

Review paper

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**PASTORALISM IN THE MAGHREB: A REVIEW ON
ENVIRONMENTAL, SOCIO-CULTURAL, ECONOMIC AND
POLITICAL ASPECTS**

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ABSTRACT

Pastoralism is a livelihood system based on extensive production of livestock (e.g. cattle, sheep, goats, camels) mainly on marginal lands. It is a traditional activity in the Mediterranean in general and the Maghreb (viz. Algeria, Morocco, Tunisia) in particular. This review casts light on research regarding pastoralism in the Maghreb. In particular, the paper analyses the benefits of pastoralism as well as the challenges faced by pastoralists in the region from the environmental, socio-cultural, economic and political points of views. A search performed in July 2020 on the Web of Science yielded 113 documents and 68 of them were included in the systematic review. The analysed literature emphasizes the negative impacts of pastoralism and the challenges faced by pastoral communities in the Maghreb. These include climate change, land degradation and desertification, poverty and livelihood vulnerability as well as the ongoing erosion of pastoral culture and traditions. Doing so, scholars question the future of pastoralism in the region and highlight the need for its adaptation and transformation through, among others, moving towards agro-pastoral systems. There is a dearth of articles that highlight the positive impacts and benefits of pastoralism in the Maghreb. However, the literature shows that pastoralism has a long tradition and is an integral part of the Maghrebi culture and history, and values the traditional knowledge of pastoralists as well as their adaptive capacity. The review shows that there is a gap in research on pastoralism in the Maghreb especially regarding economics. In this context, regional projects such as PACTORES (Pastoral ACTORs, Ecosystem services and Society as key elements of agro-pastoral systems in the Mediterranean) result crucial to bridge the current knowledge gap and foster the sustainable development of pastoralism in the Maghreb and the Mediterranean at large.

Keywords: *agro-pastoral systems, sustainability, Mediterranean, Algeria, Tunisia, Morocco.*

INTRODUCTION

Pastoralism is as old as the Mediterranean civilisations. However, the opinions about its roles in the current Mediterranean society diverge not only among scholars but also among other stakeholders. Some consider that agro-pastoral systems (APS) are marginal systems of low economic productivity, while others highlight the notorious multifunctional nature of APS and their role in the provision of multiple ecosystem services (ES). In fact, APS produce high-quality products, valorise marginal rangelands, protect biodiversity, control soil erosion and land degradation, and preserve long-standing traditions (Bewsell & Dake, 2008). Pastoralism also plays a role in climate change mitigation/adaptation and achievement of food security (Rivera-Ferre & López-i-Gelats, 2012). Furthermore, APS are central in cultural identities in the Mediterranean and create income-generating activities in marginal, remote territories. In this context, some scholars argue that pastoralism is disappearing due to different internal and external factors such as climate change, unfavourable environmental conditions, and spatial and political marginalization (Jónsson, 2010). Indeed, FAO (2020) puts that *“In spite of their social, economic, and environmental contribution to their communities, pastoralists are often misunderstood and excluded from policy processes affecting them”*. Pastoralists face different emerging issues such as land grabbing, climate change and demographic changes, which affect their mobility as well as the access to and use of rangelands (Davies et al., 2014). Other scholars assert that APS, as complex adaptive systems, are suited to changing environmental and climatic conditions (Davies & Nori, 2008; Nori, 2017). Pastoralism and agro-pastoralism are traditional activities in the Maghreb (viz. Algeria, Morocco, Tunisia) (Maurer, 1992) and play an important socio-economic role (Dutilly-Diane, 2007). However, the sector faces several challenges such as rangelands degradation (Abdelguerfi & Laouar, 2000; Rocha Correa, 2013). In this respect, scientific evidence and data are crucial to highlight the multiple roles of pastoralism. For instance, FAO (2020) stresses that *“To increase pastoralism’s recognition, data production is crucial for evidence-based policy-making. The collection of data is essential to understand the importance of pastoralism, its contribution to local and national societies and to better inform policies”*. Therefore, this review casts light on research regarding pastoralism in the Maghreb. In particular, the paper analyses the benefits and challenges from the environmental, socio-cultural, economic and political points of views.

METHODS

The article draws upon a systematic review of all documents (journal articles, book chapters, conference articles) indexed in the Web of Science. A search was performed on 17 July 2020 using the search query: *(pastoralism or pastoralist) AND (Maghreb OR “North Africa” OR Algeria OR Morocco OR Tunisia)*. The search yielded 113 documents. Two inclusion criteria were considered: geographical coverage (viz. dealing with at least one of the three Maghreb countries) and thematic focus (viz. pastoralism). Following the scrutiny of titles,

abstracts and full-texts, 45 documents were excluded. Therefore, 68 documents were included in the systematic review (Table 1).

Table 1. List of the selected documents.

Year	Number	References
2020	2	Broodbank & Lucarini (2020); Duffy (2020)
2019	4	Dressler et al. (2019); Guerin (2019); Vidal-Gonzalez & Mahdi (2019); Zerboni & Nicoll (2019)
2018	7	Boussaid et al. (2018); Brass (2018); Dunne et al. (2018); Gobindram et al. (2018); Merrills (2018); Rignall & Kusunose (2018); Vidal-Gonzalez & Nahhass (2018)
2017	10	Blanco & Michon (2017); Blanco et al. (2017); Campbell et al. (2017); Dominguez (2017); Faye et al. (2017); Gaouar et al. (2017); Giuliani et al. (2017); Mebirouk-Boudechiche et al. (2017); Volpato & Di Nardo (2017); Volpato et al. (2017)
2016	7	Ben Hounet & Guinand (2016); Ben Hounet et al. (2016); Davis (2016); Jemaa et al. (2016); Martin et al. (2016); Mebirouk-Boudechiche et al. (2016); Roubet & Amara (2016)
2015	5	Abdallah & Souilmi (2015); Blanco et al. (2015); Leder (2015); Mebirouk-Boudechiche et al. (2015); Müller et al. (2015)
2014	4	Aouadi et al. (2014); Freier et al. (2014); Ménard et al. (2014); Volpato & Howard (2014)
2013	5	Benmoussa (2013); Daoudi et al. (2013); Gamoun (2013); Linstädter et al. (2013); Muigai & Hanotte (2013)
2012	4	Akasbi et al. (2012); Chehma & Abdelhamid (2012); Dunne et al. (2012); Freier et al. (2012)
2011	1	Freier et al. (2011)
2010	3	Kuhn et al. (2010); Linstädter et al. (2010); Rössler et al. (2010)
2009	3	Le Roux & Bouazid (2009); McGregor et al. (2009); Pereira et al. (2009)
2008	1	Haddouche et al. (2008)
2007	3	Davies & Hatfield (2007); Dutilly-Diane (2007); Dutilly-Diane et al. (2007)
2006	3	Davis (2006); Roubet (2006); Smith (2006)
2005	2	Davis (2005); Le Cuziat (2005)
2004	1	Davis (2004)
2003	1	Roubet (2003)
1996	2	Benazzouz (1996); Chiche (1996)

RESULTS AND DISCUSSION

Environment

Climate change is a recurrent theme in the literature on pastoralism in the Maghreb (Blanco & Michon, 2017; Duffy, 2020; Jemaa et al., 2016; Kuhn et al., 2010). However, many pastoralists have been able to adapt to rainfall variability and droughts (Blanco et al., 2017; Daoudi et al., 2013), especially mobile pastoralists (Akasbi et al., 2012; Dressler et al., 2019; Kuhn et al., 2010). Freier et al. (2014)

indicate that the “*promotion of mobile pastoralism in semi-arid areas is a valuable option to increase resilience against climate change*” (p. 917) in southern Morocco. However, the genetic erosion of local breeds (Gaouar et al., 2017) may reduce herds’ adaptability to harsh environmental and climatic conditions.

Other articles focus on the impacts of land use changes on pastoralism (Davis, 2004; Duffy, 2020; Jemaa et al., 2016; Kuhn et al., 2010; McGregor et al., 2009; Rignall & Kusunose, 2018). In particular, they highlight that commercial agriculture development decreased mobile pastoralism (cf. transhumance) (Benmoussa, 2013; Duffy, 2020; Haddouche et al., 2008; Jemaa et al., 2016). Some authors point out pastoralism as a cause of land degradation and desertification (Benazzouz, 1996; Boussaïd et al., 2018; Gamoun, 2013; Haddouche et al., 2008; McGregor et al., 2009; Zerboni & Nicoll, 2019), and deforestation (Campbell et al., 2017; Chehma & Abdelhamid, 2012; Haddouche et al., 2008; McGregor et al., 2009; Mebirouk-Boudechiche et al., 2016, 2015). However, Blanco et al. (2015) conclude that “*Saharan agro-pastoralism activities are not necessarily incompatible with acacia tree conservation, contrary to the commonly admitted postulate in Morocco*” (p. 21). Likewise, Davis (2005) highlights that “*The existing data from southern Morocco [...] do not support the claims of widespread desertification due to [...] pastoral activities*” (p. 509). Zerboni and Nicoll (2019) stress that “*human and herd animal activities affected geomorphic surfaces that affected slope stability, intensified erosion and dust mobilization, and enhanced dust export from the African continent offshore*” (p. 22). Many of the negative impacts on land resources are due to overgrazing (Boussaïd et al., 2018; Gamoun, 2013; Haddouche et al., 2008; Zerboni & Nicoll, 2019) that is exacerbated by pastoralism modernisation and intensification (Boussaïd et al., 2018; Vidal-González & Nahhass, 2018). However, Davis (2006) argues that “*Land degradation in the dryland agricultural areas of Morocco is commonly blamed on overgrazing by local pastoralists despite existing documentation that suggests instead that ploughing of marginal lands and over-irrigation are the primary drivers of land degradation in the region*”. Linstädter et al. (2010) argue that pastoral land use management in the Moroccan High Atlas mitigates the effects of droughts, maintains the capacity of the rangeland vegetation to buffer rainfall variability, and slows down land degradation. Other authors indicate the role of pastoralists in the overexploitation of groundwater resources especially in arid Saharan areas (Boussaïd et al., 2018). The depletion of pastoral resources as a result of frequent droughts and decrease in the grazing area are among the main challenges faced by pastoralists (Gobindram et al., 2018). The degradation of pastures and rangelands increasingly lead pastoralists to provide feed supplements (Mebirouk-Boudechiche et al., 2017; Müller et al., 2015). However, Müller et al. (2015) argue that the application of supplementation is controversial, as it “*allows smallholders to avoid a breakdown in animal numbers in times of drought*” but “*keeps herd sizes high and may thus result in rangeland degradation in the long term*” (p. 153).

Society and culture

Pastoralism is an integral part of the traditions in the Maghreb. In fact, many authors analyse the history of this practice in the region (Aouadi et al., 2014; Brass, 2018; Broodbank & Lucarini, 2020; Duffy, 2020; Dunne et al., 2018; Dunne et al., 2012; Guerin, 2019; Leder, 2015; McGregor et al., 2009; Merrills, 2018; Muigai & Hanotte, 2013; Pereira et al., 2009; Roubet, 2003, 2006; Roubet & Amara, 2016; Smith, 2006; Vidal-Gonzalez & Mahdi, 2019; Zerboni & Nicoll, 2019) starting with livestock domestication (Brass, 2018; Broodbank & Lucarini, 2020; Zerboni & Nicoll, 2019). Archaeological records show different features associated with pastoralism, transhumance and herding (e.g. trails, footholds, trackways, stables, rock-shelters) (Zerboni & Nicoll, 2019), and rock engravings/painting sites (Roubet & Amara, 2016).

The literature also highlights the huge local knowledge of pastoralists (Ben Hounet et al., 2016; Davis, 2005; Gobindram et al., 2018; Linstädter et al., 2013). For instance, Gobindram et al. (2018) stress that the local ecological knowledge (LEK) of shepherds includes “*recognising and naming forage plants and rangeland types, identifying preferred or less preferred plants or plant parts, describing circumstantial palatability of plants*” (p. 207). Other authors (Davis, 2005, 2016) warn of the ongoing erosion of pastoral indigenous knowledge. In this respect, Davis (2005) argues that “*expert knowledge is based on questionable evidence and that it has been privileged over local knowledge primarily for political, economic and administrative reasons*” (p. 509). The modernisation of pastoralism also affected the culture of pastoral communities (Dominguez, 2017; Vidal-González & Nahhass, 2018) but opinions diverge on its impacts. In this sense, Vidal-Gonzalez and Nahhass (2018) argue that the use of mobile phones improved social cohesion among nomadic populations in eastern Morocco.

Some authors focus on the poverty and vulnerability of pastoral households and communities in the Maghreb (Davies & Hatfield, 2007; Freier et al., 2014; Martin et al., 2016). Indeed, the livelihood security of pastoral households is threatened by, among others, changing climate and recurrent droughts (Martin et al., 2016). Martin et al. (2016) show that drought has forced some pastoral households to abandon their transhumant lifestyle in Morocco’s High Atlas. Referring to Northern Algeria, Daoudi et al. (2013) put that “*In the steppe,[...], the increase of rainfall variability augments the vulnerability of agro-pastoralists, particularly those weakly endowed with resources, and compromises reproduction of their farming systems*” (p. 303). Other scholars highlight the resilience and adaptive capacity of pastoralists (Blanco & Michon, 2017; Dressler et al., 2019; Jemaa et al., 2016; Linstädter et al., 2013). Indeed, the livelihoods of pastoral communities are undergoing different transformations (Davies & Hatfield, 2007; Faye et al., 2017; Freier et al., 2012; Gobindram et al., 2018; Haddouche et al., 2008; Le Roux & Bouazid, 2009; Rignall & Kusunose, 2018; Vidal-González & Nahhass, 2018) induced, inter alia, by climate change, land degradation and desertification as well as social changes (Vidal-González & Nahhass, 2018). Davies and Hatfield (2007) argue that “*Pastoralism is changing, adapting to market forces as well as*

demographic pressures, and influenced strongly by policies that still encourage sedenterisation” (p. 100). The livelihood transformations include moving to agro-pastoralism (Blanco et al., 2017; Faye et al., 2017; Gobindram et al., 2018; Jemaa et al., 2016) and ‘sedentarisation’ (Blanco et al., 2017; Davies & Hatfield, 2007; Faye et al., 2017; Freier et al., 2012; Haddouche et al., 2008). Referring to Ait Arfa Guigou tribe in Morocco’s Middle Atlas, Vidal-Gonzalez and Mahdi (2019) put that they were induced to “*shifting from nomadism to short-distance transhumance as an adaptation necessary to continue practicing sheepherding in their territory down to the present day*” (p. 129).

Pastoralists face different socio-cultural challenges such as rural exodus (especially of the young) (Blanco et al., 2017; Giuliani et al., 2017) and the lack of social recognition (Blanco et al., 2017). Dressler et al. (2019) point out to an increase in inequality in pastoral communities; they show that there is a kind of ‘polarisation’ between wealthy pastoralists (with large herds transported using trucks across large distances) and impoverished households (moving only by foot and experiencing decreasing herd sizes) in eastern Morocco. Also Dutilly-Diane et al. (2007) highlight two types of dominance in rangeland use in eastern Morocco “*some fractions select the best rangelands and are able to exclude other groups from it, others respond by ploughing extensive areas as a way to secure access of the surrounding pastures*” (p. 338).

Economics

There is a dearth of articles addressing pastoralism economics in the Maghreb. Davies and Hatfield (2007) underline some of the benefits of the ‘sedentarisation’ of mobile pastoralists and put that “*Sedentarisation, at least of the household, can bring potential benefits of access to services since few countries have adopted models of mobile or community delivered service provision. It sometimes also improves access to markets, and can reduce transaction costs through improved communication*” (p. 100). However, Gobindram et al. (2018) argue that the low profitability of pastoralism, with respect to crop production, makes its future uncertain in Morocco. The low pastoralism profitability might explain why Rössler et al. (2010) found that “*Remittances from migrants, as the most important source of income for the population in the marginalized rural regions, are partly used to subsidize farming or pastoral activities and are therefore crucial for the continuity of the agricultural system*” (p. 634) in the High Atlas region of Southern Morocco. Freier et al. (2014) analyse the vulnerability of income from sedentary pastoralism and mobile (transhumant) pastoralism to reduced precipitation and droughts in semi-arid, southern Morocco and found that mobile pastoralism is much less vulnerable to dryer climate than sedentary pastoralism. Indeed, the simulations of economic impacts of droughts on rangeland management performed by Freier et al. (2011) show that drought (2 years with 33% less precipitation) determine a decrease in profits from pastoralism by up to 57%. However, Dutilly-Diane (2007) stresses that pastoralism is the primary economic activity in the arid and semi-arid steppe areas, which occupy a large part of North Africa.

Policy and governance

Policies are addressed in two different ways; by analysing the current policies that shape pastoralism and/or by highlighting policy interventions needed to preserve and develop pastoralism in the Maghreb. Blanco et al. (2017) argue that agro-pastoralism in southern Morocco is threatened by current agricultural policies. In this context, Davis (2005) warns that *“In Morocco the crisis narrative of desertification has been invoked for decades to facilitate and justify policy and legal changes that have systematically disadvantaged pastoralists and damaged the environment”* (p. 509). However, the knowledge and traditions of pastoralists and agro-pastoralists can be safeguarded thanks to heritage policies (Ben Hounet et al., 2016; Ben Hounet & Guinand, 2016). Indeed, Ben Hounet et al. (2016) argue that a *“greater recognition of farmers’ knowledge and their ability to identify hardy animals can ensure the sustainability of farms”* (p. 365). In this respect, Dutilly-Diane (2007) suggests that *“It is crucial to evaluate the contribution of the pastoral sector in national economies in order to influence government policies on livestock pastoralism and rangeland management”* (p. 69).

Different aspects relating to governance are addressed, especially the management of collective rangelands and pastures (Benmoussa, 2013; Dominguez, 2017; Dutilly-Diane et al., 2007; Rignall & Kusunose, 2018). While customary management of collectively-owned land is often blamed for chaotic or unsustainable land use, Rignall and Kusunose (2018) argue that customary land tenure systems have been effective in mediating transformations of land use and livelihoods in south-eastern Morocco. Also Blanco et al. (2017) put that *“The sustainability of natural resource use relies on flexible property rights, backed up by a social and cultural norm-based regulation system, that allow crop-livestock integration and landscape collective management”* (p. 111) in southern Morocco. Dominguez (2017) analyses a local land governance system (prohibiting access to some natural resources for a given period to assure their sustained use) in Moroccan High Atlas called ‘Agdal’ and points out that its decline is increasing social inequality and environmental degradation. Benmoussa (2013) warns that the *“The trend towards individual appropriation of tribal lands transgresses age-old norms and thus symbolises a new way of being within communal territories, part of an important process of social changes within a global context of liberalisation and globalisation”* (p. 668) and criticizes the state’s encouragement of steppe areas use for agriculture in Algeria. Also, Akasbi et al. (2012) point out that *“both the customary rules and its flexible adaptation to physical constraints are generally beneficial in terms of conservation of the arid and semiarid rangeland resources”* (p. 307) in Moroccan Atlas Mountains. The literature also denotes pastoral communities’ willingness to be engaged in developing their areas; in this regard, Le Roux and Bouazid (2009) highlight that *“the population has a strong desire to be assisted in the development of guidelines for environmental education initiatives that would enable them as a community to deal with desertification and land degradation”* (p. 59) in Sefiane (Algeria).

CONCLUSIONS

This paper provides a comprehensive review on pastoralism in the Maghreb. Despite its multifaceted and multifunctional benefits (environmental/ecological, social, cultural, economic), pastoralism is still perceived by some scholars and policy makers as ecologically damaging, economically unproductive, and culturally backward. Indeed, the analysed literature focuses on the negative impacts of pastoralism (e.g. land degradation, desertification, deforestation) and the challenges faced by pastoral communities (e.g. climate change, poverty, livelihood vulnerability, marginalization and social exclusion, pastoral culture erosion). Therefore, it is important to raise awareness about the role of pastoralism in the Maghreb to increase public investment in the sector. For that, a good starting point can be to devote more attention to pastoralism and pastoralists in the research agenda, in order to produce sound data and evidence to inform policies. This is particularly crucial since the review shows that there is a gap in research on pastoralism in the Maghreb. Future research should highlight the role of pastoralism in the provision of ES and public goods, and as an integral part of the cultural and social assets of the Maghrebi countries and communities. Furthermore, pastoralists have shown extensive capacities to adapt to variable climate and environmental conditions. Beyond being a simple production system, pastoralism is a livelihood and land-use system that is crucial for improving the living conditions of rural populations in remote, marginal areas. Beside research, there is also a need to reform the governance of the whole sector by, inter alia, improving the political representation of pastoral communities. In this respect, holistic approaches to agro-pastoral systems and communities, embedding the range of ecosystem and societal services they provide, are needed. The contribution of regional projects, such as PACTORES, can result instrumental in this respect as they allow exchanging good practices on pastoralism among academia, policy makers and pastoral communities in the Mediterranean.

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REFERENCES

- Abdallah H. & Souilmi H. (2015). Analyse des changements d'occupation du sol et des transformations socio-économiques au cours du XXème siècle dans les marges arides du Tell oriental (Dorsale centrale, environs d'Es Sraïf, Tunisie). *Physio-Géo*, 9, 81–109.
- Abdelguerfi A. & Laouar M. (2000). Conséquences des changements sur les ressources génétiques du Maghreb. In *Rupture : nouveaux enjeux, nouvelles*

- fonctions, nouvelle image de l'élevage sur parcours* (pp. 77–87). Montpellier: CIHEAM-IAMM.
- Akasbi Z., Oldeland J., Dengler J. & Finckh M. (2012). Social and ecological constraints on decision making by transhumant pastoralists: a case study from the Moroccan Atlas Mountains. *Journal of Mountain Science*, 9(3), 307–321.
- Aouadi N., Dridi Y. & Ben Dhia W. (2014). Holocene environment and subsistence patterns from Capsian and Neolithic sites in Tunisia. *Quaternary International*, 320, 3–14.
- Ben Hounet Y., Brisebarre A.-M. & Guinand S. (2016). Le patrimoine culturel du pastoralisme : perspective globale, identité étatique et savoirs locaux au prisme des races locales au Maroc. *Revue Scientifique et Technique de l'OIE*, 35(2), 357–370.
- Ben Hounet Y. & Guinand S. (2016). The Wacda of Sid Ahmad Majdūb and of Sidi Yahia: The Intangible Heritage and the Semi-Nomadic Tribes of the Algerian West. *Nom. Peoples*, 20(2), 245–264.
- Benazzouz M. T. (1996). *The causes of desertification in the northern Algerian Sahara*. (O. Slaymaker, Ed.), *Geomorphic Hazards*. Chichester, England: John Wiley & Sons Ltd.
- Benmoussa B. (2013). An effect of globalisation? The individual appropriation of 'arch lands in Algeria. *The Journal of North African Studies*, 18(5), 668–677.
- Bewsell D. & Dake C. (2008). Socio-economic issues in pasture-based farming. In R. W. McDowell (Ed.), *Environmental Impacts of Pasture-based Farming* (pp. 98–121). Wallingford (UK): CABI Publishing.
- Blanco J., Genin D., Carrière S.M. (2015). The influence of Saharan agropastoralism on the structure and dynamics of acacia stands. *Agriculture, Ecosystems & Environment*, 21-31.
- Blanco J. & Michon G. (2017). Sustaining a Livelihood in a Context of Climatic Stochasticity and Risk: Teaching from Saharan Border Pastoralists in South-western Morocco. *Hesperis-Tamuda*, 52(1), 163–192.
- Blanco J., Michon G. & Carrière S. M. (2017). Natural ecosystem mimicry in traditional dryland agroecosystems: Insights from an empirical and holistic approach. *Journal of Environmental Management*, 204, 111–122.
- Boussaïd A., Souiher N., Dubois C. & Schmitz S. (2018). L'amplification de la désertification par les pratiques agro-sylvo-pastorales dans les hautes plaines steppiques algériennes : les modes d'habiter de la Wilaya de Djelfa. *Cybergeo*. <https://doi.org/10.4000/cybergeo.29257>
- Brass M. (2018). Early North African Cattle Domestication and Its Ecological Setting: A Reassessment. *Journal of World Prehistory*, 31(1), 81–115.
- Broodbank C. & Lucarini G. (2020). The Dynamics of Mediterranean Africa, ca. 9600–1000 bc: An Interpretative Synthesis of Knowns and Unknowns. *Journal of Mediterranean Archaeology*, 32(2), 195–267.
- Campbell J.F.E., Fletcher W.J., Joannin S., Hughes P.D., Rhanem M. & Zielhofer C. (2017). Environmental Drivers of Holocene Forest Development in the

- Middle Atlas, Morocco. *Frontiers in Ecology and Evolution*, 5. <https://doi.org/10.3389/fevo.2017.00113>
- Chehma A. & Abdelhamid H. (2012). Prediction equation for determining the phytomass of spontaneous perennial plants in Saharan rangeland. *Fourrages*, 211, 239–242.
- Chiche J. (1996). Organization of pastoralism in Morocco - Prudent or improper use of resources. In *International Symposium on the Optimal Exploitation of Marginal Mediterranean Areas by Extensive Ruminant Production Systems* (pp. 307–314). Braunschweig, Germany: European Association for Animal Production.
- Daoudi A., Terranti S., Hammouda R. F., & Bédrani S. (2013). Adaptation to drought in the Algerian steppe: The case of productive strategies of Hadj Mechri agro-pastoralists. *Cahiers Agricultures*, 22(4), 303–310.
- Davies J. & Nori M. (2008). Managing and mitigating climate change through pastoralism. *Policy Matters*, 16, 127–141.
- Davies J., Ouedraogo R., Hagelberg N. & Niamir-Fuller M. (2014). Sustainable Pastoralism for the Post 2015 Agenda. <https://sustainabledevelopment.un.org/content/documents/626970-Davies-Sustainable Pastoralism for the Post 2015 Agenda.pdf>
- Davies J. & Hatfield R. (2007). The Economics of Mobile Pastoralism: A Global Summary. *Nomadic Peoples*, 11(1), 91–116.
- Davis D.K. (2004). Desert ‘wastes’ of the Maghreb: desertification narratives in French colonial environmental history of North Africa. *Cultural Geographies*, 11(4), 359–387.
- Davis D.K. (2005). Indigenous knowledge and the desertification debate: problematising expert knowledge in North Africa. *Geoforum*, 36(4), 509–524.
- Davis D.K. (2006). Neoliberalism, environmentalism, and agricultural restructuring in Morocco. *The Geographical Journal*, 172(2), 88–105.
- Davis D.K. (2016). Political Economy, Power, and the Erasure of Pastoralist Indigenous Knowledge in the Maghreb and Afghanistan. In P. Meusburger, T. Freytag, & L. Suarsana (Eds.), *Ethnic and Cultural Dimensions of Knowledge* (pp.211–228). Dordrecht: Springer.
- Dominguez P. (2017). Political Ecology of Shifting Cosmologies and Epistemologies among Berber Agro-Sylvo-Pastoralists in a Globalizing World. *Journal for the Study of Religion, Nature and Culture*, 11(2), 227–248.
- Dressler G., Hoffmann F., Breuer I., Kreuer D., Mahdi M., Frank K. & Müller B. (2019). Polarization in (post)nomadic resource use in Eastern Morocco: insights using a multi-agent simulation model. *Regional Environmental Change*, 19(2), 489–500.
- Duffy. (2020). Some Like It Hot: Mediterranean Societies at the End of the Little Ice Age. *Agricultural History*, 94(2), 176. <https://doi.org/10.3098/ah.2020.094.2.176>

- Dunne J., di Lernia S., Chłodnicki M., Kherbouche F. & Evershed R. P. (2018). Timing and pace of dairying inception and animal husbandry practices across Holocene North Africa. *Quaternary International*, 471, 147–159.
- Dunne J., Evershed R. P., Salque M., Cramp L., Bruni S., Ryan K., ... di Lernia S. (2012). First dairying in green Saharan Africa in the fifth millennium bc. *Nature*, 486(7403), 390–394.
- Dutilly-Diane C. (2007). Pastoral Economics and Marketing in North Africa: A Literature Review. *Nomadic Peoples*, 11(1), 69–90.
- Dutilly-Diane, C., Acherkouk M., Bechchari A., Bouayad A., El Koudrim M. & Maatougui A. (2007). Dominance communautaire dans l'exploitation des espaces pastoraux : impacts sur les modes de vie et implications pour la gestio. *Cahiers Agricultures*, 16(4), 338–346.
- FAO (2020). Policy Support and Governance Portal – Pastoralism. Rome.
- Faye B., Senoussi H., & Jaouad M. (2017). Le dromadaire et l'oasis : du caravansérail à l'élevage périurbain. *Cahiers Agricultures*, 26(1), 14001.
- Freier K., Finckh M. & Schneider U. (2014). Adaptation to New Climate by an Old Strategy? Modeling Sedentary and Mobile Pastoralism in Semi-Arid Morocco. *Land*, 3(3), 917–940.
- Freier K. P., Bruggemann R., Scheffran J., Finckh M. & Schneider U. A. (2012). Assessing the predictability of future livelihood strategies of pastoralists in semi-arid Morocco under climate change. *Technological Forecasting and Social Change*, 79(2), 371–382.
- Freier K. P., Schneider U. A. & Finckh M. (2011). Dynamic interactions between vegetation and land use in semi-arid Morocco: Using a Markov process for modeling rangelands under climate change. *Agriculture, Ecosystems & Environment*, 140(3–4), 462–472.
- Gamoun M. (2013). Management and resilience of Saharan rangelands: South Tunisia. *Fourrages*, (216), 321–328.
- Gaouar S. B. S., Lafri M., Djaout A., El-Bouyahiaoui R., Bouri A., Bouchatal A., ... Da Silva A. B. (2017). Genome-wide analysis highlights genetic dilution in Algerian sheep. *Heredity*, 118(3), 293–301.
- Giuliani A., Mengel S., Paisley C., Perkins N., Flink I., Oliveros O. & Wongtschowski M. (2017). Realities, Perceptions, Challenges and Aspirations of Rural Youth in Dryland Agriculture in the Midelt Province, Morocco. *Sustainability*, 9(6), 871.
- Gobindram N.-E., Boughalmi A., Moulin C. H., Meuret M., Bastianelli D., Araba A. & Jouven M. (2018). Feeding flocks on rangelands: insights into the local ecological knowledge of shepherds in Boulemane province (Morocco). *The Rangeland Journal*, 40(3), 207.
- Guerin A. (2019). Deserts, Capital and “Civilisation”: The Politics of Environmental Naming in Eastern Morocco, 1925-1939. *Global Environment*, 12(1), 134–153.

- Haddouche I., Toutain B., Saidl S. & Mederbal K. (2008). How to reconcile the development of steppe populations and the fight against desertification? Case of the wilaya of Nâama (Algeria). *New Medit*, 7(3), 25–31.
- Jemaa T., Huguenin J., Moulin C.-H. & Najjar T. (2016). Les systèmes d'élevage de petits ruminants en Tunisie Centrale : stratégies différenciées et adaptations aux transformations du territoire. *Cahiers Agricultures*, 25(4), 45005. <https://doi.org/10.1051/cagri/2016030>
- Jónsson G. (2010). *The environmental factor in migration dynamics – a review of African case studies*. International Migration Institute (IMI), Oxford.
- Kuhn A., Heidecke C., Roth A., Goldbach H., Burkhardt J., Linstädter A., ... Gaiser T. (2010). Importance of Resource Management for Livelihood Security under Climate Change in Southern Morocco. In *Impacts of Global Change on the Hydrological Cycle in West and Northwest Africa* (pp. 566–591). Berlin: Springer.
- Le Cuziat J., Vidal E., Roche P. & Lacroix F. (2005). Human activities affect the potential distribution of the houbara bustard *Chlamydotis undulata undulata*. In *International Symposium on Ecology and Conservation of Steppe Land Birds* (pp. 21–30). Madrid: Sociedad Espanola Ornitologia.
- Le Roux C. & Bouazid T. (2009). Subsistence living and eco-positive behaviour: Two diametrically opposed concepts? a case study of farmers' perspectives in Sefiane, Algeria. *Arab Gulf Journal of Scientific Research*, 27(1–2), 59–69.
- Leder S. (2015). Towards a Historical Semantic of the Bedouin, Seventh to Fifteenth Centuries: A Survey. *Der Islam*, 92(1), 85–123.
- Linstädter A., Baumann G., Born K., Diekkrüger B., Fritzsche P., Kirscht H. & Klose A. (2010). Land use and land cover in Southern Morocco: Managing unpredictable resources and extreme events. In *Impacts of Global Change on the Hydrological Cycle in West and Northwest Africa* (pp. 612–633). Berlin: Springer.
- Linstädter A., Kemmerling B., Baumann G. & Kirscht H. (2013). The importance of being reliable – Local ecological knowledge and management of forage plants in a dryland pastoral system (Morocco). *Journal of Arid Environments*, 95, 30–40.
- Martin R., Linstädter A., Frank K. & Müller B. (2016). Livelihood security in face of drought – Assessing the vulnerability of pastoral households. *Environ. Model. & Soft.* 75,414-423.
- Maurer G. (1992). Agriculture in the Rif and Tell Mountains of North Africa. *Mountain Research and Development*, 12(4), 337. <https://doi.org/10.2307/3673684>
- McGregor H. V., Dupont L., Stuat J.-B. W. & Kuhlmann H. (2009). Vegetation change, goats, and religion: a 2000-year history of land use in southern Morocco. *Qu. Sc. R.*, 28, 1434-48.
- Mebirouk-Boudechiche L., Abidi S., Boudechiche L. & Gherssi M. (2016). Evaluation of forage produced by *Erica arborea*, shrub species found in

- Algerian alder forests in wetlands of northeastern Algeria. *Fourrages*, (225), 71–74.
- Mebirouk-Boudechiche L., Abidi S., Rezkallah W. & Matallah S. (2017). Quantités ingérées et comportement alimentaire des caprins sur un parcours forestier du nord-est algérien. *Fourrages*, (229), 91–95.
- Mebirouk-Boudechiche L., Boudechiche L., Chemmam M., Djaballah S., Bouzouraa I. & Cherif C. (2015). An estimate of the foliar biomass accessible as forage produced by *Pistacia lentiscus* and *Calycotome spinosa*, two shrub species found in Algerian cork oak forests. *Fourrages*, (221), 77–83.
- Ménard N., Foulquier A., Vallet D., Qarro M., Le Gouar P. & Pierre J.-S. (2014). How tourism and pastoralism influence population demographic changes in a threatened large mammal species. *Animal Conservation*, 17(2), 115–124.
- Merrills A. (2018). Invisible men: mobility and political change on the frontier of late Roman Africa. *Early Medieval Europe*, 26(3), 355–390.
- Muigai A. W. T., & Hanotte O. (2013). The Origin of African Sheep: Archaeological and Genetic Perspectives. *African Archaeological Review*, 30(1), 39–50.
- Müller B., Schulze J., Kreuer D., Linstädter A. & Frank K. (2015). How to avoid unsustainable side effects of managing climate risk in drylands — The supplementary feeding controversy. *Agricultural Systems*, 139, 153–165.
- Nori, M. (2017). Migrant Shepherds: Opportunities and Challenges for Mediterranean Pastoralism. *Journal of Alpine Research*, 1-14. DOI: 10.4000/rga.3554
- Pereira F., Queiros S., Gusmao L., Nijman I.J., Cuppen E., Lenstra J.A., ... Amorim A. (2009). Tracing the History of Goat Pastoralism: New Clues from Mitochondrial and Y Chromosome DNA in North Africa. *Mol. Biol. Evol.*, 26(12), 2765–2773.
- Rignall K., & Kusunose Y. (2018). Governing livelihood and land use transitions: The role of customary tenure in southeastern Morocco. *Land Use Policy*, 78, 91–103.
- Rivera-Ferre M. G. & López-i-Gelats F. (2012). *The role of small scale livestock farming in climate change and food security*. http://vsf-international.org/wp-content/uploads/2015/01/STUDY_the-role-of-small-scale-livestock-farming-in-climate-change-and-food-security.pdf
- Rocha Correa P.F. (2013). *Land and Livestock Management in the Mountains of Maghreb*. Wageningen University, Wageningen (NL). <https://edepot.wur.nl/260277>
- Rössler M., Kirscht H., Rademacher C., Platt S., Kemmerling B. & Linstädter A. (2010). Migration and Resource Management in the Drâa Valley, Southern Morocco. In P. Speth, M. Christoph, B. Diekkruger, M. Bollig, A. Fink, H. Goldbach, ... M. Rössler (Eds.), *Impacts of Global Change on the Hydrological Cycle in West and Northwest Africa* (pp. 634–646). Berlin: Springer.
- Roubet C. (2003). « Statut de Berger » des communautés atlasiques, néolithisées du Maghreb oriental, dès 7000 BP. *L'Anthropologie*, 107(3), 393–442.

- Roubet C. (2006). Les comportements de subsistance et symboliques des premiers pasteurs néolithiques du Maghreb oriental atlasique. *Comptes Rendus Palevol*, 5(1–2), 441–451.
- Roubet C. & Amara I. (2016). From art to context: Holocene roots of an Initial Neolithic Pastoralism (INP) in the Atlas Ouled Naïl, Algeria. *Quaternary International*, 410, 103–122.
- Smith A. B. (2006). Origins and Spread of African Pastoralism. *History Compass*, 4(1), 1–7.
- Vidal-Gonzalez P. & Mahdi M. (2019). Transformations of transhumance in the Ait Arfa Guigou tribe (Morocco's Middle Atlas): from French colonisation to present times. *Ager*, (26), 129–150.
- Vidal-González P. & Nahhass B. (2018). The use of mobile phones as a survival strategy amongst nomadic populations in the Oriental region (Morocco). *GeoJ*. 83(5), 1079–1090.
- Volpato G. & Di Nardo A. (2017). The role of *Nucularia perrinii* Batt. (Chenopodiaceae) in the camel-based Sahrawi social-ecological system. *Journal of Ethnobiology and Ethnomedicine*, 13(1), 12. <https://doi.org/10.1186/s13002-017-0141-3>
- Volpato G., Dioli M. & Di Nardo A. (2017). Piebald Camels. *Pastoralism*, 7(1), 3.
- Volpato G. & Howard P. (2014). The material and cultural recovery of camels and camel husbandry among Sahrawi refugees of Western Sahara. *Pastoralism*, 4(1), 7.
- Zerboni A. & Nicoll K. (2019). Enhanced zoogeomorphological processes in North Africa in the human-impacted landscapes of the Anthropocene. *Geomorphology*, 331, 22–35.