



Title in English

## Barriers to community participation in climate change mitigation through tree planting initiatives in Miti, Eastern Democratic Republic of the Congo.

Title in French

## Obstacles à la participation de la communauté à l'atténuation du changement climatique par le biais d'initiatives de plantation d'arbres à Miti, dans l'est de la République démocratique du Congo.

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**ABSTRACT****Abstract in English**

Consequences of climate change are felt everywhere leaving anyone indifferent. One of the often-recommended nature-based solutions is tree planting initiatives to mitigate climate change. This study aims to understand the motivations that make farmers, although aware of the harmful effects of climate change and equipped with some major assets, prefer to grow crops than planting trees in Miti, Sud-Kivu province in the east of the Democratic Republic of the Congo. In this way, the study will determine key barriers preventing local community to participate in climate change mitigation efforts through tree planting initiatives. A formal structured interview in which 96 informants participated was used. In general, 61.5% of informants were male, over 34 years of age (70.9%) and with 7 to 10 family members (41.7%). They are generally farmers and with secondary level as high level of study. They are globally involved in forestry (87.5 %) but, they listed up to 6 major barriers to tree planting initiatives in Miti explaining why people prefers to grow crops instead of planting trees. These barriers are: lack of space, tree diseases and pests, lack of seeds, seedling theft, lack of financial resources and lack of external support in trainings and assistance. Notwithstanding these barriers, this population remains open to reforestation projects recognizing its benefits including profitability, mitigation of environmental calamities, improvement of yields (agroforestry system), biodiversity conservation... Therefore, it is important that organizations and projects involved in the fight against climate change and deforestation to support this people and consider these findings.

**Résumé (French)**

Les conséquences du changement climatique se font sentir partout et ne laissent personne indifférent. L'une des solutions naturelles souvent recommandées est la plantation d'arbres pour atténuer le changement climatique. Cette étude vise à comprendre les motivations qui font que les agriculteurs, bien que conscients des effets néfastes du changement climatique et dotés de quelques atouts majeurs, préfèrent cultiver plutôt que de planter des arbres à Miti, dans la province du Sud-Kivu, à l'est de la République démocratique du Congo. De cette manière, l'étude déterminera les principaux obstacles qui empêchent la communauté locale de participer aux efforts d'atténuation du changement climatique par le biais d'initiatives de plantation d'arbres. Un entretien structuré formel auquel 96 informateurs ont participé a été utilisé. En général, 61,5 % des informateurs sont des hommes, âgés de plus de 34 ans (70,9 %) et comptant 7 à 10 membres de famille (41,7 %). Ils sont généralement agriculteurs et ont un niveau d'étude secondaire ou supérieur. Ils sont globalement impliqués dans la sylviculture (87,5 %), mais ils ont énuméré jusqu'à six obstacles majeurs aux initiatives de plantation d'arbres à Miti, expliquant pourquoi les gens préfèrent cultiver plutôt que de planter des arbres. Ces obstacles sont : le manque d'espace, les maladies et les parasites des arbres, le manque de semences, le vol de plants, le manque de ressources financières et le manque de soutien extérieur en matière de formation et d'assistance. Malgré ces barrières, cette population reste ouverte aux projets de reforestation reconnaissant ses avantages dont la rentabilité, l'atténuation des calamités environnementales, l'amélioration des rendements (système agroforestier), la conservation de la biodiversité.... Il est donc important que les organisations et projets impliqués dans la lutte contre le changement climatique et la déforestation soutiennent ce peuple et prennent en compte ces résultats.

## INTRODUCTION

Climate change is one of the most devastating phenomena since the last decades which touched the world and involving various stakeholders (Cirimwami *et al.*, 2015). Its consequences on health, agriculture, economy, politics, biodiversity, ecosystems and other domains are incalculable. It poses many serious threats to the survival of any existing species on earth, from smallest to the biggest species, and to human well-being around the world (Kasperson & Kasperson, 2001; Pecl *et al.*, 2017). The disturbance of the global climate is expected to intensify many existing problems, particularly in Africa (Akinagbe & Irohibe, 2014) which is one of continents with high vulnerability to climate change and global warming worldwide due to several reasons (Boko *et al.*, 2007; IPCC, 2014; Serdeczny *et al.*, 2017).

To face and mitigate climate change, Nature based solutions are implemented on a range wide of ecosystems with full engagement and consent of Indigenous Peoples and local communities (Seddon *et al.*, 2020). Tree Planting Initiatives (TPIs) as nature-based solution are one of most used solutions in the world (Few *et al.*, 2015; Aba *et al.*, 2017; Holl, 2020). TPIs are also conducted for agroforestry purposes to help improve crop yields (Sanchez *et al.*, 1997 ; Akinagbe & Irohibe, 2014), fight disasters resulting from soil erosions and other environmental problems (Remaury *et al.*, 2019), and provide a wide range of other benefits: fuelwood production (Patel *et al.*, 1995 ; Kulindwa, 2016), conservation of biodiversity (Lindenmayer *et al.*, 2003), forest cover increasing (van Goor & Snoep 2019), income generation (Holl, 2020)... Overall, key motivations for tree planting initiatives belong to four main categories: compensation for past damage, economic, cultural and spiritual and, legislative (Holl, 2020). But though TPIs are currently one of the major nature-based solutions, they still face many challenges and are neither a simple solution nor a miracle solution, not even an endpoint. When TPIs are well planned and executed, they are long-term actions – continuous actions – and can be a valuable mean to solve most of critical challenges of our time (Brancalion & Holl 2020; Holl & Brancalion, 2020). Despite the various motivations and calls for TPIs worldwide, people often ignore that, if poorly planned and executed, TPIs can result into environmental problems (Liu & Li 2010; Sacco *et al.*, 2020). Furthermore, among the multitude of tree planting projects worldwide, several ended up being not successful projects (Oldfield *et al.*, 2013, Holl & Brancalion ; 2020).

Africa has contributed very little to global warming but it is one of the continents with high vulnerability to climate change (Mutimba *et al.*, 2010). East African region is recognized to be a preferred destination for TPI investors (Jindal *et al.*, 2008). In Africa, and particularly in the East, several tree planting initiatives aimed the reduction of human-driven pressure on

biodiversity (forest ecosystems), mitigation of climate change consequences, food security and income (Serdeczny *et al.*, 2017; Kulindwa, 2016; Aba *et al.*, 2017). This part of the Africa continent is known to present a higher vulnerability to climate change due to its geographic position and its economy relying on climate sensitive sectors... (East African Community, 2011; Serdeczny *et al.*, 2017). Research in east African countries uncovered the roles and benefits of tree planting projects, populations' attitudes with regard to climate change, as well as global vulnerability to climate change and adaptation (Patel *et al.*, 1995; Mutimba *et al.*, 2010; Carr *et al.*, 2013; Bele *et al.*, 2014; Serdeczny *et al.*, 2017; The World Bank Group, 2021).

Climate change is currently threatening many regions of the globe with pervasive consequences. In the Eastern part of the Democratic Republic of the Congo (DRC), extreme changes in temperature and rainfall are expected in the future, with their consequences on food security and water availability (Ministry of Foreign Affairs of the Netherlands, 2018). In Bukavu and the villages alongside the Kahuzi-Biega National Park (KBNP), climate change perception and consequences had been reported (Muhigwa, 2010; Bele *et al.*, 2014). In this region of the DRC known for its unique biodiversity features (Cirimwami *et al.*, 2019a), a study found that climate change disturbances have been observed mainly on rainfall, temperature, wind pressure and air humidity. These changes impacted negatively farmers' yields including maize, corn, beans and potatoes (Cirimwami *et al.*, 2019b). This vulnerability of agriculture results from its direct dependency to climate factors (rainfalls, temperatures, solar radiation) which have sound effects on agriculture (Mushagalusa *et al.*, 2021). Despite the knowledge that climate change is real and that agrosystems in the Sud-Kivu province (eastern DRC) are fragile in the face of climate change (Muhigwa, 2010; Bele *et al.*, 2014), no publication has shown that farmers would also want to focus on reforestation activities, either as part of agroforestry, climate change mitigation or poverty alleviation (Cirimwami *et al.*, 2019b, Neema *et al.*, 2021). Thus, this study aims to determine the reasons why farmers around the KBNP prefer to grow crops instead of planting trees in this corner.

## METHODS

### Study area

This study was conducted in Miti, one of the administrative territories surrounding the Kahuzi-Biega National Park (KBNP) as shown on figure 1. The people of Miti are mainly farmers, thus generating their income from agricultural activities. The temperature in Miti is cooler varying between 15 and 21°C and mean annual rainfall being 1900 mm maximum (Ndjedi *et al.*, 2019, Cirimwami, 2021).

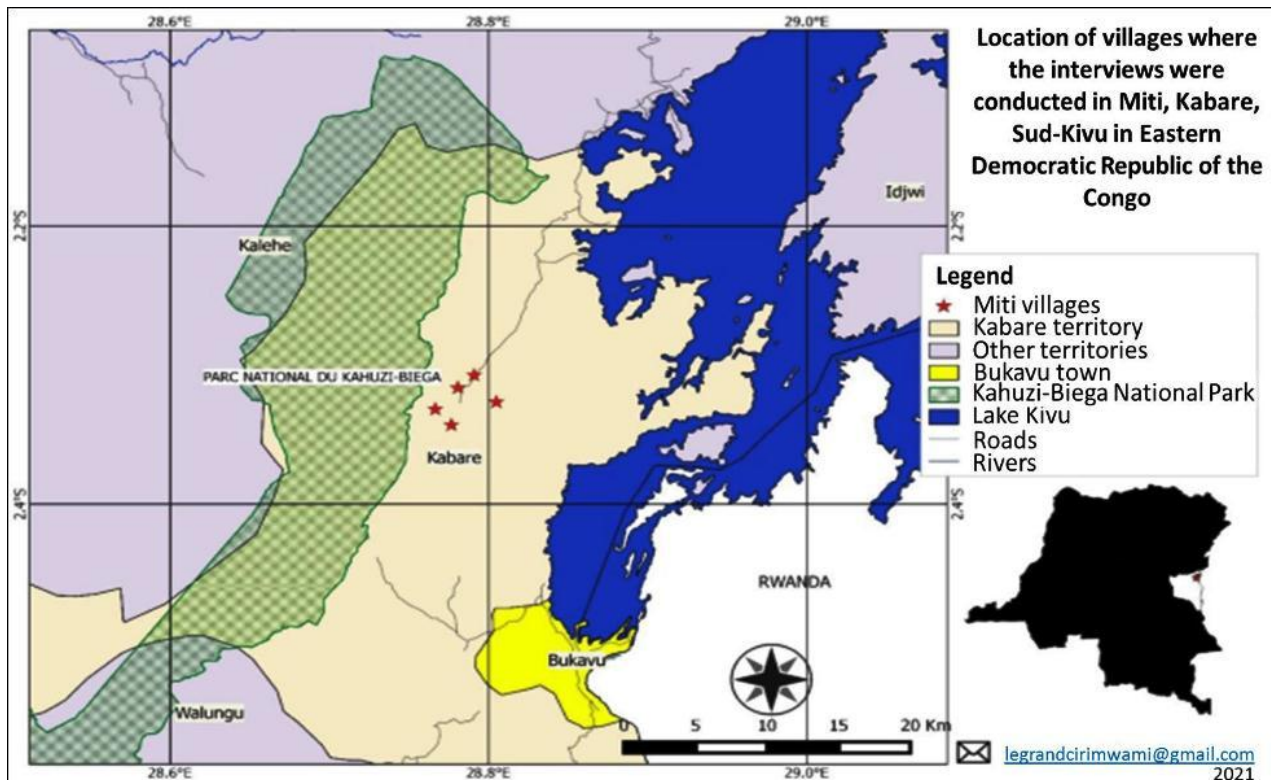


Fig. 1. Location map of the study area

### **Data collection, analysis and availability**

Data were collected in the five villages of Miti (Chibinda, Kashusha, Kakenge, Combo and Miti-Centre) using a formal structured interview. In each village, 20 people were surveyed, except in Chibinda where only 16 people were surveyed, making a total of 96 people. Data were analyzed using Excel and R (R Core Team, 2021). A Khi squared test was used in order to compare the different categories, and statistical decisions were made on the traditional 5 % threshold ( $\alpha = 0.05$ ). All the database will be made available on request.

### **Ethics**

In the questionnaire, before starting to answer to questions a clear and brief explanation, an overview of

the study presenting its aim followed the questions standing for an informed consent section. The participants' right to get involved or withdrawal from the study was respected. Thus, only participants who adhered to this informed consent section participated in the study. The study was double approved by the second author's institutional ethics committee before and after data collection.

## **RESULTS**

### **Overview on informants**

In table 1 below, we present an overview on the informants in the studied area.

**Table 1:** Socioeconomic view on informants in Miti

	Number	Percent	Statistics (Chi <sup>2</sup> )
<i>Gender</i>			
Male	59	61.5	Chi <sup>2</sup> = 5.04, df = 1, p = 0.024
Female	37	38.5	
<i>Age</i>			
18 - 25	15	15.6	Chi <sup>2</sup> = 16.83, df = 3, p = 0.0007
25 - 33	13	13.5	
34 - 40	35	36.5	
40+	33	34.4	
<i>Marital status</i>			
Single	15	15.6	Chi <sup>2</sup> = 121.75, df = 3, p < 0.0001
Married	70	72.9	
Divorced	1	1.0	
Widowed	10	10.4	
<i>Household size</i>			
1	4	4.2	Chi <sup>2</sup> = 61.625, df = 5, p < 0.0001
2 - 4	7	7.3	
4 - 7	24	25.0	
7 - 10	40	41.7	
10 - 13	16	16.7	
13+	5	5.2	
<i>Level of study</i>			
No instruction	26	27.1	Chi <sup>2</sup> = 25.42, df = 3, p < 0.0001
Primary	17	17.7	
Secondary	43	44.8	
University	10	10.4	
<i>Occupation of the head of the household</i>			
Farmer	60	62.5	Chi <sup>2</sup> = 146.62, df = 5, p < 0.0001
Breeder	6	6.3	
Fisherman	8	8.3	
Trader	11	11.5	
Teacher	5	5.2	
Park ranger	6	6.3	
<i>Involvement in tree planting initiatives</i>			
Yes	84	87.5	Chi <sup>2</sup> = 54, df = 1, p < 0.0001
No	12	12.5	

In general, our informants were Male, over 34 years of age and having or belonging to households with 7 to 10 family members. They are generally farmers, with state diploma (Secondary level) as high level of study and involved in tree planting initiatives (87.5 %).

***Practice of forestry in Miti: reason, socioeconomic and environmental impacts***

In the following graph (figure 2), we illustrate the key reasons why people practice tree planting initiatives in Miti and their social and environmental impacts.

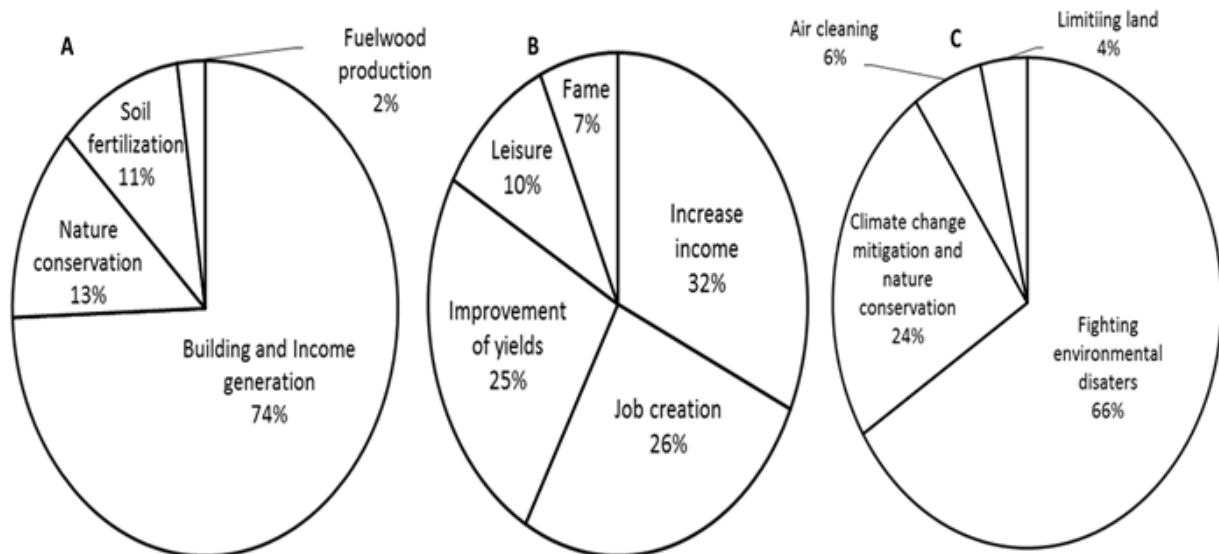


Fig. 2. Reasons motivating tree planting (A) and their social (B) and environmental impacts (C).

In general, people in Miti practice tree planting initiatives for building and income generation ( $\text{Chi}^2 = 114.09$ ;  $\text{df} = 3$ ;  $p < 0.0001$ ). The main social advantages of TPIs in Miti are income-oriented, given that the informants earn very little money from crops production and sales ( $\text{Chi}^2 = 43.1$ ;  $\text{df} = 4$ ;  $p < 0.0001$ ). As main environmental advantages of TPIs in Miti, the informants mentioned the fight against environmental

disasters, followed by climate change mitigation and biodiversity conservation ( $\text{Chi}^2 = 102.86$ ;  $\text{df} = 3$ ;  $p < 0.0001$ ). Key species for forestry in Miti

The inhabitants of Miti prefer some trees in their TPIs than others (figure 3), the five most appreciated species being *Eucalyptus globulus*, *Grevilea robusta*, *Maesopsis eminii*, *Cupressus lusitanica* and *Cinchona ledgeriana*.

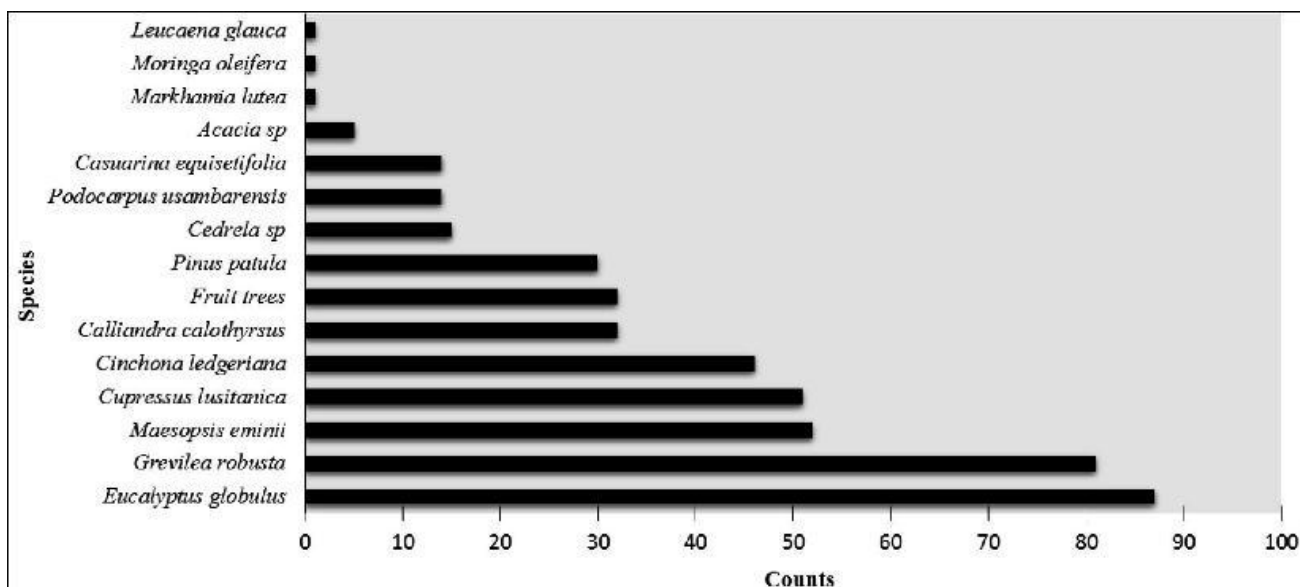


Fig. 3. The most appreciated species by the population of Miti

These species are used to control erosion, for fuelwood, building and medicinal purposes. At least; 46 informants (47.9 %) mentioned these five species.

#### **Need of external support in the sector of TPIs in Miti**

Most of external support needed for the tree planting initiatives are expected from the KBNP whose Head Quarters are very closer to Miti (figure 4).

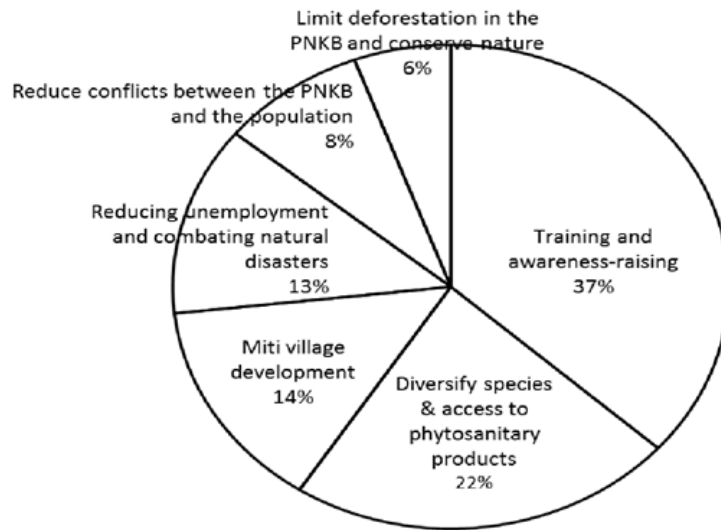


Fig. 4. Advantages of needed external support from the Kahuzi-Biega National Park

People in Miti needs to have some supports from the Kahuzi-Biega National Park as the closest biodiversity conservation institution to improve their tree planting initiatives. The most expected support could be “Training and awareness-raising” ( $\text{Chi}^2 = 27.45$ ;  $\text{df} = 5$ ;  $p < 0.0001$ ), species diversification, overall development, employment, mitigation of natural disasters, reduction of conflicts between the park and the population, and to mitigate the rate of human-led deforestation towards the KBNP.

**Reasons for failure of the tree planting initiatives in Miti**

The benefits of forestry are well known by almost all the informants of this study but, in some cases, people simply lack incentives to get engaged into TPIs (Figure 5).

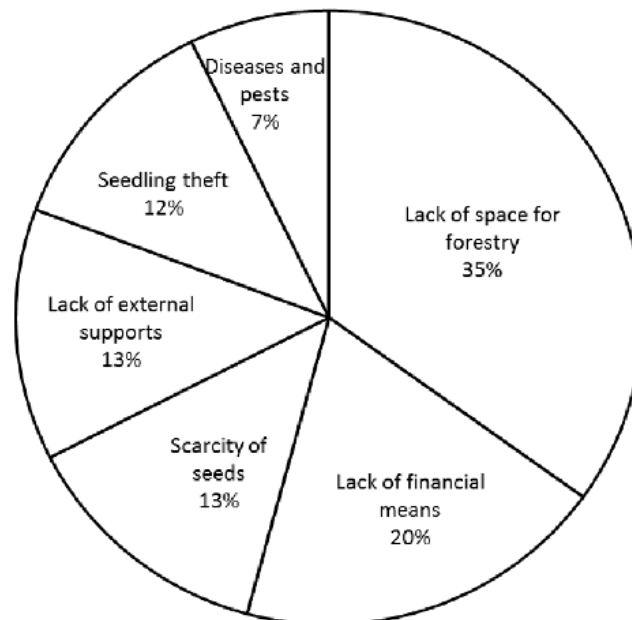


Fig. 5. Demotivation of local communities to undertake tree planting initiatives

In general, people who appear not to have enough spaces to grow trees are the most demotivated to undertake TPIs ( $\text{Chi}^2 = 23.63$ ,  $\text{df} = 5$ ,  $p = 0.0003$ ). They rather prefer to grow crops on the few small spaces they have so as to meet their family responsibilities.

**DISCUSSION**

Due to different reasons including mitigation of climate change, fighting various environmental disasters, and poverty, tree planting initiatives have become one of the common development projects in urban and rural areas worldwide (Konijnendijk *et al.*, 2004). From tree sowing to tree growing, there exist many challenges among which are found physical conditions, some

limiting key resources and farmers' motivation and willingness (Duguma *et al.*, 2020). Authors in the USA described key barriers preventing people to get involved in greening projects in urban areas: tree disservices and financial burdens they cause, neighborhood development and gentrification, communication and relationship barriers and, limited space, time, and resources (Riedman *et al.*, 2022). In Africa, the willingness to undertake reforestation is not automatic and requires sometimes external stimulations (Nawir *et al.*, 2007) and even financial incentives (Danquah & Kuwornu, 2015; Bossière *et al.*, 2021). Therefore, to shape future tree planting initiatives (TPIs) for the project success, recommendations from local people knowledge are very necessary to be considered (Smith *et al.*, 2015).

In Miti, although local people are aware that tree planting initiatives have several socioeconomic and environmental advantages, as recognized in other studies (Patel *et al.*, 1995; Mutimba *et al.*, 2010; Bele *et al.*, 2014 ; Serdeczny *et al.*, 2017), they still focus on external support (including financial means) to really get involved in TPIs. As an explanation, the 87.5 % of informants practicing reforestation are almost constrained to do so because of their large families (with generally 7 to 10 family members) and insufficient income. They are coerced to do more than one activity to fill their economic gap because high family workforce as an agricultural labor force does not influence their income (Neema *et al.*, 2021). Another explanation is the abundance of erosive sites in eastern DRC. More than 600 landslides were inventoried between the city of Goma and Bukavu (Mateso & Dewitte, 2014), all of them requiring reforestation as a nature-based solution. Additionally, it has been found that in Sub-Saharan Africa, people alongside forests are more inclined to grow trees (Miller *et al.*, 2017) as it is the case of Miti which is closer to the Kahuzi-Biega National Park.

Despite the recognition of several opportunities and benefits of tree planting initiatives, there exist nonnegligible challenges for their expansion. The lack of space to grow trees appeared to be one of the main obstacles to TPIs in Miti. Indeed, access to land is one of the major issues in the area as shown by many studies (World Bank, 2018 ; Neema *et al.*, 2021). This is also one of the regions of the DRC with high demographic densities (World Bank, 2018). One more explanation for the reason why the inhabitants of Miti may be reluctant to engage into tree planting initiatives is that, in general, poor farmers usually prefer fast growing crops for rapid income generation, as this was witnessed in Eastern Africa by Muoni *et al.* (2019).

## CONCLUSION

This study was conducted in the East of the Democratic Republic of the Congo to evaluate the willingness of local people in Miti to grow or not trees. A total of 96 informants accounting for 62.5 % are farmers with large families (7 to 10 family members) were

interviewed. The results showed that the majority of informants grows trees (87.5 %) and recognizes different advantages of tree planting initiatives (socioeconomic and environmental advantages). Both informants who practice tree planting and those who don't practice TPIs identified six main challenges for the implementation of TPIs in Miti: lack of space (land access difficulties), lack of financial means, scarcity of seeds, lack of external support, seedling theft, diseases and pests. We recommend all stakeholders in this sector to consider all the above-mentioned challenges before the implementation of any reforestation project in this area or other similar areas.

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