In the Future Now

Entangled Mobilities and Temporalities in Climate Adaptation in Morocco

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I. Introduction

The first thing you would notice as the taxi climbs the winding road up the mountain in this remote region of central Morocco is the waterfalls. There are three that fall from the cliff onto the slopes below, splitting into irrigation canals that bubble from village to village down into the valley. If you climb the trails next to the biggest waterfall, like the teenagers often do at sunset, you'd arrive at the top of the cliff. You can follow the water streams, the ones that feed into the waterfalls, back through the fields of corn and wheat, past the government-contracted tree nursery – little cedar seedlings grow as future foot soldiers against desertification – to where the mountain begins to grow out of the plateau. That's where the spring is. Here in the summer is where young boys learn how to swim and dive in deep pools of clear gurgling water, and where women bring their tagines to picnic with their families under the shade of walnut and fig trees.

This collection of villages, from the top of the cliff and down to the river and across the valley, is called Skoura M'Daz.[1] Unlike many places across the spread of desert, mountain, and Mediterranean climates within Morocco, this ∼11,000-person commune[2] on the westward side of the Middle Atlas Moun-

1 Skoura M'Daz is often shortened to Skoura in everyday speech within the town. However, this is not to be confused with the more well-known "Skoura" in the southern desert near Ouarzazate.

2 Commune: an administrative district that encompasses a set area of land, including its villages or small towns, below the level of the province. The Skoura M'Daz commune is made up of ∼23 villages.

tains is rich with water. "It's like a paradise", Saeed,[3] a 30-year-old community activist, said to me. Tourists come in the summer to soak in the famed natural beauty, away from the cutting heat of Fez and Meknes. Many come from families with origins in Skoura M'Daz, seeking to reconnect with their Amazigh[4] roots, while others are hikers, outdoorsmen, and wildlife photographers.

Fig. 1: The main waterfall of three in Skoura M'Daz, alongside which tourists, like these medical student volunteers, hikers, and residents often climb.

Photograph taken by the author.

Yet when I left Skoura M'Daz in fall of 2022, the dull roar of the waterfalls was conspicuously absent. From the roof of my apartment building, I could see only a thin ribbon of water in the main waterfall channel. For weekly souq[5]

3 All names in the chapter are changed to pseudonyms to protect the confidentiality of participants.

4 Amazigh: an indigenous ethnic group across Morocco and North Africa.

5 In rural areas, residents go to the weekly souq, or market, in the central village for groceries and supplies, as well as social catch up. Market vendors for produce, household supplies, toiletries, clothing, animals, and other supplies travel to a different commune each day of their work week.

on Wednesday, I strategically waited until eleven in the morning, the busiest time, to ensure I would run into people I knew to catch up, say goodbye. But the normal crowds were thin. I approached Bilal, an overextended association leader and commune representative, sitting at a café paying the rosemary cooperative's harvesters. As soon as I greeted him, he commented, "Souq is empty today, right?" *Aiwa, 3lach — yes, why*? "The olives are bad this year, and people don't have money." The week prior, I had walked through the olive groves in the valley below, called Lfwerem, and seen the olives turning from green to violet to black – time to harvest. But they had also seemed drier, wrinkly, and shriveled. Farmer after farmer told me about their water problems, and there was the result.

The problem of water is clear and worsening. The abundance of water one can hear and see walking through Skoura cloaks the other reality of its diminishing water supply. Prolonged and repeated droughts in Skoura, across Morocco in the past decades, have harmed agriculture and thus the livelihoods of smallholder farming families like the ones I met. Mohcine was originally raised in Skoura M'Daz but is now living in Casablanca, and he sees the changes when he visits his mother and brothers still remaining in Skoura. "[There is] less rain [….] People steal water, people clear lands, and the climate has changed as well [….] Before there used to be more rain, and the drought years were spaced out in four years, eight years, ten years. Now the drought comes one year, then the next year, it doesn't." Skoura M'Daz has not been immune to climate change, to overconsumption of water, to changes in agricultural crops, livelihoods, and mobilities.

What, then, is the future of Skoura M'Daz? While many people I interviewed suggested that agriculture was going to die out, still many others are adapting. Farmers like 54-year-old Tariq are taking action. "We demanded that the government renovate the well – because the olive trees had dried, and people had migrated because of drought – so that we could refresh the land. The olives have dried, so there is no harvest." After visiting a friend near Meknes, Tariq was inspired to install a drip and sprinkler system on his land, increasing vegetable production and ensuring his olive trees were watered. He applied for and received funding for three more community wells to be dug across his village. Another farmer, 30-year-old Farid, excitedly told me his upcoming plans for the year. He had seen the pool and drip system of his neighbor, who had seen larger farms with drip irrigation during travels around Morocco. With his income affected by the drought's effects on his carob trees, Farid was making moves to dig a pool and install a drip system.

Their efforts are, in theory, supported by the national government's agricultural strategies, the Green Morocco Plan (2008–2020) and Green Generation Plan (2020–2030), which provide subsidies for water-conserving irrigation methods.

At the same time, the water landscape of Skoura M'Daz will be drastically changing in the next few years due to the building of a dam nearby. The Moroccan government has also been concerned about the future of the kingdom's water supplies. The M'Daz dam project is explicitly represented as a climate adaptation project that seeks to conserve the aquifer in the Saiss Plain, an important agricultural region encompassing Meknes and Fes, due to rapid overwithdrawal disproportionate to its renewal rate. Yet consequences for farmers in Skoura M'Daz include displacement and limitations on digging wells.

This chapter seeks to understand how forms of mobilities and temporalities are co-produced with climate change adaptation across scales in Skoura M'Daz, Morocco. I assess how complex entanglements of mobilities and temporalities create and are created within the process of adapting to climate change, thus subsuming this chapter under the conceptual direction of "climate mobilities" (Boas et al. 2022). Specifically, looking at mobilities-in-adaptation, I examine the interlacing and circulation of mobilities deriving from "planned adaptation" from the national government with mobilities involved in "autonomous adaptation" from the farmers' side, both driven by diminishing water resources. I employ the analytical lens of "entangled mobilities" (Wyss and Dahinden 2022) to illuminate these interactions.

II. Entangling Concepts to Study Mobilities-in-Adaptation

News reports have highlighted the "human face of climate change": people being forced to move due to drought, rising sea levels, or extreme weather (see Bittle 2023; Pannett 2023; Burleigh 2023; Office of the High Commissioner for Human Rights 2022). Alarmist narratives of "climate displacement" or "refugees" have dominated news headlines and politics, as well as early in migration-environment research communities (Durand-Delacre et al. 2020; Morrissey 2012; Boas and Wiegel 2021). Yet the fact remains that the relationship between people's movements and environmental changes varies and is more complex than what is often portrayed (McLeman 2014; Tacoli 2009). In the context of environmental change, people have many reasons for moving, a decision to move or stay can range from voluntary to involuntary, they can

move far or nearby, and the temporalities of such movements can fluctuate from a few weeks to years (Borderon et al. 2019; Obokata, Veronis, and McLeman 2014; Barnett and McMichael 2018).

This diversity of movements resulting from climate change can be encompassed under "climate mobilities", a term expounded upon by Boas et al. (2022). Rather than seeing climate mobilities or migration only as exceptional, they can also be understood as part of everyday life. Instead of pointing to a simple causal relation between climate change effect and physical, human mobilities, they can be considered in relation to local environmental changes, climate policies, and other social, political, or economic contexts produced by climate change (Boas et al., 2022). Moreover, we can view "climate mobilities" as "deeply embedded within historical, current, and evolving practices of mobility" (Boas et al. 2022, 3368). Studying climate mobilities simultaneously means studying climate immobilities (Wiegel, Boas, and Warner 2019); more research points to the complicated relationship of staying or of immobility in the context of environmental change, whether voluntary or involuntary, within contexts of governance and socioeconomic factors shaping capabilities and aspirations (Schewel 2020; Black et al. 2013; Zickgraf 2019).

"Migration-as-adaptation", a specific strain of literature investigating the relationship between climate change and migration, could also be placed under this overarching category of climate mobilities. Migration-as-adaptation as a concept grew out of awareness that migration could be a choice, intentionally or unintentionally in reaction to environmental change, that could allow a household to diversify incomes, livelihoods, and locations (Black et al. 2011; McLeman and Hunter 2010). In turn, migration could potentially enhance adaptive capacity or resilience to climate change effects through financial or social remittances (Sakdapolrak et al. 2016; Porst and Sakdapolrak 2018; Birk and Rasmussen 2014). However, researchers also caution against misplacing a responsibility to adapt through migration only on the individuals affected by climate change (Bettini, Nash, and Gioli 2016), that migration-as-adaptation can have limits or even reduce adaptive capacities (Vinke et al. 2020; Sakdapolrak, Borderon, and Sterly 2023), and that local contexts and people's own perceptions should be considered when linking migration, environmental change, and adaptation (Van Praag et al. 2021).

Two categories of adaptation have emerged in literature and policy documents: planned and autonomous (Intergovernmental Panel on Climate Change [IPCC] 2007). Especially within climate negotiations and on the international stage, planned adaptation has taken a front seat. Planned adaptation

are the deliberate plans and programs from national or other policy-level actors that directly organize climate adaptation action, facilitate adaptation at more local levels, or "strengthen conditions favorable for effective adaptation and investment in new technologies and infrastructure" (IPCC 2007, Chapter 5.5). This type of adaptation is heavily forward-looking, based on anticipated futures, forecasts, or scenario-planning (Rickards et al. 2014). They can be based on quantitative research, use technological solutions, and aim to respond to the need for understanding the future and predicting the future for policymaking. For example, Rahman and Hickey (2019) describe two types of planned adaptation with technical solutions by Bangladesh's government: one, an explicit adaptation plan to build flood protection infrastructure, and two, a livelihoods support policy through agricultural technology transfer, which indirectly supports climate adaptation at the local level.

Autonomous adaptation[6] means the actions taken by individuals, households, or communities to adapt, whether consciously or not, to environmental changes that they are experiencing (Thorn, Thornton, and Helfgott 2015; Mycoo 2014). For example, environmental changes like erratic precipitation patterns and increasing temperatures affected the agricultural productivity and, thus, livelihoods of smallholder farmers in Ghana. Households adapted their farming practices, including using fertilizer for soils and introducing crop rotation and additional irrigation (Adade Williams, Crespo, and Abu 2019). Adaptive capacity depends on the level of power or control agents have within communities and over resources, including financial ability and access to information (Pecl et al. 2019; Adade Williams, Crespo, and Abu 2019).

As such, planned and autonomous adaptation do not function in completely separate spheres; rather, they overlap, influence, or even create barriers for each other (Juhola et al. 2022; Mycoo 2014). Assefa Mersha and van Laerhoven explore the interplay between the two scales of adaptation for drought in Ethiopia, whereby "both government and smallholder farmers attempt to tackle this issue, and as a consequence, their respective actions become linked" (2018, 95). However, they found that the planned adaptation program that they examined dominated over the autonomous adaptation of those the policy aimed to assist; there were some negative effects, a result somewhat of problematic framings and assumptions within the adaptation program

6 The usage of "autonomous" should not be taken to imply that these adaptation actions happen in a vacuum or separately from contexts, as this chapter also seeks to demonstrate.

and surrounding contested political narratives (Assefa Mersha and van Laerhoven 2018). Despite seemingly successful local adaptation practices being developed by slum residents in Nairobi in the face of flooding, they are left out of adaptation planning at the municipal and national levels, due to the 'illegitimacy' of informal settlements (Thorn, Thornton, and Helfgott 2015). Rahman and Hickey (2019) argue that planned adaptation actors should take the autonomous adaptation actions of beneficiaries into consideration to ensure that policies do not end up being maladaptive. Power asymmetries between governments and people then create differentials that create an unequal interplay between planned adaptation and autonomous adaptation.

What can also lead to differences between scales of adaptation is a difference in temporalities (Arnall and Kothari 2015; McMichael and Katonivualiku 2020). Rickards et al. (2014) describe how scenario planning brings the future into the present, though there is a discrepancy in how the future is understood and imagined between scales. In describing residents' experiences with anticipated sea-level rise in Australia, Fincher et al. (2014) argue that people link the imagined futures in climate change adaptation to the past and present through time stories, which allow them to make sense of their experiences – quite different from how policymakers understand the issues. "If implemented as intended", Fincher et al. write about an Australian sea-level rise policy, "this would bring forward the costs of adaptation over multiple generations onto present generations who, as we have explained, at present see little need and even less justice in this cost shifting exercise" (2014, 207).

Instead of viewing migration as a form of climate change adaptation, this chapter seeks to understand how forms of mobilities are co-produced with climate change adaptation. I analyze the interactions between planned and autonomous adaptation action through the concept of "entangled mobilities." This concept provides a way to "systematically examine the ways in which mobilities are interconnected and interdependent – and thus to consider the local and global entanglements as well as the power structures in which they are embedded" (Wyss and Dahinden 2022, 2). This chapter adds to their work by proposing to study entangled mobilities surrounding a specific process or action: in this case, climate adaptation in Skoura M'Daz, Morocco. What are the mobilities that help create climate adaptation action, and which mobilities are created by climate adaptation? What are the interactions among and across the different actors, and how do they shape the goals and direction of climate adaptation actions? Through following these linkages in the case of Skoura M'Daz, the entangled temporalities in adaptation are also exposed. Thus, I argue that

both entangled mobilities and entangled temporalities influence and commingle with each other to create climate adaptation outcomes.

The starting point of the two cases explicated below are the planned and autonomous adaptation counteracting diminishing water resources experienced by residents in Skoura M'Daz. One is the planned adaptation of the dam-building project in M'Daz, and the other is the autonomous adaptation of farmers' conversions to drip and sprinkler irrigation. By exploring the mobilities and temporalities involved in these changes, we can better understand the relationship between planned and autonomous adaptation, between far-off futures, current happenings, and past histories.

I lived in Skoura M'Daz from 2017 to 2019 as a US Peace Corps Volunteer in youth development, then again for nine months from 2021 to 2022 for dissertation fieldwork. During fieldwork,[7] I conducted 120 household surveys and interviewed over 80 people. They were mostly residents of Skoura M'Daz, with some translocal residents still connected to Skoura M'Daz but living in other cities, in addition to regional and provincial government officials. I worked with two research assistants, Mustapha and Driss, from Skoura M'Daz and fluent in English, Darija,[8] and Tamazight.[9] I talked to farmers and herders, cooperative and association leaders, amghrars,[10] university students, and seasonal laborers. These participants skewed male, 66 of the 81 total, in stark contrast to my job as a volunteer working with young women and girls and hanging out with families, usually the mother and children, at home. They are the ones who taught me another side of life: my host mother Aziza showed me how to sort the olives shaken to the ground, my neighbors, Aicha, Layla, and Basma, took me along to festivals and family visits in other villages, and the middle school girls to whom I taught English – Hanae, Nadia, Mouna, and Sabrine – hiked with me to various springs, pools, and waterfalls around town. Everyday conversations with them and others helped contextualize the collected data from interviews and surveys and gain a holistic understanding to embed the processes and actions of environmental change and human mobilities. Thus, I

7 Project was approved by the Ethics Committee at the University of Vienna in spring 2021, Reference Number: 00631.

8 Darija: the spoken Moroccan Arabic dialect.

9 Tamazight: the spoken indigenous language in Skoura M'Daz.

10 Amghrar: the water irrigation manager for a certain sector of the overall irrigation system in Skoura M'Daz and who is elected by the water users.

situate my understanding of these climate adaptation issues from this participant observation through frigid winters, Ramadan iftars, and school assembly days.

III. Making Way for a Planned Future: The M'Daz Dam

> The wells will refill, and the ravines will have water. And there will be fish, birds, and boats. The region will prosper.
>
> —Rachid, 27-year-old farmer

> We will not benefit at all. They will only bring some fish. If you can, you can go fishing.
>
> —Hafid, 79-year-old farmer and herder

> The clouds will affect the trees in the period of pollination. It will have an effect on the olive trees… so it will create a big problem for us.
>
> —Ali, 24-year-old agriculture diploma graduate

From the top of the cliff in Skoura M'Daz, as of 2022, one can make out the white blocks arising between two hills: a dam is being constructed. In talking to residents of the commune, I found positive and ambivalent responses to the dam's construction. All were aware that the conserved reservoir water itself is not to benefit Skoura, as the water is intended for Saiss Plain, where most of the industrial agriculture in the region is. Nevertheless, this state-mandated structure will most certainly change the environment, for better or worse, and its construction has entailed the entanglements of various mobilities to make sure this planned climate adaptation project of the government succeeds.

Droughts have had major effects across Morocco, as seen also in Skoura M'Daz, particularly for agriculture (Taha 2022). With precipitation steadily decreasing over the past few decades (Jnina 2022; The World Bank Group 2021), 2022 marked one of the most severe droughts recorded (Eljechtimi 2022). Water overexploitation and inefficient irrigation systems for agriculture have only further exacerbated the issue (USAID 2016; Verner et al. 2018). After announcing a "water emergency" in June 2022 (Ministry of Equipment and Water 2022; Aamari 2022), the Moroccan Ministry of Equipment and Water slapped public service announcements forewarning of desertification on television, buses, and billboards, and encouraging water conservation.

Given the importance of the agricultural sector for Morocco's economy, making up 15% of Morocco's GDP and employing about 31% of the workforce (International Trade Administration 2022a), the government has long been aware of the country's environmental vulnerability. In the 1960s, the government intensified its policy of dam construction. The government's future vision was to transition to using surface water for agriculture to conserve the fossil aquifers. Now, with growing awareness of climate change, a new program, the National Priority Program for Drinking Water and Irrigation (NPP) under the Ministry of Equipment, Transport, Logistics, and Water aims to build 20 large dams from 2020 to 2027, in addition to desalination plants and wastewater treatment stations (International Trade Administration 2022b). The ambition of its overarching policy, the Priority Water Program, is for 50 large dams by 2050 (International Trade Administration 2022b). Thus, the government has enacted planned adaptation.

Based under the NPP, and with funding from the Green Climate Fund and the European Bank for Reconstruction and Development, the M'Daz dam is explicitly couched as a climate adaptation project (Green Climate Fund 2017, 1–2). It aims to ensure future agricultural productivity in the Saiss Plain through aquifer conservation, also part of the agricultural strategy of the Green Morocco Plan (Green Climate Fund 2017, 9). Two of the three objectives are "to increase climate resilience of irrigation infrastructure", as well as "to promote […] improved awareness of climate resilience issues among end users of water services" (Green Climate Fund 2017, 2). On the Plain between the cities of Fes and Meknes are around 200,000 hectares, both smallholder agriculture and company-held, with lines of drip irrigation, greenhouses, and sprinklers, for vineyards, cereals, fruit and olive trees, splayed over red dirt. The irrigation is fed by surface water, but more and more often supplemented with wells. "In this groundwater", Ilyas, one of the Ministry of Agriculture officials leading the project, told me, "We have 240 million cubic meters from rain and snow, and we use 300 million cubic meters every year, so the deficit is 100 million cubic meters." The M'Daz dam will have three pipes, twelve meters in diameter – "the largest in Morocco", he emphasized – and will take 125 cubic meters of water per year from the M'Daz dam to the Plain, a journey of between 80 and 140 kilometers. Secondary objectives include flash flood management and providing potable water. The king struck down the plan to make the dam hydroelectric, which would have increased water prices for farmers; saving the Saiss Plain was the priority.

Here, temporalities come into play; the program – which counts on the mobility of water – is strongly informed by the past. In previous decades, the region around the southern coastal city of Agadir had witnessed an agricultural boom. Corporations, many international, built vast farmlands and greenhouses for all types of agriculture, sending clementines, tomatoes, and onions around the country or exporting to Europe. People from around Morocco moved there to work as seasonal laborers, including many older men I met in Skoura M'Daz. But over time, the aquifer feeding the irrigation there had been depleted. Smallholder farmers could no longer water their lands; big companies let go many of their workers. People moved back home, or to the cities, and now Agadir's municipal water supply is supplemented by a desalination plant. Ilyas explained that, based on the experience in Agadir, "[t]he government addresses the problem, before the problem arrives. So, the objective is to bring 125 million cubic meters from the dam, from the surface water to help the groundwater, to annul the problem. This is the idea of the project; the dam, its first objective is this." By learning from the past and projecting that possibility into the future, the dam's planned adaptation hopes to counteract it.

But mobilizing 125 million cubic meters of water will not magically end groundwater exploitation. Although the government is well-aware of potential scenarios based on the past, that future vision did not cross easily between scales; local farmers considered temporalities differently – putting more weight onto the present than the future. Water users, including about 2,849 farms, on the Saiss Plain will pay fees to use the water from the dam supply (Green Climate Fund 2017, 1, 47). Signing up the big companies was easy, Ilyas explained. They have technicians and engineers who are well-aware of the risk of continuing without change over the next decades. It was harder to convince the smallholder farmers, who have a less futuristic outlook, and are living day-by-day, rainfall to rainfall, according to Ilyas. The solution? Flying 30 to 40 farmers down to Agadir to see the consequences of overwithdrawal and drought. "We chose farmers who can gossip and are talkative!" When they returned home and shared what they saw (also their experience of flying on a plane for the first time!), more and more farmers signed up to use the to-be-transported water. The program also aims to raise awareness in schools and among farmers, providing support especially to women.

This prior example of mobilities and temporalities intertwining, spurred by the assumption that a past seen before could become a potential future, are not the only mobilities to map in this project's goal to create a different future

through planned adaptation. As material mobilities move into the dam area – rocks from the quarry down the road, machines from France and the Netherlands, pipes from Turkey – people must make room.

Fig. 2: The M'Daz dam in 2022, with the River Guigou flowing towards it.

Photograph taken by the author.

Dams around the world have displaced populations, and the M'Daz dam is no exception: material mobilities entangle with human mobilities. It will be the sixth or seventh largest dam in Morocco at completion. After several delays, it is now expected to be finished by the end of 2024, *inchallah*,[11] a dam construction manager, Soulaimane, told me. Despite its visibility from Skoura M'Daz, the physical structure of the dam is located just over the borders of the nearby Tazouta commune, and its reservoir will fill the Guigou river that extends through Aderj and Skoura M'Daz communes. The expected reservoir will be 28 kilometers long, reaching the foothills at the edge of the mountains on which the central villages of Skoura M'Daz are situated. Dozens of former farms and herding lands, an area of 500,000 hectares, will be submerged.

11 Inchallah: Arabic for "God willing."

In this case, climate change is not directly causing migration; rather, the government's planned adaptation action in response to climate change *requires* mobilities. With the reservoir comes the displacement and forced mobility of four villages in Aderj, about 500 to 600 people, 80 to 90 households. The Ministry of Equipment surveyed the land: how many trees, what type of irrigation, if there is a house or not, whether people had land titles or not. Based on predetermined prices under the Law of Expropriation, people who are affected were compensated monetarily. Some of the (future) displaced were offered jobs and training during dam construction. Interestingly, the governmental offices involved in the dam have different ways of operating and compensating, which leads to confusion. The Ministry of Agriculture, the Ministry of Equipment, and the Agency of Water and Forest are each separately responsible for compensating those whose lands they take through eminent domain: for the placement of the water pipes, for the dam construction and the expected reservoir area, and for erosion-prevention measures, respectively. I found that the offices did not fully coordinate with each other, and I did not find a total number of people displaced by each office's activities.

In contrast to the government information on dam displacement, there were competing narratives from Skoura's residents. According to onlookers in the area, several years prior to the dam being built, government workers under the Green Morocco Plan planted trees in rainfed fields surrounding the dam's future location. According to the Forestry official I talked to, if this had happened (which he had not heard about), the point of the plan would have been to prevent soil erosion and help facilitate the health of the ecosystem before dam construction, on lands considered public and, thus, under the control of the Forestry Agency. Here, the main problem is one familiar across Morocco: the lack of land titles for people using the land. There are several reasons for this, including histories of collective land, customary rights through oral agreements, and disagreements over inheritance. The Moroccan government has worked over the past decade to increase the number of farms with land titles (Balgley and Rignall 2022). However, the problem persists.

The dam-building may aim to assist climate adaptation for farmers on the Saiss Plain, but makes some of the displaced local residents more socioeconomically – and climate – vulnerable. I met 30-year-old farmer Omar, whose family was displaced from their farming and herding lands located on the slopes in the vicinity of the dam. Said Omar:

> They did everything for the sake of the government, not for the people. They did this to take over our lands to indirectly stop and prevent herding. There are some farmers who had more than 500 sheep, but now they have only 50. So, the Green Morocco Plan has only made things worse for small farmers. Now, if the guard catches you herding in the area, you will pay for it.

Omar's grandfather was awarded land for his contributions in the military, but the land was never titled. His family is thus unable to prove the land is theirs, despite cultivating it for decades, not only for the purposes of preventing the land appropriation but also for receiving compensation.[12]

In Omar's interpretation, only the wealthy and those with connections were able to press for compensation. Each family, he said, sought their own individual benefit rather than collectively protesting. Several families chose to take an option of land compensation, moving to land outside a nearby provincial capital called Sefrou. Some families remain on their farm, and others have taken money reimbursement and moved to surrounding communes. Now, a mistrust of government, perhaps a result of past and present experiences, affects his perception of the future. He understands the potential benefits of the dam for those in Skoura M'Daz. But, he emphasized, "They shouldn't forget that some people suffered."

And those benefits for Skoura M'Daz? Ecotourism cooperative leader Mustapha is excited about the possibility of hosting more tourists. An association in Tazouta is already planning biking paths. A wildlife photographer from Skoura, Hassan, looks forward to migratory birds stopping by, and to take visiting photographers with him on tours.

The biggest benefit from the dam and reservoir, as I heard over and over again from farmers, is the rise in the water table for Lfwerem, the agricultural valley. Mohamed I., a co-owner of the most popular hanut[13] in town, told us his prediction: "The groundwater will be replenished. The people of Lfwerem will find water. The area of Lfwerem is threatened by drought. The water there is not enough. If there is groundwater, people will dig wells." This optimism extended to what Mohamed O., a farmer and amghrar, also felt, "Whoever digs a well will find water. People dig wells now, but they end up with nothing. If there

12 It was unclear from my interviews whether the Ministry of Agriculture or the Agency of Forest and Water was in charge of compensation for this case.

13 Hanut: a small grocery store.

is enough water, we will build a well. In the future, there will be enough water in the ravines; there will be enough water in Lfwerem." Farmers are already trying to take action against loss of water, from drought, agricultural expansion, overuse, irrigation timing disagreements, and a broken irrigation pipe in the valley. The dam reservoir, spawned by the government's planned climate adaptation, will inadvertently assist the farmers' own autonomous climate adaptation actions.

Fig. 3: A well being dug by a farmer in Lfwerem.

Photograph taken by the author.

However, there's an asterisk that comes with this benefit. Once the dam reservoir is filled, the digging of wells will become restricted. Already, farmers need permission to dig wells from the overseeing agency of the Sebou River basin. The additional restriction aims to prevent overwithdrawal, ensuring the reservoir's future for the intended farms in the Saiss Plain, as well as the replenishment of the aquifer over the next century. "The water is public, and anyone has the right to use it. Still, we should manage the usage of it", a Ministry of Equipment official told us. He told us a commission between the various Ministries involved in the dam will be created. They will decide on approval for digging new wells, which will depend on the number of existing wells, for which type of crops they are intended (no water-intensive crops like watermelons allowed!), and how the water will be managed: drip or sprinkler systems preferred. This last consideration of water-efficient irrigation systems is discussed in the next case.

IV. Cobbling Together a Future: Farmers' Drip Irrigation Systems

Complementing the planned adaptation of the M'Daz dam against a future of water scarcity is the seemingly autonomous adaptation arising from farmers' past and current mobilities. Human mobilities, which leads to people encountering different contexts and perspectives shaped by overarching policies like planned adaptation programs, spur the mobilities of ideas for climate adaptation. Therefore, planned adaptation indirectly influences autonomous adaptation through human mobilities. This linkage becomes apparent in Abdellah's case.

Abdellah, a van driver and farmer, drove my research assistant Mustapha and me down from the central village, across the River Guigou, past the commune's landfill, and onto his father's farm. Four years earlier, I had met Abdellah, and I was talking to him again in 2022, a nice surprise to see him, because he and his father were one of only a few farmers in Lfwerem who had installed a drip system. Abdellah had gotten the idea for drip irrigation due to his mobility in the region as a van driver, seeing it on other farms. He thought it was a good idea because drought was affecting their olive trees. Now, Abdellah was taking us on a tour to show how the system worked.

Fig. 4: A water collection pool for a drip system.

Photograph taken by the author.

He walked us to the well that they, together with a technician, had dug four meters deep, a pump running beside it. The way irrigation works here is that water is diverted from the main irrigation canal[14] farm-by-farm for a certain amount of time, in a cycle of every few weeks or so, depending on the season. Abdellah's well and pump supplement that surface water. "We used to have plenty of water. We used to get 12 hours. Now, we have only three hours,

14 The main irrigation canal for Lfwerem is a big pipe connected to a series of concrete irrigation canals, originally built under French management in the 1950s, which siphons off surface water from the River Guigou.

so we were obliged to build this system", Abdellah told us. He showed us their huge pool, enclosed with a fence for safety and to keep animals out, where they collect the water before pumping it into the drip system. Plastic hoses laced among the trunks and roots in the olive grove, almost taunting the hardened earth of the mud irrigation canals, no longer in use. "The mud canal is useless, we lost a lot of water", Abdellah explained, "while, with the drip system, the trees get enough water."

Mobilities of Skoura's residents entangle for the adaptation practices to be successfully implemented. In addition to Abdellah's own mobilities giving rise to the idea of drip irrigation and transferring it home, experiences arising from the past mobilities of Achraf, another Skoura resident, enabled Abdellah to implement and install the drip system. Achraf had lived all over Morocco in his 36 years, including near Agadir as an agricultural laborer. He had learned a lot – installing drip irrigation, building greenhouses, working with pesticides and fertilizers. He has been able to share these skills and knowledge with others during a period of immobility in Skoura M'Daz. He got stuck in Skoura during the pandemic lockdown in 2020, and since then, he had already assisted four farmers in installing drip irrigation: one for potatoes, and the other three for olive trees. Achraf was anxious to get back to traveling for work; he was a mobile person, and being immobile in Skoura – though helpful to transmit his social remittances, his expertise – was not ideal for him. He told us he had changed from his travels, "If you meet more people, you will learn more ideas, not like someone who has lived in only one place." As he seeks out his next job, seven more farmers in Skoura have asked for his assistance with drip system installation.

Physical mobilities have been key to the spread of these autonomous adaptation practices – drip and sprinkler irrigation – as social remittances in Skoura M'Daz in response to decreasing water supplies. In contrast to financial remittances, social remittances are, as termed by Peggy Levitt (1998), the intangible transfers of "ideas, practices, identities, and social capital" that are shared across migrant connections (Brown and Connell 2015, xlvi; see also Levitt 1998). People have seen or had experience with drip and sprinkler irrigation through their mobilities. They then transfer this idea home through communication or returning and sometimes implement it as a new agricultural practice. The nature of these translocal mobilities are diverse: near within the same region, others cross-country. Some are short-term, from a visit of only a few hours; some are from longer migration stints for seasonal or long-term agricultural work.

Saad, the manager of the tree nursery, started using sprinklers to water seedlings after getting the idea from visiting other nurseries in the region: "I visit them if I have work. There are some nurseries that are fully equipped by the government. They have installed surveillance cameras to control the nurseries remotely, and they water the seedlings automatically. I get new ideas from other gardeners." Sometimes the practices take time to be implemented. Badr had worked as a seasonal laborer on a vineyard near Fes, where he saw drip irrigation for the first time. He wanted to implement it on his family's lands. However, he was delayed:

> My dad was sick, and we were a poor family, so I moved for work, and I sent money back to them. My father didn't know how to use the land well – he was not a good manager. I told him that we had to work and renovate. He told me no, because we used to share land back then. When my father died, I started to develop our agriculture.

Badr installed drip irrigation for his carob trees near the river, also taking inspiration from the irrigation system the French had designed in Skoura. He had even set up a sprinkler system for his vegetables, after seeing examples on Facebook and YouTube, and has plans to increase his agricultural production in the future.

Yet for every person we met who had implemented new irrigation systems, or were actively making plans to implement them, there were four more who had thought about it, but could not put them into practice. It stood in complete contrast to the places surrounding Skoura M'Daz, which seemed rife with these new irrigation practices. Just one or two towns over, every farm seemed to have drip and sprinkler systems. What was different in Skoura? We visited one other commune, Serghina, deeper into the mountain plateaus, where the crops were organized in rows along drip irrigation hoses. In front of one big tract of land, I took a photo of the white, wooden sign: "Plan Maroc Vert."

"Plan Maroc Vert", or the Green Morocco Plan of 2008, was the Moroccan government's strategy to invest and strengthen the agricultural sector, with parts of the plan taking into consideration diminishing water resources. One program subsidizes the conversion of traditional irrigation systems to water-conserving technologies, like drip and sprinkler. A farmer submits an application to regional agriculture offices, and the farmer (usually) partners with an entrepreneur to assess the land and water supplies, conduct a study plan, and build the new irrigation system. The entrepreneur is then reimbursed by

the government. For farmers who have under five hectares of land, the cost is 100% reimbursed; for others, it can be reimbursed up to 80%. "Climate change" or "adaptation" were not a large part of the Green Morocco Plan's underlying framing; rather, dealing with water scarcity, building efficient agricultural production chains, and ensuring rural livelihoods were stated as the main objectives. However, since the Green Morocco Plan's end in 2020, the Green Generation Plan (2020–2030) has been implemented, with a shift to a more "people-centered" approach for economic development (The World Bank 2020, 6). It explicitly seeks to "increase the resilience and adaptation of rural populations to climate change" (The World Bank 2020, 8), especially in the face of more extreme droughts: "Climate Smart Agriculture (CSA) solutions – including more efficient irrigation systems – can sustainably improve agricultural productivity, adapt and build the resilience of the agriculture and food systems, and reduce greenhouse gas (GHG) emissions from agriculture" (The World Bank 2020, 12). The irrigation subsidy program will continue under the Green Generation Plan. Preparing for a future in which climate change may harm people now underlies the continued irrigation subsidy, making it "planned adaptation" from the government.

But planned adaptation has not transferred easily to Skoura M'Daz. While areas surrounding Skoura M'Daz have experienced a rapid spread of these irrigation systems thanks to the subsidy, Skoura farmers in the productive valley farmland of Lfwerem have encountered a key barrier: the lack of land titles to prove land ownership, required to apply for the subsidy. As stated in the previous case, this problem is not unique to Skoura. What is particular to Skoura M'Daz is an ongoing legal question that is still unresolved.

The immobilization of planned adaptation in Skoura M'Daz is a result of history, specifically of French colonization. Following World War II, Skoura M'Daz became home to a French model farm in Lfwerem. As the French protectorate came to an end in 1956, the French parceled out the model farm in Lfwerem to families in the area. However, in the late 2000s, the tribe of Ait Seghrochen, one of the main tribes, put forth their own claims to the land of Lfwerem. According to an agreement with the French in 1952, the land was a gift to its tribesmen, who had been recruited to fight with the French military in the First Indochina War. The dispute is unresolved, because that agreement to the tribe was never signed by King Mohammad V, who was still in exile until 1956. Today, the disagreement has landed with Skoura M'Daz's qaid, the commune-level Ministry of Interior official. But in the succession of qaids since the

late 2000s, not one has broached and solved the case. And so, until the conflict is decided, farmers cannot get their copies of land titles.

The idea of new irrigation systems becomes immobile by other causes, too. There are additionally many barriers that can prevent farmers from installing new irrigation systems: cost, inheritance patterns splitting lands inter ever-smaller parcels, disagreements over land inheritance, and more. Temporalities come to play between older and younger generations: decision-making and land ownership by older generations can block innovating members of the younger generation. Agriculture officials I talked to were aware of many of these issues, including the land titling problem in Lfwerem. However, planned adaptation at the national level does not take into account different contexts at the local level, proffering little support for people hindered from taking advantage of the subsidy.

Nevertheless, entangled human mobilities have assisted farmers like Abdellah and Badr in Skoura M'Daz to maneuver around the immobilization of planned adaptation and enabled the mobility of ideas themselves, leading to autonomous adaptation. Their mobilities have exposed them to new irrigation methods in other provinces and regions where the Green Morocco Plan has made a difference. They brought new ideas for agricultural practices back to Skoura M'Daz as social remittances. Mobilities also provide the financial means for implementation without relying on the subsidy: absentee landowners with jobs in the city or living in Europe, as well as transportation drivers like Abdellah, have higher incomes. The immaterial mobility tied to human mobilities enables the climate adaptation the government had aimed for. All of these mobilities become climate mobilities.

V. Present Futures: Entangled Mobilities and Temporalities for Climate Adaptation

These cases reveal the realities of climate mobilities within the context of present futures. Following entangled im/mobilities in the context of planned and autonomous adaptation shows "how new environmental change-related im/mobilities intersect with previously established patterns of relative mobility and relative immobility" (Wiegel, Boas, and Warner 2019, 5). Not only are existing mobility patterns affected by climate change, nor only new im/mobilities created by climate change, but also manmade reactions to climate change are intricately linked to and causing mobilities.

Within planned and autonomous adaptation actions, mobilities circulate and become entangled before, during, and after implementation, including with entangled temporalities. Climate change discourse, including in planned adaptation, is often future-oriented. However, the realities of preparing for the future are tied up in temporalities: in the past (e.g., like an obstruction to obtaining land titles) and in the present (e.g., ongoing generational issues). The actions and mobilities for climate change adaptation then enact "present futures", wherein acts oriented towards the future take place in the present and affect the present and future (Anderson and Adey 2012). Anderson and Adey (2012) emphasize the paradoxical relationship of a future being present, even though the future has not come to pass; temporalities thus become entangled.

The first case of planned adaptation in the form of dam-building starts from an awareness of climate temporalities and creates mobilities. The dam project, too, exposes a web of entangled temporalities and mobilities, which are derived out of necessity for the government's planned climate adaptation goals to be fulfilled. The government flies smallholder farmers to Agadir to convince them to join their climate adaptation program. The dam and reservoir displace people and submerge their land to ensure the sustainability of agriculture and livelihoods hundreds of kilometers away. These mobilities are embedded in temporalities. Preventing a certain future is the goal. That future is the projection of what happened in the past in Agadir, where the water gradually disappeared after intense agricultural overuse. Creating a new future, a sustainable future where the government successfully adapts to environmental change, becomes the goal. The im/mobilities that happen in the present – transporting pipes, forcibly displacing families, halting a natural river flow – are steps towards creating a new future, away from that past-inspired pessimistic outcome. And, taking a U-turn back to the irrigation case, the dam will potentially assist the farmers of Skoura M'Daz experiencing diminishing water supplies, too, with the rise in the water table. They seek to dig wells now, soon, and in the future. Planned and autonomous adaptations converge.

In the latter case of drip and sprinkler irrigation, entangled mobilities reveal how the planned and autonomous adaptation actions are intertwined, beyond what would have been expected by the government planners. For Skoura M'Daz itself, the Green Morocco Plan and now the Green Generation Plan will have less direct influence for irrigation because of the lack of land titles. However, the planned adaptation for water-conserving irrigation has indirectly influenced the autonomous adaptation of farmers fighting drought and water scarcity in Skoura M'Daz through farmers' own mobilities. They

travel or work in other locations, where farmers may have directly benefited from the Green Morocco Plan, and return home with social remittances to implement. Throughout each of their actions, farmers' own mobilities give rise to social remittances: inspiration for ideas, a transfer of knowledge, a method for implementation, as well as concrete means through which to obtain wealth. The planned adaptation of the government may not have expected mobilities in this way to assist the implementation of water-conservation irrigation. After all, one of the objectives of the Green Generation Plan is to bolster rural livelihoods to decrease youth migration to cities. However, as these cases exemplify, mobilities are deeply entangled in these climate adaptation actions.

Again, climate mobilities intertwine with and become spatial dimensions of climate temporalities. Mobilities enable a work-around of the barrier from the past: the land dispute preventing farmers from getting land titles for the irrigation subsidy. The present discomfort with solving it – the decision stuck in the qaids' office – seems to delay the future imagined by the government. Fortunately, the government's goal to conserve water overlaps with the goal of the farmers. The farmers are reacting to diminishing water resources through their own water-seeking and -conservation methods, through saving money; installing drip irrigation, sprinklers, wells, and pumps from the river; and changing crop types. They know that to ensure their future, they must take action. The imagined futures of planned and autonomous adaptation align, but the past creates complications for the present to address.

The cases reveal the give-and-take between planned adaptation and autonomous adaptation for climate change. However, power differentials between actors and scales lead to the goals of the government often superseding local concerns, thus questioning the efficacy of planned adaptation. The lack of consideration given to local situations, in addition to lack of coordination of local adaptation actions, can potentially lead to maladaptation. Like the M'Daz dam, hundreds of dams, including hydroelectric dams, are being built around the world with the justification of climate adaptation or mitigation (Walicki, Ioannides, and Tilt 2017). Warner and Wiegel (2021) point out the ethical issues that arise from such "climate buffer infrastructure" aiming to decrease climate vulnerability of intended beneficiaries, at the cost of increasing climate vulnerability of the populations displaced by such projects. In the second case, people's mobilities helped transfer the planned adaptation ideas of the government and transformed them into autonomous adaptation by farmers. However, Studies have also questioned the outcomes of the irrigation program in Morocco (Mathez and Loftus 2023; Venot et al. 2014; Alonso et al. 2019). As

seen even in Skoura M'Daz, conversion to drip systems have led farmers to extend their lands, or switch to using more groundwater than surface water, defeating the purpose of the program. Planned adaptation like Morocco's must better track and respond to its resulting effects, even unintended maladaptive ones, that may end up increasing vulnerability to climate change.

Overall, this chapter has shown how researching climate mobilities means looking into these extended effects and complex dynamics that start from or entangle with climate change. Mobilities-in-adaptation stretches beyond a traditional approach that asks whether migration leads to or performs as adaptation, and instead examines the broader web of entanglements of mobilities, temporalities, and power, within planned or autonomous adaptation – or, as is often the case, an amalgamation between both. As climate change adaptation is becoming more embedded into programming at national and local levels, more attention needs to be paid to the power dynamics that potentially frustrate complementary goals and outcomes of planned and autonomous action. Scenarios and imaginations of the future will continue to guide government and people's responses to climate change, creating present futures and alternative futures. Climate mobilities and temporalities expose how people are living in the future – now.

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