Human Ecology
https://doi.org/10.1007/s10745-025-00568-y

The Adoption of Farmer-managed Natural Regeneration in Dogonkiria, Niger

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Accepted: 3 January 2025

Abstract
We examined the diffusion of agricultural innovations that improve smallholder well-being in sub-Saharan Africa. Innovations are slowly being accepted in the region, but villagers of Dogonkiria in Niger are an exception in adopting a technology known as farmer-managed natural regeneration (FMNR). We employed an exploratory qualitative methodology based on Everette Rogers' diffusion of innovation (DOI) theory to investigate the microlevel dynamics behind the success of FMNR. Our findings demonstrate that the top-down technology transfer model required robust local-level participation, with local knowledge being a substantial element in the diffusion process. In effect, the area is experiencing improved crop yield and availability of wood for construction and energy. The results enhance understanding the relationship between external agents (state and non-state actors) and local beneficiaries in the context of new technology dissemination.

Keywords Agricultural innovation · Farmer-managed natural regeneration · Innovation transfer · Dogonkiria · Dosso · Niger

Introduction

Rural agriculturalists, typically smallholder farmers, have maintained a significant presence worldwide. An estimated 84% of farms globally occupy less than two hectares (approximately five acres) of land. A greater share of small farms is in lower-income countries. In sub-Saharan Africa (SSA), as in East and South Asia (excluding China), between 70 and 80% of farms also occupy less than two hectares of land. These are farms identified as smallholder and/or family farms (Kassam, 2010; Lowder et al., 2016). There are at least 500 million smallholder farms globally, from which some two billion people earn a living by helping to meet food demand in Asia and SSA (Koohafkan & Altieri, 2011). Whether small farmers earn profits or strictly feed their families, smallholder agriculture addresses poverty. Christiansen et al. (2011) present empirical evidence supporting the claim that agriculture is a feasible means for fighting poverty.

Sub-Saharan Africa's dependence on rainfed agriculture is one of the major setbacks to food productivity in the region; slightly less than 5% of the region's cultivable land is under irrigation (Kassam, 2010). Galli et al. (2020) argued that the smallness of the farms does not permit the enjoyment of economies of scale, as farm production is insufficient to meet the demands of processing plants. Further, local farmers are somewhat aware that climate change negatively impacts agriculture (Djibo et al., 2016; Sarr et al., 2015) and perceive its negative impacts on agricultural returns. However, this only accounts for one explanation of why local agricultural productivity is decreasing. Niger's colonial history and domestic traditions also have created unique challenges.

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Published online: 27 January 2025

In the 1980s, government policy discouraged farmers from keeping trees on their land. At that time, all trees belonged to the government, and tampering with them in any form attracted severe punishments ranging from fines to imprisonment. This was a colonial legacy that the Nigerien government inherited. As far back as the 1930s, a colonial land law triggered land clearing and tree felling. The French colonial government's new land law required farmers to buy permits to use trees on their lands. This policy was intended to commercialize agriculture, where cash crops would be cultivated mainly for export (Brough and Kimenyi, 2002 as cited in World Resources Institute (WRI) et al., 2008).

The persistence of this post-colonial-era policy made the presence of trees on agricultural fields a source of worry rather than a benefit to farmers. Farmers preferred to keep treeless fields for fear of getting into trouble with the State Forest guards. It took the intervention of the Maradi Integrated Development Project staff to change the status quo, albeit gradually. They involved local state environmental authorities in negotiations that resulted in their relaxing the strict laws on tree protection during the short term. In 2004, farmers finally gained full ownership rights of trees in their fields with the enactment of the FMNR law in 2010.

Before this policy change, the country suffered a severe humanitarian crisis: a famine during the 1970s and 1980s strongly related to massive tree loss due to drought and land clearing. The cataclysmic deforestation resulted in heightened efforts towards reversing the situation. International organizations, in collaboration with Niger's government, embarked on a national campaign of massive tree planting (Reij et al., 2009). This was happening at a time when local farmers and forestry agents had a strained relationship regarding tree ownership and management. This possibly could explain why there is no mention in existing literature of incorporating local knowledge in action against desertification during that period. It is understandable, therefore, that a feeling of marginalization and resentment toward government forestry agents by local farmers could have resulted in non-cooperation, leading to the eventual failure of the tree-planting campaign. Further, at that time, "a good farmer was considered one who had treeless land and kept his fields free of any regrowth shoots" (Cunningham and Abasse 2005, p.2). It is, therefore, unclear whether the failure of the government's reforestation initiative was related to the strained situation between local people and environmental protection agencies or merely incompatible with prevailing cultural norms of that period. The extant literature largely attributed the failure to the Sahel's capricious climate. Reports suggested that a chunk of the planted trees perished because of the harsh temperatures in Niger (Tougiani et al., 2008).

Because of these challenges, various innovative practices have emerged to improve agricultural resilience. In 1983, the farmer-managed natural regeneration (FMNR) program was introduced through the Maradi Integrated Development Project (MIDP), established by the Christian missionary organization Serving in Mission (SIM). This initiative began with twelve farmers but quickly grew into a larger group, spreading mainly through farmer-to-farmer communication. Currently, FMNR affects five to six million hectares of land in Niger. The diffusion of this innovation has resulted in widespread adoption with varied benefits. The practice has ensured the continuous availability of trees for fuel, wood for building, and food and fodder at almost no cost. Binam et al. (2016) found that edible fruits from these trees provided food and nutrition supplements, especially for marginalized groups. Moreover, pruned branches have served as fuelwood for domestic purposes since the first year of implementation. During subsequent years, tree branches grow large enough to be sold by farmers for additional revenue. Another benefit of FMNR is increased crop yield due to soil enhancement. Trees allow nutrient transfer from trees to crops and provide shelter for birds and shade for livestock whose excreta contribute to soil enrichment (Buerkert & Hiernaux, 1998). Thus, for resource-poor societies to attain such levels of self-sufficiency from a non-technical agroforestry practice, with minimal involvement from the state, was described as a "Sahelian miracle." This Nigerien phenomenon could inspire the adoption of such agricultural technology in other developing countries (Pender, 2004; Teklewold et al., 2013).

FMNR was adopted on some 200,000 hectares of land (on average) annually for 25 consecutive years in Niger (between 1983 and 2008; Tougiani et al., 2008), but the adoption of this program throughout southern Niger is hardly understood at all by Sahelians. Since its inception, the scientific community has shown great interest in the benefits of this innovation (Sendzimir et al., 2011), so much so that the benefits have overshadowed the details of its diffusion and adoption process. Our study, to the best of our knowledge, is the first empirical study describing the social, cultural, and bureaucratic processes (within the context of Rogers' diffusion of innovations theory; 1962, 1983, 2003) characterizing the endemic spread of FMNR in rural Niger. It contributes to understanding how practicality intersects with academia. The successful adoption of FMNR benefited from having the support of a dynamic relationship between external agents (state and non-state actors) and local beneficiaries.

Theoretical Background

Everette Rogers', 1962 seminal work on the diffusion of innovations and subsequent work in 1983 and 2003 comprise the framework that guides our study. The ultimate reason for following innovation theory is to understand how the midpoint of his theory—the Adoption Stage—affected the FMNR success rate in Dogonkiria. Rogers (1962, 1983,

2003) outlined four features characterizing innovation adoption processes and called them elements or phases of innovation diffusion: innovation, communication channels, time, and the social system.

The Innovation The adoption rate of an innovation can be explained by its relative advantage, compatibility, complexity, trialability, and observability, arguing that it is easier to adopt less complicated ideas that do not require additional skills. Thus, in areas such as Dogonkiria, which tend to have largely non-schooled populations (Kassie et al., 2015; Zua, 2021), it is prudent to focus on less complicated innovations to preserve preciously needed time and resources for training and/or input subsidies and increase the potential for adoption.

Communication Channels The second element in innovation diffusion is communication between individuals or entities transferring new ideas to potential adopters. Local leaders appear extremely instrumental in African communication channels (Kante, 2007). One-on-one communication is regarded as a more efficient channel of information transfer (Rogers, 2003; Kante, 2007; Kante et al., 2009). Face-to-face information transfer is relevant compared to mass media, as Kante et al. (2009) show.

Time Rogers' theory acknowledges that while it may take only a couple of years for specific innovations to diffuse widely, others may take much longer to reach high adoption rates. He argues that the characteristics of innovations perceived by individuals or potential adopters are a window for understanding different adoption rates. He explains that a given innovation is most likely to gain rapid acceptance if perceived as more advantageous than existing practices/products–thus, the criterion of relative advantage.

The Social System The final element of technology transfer is the social system, arguably the most important given that without a community of need, there might not be a sufficiently large enough underlying demand for a particular innovation. Diffusion occurs within a recognized border/limit containing individuals or units of adoption interacting in a certain pattern. It appears that every aspect of the social system affects innovation transfer as much as the characteristics of the innovation and potential adopters. The deciding factor of whether the promotion of innovation will succeed within a given context depends on the dynamics within that system. The binding factor for units in a social system typically is the need to achieve a goal of shared interest (Rogers, 1983).

Data and Methods

Study Area

The municipality of Dogonkiria is in the northern part of the department of Dogondoutchi (Dosso region). It spans an area of approximately 2,886 km^2 and lies between longitudes of 4°18′0"- 4°9′40" East and latitudes of 14°36′50"—13°56′30" North. It is bordered to the south by the municipalities of Matankari and Dankassari, to the east and north by the municipalities of the department of Bagaroua, the municipality of Alléla (department of Konni), and the municipality of Sanam (department of Filingué) and to the west by the municipality of Soucoucoutane. The capital town of the municipality, Dogonkiria, is located 75 km from Dogondoutchi (Fig. 1).

The municipality of Dogonkiria was created on 11 June 2002. It comprises forty-eight administrative villages, six Tuareg camps, and seven Peulh tribes. The local elections on 24 July 2004 introduced the first democratically elected council headed by a mayor (PDC, 2014).[1]

The climate includes three main seasons: the hot-dry season from March to July, the cold season from October to February, and the rainy season from June to September. The highest temperatures are recorded in April and May (45 °C, 113°F) and the lowest in January and February (18 °C, 64.4°F). The two types of dominant winds are harmattan and monsoon. Harmattan winds blow from north to southwest during the dry and cold seasons, and monsoon winds blow from the southwest to the northeast from June through September and bring rainfall (PDC, 2014).

The vegetation is characterized by three major strata: the tree stratum, shrub stratum, and herbaceous stratum. It is composed of woody species (their local names in parentheses) such as *Accacia albida* (Gao), *Balanites* (Adoua), *Combretum glutinosum* (Taramnia), *Prosopis africana* (kiria), *Cacia sieberiana* (Malga), and other shrubs such as *Guierra senegalensis* (Sabara), *Combretum micrantum* (Guéza), *Boscia senegalensis* (Anza) and Jujubier or *Ziziphus mauritiana* (Magaria). The herbaceous cover is sparse because of desertification (PDC, 2014).

Methods

We used qualitative methods to collect data from local key informants, agricultural experts (scientists), and relevant documents. Rogers' diffusion of innovation theory provided a theoretical framework for describing

[1] Plan de Développement Communal (PDC): A Municipal Development Plan document that profiles a municipality or district and outlines its development agenda.

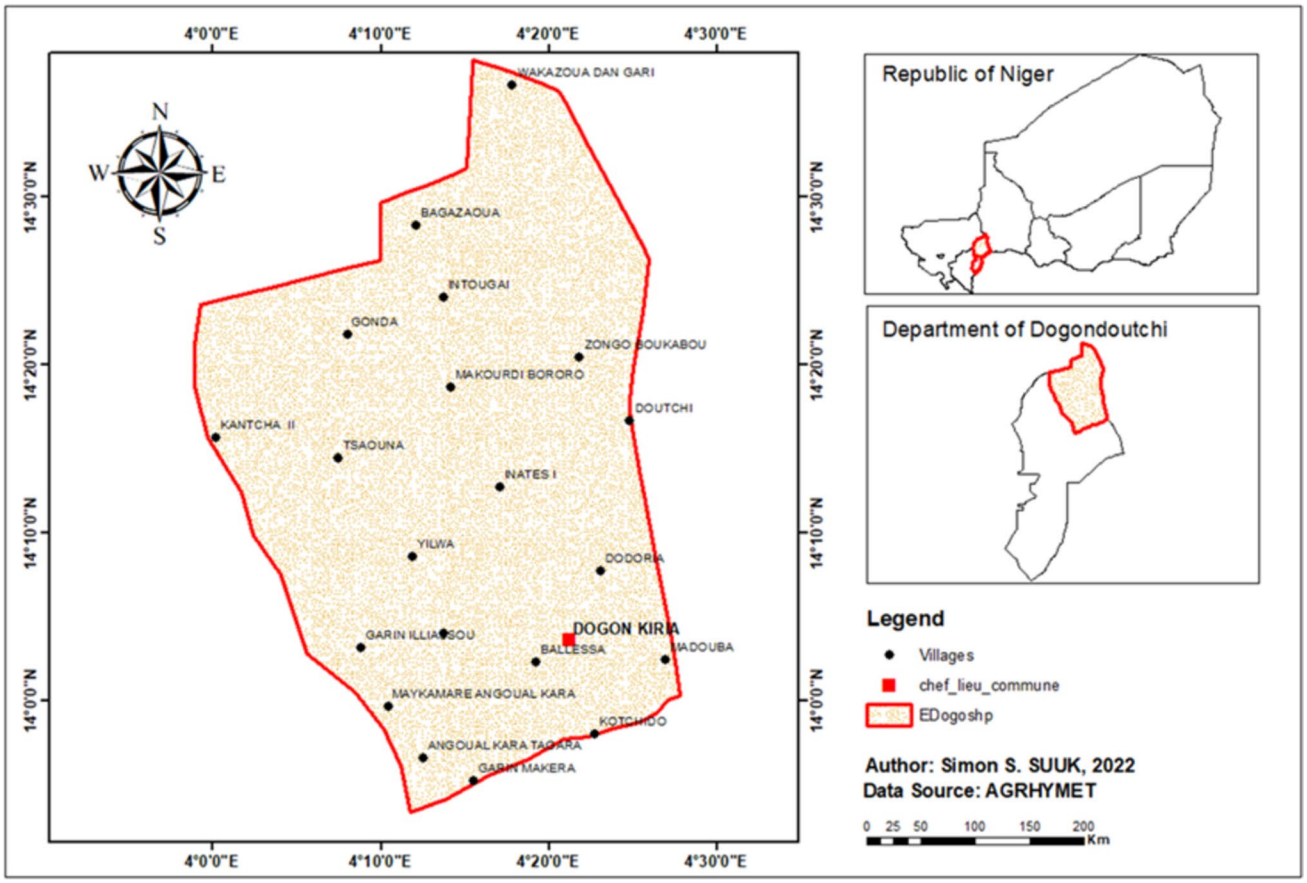

Fig. 1 Map of the study area. Source: authors' fieldwork in 2022

the FMNR adoption process. This required purposive sampling, in-depth interviews, observations, document reviews, and content analysis.

Sampling

We used purposive sampling to select key informants. The threshold for an acceptable key informant was at least five years of experience with FMNR as a local farmer or authority. Experts also had at least five years of experience, but they were more technical and less applied to corroborate the farmers' narratives. However, this process is not uniformly reliable across all parties considered within the potential sample, so this variability must be accounted for prior to sampling to ensure that the scientific method has been applied to qualitative studies. This approach resulted in a sample of 30 participants: the environmental agent of Dogonkiria municipality, two agricultural research scientists, 26 local farmers, and one local NGO coordinator of FMNR projects (Table 1).

Demographic Characteristics of the Study Area

The Dogonkiria community has a population of 4,519 (2,174 females and 2,345 males), equivalent to 6.8% of the municipality's total population. Fifty-two percent of the municipal population was younger than 15 (which is approximately the median age in Niger). The total population of this rural municipality is also distributed among Hausa, Peulh, Tuareg, and Zarma speakers, with Hausa comprising the majority. Households participating in this study had an average size of 11 members, ranging from a minimum of seven to a maximum of 21. Table 2 summarizes the demographic characteristics of the farmers who responded during the interviews.

Results

Local Farms Experiencing Practices before FMNR

The evidence suggests that farmers in Dogonkiria did not allow any naturally occurring vegetation to grow on the

Table 1 Respondent selection criteria

Respondent	Eligibility requirements
A Key informant	Should be a farmer or local authority (e.g., chief farmer, village chief, etc.)
	Could be male or female
	Should have at least five years farming experience
	Should have had their farming experience in the study area
An Expert	Could be an agricultural extension officer
	Could be an NGO agricultural projects coordinator
	Could be an agricultural scientist
	Could be male or female
	Should have a minimum of five years working experience in their position as well as the study area

Source: Authors' criteria, 2022

Table 2 Demographic characteristics of respondents

Age	Number of people	Percent
76 +	1	0.04
66 – 75	4	0.15
56 – 65	2	0.08
46 – 55	8	0.31
36 – 45	9	0.35
26 – 35	2	0.08
Sex		
Male	19	0.73
Female	7	0.27
Ethnicity		
Hausa	25	0.96
Others	1	0.04
Religion		
Islam	26	100.0
Education		
Elementary school	8	0.31
Secondary	3	0.11
None	15	0.58
Professionals in agriculture		
Municipal environmental officer	1	0.25
Agricultural scientist (formerly of SIM international)	1	0.25
Agricultural scientist (INRAN, Niger)	1	0.25
Project Coordinator (CRESA, Niger)	1	0.25

Source: authors' fieldwork, 2022

farm for many years. The farms were for crops, and all other vegetation, such as trees and shrubs, was cleared. Farming was considered a cultural heritage, whereby many farmers believed that clearing their fields, raking, and burning all organic material during land preparation was part of their heritage as an agrarian community.

> *"… all we do here is more about what we learned from our parents. Before they [the external development agents] came, everything in the form of regrowth [natural vegetation of tree stumps or shrubs] in the farm, we used to clear them. Just so the crops will feel at ease. We also thought insects were attracted to the farm because of the regrowth, and they disturbed the crops."* (Male Farmer, 53 years, Dogonkiria, February 5, 2022)

An expert from the national agricultural research center, *Institut National de la Recherche Agronomique du Niger (INRAN)*, explained:

> *"The farmers who cultivated the land believed that crop parasites always hid in the natural vegetation as well as residue from previous harvests, and that is why during land preparation, they would clear everything, pile them up, and set fire to it."* (Agricultural scientist, INRAN, Niamey, January 13, 2022)

The Concept of FMNR

FMNR is an agroforestry technology that protects and nurtures naturally occurring shoots and the stumps of felled or otherwise destroyed trees so they can regenerate and grow into mature trees or shrubs. This is done on the farm by farmers. Hence, the name "farmer managed." Its proliferation followed failed national attempts at restoring the productivity of degraded agricultural lands of rural Niger. In the 1980s, the government promoted nationwide tree planting, and millions of dollars were spent to develop nurseries and plant seedlings for agricultural "windbreak" fencing. This approach did not succeed because the mode of operation was top-down and did not incorporate local knowledge and experience (Tougiani et al., 2008). Years later, the same

top-down approach would characterize the promotion of FMNR–this time with success.

Introduction of FMNR in Dogonkiria

Tony Rinaudo, the first to promote FMNR in Niger, was an Australian working with SIM in 1983 on the Maradi Integrated Development Project (MIDP). In the study area, FMNR was vaguely understood as a modern-day agricultural technique that allows crops to coexist with trees on the farm. It was first introduced in this municipality in 2010 by *Centre Régional d'Enseignement Spécialisé en Agriculture* (CRESA)[2] in a project named *Initiative pour le Reverdissement du Sahel*[3] (IRS). CRESA is an agricultural research institute in Niamey, Niger's capital. The institute, in collaboration with the *Comité Inter-Etate pour la Lutte contre la Sécheresse au Sahel*[4] (CILSS) and a partner institution in the Netherlands, secured funding to expand the experience of FMNR in the Maradi region to other parts of the country. Implementing the IRS in Dogonkiria resulted from a mutual agreement between the local authority and the project coordinator regarding its necessity. For the Dogonkiria community, the decision team consisted of the mayor and the community development officer in charge of environmental issues, a *chef de canton* representative, and a representative of the people of Dogonkiria.

Local Farmers' Role in Promoting FMNR

Our findings demonstrate that practitioners of FMNR employed the farmer-to-farmer diffusion strategy (i.e., communication phase) to promote the technique after being triggered by NGOs. The local farmers discussed the technique at social functions such as naming ceremonies and at *Fada*.[5] In the study area, *Fada* was observable in the evenings from around 4:00 PM until late at night. During their conversations at *Fada*, men discussed, among other things, FMNR. This study found that *Fada* was the primary medium through which farmers promoted FMNR in the sort of informal farmer-to-farmer communication vaguely reported in existing literature (Tougiani et al., 2008; World Resources Institute (WRI) et al., 2008).

> *"I was able to mentor many people to do FMNR because I had the habit of discussing it at Fada. It is because of this that some people came to adopt the practice. So, some people who heard about it either from me or others (at Fada) went and experimented on their farms, and things were not going as expected, then came to me personally for an explanation. So, when they come to me for clarification, I explain things with illustrations on the ground [in the sand], explaining the spacing of trees and regrowth. Like I said earlier, when you cut one stump, you skip the next in that order."* (Male farmer, 52 years, FMNR committee president, Dogonkiria, January 28, 2022)

The Dynamics of Farmer-External Agent Relations and its Influence on FMNR Adoption

We found that NGOs (CRESA, CARE, World Bank) were the leading promoters of FMNR in the research area. They actively engaged communities to adopt FMNR technology and created social interfaces between external agents (NGO project coordinators) and local farmers, where the former tried to convince the latter about the pertinence of a land recuperation technique such as FMNR to agriculture. It is worth noting that NGOs, in their engagement with local farmers, did not make the mistake of purporting to know everything while farmers know nothing and, therefore, must accept wholesale what they are being taught (Freire, 2020). The following recounts illustrate the kind of interaction that ensues when the top (state and external agents) meets the down (local farmers):

> *"When they came, they assembled everyone at the chief's palace. They first asked to clarify if there was a good relationship among everyone in the village. They explained that their objective was to help the community to fight against desertification. […] When asked how we are fighting against desertification, we explained that we take animal droppings from within the neighborhood to the farms. The IRS agents encouraged us to continue with that, but instead of throwing them [haphazardly] on the field, we should spread them on the field so that it covers as much space as possible."* (Male farmer, 52 years, Dogonkiria, January 28, 2022)

Secondly, local farmers' interest in improving agricultural performance appears to have coincided with that of the external agents, a rarity, as noted by Long (1999). A farmer lamented, *"Before FMNR, I had farms that were not producing. You farm, and you get nothing. But with FMNR, I am getting good yield" (Male farmer, 45 years, Dogonkiria, February 6, 2022).*

A professional commented on why the locals seemed to have suddenly done a U-turn in favor of trees on farms,

[2] Regional Specialized Teaching Center in Forest-Wood Agriculture

[3] Initiative for Re-greening the Sahel

[4] Committee for the Fight against Drought in the Sahel

[5] An existential phenomenon of the Nigerien society involving clusters of men sitting under sheds in the neighborhoods, along the streets etc. in the period between late afternoons and the night, drinking tea and conversing.

which corresponds with the farmers' sentiments and describes the crisis farmers were experiencing.

> *"The villagers in Niger depend on the natural resources. They depend on groundwater resources, the ponds, if there is a river. As I said, they use woody resources and natural trees in the bush. They depend so much on the land and the soil to cultivate crops. There came desertification; many water bodies dried up, killing many trees and leaving only soil. So, there was an ecological crisis. So, once these were depleted, it is no surprise that they cooperated with us to fight the desertification"* (Prof. Toudou Adam, CRESA, February 24, 2022)

The Role of local Knowledge and Experience in FMNR Diffusion in Dogonkiria

We found that FMNR promotion in Niger benefitted greatly because of the knowledge of experienced farmers. The training provided by external agents was complemented by peer-to-peer training. The experienced farmers facilitated the diffusion of the technique among new adopters with the help of NGOs who organized the study trips. Farmers also promoted FMNR in their localities and within their networks.

The IRS project coordinator said:

> *"…we started in 2010, and there were newcomers [adopters] each year. Hence, we picked 10, 20, and 30; we took them to IFAD sites to see how it [FMNR] worked. That is what we call the study trip or experience sharing."* (Prof. Toudou Adam, CRESA, February 24, 2022)

As part of a World Bank project, *Projet d'Appui à l'Agriculture Sensible aux risques Climatiques (PASEC),*[6] a two-day workshop was organized (28th and 29th January 2022) for FMNR farmers from Dogonkiria. Twenty-five farmers from five communities, including 10 females, traveled to Toudoungao in the Scoucoutane municipality to interact with FMNR practitioners. On the opening day of the workshop, the nature and purpose of the visit were communicated to the chief and the local FMNR committee by a representative of the Mayor of Scoucoutane municipality, the environmental officer of Dogonkiria, and a representative of PASEC. The visiting team spent the second day touring three preselected FMNR farms. The environmental agent described the selection process for those three farm tours: one male- and one female-owned and a third because of its nearness to the community. The owner was present at each farm to explain FMNR. Visitors asked questions of the owners after the conclusion of their FMNR explanations to generate discussion among the group before completing each tour.

We observed that FMNR promotion thrived on creating a stable system (ably supported by the formation of village FMNR management committees) of communication among major stakeholders and beneficiaries, particularly a system that brings together external agents (NGO project coordinators), state actors (technical services personnel), and local communities (traditional authorities and subsistence farmers). This facilitated communication and information sharing, making information easily and readily available for farmers to decide on adopting the innovation.

Discussion

The results of our study provide evidence to understand better how the FMNR innovative practice/technique diffused and was adopted in the Dogonkiria area of Niger. This process occurred within the framework of a development intervention that started as a top-down approach but also heavily relied on horizontal and participatory approaches. The use of a farmer-centric strategy appears to have strongly influenced the outcome compared to some of the classical top-down methods of technology transfer. The external agents' routine face-to-face interaction gained local farmers' support. The agents demonstrated that others could believe in their knowledge of the local environment and collaborate with them. This confidence in a working relationship resulted in farmers and agents sharing knowledge regarding FMNR, which motivated the farmers to teach other local farmers. Most new adopters learned the technology in an informal instructional format involving experience sharing. Thus, it was less technical, culturally compatible, and more comprehensible for farmers, irrespective of their educational backgrounds. The study also found that local knowledge became the primary driving force behind FMNR's successful adoption. The development interventions' objectives to fight desertification and enhance agricultural productivity adequately overlapped with farmers' concerns about environmental degradation, dwindling natural resources, and decreasing farm yields.

As previously discussed, innovations that fail or lag in garnering acceptance may have characteristics that are misaligned with the four criteria posited by Rogers (2003). For example, Kutter et al. (2011) reported that in their study of precision farming technologies, participants admitted compatibility problems, which included a lack of opportunity to observe the benefits of precision farming. However, the evidence in our study shows that FMNR demonstrated the qualities necessary for easy adoption. First, local farmers saw that by merely nurturing on-farm trees, their chances were enhanced to arrest desertification and the downward

[6] Project to Support Agriculture Sensitive to Climate Risks (PASEC)

trend of agricultural production. This is illustrative of the farmers' perception of reasonable prospects of environmental restoration for agricultural growth–something they had been grappling with in the context of their "business as usual" farming practices. This is what Rogers refers to as an innovation having a relative advantage. Also, no specialized farm equipment was needed for adoption; hence, no financial burden was incurred due to adopting the innovation. Consequently, local farmers considered the innovation to be a simple application.

It is argued that households' economic status determines the ability to adopt innovations. For instance, Tey and Brindal (2012) discussed the high entry cost associated with adopting precision agricultural technologies (PATs), noting that farmers with less capital were not as well-positioned to adopt PATs because of difficulty raising capital. Further, beginning the promotion of FMNR on an experimental basis and sustaining subsequent campaigns through experience sharing demonstrates its trialability and observability. Taking the study trips, which expose farmers to the physical manifestation of FMNR, assisted in triggering discussions among peers that helped potential adopters evaluate the usefulness of the new idea while processing through their decision-making phase.

The overlap of interest between adopters and external change agents in the presented study was probably one of the reasons no conflicts, such as those described by Mikwamba et al. (2019), were reported. The key implication here is that farmers and external agents need to see evidence of the introduction of innovations to glean their objectives. This notion is supported by Segers et al. (2008), who show that for an innovation to attain its overall aims, the goals and objectives of all actors need to be aligned. Innovations, compatible with local needs and therefore capable of achieving high adoption rates, are pivotal to achieving the United Nations (UN) sustainable development Goals 1 and 2: no poverty and zero hunger, respectively. Innovations such as FMNR aim to address the resilience of the rural poor against undesirable climatic conditions and disasters while maintaining ecosystems. They are geared towards sustaining the agricultural productivity of small-scale food producers, which is consistent with Ajayi's (2007) and Eze et al. (2021) arguments.

The proliferation of FMNR is partly due to local leaders' role as farmers' mobilizers. In the study area, chiefs are installed by the authority of the Ministry of Territorial Administration, which means they are responsible to mayors, who are local-level political actors through whom development projects flow. Once installed, a chief has authority over every individual within his village, making them the municipal assembly's first-choice influential personalities for information dissemination. This partly explains why the mobilization of local farmers seems to occur swiftly upon the arrival of external change agents, and information seemingly passes down with ease after the first communal meeting. This is an important trigger for peer-to-peer discussions. It is, thus, not surprising that social networks support successful diffusion of innovation because they are fertile grounds for homogenous interactions, as in the case of *Fada* in Niger.

Indeed, FMNR campaigns benefit significantly from the elimination of heterogeneous relationships. It should be noted that change agents are often at a different level of technical ability than their clients (i.e., heterogeneous relationship), constituting a significant "language barrier" between them. The farmer-to-farmer experience sharing at the level of social networks and through study trips ensures less dependence on development agents' technical expertise. Thus, our study shows that education is not a determining factor in FMNR campaigns, which is important because it emphasizes that neither formal education nor youthfulness is necessary to understand and adopt FMNR. Therefore, FMNR should be adequately adaptable to deprived regions of developing countries where most farmers have no formal education (Zua, 2021).

Evidence in the literature points to interpersonal communication as a potent medium with high prospects for innovation adoption (Kante et al., 2009). This observation justifies the *Fada* system's ability to allow individuals easy and quick access to information from their peers that can be crucial to evaluating their preparedness for adoption. This might help explain the rapid diffusion rate that led to the adoption of FMNR.

Family is an element of successful technology transfer because it is the heart of a social system in SSA and a key element of social capital (Di Falco & Bulte, 2013). The social system of the study area provided several supporting factors to the success of the diffusion process leading to adoption. We argue that FMNR's compatibility with the social system of the area is seen in the fact that it did not infringe on any existing belief and value systems.

The age of farmers encountered in the study area might also help explain our findings. The primary respondents, local farmers, comprised individuals mostly 30 years and older. In a system where farming is a proud heritage, most participants have been farming since childhood and, therefore, have gathered much experience. Kassie et al. (2015) argued that the wealth of experience gained from years of farming offers sufficient ecological knowledge and accumulated social and physical capital to facilitate the adoption of new ideas. But this is an indeterminate variable, as acknowledged by Kassie et al. (2015) and supported by Batte et al. (1990). Although age and experience may not be perfect determinants of innovation adoption, they should not be ignored in development interventions.

In the area of native Hausa people, land ownership is possible mainly by inheritance, a system that ensures tenure security and, therefore, enhances the implementation of innovations (Zounon et al., 2020). Though the chief is the custodian of lands within his jurisdiction, supervising all land transactions between natives and settlers, local farmers have the right to manage their fields as necessary. This freedom is likely to positively influence farmers' decisions concerning adopting innovations. This logic is in tandem with previous studies that found tenure security correlating with adopting sustainable intensification practices (SIPs). For example, Jansen et al. (2006) concluded that sustainable land management practices are observed more in owned fields than in rented ones. Similarly, Kassie et al. (2013) and Wossen et al. (2013) found a positive relationship between land tenure security and adopting new farming practices.

Conclusion

We explained how the diffusion process affected the adoption of the innovative agroforestry practice of FMNR in Niger by providing evidence supporting the "farmer-to-farmer" mode of information transfer that was largely unexamined in previous studies. We also clarified why farmers destroyed every land cover before farming, which was unexamined in the extant literature until now. Our research represents an important step toward responding to two gaps of missing information that accounted for the successes of FMNR in Niger. Our findings will serve as essential inputs for similar initiatives in locations beyond the borders of Niger that reflect similar social and environmental profiles. This study also supports Rogers' theory on how innovations diffuse and are adopted by highlighting the effectiveness of communication between peers, demonstrating the relevance of using local expertise, projecting the role of the social system in providing the conditions necessary for peer-to-peer education, and demonstrating the relevance of integrating neo-populist ideals into a top-down rural development intervention (Rogers, 1962, 1983, 2003).

Acknowledgements Our appreciation goes to the mayor (Monsieur Ousmane Mahaman Ahamed) and people of Dogonkiria rural municipality who accepted to have this study done in their community and provided invaluable information leading to the reduction of this paper.

Author Contributions Author contributions: S. Suuk: Conceptualization, methodology, investigation, formal analysis, writing – original draft. W. Laube: Supervision, conceptualization, methodology, formal analysis, validation. A. Seyni: Supervision, validation. R. Cantrell: Conceptualization, writing – review & editing.

Funding Open Access funding enabled and organized by Projekt DEAL. The authors acknowledge that this study was supported by the DAAD with funding of the German Federal Foreign Office.

Data Availability Data generated in the course of the study is included in the manuscript.

Declarations

Ethical Approval Local authorities approved of the investigation before all participants consented to participate in this study with the freedom to withdraw anytime they wished.

Conflict of Interest The authors declare no competing interests.

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