 2009; Place & Otsuka, 2010; Rao et al., 2016). However, this distinction fails to account for the plurality of modes of access, the strategies implemented by farmers to access land and the influence of both on crop diversity (Mackenzie, 2003). This is important because access to new plots can increase not only the total cultivation area of a farmer, but also the suite of environmental conditions under which various plants can thrive.

Our aim is to fill this research gap. We ask the following questions: Does the diversity of access to land relate to the diversity of crop species grown by farmers, and to the diversity of soil and topographic conditions? Do farmers use new plots to diversify their crop portfolio and/or to increase the area of their main crop? Answering these questions required a better understanding of the social strategies involved in accessing new plots and the consequences of these strategies for crop diversity. More specifically, we will focus on the richness (number) of crops at the species level. We addressed these questions in north-western Morocco. Within the Mediterranean basin, our study region is considered a hotspot of agrobiodiversity (Hmimsa & Ater, 2008). As elsewhere in the Mediterranean basin, in numerous rural communities, access to land is fragmented due to the inheritance system and environmental heterogeneity. Access to land also depends on overlapping norms, leading to very diverse ways of accessing land and diverse motivations for gaining new plots. Owning land and increasing one's cultivated area is, for example, the cultural basis of the honour system in the Rif Mountains (Jamous, 1981). Crop diversity, based on intercropping between cereals and legumes domesticated in the region and agrosilvopastoral practices (Zeder, 2008; Zohary et al., 2012), is the mainstay of Mediterranean societies in terms of food, culture and adaptation to change (Aboussaleh et al., 2017; Aguilera et al., 2020; Alcon et al., 2020). This paper explores the idea that the multiplicity of modes of access to land is an important lever in maintaining the ancient poly-cultural system highly adapted to this socio-ecological region.

2 | MATERIALS AND METHODS

2.1 | Context of the study

This study draws on 2 months of fieldwork conducted between October 2019 and January 2020 in Jahejouka in Larache province, northwestern Morocco (Figure 1). The village (*dchar*, the smallest rural territorial unit) comprises about 400 inhabitants, mostly

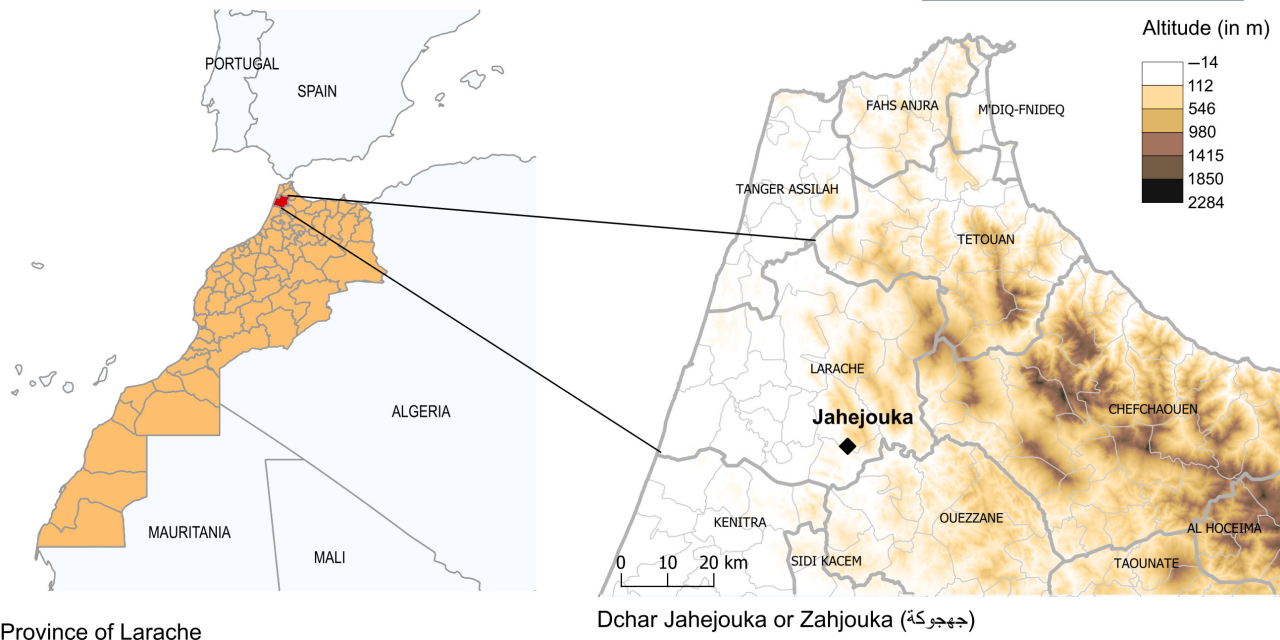


FIGURE 1 Location of the study area in northwestern Morocco: *dchar* Jahejouka within the province of Larache.

farmers. The term in *darija* (the Moroccan Arabic dialect; the choices of transcriptions are detailed in the [Supporting Information S1](#)) that farmers use to describe themselves is *fellah* (pl. *fellahin*), which is usually translated as 'peasant', with no negative connotation attached to that term (Hopkins & Ibrahim, 1997; Karabenick, 1976). Inhabitants of Jahejouka belong to the *Ahl Serif* tribe of the *Jbala* (literally 'mountain people'), a confederation of tribes and an ethnic group of the western Rif.

Agricultural land ranges from 50 to 800 m in altitude. Above this altitude and to the north of the village, the area is largely forested. The southern part of the village's territory is composed of gentler hills with olive trees planted on the slopes. The geological heterogeneity (Benyaich, 1991) produces a diversity of soils distinguished by farmers according to various characteristics and associated uses. The climate is Mediterranean with warm, dry summers and mild, wet winters. Rainfall in northwestern Morocco is the highest in the country, with more than 800 mm per year. Rainfed agriculture is predominant in the study site and northern Morocco more generally. Irrigation water is generally kept for vegetables and fruit trees grown in home gardens in close proximity to wells.

2.2 | Characterization of agricultural practices and crop diversity

Farmers practice agroforestry, with three pillars in the system: trees (fig, olive, carob and other fruit trees), cereals such as durum and common wheat, sorghum and barley and legumes (including lentils, chickpeas, green peas and fava beans; cf. [Supporting Information S2](#)). Olive is the most important cash and cultural crop. The region has a long history of social and ecological use of wild

olive forests, including through grafting them as a system of access to land (Aumeeruddy-Thomas et al., 2017). Although influenced by multiple national-level programs supporting the intensification of olive production (based on irrigation, fertilization and improved varieties cultivated in monoculture), traditional olive cultivation and associated practices still have strong cultural significance, notably as a marker of access to land.

The village is located at the interface of mountains and plains. People of the Rif Mountains have a long history of resistance to colonial and State authorities (Wolf, 2019). This history, and the marginalization of the Rif during colonization and decolonization processes, have reinforced the opposition between two territories: the *bled es siba* (land of dissidence) and the *bled el Makhzen* (land of the central government). The latter corresponds to the people under the authority of the Sultan, who pledged allegiance first to the colonial administration and then to the State. This opposition corresponds to different agricultural systems, that is, small farms in the mountains, modern and more intensive agriculture in the plains.

2.3 | Characterization of access to land

Mountain regions are characterized by micro-properties and by plots disseminated in the landscape. Access to land is characterized by (i) great regional and social disparities due to colonization and decolonization processes; (ii) fragmentation due to the inheritance system; and (iii) social relations linked to the symbolic figure of saints (Gellner, 1969).

- (i) Regional and social disparities: In a century, Morocco has moved from a predominantly tribal occupation of land to a

predominantly private occupation (Bouderbala, 1999). Before the French and Spanish protectorates (1912–1956), the land that was occupied by tribes had a flexible spatial dimension linked to the limits of the tribes' sedentary agriculture, and to the territory they were politically and demographically able to occupy (Karsenty, 1988) which did not exclude the existence of private property referred to as *melk*. Colonization instituted different property regimes, including the registration of land, which benefited colonial property claims. At independence, the colonial domains were transformed into State domains or sold to private Moroccan buyers, who constituted a new class of agrarian bourgeoisie. Northern Morocco in particular was under the Spanish protectorate and the colonial administration did not prioritize land registration. Land registration in the region started with independence and has led to cadastral conflicts since then.

- (ii) Fragmentation: The traditional inheritance system and associated laws are a source of land fragmentation and conflicts. The inheritance system contributes to a reduction in the area of cultivated land per household, as each family member can claim a share of the inheritance. Fragmentation of plots in the landscape is also linked to an ancient and collective division of tribal lands into different cultivation areas (Fay, 1979). Each new cultivation area established by the tribe for agriculture was distributed among the different families, allowing each household to have plots in agriculturally different land types on a territorial scale (Le Coz, 1964).
- (iii) Symbolic role of saints: The organization of territory in rural Morocco cannot be understood without considering the role of the saints. Saints are historical spiritual and war leaders who symbolically represent the founding of the territory of the tribe (Berque, 1955; Gellner, 1969). Their presence is marked by their mausoleum and by practices associated with them. Simenel (2010) has notably shown different strategies related to land among social groups, founded on the relationship of each group with the saint. The local saint of Jahejouka, *Sidi Ahmed Sheikh*, who may have settled in the 16th century (Askar, 1913), is an important saint for the village and the region.

Land access in the Maghreb, in Morocco and northern Morocco in particular, is thus a complex system of entangled norms. The different regimes and their overlaps, as well as the conflicts they generate, have been widely described (Bouderbala, 1999; Lazarev, 2013). Within this complex land system, farmers have several modes of access to land. Eight modes can be differentiated:

- (i) Inheritance: the plot was inherited from the farmer's father or mother (or more rarely, from another family member). The inherited plot has the status of a private property registered by Islamic law notaries (*melk*).
- (ii) Family: the plot belongs to the farmer's parents but is worked by the farmer.
- (iii) Purchase: the plot was purchased from another farmer.
- (iv) Rental: the plot is rented annually from another farmer.
- (v) *Habous*: this land is bequeathed by an inhabitant for religious works and is rented by auction every year in April.
- (vi) Sharecropping: sharecropping and its forms, also known as agricultural associations between farmers, are of pre-Islamic custom (Bouderbala, 1999; Nef & Voguet, 2011) and correspond to different contracts, named according to the minimal share due to the party working the land: *b'l'khomss*, for a fifth, *b'l'rba3*, for a quarter, *b toulout*, for a third, *b nss*, for half. The share of the harvest that each farmer receives is negotiated according to each party's contribution to the agricultural work: land, labour force, ploughing animals, seeds and inputs.
- (vii) Clearing: this is an ancient form of creating private rights to land in the Muslim world (Benhima, 2003; Denoix, 1996). It is also referred to by scholars as vivification of the land (Lazarev, 2013) by clearing the matorral (a Mediterranean vegetation type of bushes and small trees, linked to processes of forest exploitation and abandonment or temporary use of cultivated land) or through clearing of forest, stubble removal, etc. This practice was already described by Berque (1955) in the High Atlas and is currently used in the Rif, especially through the grafting of olive onto wild oleaster (Aumeeruddy-Thomas et al., 2017). Clearing is linked to tree plantation, as planting of trees has been used to secure access to land since the Roman era (cf. Supporting Information S3).
- (viii) Gift: exceptionally, poor farmers were given land by distant relatives if these relatives were absent or unable to cultivate their land. This gift implies social dynamics of counter-gift.

2.4 | Data collection and ethics approval

We collected ethnographic, geographic, ecological and ethnoecological data, both qualitative and quantitative. First, we conducted individual semi-directed interviews with 51 farmers of Jahejouka (representing approximately half of the families of the village), either at the farmers' homes or on their plots. This approach was completed by field ethnography, during which we accumulated observations as farmers shared their experiences with us. Extended immersion in the field, as well as participant observation, allowed us to deepen our understanding of the multiple relationships among farmers and those between farmers, their crops and the environment. In order to evaluate the link between the diversity of modes of access to land and crop diversity, farmers were questioned about different aspects of their agricultural activity, specifically the species of crops they grew on each plot, the associated practices, the uses of the crops and farmers' modes of access to each plot of land. We focused on species level because the relationships between land access patterns and crops play out at the species level more than at the landrace level. The interviews were facilitated by a farmer from the village who acted as a guide and interpreter. This person was chosen because he was the only French speaker in the village. He was also a relative outsider, having studied and worked outside the village. As such,

he was not tied (positively or negatively) to any particular family and in fact had access to all families. His knowledge of the village's different families and dwellings was also an asset in facilitating the introduction to the families. A selection bias by affinity cannot be totally ruled out, but this was reduced by interviewing a large proportion (over half) of all the village's families.

Second, we collected systematic data on 312 plots cultivated by 29 farmers. Generic information about each farmer (age, area cultivated, farming experience, number of plots, number of species cultivated) is presented in the [Supporting Information \(S4\)](#). We located and estimated the area of each plot using a GPS (GARMIN eTrex® 10) or identified plots by inspecting satellite images with the farmers (Google images, CNES/Airbus, Maxar Technologies, cartographic data, 2019). Classes of topographic conditions were defined using STRM files (N35W006 and N34W006, 30-meter resolution) of the site. Each cell of the SRTM was then classified into 12 categories of altitude and slope orientation ([Supporting Information S5](#)). The species cultivated were denoted using the local names ([Supporting Information S2](#)). Soil types were identified using an ethnoecological survey based on the local classification of soil types (results of this survey are detailed in [Supporting Information S6](#)). These data were stored in a GIS (QGIS 3.4.1-Madeira).

Authorizations for fieldwork were sought from national and local authorities. Although no specific permissions were required, we considered ethical protocols throughout the data collection process. We informed the authorities in charge of access to genetic resources and the sharing of benefits arising from their utilization. We explained the purpose of the project to all participating individuals at the beginning of each interview and the research team was given a verbal consent. Participation of interviewees was voluntary. Answers of all individuals were analysed anonymously and used strictly for the purpose of the study. In agreement with our partners and local authorities, a preference was given to oral consent over written consent, for three principal considerations. Firstly, the language barrier, as not all participants could read standard Arabic easily. Second, the intrusive and intimidating nature of the act of signing could induce apprehension among participants, even if the document was read and explained comprehensively. Lastly, the symbolic weight associated with the signature and the power dynamic it established, could distance the respondent and the interviewer. The research project under which this study was conducted complied with the European General Data Protection Regulation (RGPD) on the protection of individual information under the reference 2-21088.

2.5 | Data analysis

Interviews and observations were compiled and analysed thematically to understand the social organization of access to land and to compare how different farmers viewed their access to land and how it interacted with the choice of the crop species they grew.

For each farmer with whom we worked, we calculated the number of plots, total cultivated area, crop species richness (total number

of species) and the number of ways each farmer gained access to land. We compared the distribution of plots between the different patrilineages with information obtained through the interviews and calculated the share of each category of access to land in the total area cultivated by the farmer. Based on this information, we drew several profiles of farmers. The relationship between various ways of gaining access to land and crop diversity was interpreted thanks to interviews with farmers.

In order to test the relationship between crop species richness and the diversity of modes of access to land, we used bivariate and multivariate analyses. All analyses were performed using R v.4.1.3 (R Core Team, 2022). We used a generalized linear model with a Poisson distribution and a log link to estimate the effect of both total cultivated area and mode of access to land on crop diversity. As there was no significant difference in species richness between farmers having one or two modes of access to land, we grouped them in a single category in the model. To estimate the significance of each effect, a likelihood ratio test determined whether the full model was significantly better than the model without the effect of the plurality of modes of access to land. Residuals were checked with the DHARMA package (Hartig, 2018). For each farmer profile, we compared the total cultivated area for each farmer, crop species richness and the diversity of topographic and soil conditions using non-parametric tests (Wilcoxon–Mann–Whitney test and Kruskal–Wallis chi-squared test).

3 | RESULTS

3.1 | A common pattern of crop diversity despite social disparities in access to land

3.1.1 | Farm description

Among the 29 farmers surveyed, we observed great variation in both the number of plots cultivated and the total area of cultivated land. The number of plots per farmer ranged from 1 to 17 (mean of 5 ± 3.6 SD) and the total area ranged from 0.1 to 16.6 ha. The average farm size (including all plots) was 3.2 ha (± 3.4), which corresponds to the mean area of holdings in the western Rif (Conseil Général du Développement Agricole, 2009). The region is indeed characterized by small properties, with 58% of farmers owning less than 5 ha and 37% less than 3 ha. Micro-property was slightly over-represented in our sample: half of the farmers cultivated less than 2.4 ha and 75% of farmers cultivated less than 5 ha. Only two farmers cultivated more than 10 ha. The number of modes of access to land varied from one to four, with a mean of 2 ± 0.92 (SD). Farmers cultivated from 2 to 10 crop species (mean of 5.2 ± 2.5). Almost all farmers (27 out of 29) managed to grow cereals, legumes and trees ([Figure 2](#)). Cultivating this triad of crop groups seems to be a practice towards which all farmers tend, a conclusion that was confirmed by the interviews. When asked about the reasons for cultivating a particular species, farmers generally answered that this crop was *darori*, which means

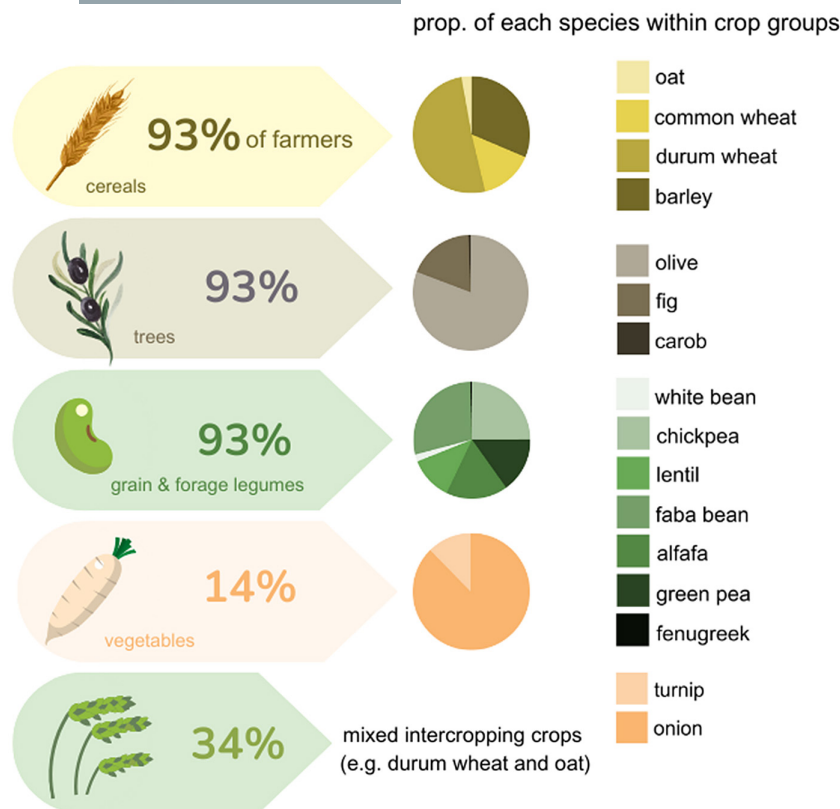


FIGURE 2 Proportions of farmers growing the different crop groups: cereals, legumes, trees, vegetables (here, only vegetables cultivated in fields are considered; many farmers grow vegetables in home gardens) and mixes of crops (mixes of cereals sown as forage for animals). Pie charts show the proportion of the total area covered by each crop species within each crop group.

both necessary and mandatory. They therefore ensure a minimum of diversity by cultivating each of the three pillars (cereals, legumes, trees).

3.1.2 | Not all farmers can mobilize multiple modes of access to land

Farmers are not equal in their ability to access new plots. Based on the proportions of each mode of access to land calculated for each interviewee, we identified two profiles of farmers: farmers who have only inherited plots and do not necessarily manage to increase their cultivated areas (Figure 3, H profiles) and those who have inherited plots and can mobilize resources to acquire new plots (Figure 3, D profiles).

Most H farmers cultivate only the plots they have inherited (H1, $n=9$) but a small proportion of them (designated H2, $n=3$) also cultivate plots belonging to other members of their family such as a retired parent. The situations of farmers with H profiles explain why they do not seek other lands. Some already have a large number of plots and cannot cultivate more, owing to a restricted labour force, for example. Others have smaller holdings but are old or even ill and cannot work much, and yet others are inexperienced farmers who have returned to the village after emigrating to Tangier or Spain.

Among farmers of the diversified (D) profile, the proportions of cultivated area from inheritance and non-inheritance varied (Figure 3). For some, inheritance was their main mode of access to land (D1) and for others, it was a marginal mode (D2). D farmers mobilize from one (D1a) to three (D1b) additional different modes of

access to land. This category corresponds mainly to the families of patrilineages 1 and 6 (Figure 4), who use their social and economic capital to acquire new land. Other situations also occur. Some small farmers have very small inherited or family areas and cultivate plots in sharecropping arrangements or illegally clear forest plots (for example, D3). Some influential or pluri-active farmers have the economic resources to buy or rent plots (D2). Intermediate situations exist for farmers who reach an agreement with the other heirs of their father's or uncle's plot to unify larger cultivated areas by renting from the heirs or engaging in sharecropping arrangements with the heirs on the plots divided after the inheritance.

We thus distinguish two types of farmers who mobilize several modes of access to land: those who do so out of necessity because their initial capital does not allow them to secure the minimum surface area for viable production, and those who already have a relatively large area, who mobilize additional land for relational reasons, for example, power relationships and symbolic capital. As stated by one of the interviewed farmers, who owns the most land in the plain south of the village:

I must always increase my property because real farmers want to increase their property.

[farmer 28]¹

¹Detailed information about each interview participant is provided in [Supporting Information S4](#).

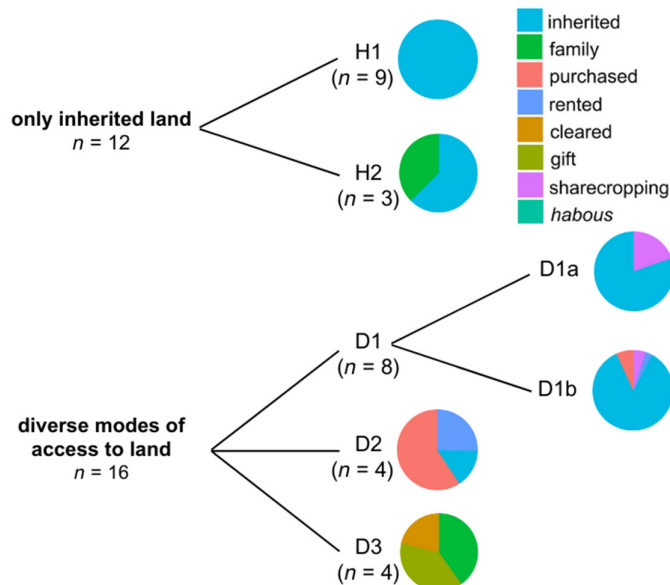


FIGURE 3 Two profiles were defined based on the proportion of each mode of access to land in the total area cultivated by the farmers. H are farmers with only inherited land (H1) and with inherited plots plus shared family plots (H2). D are farmers with a diversity of modes of access to land, including farmers with a majority of inherited area (D1a and D1b), farmers with a large proportion of their land purchased thanks to their economic capital (D2) and farmers with a large proportion of their land acquired through customary practices (cleared land, sharecropping and gift) (D3). Each pie chart represents the proportion of each mode of access for a single farmer randomly chosen as an example of each category. One farmer was not integrated into the figure because he had no inherited plots. He is a blacksmith, whose family has no land, and who has rented a few plots to supplement his activity.

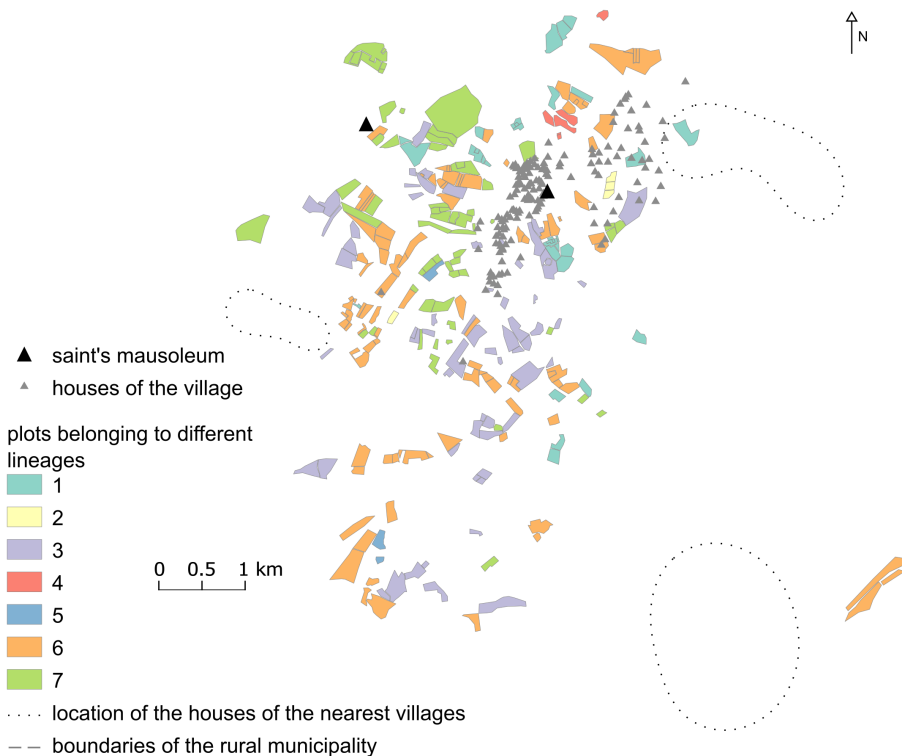


FIGURE 4 Location of the plots of seven important patrilineages of the village: 1 are former musicians who have become rich through the commercialization of music, 2 are former dyers and weavers. They now have the same opportunities as other farmers (but they inherit the situation of their ancestors and therefore have few plots). 3 are an ancient patrilineage of farmers, 4 are descendants of a musician patrilineage, 5 are from a patrilineage of blacksmiths, 6 are farmers who are identified as descendants of the prophet (*chorfa*) and 7 are members of a patrilineage linked to another saint.

The concept of honour and being a *fellah* is closely linked to land ownership, but sharecropping is a temporary solution to demonstrate one's work capacity and invest in the land. The same farmer describes his journey to becoming a 'real farmer' as follows:

Before, I used to herd the goats of [patrilineage 1]. Then we acquired parcels in partnership (*tferdna*: literally, we participated), and then we bought land here and there.

[farmer 28]

The ability to show one's capacity as a farmer by cultivating one's own land and expanding one's property is an implicit norm, as stated by another farmer, who works with numerous other farmers in the village:

Agriculture is a necessary evil. Why do we do this, what is the use? We seek consideration, respect and we want to secure a position in the community.

[farmer 14]

Thus, being entrusted with the cultivation of plots of land owned by another farmer is a recognition of a farmer's value. Only a 'real farmer' is capable of working the land well and respecting it so that the land gives back what is given to it. This notion of respect, of the land and of other farmers' work, is strongly linked to the definition of honour and comes into play in the choices made by farmers when deciding to partner with other farmer. An elderly farmer who is no longer able to work alone but is determined to have his land cultivated, explains these choices:

The land must be cultivated but not by just anyone. One must respect the status of the land: one must look at the alternation of cereals and legumes, pay attention to the trees and the limits of the plot.

[farmer 29]

The vision of the territory associated with the concept of honour is one where the land is cultivated through the labour of farmers. Land left unproductive is synonymous with a collective dysfunction. An elderly retired farmer, renowned for having been a great farmer in his time, emphasizes the collective duty to cultivate the village's lands:

It is easier today, there is space, there are offers. Before, there were more people, [...] no land was left uncultivated, today there is abandoned land.

[farmer 21]

3.1.3 | Social and relational drivers of different types of access to land

The disparities in the diversity of modes of access to land are historically linked to the social position of each farmer in the village.

As elsewhere in Morocco, social categories are based on a combination of social, spatial and temporal logics: individuals are differentiated by patrilineage, profession, relationships to the saint, the religious authorities, the central state (*makhzen*) and the origin of the individual's family. The presence of the saint on the territory has been used socially to institutionalize differentiations between the patrilineages generally associated with different professions and social status (Supporting Information S7). These differences result in various social categories that affect access to land—in terms of total area and spatial distribution. We distinguished four categories that are similar to those recognized in other parts of Morocco (Simenel, 2010): (i) Socially acknowledged servitors of the saint, whose major profession is to be musicians associated with rites of the saint. They traditionally can neither own nor cultivate land and depend on alms from other patrilineages and are at the bottom of the social ladder. Thus, most of the families that descend from musicians own very few plots of land today. (ii) Artisans, such as blacksmiths and dyers, who have traditionally had little access to land. (iii) A class of land workers or farmers under the authority of the saint who have no social limitations on their access to land. Another patrilineage related to a different saint has their holdings located near their saint's tomb. (iv) Finally, a class of *chorfa*—socially acknowledged descendants of the prophet—who have many possessions and a central role in agricultural modernization. These social positions still influence farmers' access to land (Figure 4).

Strategies mobilized by farmers to access new plots of land are based on these social positions. Farmers play on the different relational levers, including through matrimonial exchanges between families or attempts to get legal recognition of their origins as descendants of the prophet. We observed various situations that we illustrate with two examples:

- (i) A patrilineage of *chorfa* (lineage 6 in Figure 4) arrived in Jahejouka in the late 19th or early 20th century, following banishment from another village of the tribe. After a blood crime, banishment is sometimes the only way to end the chain of revenge, as shown in other parts of the Rif. Newly arrived families of external origin are positively perceived by the village communities, and welcoming newcomers contributes to increase the labour force and alliances as well as to acquire new techniques (Jamous, 1981; Simenel, 2010). The new settlers have to gain access to land to be accepted and have influence in the village. This family benefited from their social status of *chorfa* to gain influence on the territory. Today this patrilineage is the one with the most land capital, including the largest holdings within the village. They also hold positions of legal and spiritual power, as one of their members is the representative of the state authority and another is the imam of one of the village's mosques. Their acquisition of large areas of land is linked in particular to their relations with the former colonial power and to the control of agricultural production. One of their ancestors, known to be an outlaw leader in the 1920s, was chosen

by the colonial administration to be a local representative of the State (*caid*). Thanks to their interest in and knowledge of modern seeds and agricultural practices, members of this patrilineage were able to acquire new plots of land, particularly in exchange for food in times of famine. Farmers interviewed reported that a bucket (~10L) of sorghum could be sufficient payment to obtain a plot of land.

- (ii) Another great transformation of the social relationships and access to land in the village concerns the musicians. The current leader of the musicians, and his father, both became rich thanks to the international recognition of the traditional Sufi music of Jahejouka in the 1970s. The 'masters' (musicians) of Jahejouka have fascinated musicologists and artists and toured many countries. Their success transformed social relationships, as stated by one farmer of the village who is a descendant of one of the most famous musicians:

Before, the musicians had to play every Friday morning and the farmers had to give them free wheat. Today they are the ones who give dollars.

[farmer 52]

This family took advantage of the commodification of land and acquired some plots in the village. Today they hold more plots than the other musician patrilineages (Figure 4).

3.2 | Relationships between mode of access to land and crop diversity

Although most farmers grew the same groups of crops, variation in the diversity of crop species persists among farmers and follows variation in the number of land access modes and farm size. The generalized model indicates that farmers with three or more modes of access to land have 1.6 times more crop species than farmers having only one or two modes of access (CI: 1.04 to 2.35 species, p -value=0.01, difference illustrated in Figure 5). The effect of total cultivated area had a negligible effect on crop diversity (each additional hectare multiplied the number of species by only 1.03) and was marginally significant (p -value=0.08).

3.2.1 | Choice of crops and their management vary with the mode of access to land

The interviews revealed that the identities of the crop species grown were tied to the implicit rules that govern each mode of access (Table 1).

First, the choice of crops was influenced by the mode of access. Inherited lands are subject to fewer restrictions on the identity of crops that can be grown. We observed species of cereals, legumes or trees cultivated in monoculture or both trees and annual crops grown together on the same piece of land. Inherited

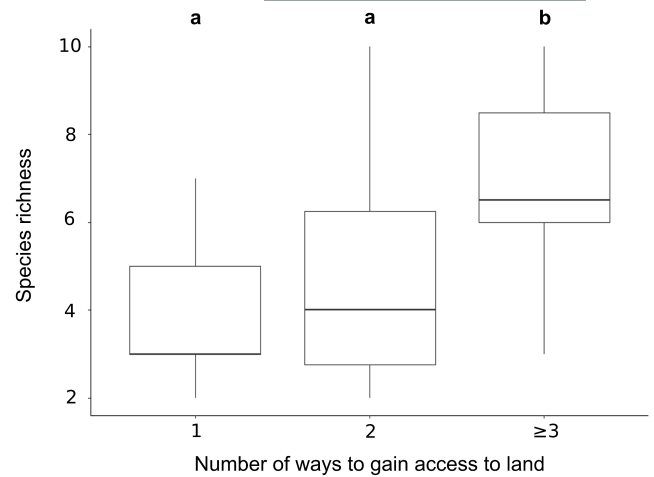


FIGURE 5 Mean species richness as a function of the number of ways to gain access to land. Different letters indicate a significant difference in crop diversity between groups using pairwise Wilcoxon tests.

lands often contain old olive trees grafted onto oleasters by preceding generations. Because sharecropping plots require a division of the harvest into shares, no sharecropping contracts were established when harvests could not be easily shared. This is the case for example for products harvested regularly during spring for fresh consumption such as fava beans, peas and forage crops or sown pastures. When harvests can be more easily shared, we observed different contracts (see general description in the materials and methods section) depending on crop types: cereals (one-fifth share to the person working the land), legumes (one-fourth) and the harvest of fruits of mature trees (mainly olive, for one-half). Rented lands can be used to produce green animal feed or grazed fields, legumes harvested green or vegetables such as onion. The *habous* plots, rented at auction, are preferentially used for the production of lucrative crops such as chickpeas. The rented parcels are generally free of trees, and any trees present are subject to a different regime because they are not rented with the land. Since the olive is a central commodity, people who are absent or unable to work prefer to recover half of the harvest by sharecropping rather than to collect rent. Cleared lands are systematically planted with olive trees, following customary practices of vivification. Although clearing land appears to have been a widespread practice in preceding generations, it is now illegal because the forest belongs to the state domain. Purchased plots are also, with some exceptions, planted with olive and fig trees. In addition to the economic and cultural importance of the olive in the region, the practice of planting trees is also linked to the recent tendency towards individualization of property. It is indeed customary for herds of domestic animals to be able to move and graze freely on plots that are not cultivated, or not marked with a stone or a small cairn painted with whitewash to indicate that grazing is prohibited. With the division of collective lands and the reinforcement of legislation on forests, finding grazing areas has become increasingly complicated. Landowners therefore prioritize the defence of their

TABLE 1 Crops grown as a function of mode of access to land.

Mode of access	Crops generally grown	Crops generally absent	Changes in the practice over time
Inherited land	All crops	-	-
Sharecropping	Cereal (1/5 contracts) and legume (1/4 contracts) that can be harvested at one time, harvest of mature trees (1/2 contracts)	Crops harvested regularly (peas, fava bean), fodder and grazed cereals	Planting trees on another person's plot to claim a share of the harvest is less often practised
Rented land	Fodder, vegetables	Trees	-
Habous	Lucrative crops (chickpeas)	Trees	There is a form of speculation by people external to the village to rent <i>habous</i> land to grow hashish. As a result, this mode of access is increasingly unaffordable for farmers
Cleared land	Trees	-	Now illegal
Bought land	Trees	-	Tree planting is now used as a way to prevent undesired grazing

plots against uncontrolled grazing at the expense of customary collective management of grazing. The planting of trees then has a dissuasive role, as the damage caused by the animals may lead to conflicts for the transgressors.

Second, the flexibility offered by the existence of various modes of land access influences the allocation of annual crops throughout the year. We observed that farmers make decisions on crop allocation in their plots in order to minimize the risk of harvest failure. If climatic conditions are perceived as good for a certain crop, farmers will sow as many plots as possible with that crop. As spring conditions are usually more uncertain, farmers dedicate lands in priority to winter crops, mainly cereals (e.g. barley, wheat, oat and broad beans). When the late winter/early spring crops (e.g. onions, white beans and chickpeas) are ready to sow and the weather seems appropriate, some farmers rent additional plots specifically for these crops, while others look for sharecropping arrangements. Finally, if these crops fail, some farmers may look for a new plot to grow sorghum, which is considered a fallback crop.

3.2.2 | Non-inherited plots are used to diversify the farmer's species portfolio and increase environmental heterogeneity of his holdings

We found that farmers who have only inherited plots (H) had lower total cultivated area, species richness and diversity in topographic conditions and soil types on average than farmers who have diverse modes of access to land (D). If we only consider the inherited plots of D farmers, their mean cultivated area (1.91 ha), species richness (4.3), number of topographic conditions (2.9) and number of soil types (2.3) were all similar to those of H farmers (2.09, 4.2, 2.4 and 2.3, respectively, see Table 2). With the plots acquired through multiple ways, D farmers on average doubled their cultivated area, cultivated 1.7 more species (up to four more species in some cases) and gained diversity in the environmental conditions of the plots cultivated. However, we observed great variation among diversified farmers

around these average numbers. While some farmers more than doubled their cultivated area or species richness with new plots, others did not gain diversity in any of the dimensions measured (species, topographic conditions and soil types). For the four variables tested, differences between groups D and H were significant only for topographic conditions (Table 2). Differences in area cultivated, crop species richness and number of soil types were non-significant (but with a quite strong trend for the first two variables). The effects of all these variables should be tested in a larger sample to provide more statistical power.

Increasing the environmental and soil heterogeneity of plots can allow farmers to grow more kinds of crops, to grow crops under conditions more suitable for them and to adapt to the effects of interactions between soil and climate on crop performance. Depending on the different types of soil and conditions, different crops are favoured, as shown in Table 3 (and Supporting Information). The environmental factors motivating crop choices by farmers are developed in detail in a companion paper in preparation.

4 | DISCUSSION

Our work shows that as part of their cultural identity, which includes having access to land and strong motivations for maintaining crop diversity, farmers develop multiple modes of access to land. This effectively acts as a lever to diversify crops as well as the suite of environmental conditions in which the farmer can cultivate. As a factor driving crop diversification, mobilizing diverse modes of access to land seems to be more important than the increase in area cultivated per se, which is a factor often considered in other smallholder agriculture contexts (Samberg et al., 2013). Mode of access to land is overlooked but important because the types of crop(s) planted depend on the mode of access in addition to other parameters such as environmental heterogeneity. Finally, farmers show different profiles depending on their ability and/or their need to diversify their portfolio of land and crops. We discuss these results, and their

TABLE 2 Mean (\pm SD) area, species richness, number of topographic conditions and number of soil types as a function of farmers' profiles for their inherited plots and all their plots. Results of the non-parametric tests compare the differences between D and H farmers for the four variables presented.

Farmers' profile	Category of plot	Mean area (ha)	Mean species richness	Mean number of topographic conditions	Mean number of soil types
H	All plots	2.09 \pm 1.8	4.2 \pm 1.8	2.4 \pm 1	2.3 \pm 1.2
D	Only inherited plots/all plots	1.91 \pm 1.8 // 4.04 \pm 4	4.3 \pm 2.5 // 5.9 \pm 2.6	2.9 \pm 1.9 // 3.8 \pm 1.9	2.3 \pm 1.3 // 2.8 \pm 1.3
Test		Wilcoxon-Mann-Whitney test = 132, p-value = 0.1	Kruskal-Wallis $\chi^2 = 3.2642$, df = 1, p-value = 0.07	Kruskal-Wallis chi-squared = 4.378, df = 1, p-value = 0.04*	Kruskal-Wallis $\chi^2 = 0.93361$, df = 1, p-value = 0.33

The star refers to the level of significance of the p-value: *p < 0.05.

implications, in the light of contemporary changes in access to land and crop diversity, for the relational dimension of access to land and resilience.

4.1 | Contemporary changes in farmers' modes of access to land and crop diversity

In this study site, we observed an individualization of agricultural management: collective land was divided in the 1970s and tree planting has been used since then to prevent access to plots by grazing animals. Formerly, the organization of agriculture was related to the management of herds by patrilineages on commons and to collective agreement on cultivation areas. As Berque (1955), Karsenty (1988) and Lazarev (2013) have shown, this did not exclude individual management of plots. Rather, it was a collective effort to clear new cultivation areas, that is, agroecological zones favourable to a particular crop were distributed among the heads of the families of the village. This historical context is also the reason for the wide dispersion of plots across the village territory. Interviews with farmers showed that the disappearance of this traditional mode of socio-ecological functioning, under the effect of the division of collective lands, new agrarian policies, political changes in forest management and the prohibition of land clearing, has led to an individualization of the management of plots of land with, in particular, a reduction in the rights to graze (Lazarev, 2013). Farmers thus had to grow more forage crops, decrease the size of their herds and intensify their practices, leading to increased soil erosion (Fay, 1979). These mechanisms are related to a widespread trend that took place in Mediterranean Europe at the end of the 19th century. Comparable trends towards individualization are linked to social and political changes and are consistent with results from other African land studies. Bainville (2017) and Turner and Moumouni (2019) notably showed that intensification and individualization of agricultural practices in Burkina Faso and Niger are not linked to pressure on land resources due to a demographic increase or to market forces, but rather to social dimensions such as technical changes in agriculture or power competition among chieftaincies.

Our results suggest that designing tenure reforms that support practices favouring crop diversity must thus take into account the diversity of customary modes of access. Our study challenges the widespread, but controversial, notion that the productivity and sustainability of agriculture could be improved by commodification of land and individualization of land rights. Some studies on the impact of land reforms in different African countries show a positive effect of codifying in law statutory ownership on crop diversification (Nkomoki et al., 2018) and on investment in soil conservation practices (Bizoza & Opio-Omoding, 2021). However, most scholars agree that such reforms have generally not increased farmers' security or investment (Barrows & Roth, 1990; Gavian & Fafchamps, 1996; Krusekopf, 2002; Melmed-Sanjak & Lastarria-Cornhiel, 1998; Place & Hazell, 1993), nor have they necessarily promoted sustainable practices (Guillerme et al., 2011; Hu, 1997; Jakobsen et al., 2007). These

TABLE 3 Examples of the influence of soil type and soil-climate interactions on crop choices.

Soil type	Description	Crop choice and soil-climate interaction
Soil that 'cooks' the legumes (<i>tayba</i>)	Soil that produces legumes that are easily cooked	Legumes on soils that 'cook'; cereals on soils that do not 'cook'
Soil that 'gives oil' (<i>kate3a zit</i>)	Each type of soil gives a different percentage of olive oil	Olive trees
Soil <i>trab</i>	Soil that has a good balance of clay and keeps humidity	Suited for all crops, but preferred for sensitive crops such as chickpeas or modern varieties of wheat
Cold soil	Soil located at the bottom of the slope, more humid; stores water, cool climate on the plot	Vegetables and forage legumes (alfalfa); not suited for grain legumes, particularly chickpeas, except in dry years
Warm soil	Soil located at the top of the slope, always dry because rainwater rapidly infiltrates	Olive trees; not suited for most annual crops, except in rainy years, when it can prevent crops from rotting

findings may be explained by the fact that the new policies often failed to take into account local practices (Ducourtieux et al., 2005) and have not always resolved inequalities in access to land that were inherited from colonial times (Clover & Eriksen, 2009). Even though traditional land tenure systems are not inherently equitable, individualization of rights does not guarantee greater equity in access to land (Feder & Noronha, 1987; Mwangi, 2006). Abbott (2005) and Nkuba et al. (2020) show, on the contrary, the importance of traditional land tenure systems for the preservation of local varieties and for adaptation to climate change.

4.2 | Relational dimension of farmers' access to land

As shown for example by the work of Bourdieu (1972) in Berber communities in Algeria or by that of Jamous (1981) in the Rif, access to land is strongly linked to the honour of the farmer in Mediterranean societies. Between different norms (customary, legal, Islamic) and different means of gaining access to land (economic as in purchasing or renting, social as in sharecropping, land clearing, family labour or inheritance), there is not a substitution but a coexistence that leads to a bundle of rights linked to different dimensions of individual power (Mackenzie, 2003; Mwangi, 2006; Schlager & Ostrom, 1992). Mobilizing multiple ways of gaining access to land is linked both to economic and symbolic capital (Bourdieu & Wacquant, 2013) and sustains the production of diverse crops. Certain farmers increase their cultivated area through relations with other farmers. We found that it was not necessarily the farmers with less inherited land who were looking for new plots. Particularly, members of a lineage coming from outside the village have used multiple strategies to gain access to land and to become authority figures. These strategies include the use of their religious status to gain authority, their capacity to buy land from other lineages, their innovative agricultural skills and their relations with central state power. Similar strategies were described by Simenel (2010), who showed that banned families have particular roles in the diffusion of agricultural modernity. How farmers gain access to land, and control this access, is not only a matter of agricultural production and livelihood, but also a matter of identity and social organization. Land is also valued as an element of social exchange for

farmers (Bourdieu, 1972). The diverse modes of gaining access to land do not have the same social function or the same contribution to the honour of a family. Finally, the diverse modes of access contribute to farmers' symbolic capital by increasing the diversity of crops they can cultivate, and the crops they can exchange at the souk, which is part of their cultural identity (Troin, 1975).

Our results contribute to understanding the importance of the relationship to land of the different social groups in land access practices. Consistent with the work of Beyene et al. (2006) in Ethiopia, we found that the social values of land and the relationship to land of Moroccan farmers are interdependent with agricultural practices. Access to land is not a timeless structure, but is under construction and is reorganized with the introduction of new practices and relations between farmers (Ruf, 2010; Saïdou et al., 2007).

4.3 | Multiple modes of access to land: Links to crop diversity and its spatio-temporal distribution

Previous studies suggested that in Zambia, households with customary access to land were less likely to adopt crop diversification (Nkomoki et al., 2018). In China, Rao et al. (2016) showed that households with less secure access to land were less likely to adopt crop-tree intercropping practices. In Ghana, people with more secure access to land were more likely to invest in agrobiodiversity-friendly practices such as selective clearing and tree-crop intercropping (Awanyo, 2009). However, the practices of farmers show that tree planting is also a strategy of land appropriation. We agree with Awanyo (2009) about the complexity of the links between access to land, crop diversity and socio-cultural identity:

These processes—comprising components of tenure acquisition, tenure building and tenure renewal—are crucial for explaining not only how some privileged farmers obtain more secure formal land tenure rights that shape agrobiodiversity investments (the conventional land tenure security/investment causation link) but also why farmers with varying formal land tenure security rights invest in agrobiodiversity practices in order to strengthen their land tenure security (the

reverse land tenure security / investment causation link).

(Awanyo, 2009: 152)

We show that the situation of farmers with respect to access to land is more accurately described using multiple modes of access rather than by comparing two broad types of access, secure and insecure, that have been distinguished in most previous studies. Farmers' modes of access to land overlap customary and statutory norms of more or less permanent access, and this complementarity supports crop diversification. The plurality of modes of access to land allows for a flexible use of resources and management of agrobiodiversity across different temporalities. Long-term management of agrobiodiversity coexists with short-term and more flexible practices. The decision to plant olive trees relates to medium- to long-term profits, with trees beginning to produce after three to 5 years and for decades thereafter. Some farmers continue to harvest the fruits of trees planted by their grandparents. Short-term flexibility allows for more adaptable practices and relies on partnerships between farmers. Our results illustrate that such flexibility is particularly important in a context of increasingly uncertain weather in spring. The plurality of modes of access to land thus allows farmers to adapt in time (short and long term) and space (under different environmental conditions), to obtain land and crops, and is also a lever to gain access to seeds and knowledge from other farmers.

In this regard, Wencelius (2016) uses the notion of performance developed by Richards (1993) to describe farmers' practices, rather than that of strategy. The diversity of crops grown by farmers is not a fully anticipated scheme but a result of the environmental conditions of the year, the economic and agronomic resources of farmers and their capability to gain access to land through social alliances. This diversity is constructed event after event. The idea that agriculture is a 'performance' illustrates three dimensions of farmers' knowledge analysed by several studies (e.g. Ingold & Kurttila, 2000; Roué & Nakashima, 2002): it is adaptive, malleable and in constant evolution; it is place-dependent, rooted in the specificities of a group and a place; it is also holistic in that it integrates multiple dimensions in decisions, ecological, social and economic. Farmers' knowledge is not a stock of information on different topics but practical dispositions that are co-constructed by interactions with others, and by external, often unexpected events. For the existing inherited plots, the crops are distributed at each time of the year to minimize the risks and respond to the constraints of each crop (in terms of soil, slope, alternation between cereal and legumes, etc.). In contrast, the temporary plots are linked to the search for a specific product to complete the basket of crops already sown. Farmers use their plots to grow new species for a variety of reasons, including species complementarity, soil diversity and environmental heterogeneity.

5 | CONCLUSION AND PERSPECTIVES

Multiple modes of access to land, and intimate linkages to crop diversity and the social processes linked to these modes of access, are

undoubtedly key to adaptability, but this point is ignored if only the security of access to land is considered and/or if linkages to the role of mode of access to land in maintaining crop diversity are ignored. The increasingly narrow circumscription of ways people can gain access to land raises questions about the future of farming practices and crop diversity. It is thus crucial to take these different modalities of social organization into account when analysing adaptation to environmental changes like climate change (Eriksen & Selboe, 2012). Policies that constrain farmers' modes of access to land are not without repercussions on agricultural practices, or even on the socio-political organization of rural communities, which must be more fully taken into account and analysed.

AUTHOR CONTRIBUTIONS

Marilou Demongeot, Younes Hmimsa, Doyle McKey, Yildiz Aumeeruddy-Thomas and Delphine Renard conceived the ideas and designed the methodology; Marilou Demongeot collected the data; Marilou Demongeot and Delphine Renard analysed the quantitative data; Yildiz Aumeeruddy-Thomas assisted Marilou Demongeot in analysis of the qualitative social and cultural data. Marilou Demongeot led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

Data available from the Dryad Digital Repository: Demongeot, Marilou (2022), Farmer's access to land and crop diversity, Dryad, Dataset, doi:10.5061/dryad.6t1g1jx1p (reviewer URL: [preview](#)).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

- Appendix S1.** Transcriptions of terms in darija.
- Appendix S2.** Local English and scientific names of the main crops encountered.
- Appendix S3.** Mode of access to land and tree planting.
- Appendix S4.** Information about interview participants.
- Appendix S5.** Model of elevation and orientation.
- Appendix S6.** Local classification of soil types.
- Appendix S7.** Narrative of the arrival of the saint.

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