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Farmers' Perceptions of the Influence of Wildlife Biodiversity on Crop Yield in Dargué, Niger

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Background: Wildlife biodiversity in agricultural fields can provide ecological functions that support crop production, while some species may also damage crops. This study assessed farmers' perceptions of the influence of wildlife biodiversity on crop yield in Dargué, Niger.

Methods: Data were collected from 200 participants, comprising 176 men and 24 women, through individual surveys and focus-group discussions. Descriptive analysis was used to summarise reported wildlife diversity and perceived effects on crops.

Results: Farmers reported 74 wildlife species, including 29 bird, 26 insect, 9 mammal, 7 reptile, and 3 amphibian species. Wildlife was perceived as having both beneficial and harmful effects. *Varanus exanthematicus* and several bird species were regarded as beneficial mainly because of predation on crop-damaging insects. By contrast, *Quelea quelea*, *Erythrocebus patas*, *Oedaleus senegalensis*, toads, and mice were perceived as harmful at different stages of crop development. Farmers also associated the presence of plant species in fields with the return and maintenance of wildlife biodiversity.

Conclusion: The findings indicate that farmers perceive wildlife biodiversity as a combination of ecosystem services and crop-related disservices rather than as uniformly beneficial or harmful. Management approaches should therefore seek to retain beneficial wildlife functions while reducing damage from species perceived as crop pests. The study provides a local basis for further assessment of wildlife–crop interactions in the wider region.

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Keywords: Wildlife biodiversity; crop yield; farmer perceptions; biological control; crop pests; agroecosystems.

1. Introduction

Niger is a landlocked country located between 0°16’ and 16° east longitude and 11°1 and 23°17 north latitude (Republic of Niger, 2006). The productive potential is increasingly deteriorating as a result of climate change and human activities that affect natural resources (Andres *et al*., 2016). This land degradation has numerous adverse ecological and socioeconomic consequences. In addition, the lack of wildlife biodiversity in fields, particularly predators of insect pests, leads to a decline in agricultural production. Assisted natural regeneration (ANR) can be an effective solution for restoring wildlife biodiversity because it promotes the development of habitats conducive to wildlife (Rinaudo, 2010). This practice promotes the return of wildlife biodiversity, which has an impact on crop yields. Animal species can have both beneficial and harmful effects in the field. Plant biodiversity in the field provides wildlife with suitable refuges and habitats for resting, feeding, and reproducing.

Within this framework, wildlife biodiversity is best interpreted as a context-dependent set of ecosystem services and disservices rather than a uniformly beneficial or harmful factor. Peer-reviewed ecological syntheses indicate that biodiversity-mediated pest regulation depends on the identity of service-providing organisms, landscape composition, habitat quality, and the balance between natural enemies and pest species (Bianchi *et al*., 2006; Kremen, 2005; Tscharntke *et al.,* 2012). Consequently, farmer perceptions in Dargué provide locally relevant evidence for identifying which faunal groups are associated with crop protection, soil improvement, or crop damage under semi-arid smallholder conditions.

Recent evidence indicates that biodiversity-related benefits in agricultural systems are mediated by the composition and abundance of natural enemies and other service-providing organisms, and that their contribution to crop production varies with farming intensity and ecological context (Hema *et al.*, 2023; Bucher *et al.*, 2025; Mallick *et al.*, 2026). Farmer-centred studies in African and West African farming systems also show that local knowledge and attitudes can differ between beneficial organisms and wildlife perceived as crop-damaging, supporting the use of locally grounded perception assessments (Tripathi *et al.*, 2024; Chaves *et al.*, 2024).

However, local evidence remains limited on how farmers in Dargué perceive the simultaneous beneficial and harmful influences of wildlife biodiversity on crop yield in fields where assisted natural regeneration is practised.

The overall objective of this study is to determine the influence of wildlife biodiversity on crop yield.

2. Materials and Methods

2.1 Study Site

The study was conducted in Dargué, located in the Maradi Region of Niger. The study area covers approximately 13,625 hectares and lies within the North Sudanese phytogeographical sector. The area is characterised by a unimodal rainfall regime, with a distinct rainy season extending from June to October. Mean annual rainfall generally ranges between 400 and 500 mm, while temperatures vary considerably throughout the year, ranging from approximately 10 to 40 °C. These climatic conditions strongly influence agricultural production and the distribution of natural vegetation within the area. The soils of Dargué are predominantly tropical ferruginous soils. The natural vegetation is mainly characterised by shrubby steppes interspersed with scattered woody species, including *Acacia albida* Del, *Balanites aegyptiaca* (L.) Del, *Acacia raddiana* (Forsst.) Hayne, *Parkia biglobosa* (Jacq.) R. Br ex G. Don, *Acacia senegal* (L.) Willd., *Acacia nilotica* (L.) Willd. ex Del. subsp. abstringens, *Sclerocaria birrea* (A. Rich.) Hochst., and *Tamarindus indica* L. These species constitute important components of the local vegetation and are commonly associated with the agro-pastoral landscapes of the study area. The population of Dargué consists predominantly of Haoussa, Touareg, and Foulani communities. Agriculture constitutes the principal livelihood activity and is primarily rain-fed, extensive, and largely unmechanised. Agricultural production is practised alongside livestock rearing, which represents the second major economic activity in the area. Consequently, crop production and livestock husbandry constitute the main components of the local production system and play important roles in sustaining household livelihoods.

2.2 Data Collection

A total sample of 200 farmers was selected for the study using a stratified random sampling technique. Stratification was based on gender and educational level in order to ensure adequate representation of farmers with different socio-demographic characteristics within the study population. Following the establishment of the respective strata, respondents were randomly selected for participation in the survey. Primary data were collected using a structured questionnaire designed to obtain information relevant to the objectives of the study. Interviews were conducted directly with the selected farmers in Hausa, the predominant local language, to facilitate effective communication and improve respondents' understanding of the questions. Conducting the interviews in the local language also helped to minimise potential misunderstandings arising from linguistic differences. In addition to the questionnaire-based interviews, focus group discussions were conducted to support the identification of plant species reported or recognised by the respondents. These discussions provided complementary information and facilitated the identification and confirmation of plant species known and used within the local communities.

2.3 Data Analysis

The collected data were analysed using descriptive statistical methods, particularly frequencies and means. Frequencies were used to describe the distribution of respondents across the different variables considered in the study, while mean values were calculated where appropriate to summarise the central tendency of the observations. These descriptive statistics provided an overview of the socio-economic characteristics of the surveyed farmers and the patterns observed in the collected data. Particular attention was given to socio-economic characteristics because such factors may influence farmers' behaviour and decision-making processes. According to Nana and Thiombiano (2018), household socio-economic characteristics, including age, gender, educational level, and farm size, can influence the capacity of households to adapt to changing conditions and adopt new methods. These variables were therefore considered relevant for characterising the surveyed population and interpreting the observed patterns in the study.

3. Results and Discussion

3.1 Mammals

Table 1 shows the effects of mammals on crop yields. Analysis of the results indicates that farmers are aware that mammals cause more damage to crops than they provide benefits. In fact, 87.5% of farmers did not report any positive impacts from these animals. Only 12.5% of farmers acknowledged some of the beneficial effects of hedgehogs, which feed on the termites responsible for destroying grain crops. Among mammals, mice cause the most damage (73%), followed by hedgehogs and hares at 30.5% and 20%, respectively (Table 1).

This pattern is consistent with the broader literature on agricultural rodent pests, which identifies rodents as important causes of crop loss during seedling, maturation, and storage stages, particularly in smallholder systems where field and storage protection may be limited (Stenseth *et al.,* 2003; Swanepoel *et al*., 2017; Tscharntke *et al.,* 2012). However, the limited positive perception of hedgehogs should be interpreted cautiously because mammalian effects on crops can be species-specific and may include both disservices through feeding damage and services through predation on invertebrate pests or other small animals (Capizzi *et al*., 2014).

Table 1. Harmful Effects of Mammals in Fields

English name	Local name (Haousa)	Scientific name	Citation Frequency (%)	Damage
Mouse	Koussou	*Mus musculus* (L.)	73	Seedlings
Hedgehog	Bouchia	*Atelerix albiventris*	30.5	Crops
Hare	Zomo	*Lepus microtis*	20	Flowers
Squirrel	Kouredjé	*Xerus erythropus*	2	Crops
Monkey	Biri	*Erythrocebus patas*	2	Crops
Fox	Yanyawa	*Vulpes zerda*	1	Crops
Gambian Rat	Bourgou	*Cricetomys gambianus*	1	Crops

3.2 Birds

The beneficial effects of birds on crop yields are presented in Table 2. Analysis of the results shows that the birds most frequently cited by farmers are *Tockus erythrorhynchus* (15%), *Coracias abyssinicus* (13%), *Lamprotornis cadatus* (13%), *Necrosys temonachus*, *Accipiter badis*, *Hieraatus spenntus*, and *Oena capensis*, each accounting for 12%. These birds are the main predators of crop-damaging insects. In addition to these birds, another group of birds significantly reduces crop yields. These include *Quelea quelea* (59.5%), *Cervus albus* (29%), *Streptepelia senegalensis* (26.5%), and *Ploceus melanocephalus*, *Ploceus cullatus*, and *Ploceus cucullatus* (12%) (Table 3).

Table 2. Beneficial Effects of Birds on Crop Yields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Usefulness
Red-billed Hornbill	Tikoko	*Tockus erythrorhynchus*	15	Feeds on pests
Abyssinian Roller	Sanwaka	*Coracias abyssinicus*	13	Feeds on pests
Long-tailed Choucador	Sanwaka	*Lamprotornis caudatus*	13	Feeds on pests
Scavenger vulture	Angoulou	*Neophron percynopterus*	12	Feeds on pests
Shirka Sparrowhawk	Shirwa	*Accipiter melanoleucus*	12	Feeds on pests
Booted eagle	Shaho	*Hieraaetus pennatus*	12	Feeds on pests
Masked dove	Kourtia daji	*Oena capensis* (L.)	12	Feeds on pests
Eat millet	Tsiriri	*Quelea quelea* (L.)	8	Feeds on pests
Raven	Hankaka	*Corvus albicollis*	7.5	Feeds on pests
Cattle Egret	Balbela	*Bubulcus ibis* (L.)	6	Feeds on pests
Black-headed Weaver	Marey	*Ploceus melanocephalus* (L.)	5.5	Feeds on pests
Mesh dove	Kourtia	*Streptepelia senegalensis*	5	Feeds on pests
Abdim's Stork	Shamoua	*Ciconia abdimii*	4.5	Feeds on pests

The dual role reported for birds agrees with studies showing that insectivorous birds can suppress arthropod pests and contribute to crop protection, while granivorous or opportunistic species may generate direct crop losses depending on feeding behaviour and crop stage (Whelan *et al.,* 2008; Johnson *et al.,* 2010; Monteagudo *et al.,* 2023). Thus, the high citation frequency of *Quelea quelea* as harmful should not be generalised to all birds; rather, the results emphasise the need to distinguish functional feeding groups when evaluating avian effects on agricultural production.

Table 3. Harmful Activities of Birds in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Damage
Eat millet	Tsiriri	*Quelea quelea* (L.)	59.50	Cereal Stink Bug and Leaf Miner
Raven	Hankaka	*Corvus albicollis*	29	Grain bug
Mesh Dove	Kourtia	*Streptepelia senegalensis* (L.)	26.50	Grain bug
Black-headed Weaver	Marey	*Ploceus melanocephalus* (L.)	21	Grain bug
Shining Drogon	Babaka	*Dicrurus atripennis*	20.50	Grain bug
Black Hornbill	Tilako	*Ceratogymna atrata*	13	Grain bug
Stonechat	Tchara	*Saxicola torquatus*	13	Grain bug
Little sparrow	Ommafara	*Tachyspiza minulla*	12	Grain bug
Masked dove	Kourtiar daji	*Oena capensis* (L.)	12	Grain bug
Cape toutererelle	Bardo	*Streptopelia capicola*	11.5	Grain bug
Armed lapwing	Tchakaki	*Vanellus spinosus*	10	Grain bug
Booted eagle	Shaho	*Hieraaetus pennatus*	3.5	Grain bug
Hoopoe	Alhuduhudu	*Upupa africana*	3.5	Grain bug
Southern shrike	Souda	*Lanius collaris*	3.5	Grain bug
Rufous pigeon	Habjia	*Columba guinea*	3.5	Grain bug

3.3 Reptiles

The impact of reptiles on crop yields is presented in Table 4. Analysis of the results shows that farmers are aware that reptiles play an important role in controlling crop pests. In fact, sand lizards rank first (42%), followed by geckos (15.5%) and snakes (10%), with *Scincopus fasciatus* and *Sphenops* at 0.5%.

The perceived usefulness of sand lizards, geckos, and snakes is compatible with evidence that insectivorous reptiles can contribute to biological control by consuming arthropod pests, although the magnitude of this service varies with habitat structure, prey availability, and land-use intensity (Knowlton, 1934; Monagan *et al.*, 2017). For snakes, the expected benefit is more likely to occur indirectly through predation on rodents and other small vertebrates; nevertheless, such services must be evaluated alongside farmers' safety concerns and local tolerance of reptiles (Carter *et al*., 2024).

Table 4. Beneficial Roles of Reptiles in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Usefulness
Sand monitor lizard	Damo	*Varanus exanthematicus*	42	Feeds on insect pests
Margouillat	gadangaré	*Agama agama* (L.)	15.50	Feeds on insect pests
Parker's snake	Takwasara	*Chamaelycus parkeri*	10	Feeds on insect pests
Chameleon	Hawainia	*Cameleo africanus*	4.50	Feeds on insect pests
Géryville Banded Skink	Tamasiri	*Scincopus fasciatus*	0.50	Feeds on insect pests
Isle Skink	Koulba	*Trachylepis comorensis*	0.50	Feeds on insect pests

3.4 Amphibians

Table 5 illustrates the beneficial effects of amphibians in fields. Amphibians increase agricultural production by feeding on crop-damaging insects (Table 5).

Evidence from rice-field and agricultural landscapes supports the idea that frogs and toads may consume crop pests, but recent experiments also show that amphibian-mediated pest regulation is density-dependent and can be weakened by intraguild predation or low habitat heterogeneity (Khatiwada *et al.,* 2016; Ghosh & Basu, 2023). Therefore, the beneficial role attributed to amphibians in Dargué should be interpreted as potential biological control rather than as direct proof of yield increase, especially because amphibian abundance and habitat requirements are strongly affected by agricultural management (Hansen *et al.,* 2019).

Table 5. Beneficial Effects of Amphibians in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Usefulness
Toad	Kwado	*Sclerophrys regularis*	18	Feeds on insect pests
Frog	Kwado	*Xenopus laevis*	0.50	Feeds on insect pests
Land tortoise	Kounkourou	*Centrochelys sulcata*	0.50	Feeds on insect pests

Despite their usefulness, amphibians also pose a threat to crops (Table 6).

Table 6. Harmful Effects of Amphibians in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Damage
Toad	Kwado	*Sclerophrys regularis*	15	Abortion and Seedling Removal pests
Frog	Kwado	*Xenopus laevis*	0.50	Abortion and Seedling Removal
Land tortoise	Kounkourou	*Centrochelys sulcata*	0.50	Seedling abortion

3.5 Insects

The beneficial effects of insects in fields are shown in Table 7. Ants improve soil fertility by digging tunnels and breaking down plant debris.

These farmer observations align with evidence that soil macrofauna can influence nutrient cycling, soil aggregation, water infiltration, and crop growth, although their effects vary by species and ecological context (Jouquet *et al.,* 2011; van Groenigen *et al.,* 2014). Ants can also act as biological control agents in some farming systems, but their role should be evaluated together with possible disservices, including plant damage or facilitation of honeydew-producing pests (Offenberg, 2015).

Table 7. Beneficial Effects of Insects in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Usefulness
Ants	Tourourouwa	*Centrochelys sulcata*	4	Increase soil fertility
Termite	Gara	*Macrotermes bellicosus*	3	Breaks down debris
Butterfly	Malan batata	*Papilio antimachus*	1	Biological control
Spider	Tawtaw	*Cleome gynandra*	0.50	Kill insect pests

Despite these beneficial effects, insects can also be pests to crops (Table 8).

Table 8. Harmful Effects of Insects in Fields

English name	Local name (Haoussa)	Scientific name	Citation Frequency (%)	Damage
Meloids	Hangara	*Mylabris oculata*	39.5	Cereal ear miner
Termite	Gara	*Macrotermes bellicosus*	32.5	Main root, pod stalks cut off
Grasshopper	Adindima	*Oedaleus senegalensis*	55.50	Leaves, stems, seedlings, flower buds
Cereal aphid	Darba	*Rhopalosiphum maidis*	52	Leaves, stems, seedlings and flower buds of beans
Ants	Tourourouwa	*Centrochelys sulcata*	34.50	Destroy fallen ears and seedlings
Cereal ear miner	Zuzuda	*Heliocheilus albipunctella*	33.50	Destroy the ears of corn
Red bug	Karbobo	*Cenaeus carnifex*	9	Leaves, stems, seedlings, flower buds
Stem driller	Birinsama	*Busseola fusca*	8.50	Destroys leaves, burrows tunnels into the stems
Earthworm	Dolidoli	*Eudrilus eugeniae*	5.50	Destroys leaves, burrows tunnels into the stems

Socioeconomic surveys have shown that the practice of natural regeneration has promoted the return of wildlife biodiversity, with 74 wildlife species identified across six categories. Ousseini Niandou *et al*. (2016), in Dan Saga rural municipality, observed the return of 29 bird species following the implementation of natural regeneration. Anabi Toudjani *et al*. (2013) identified 34 and 29 species, respectively, at Lake Madarounfa and Kourfin Koura. This difference may be related to the nature of the habitat. Indeed, wetlands are generally the best habitats for wildlife. According to the citation frequency analysis, the most frequently cited faunal groups, in order of importance, are birds, insects, mammals, and reptiles.

The farmers surveyed believe that the abundance of wildlife species in the fields is closely linked to that of plant species. Among the plant species that attract wildlife biodiversity, the families most frequently cited are the Mimosaceae (8 species), the Caesalpiniaceae (5 species), and the Combretaceae (5 species). The analysis shows that wildlife biodiversity is most frequently attracted to species such as *Guiera senegalensis* (98%), *Piliostigma reticulatum* (97.5%), *Ziziphus mauritiana* (47%), *Faidherbia albida* (32.5%), and *Acacia senegalensis* (29%).

This preference among wildlife species is due to the presence of shelter offering protection from threats and also to the availability of food. This finding shows that the types of plant species in the natural regeneration influence the return of wildlife. This corroborates the findings of Ousseini Niandou *et al*. (2016) on avian biodiversity in Dan Saga rural municipality. Plant species provide a favourable gathering place for wildlife. It should be noted that, according to 90% of respondents, agricultural yields are closely linked to the practice of RNA. According to farmers, this increase in agricultural production is due, on the one hand, to the contribution of organic matter from trees through the decomposition of litter and, on the other hand, to the benefits of combining trees with crops by creating a microclimate conducive to healthy crop growth. However, this return and maintenance of wildlife biodiversity is primarily due to the presence of plant species in the fields. While this is a major asset for farmers, this wildlife also poses a threat to agricultural production. All respondents stated that certain wildlife species have a negative impact, as they destroy crops and are responsible for many diseases. Damage is caused primarily by birds at all stages—from sowing to storage—by insects and reptiles during flowering, by mammals during sowing and storage, and by amphibians during sowing. According to farmers, this increase in agricultural production is due, on the one hand, to the contribution of organic matter from trees through the decomposition of litter and, on the other hand, to the benefits of combining trees with crops by creating a microclimate conducive to healthy crop growth. However, this return and maintenance of wildlife biodiversity is primarily due to the presence of plant species in the fields. While this is a major asset for farmers, this wildlife also poses a threat to agricultural production. All respondents stated that certain wildlife species have a negative impact, as they destroy crops and are responsible for many diseases. Damage is caused primarily by birds at all stages—from sowing to storage—by insects and reptiles during flowering, by mammals during sowing and storage, and by amphibians during sowing. However, wildlife plays a vital role in agricultural environments by controlling crop pests and helping to improve soil fertility. This finding was noted by Tréca *et al.* (1996), who reported that in the Sahelian region, bird droppings serve as a good fertiliser and thus enrich the soil. Marion *et al.* (1994) demonstrated at Lake Grand Lieu in Brittany that birds contribute between 5,800 and 7,640 kg of nitrogen annually (an average of 1.07 kg N/ha) and between 2,000 and 2,530 kg of total phosphorus (an average of 357 g P/ha). According to Paoletti (1999), earthworms are important indicators of soil fertility, the evaluation of agricultural practices, and the monitoring of soil contamination. Ants play a crucial role in soil aeration and act as decomposers by feeding on organic waste, insects, and other animals. They also contribute to seed dispersal, thereby promoting plant regeneration. Furthermore, their burrowing activity improves soil structure, facilitating water infiltration and increasing the availability of nutrients to plants. Free-living nematodes are bioindicators of soil health; their abundance helps characterise the level of biological activity in the soil. These nematodes contribute to the decomposition of organic matter and the recycling of nutrients by interacting with plant roots and microorganisms. Therefore, generally speaking, the restored biodiversity of wildlife does not significantly reduce crop yields today and even serves as a food source; however, other strategies should be adopted to minimise the damage caused by legume pests, *Quelea quelea*, Senegalese locusts, and monkeys.

Integrated pest management would therefore be an appropriate framework for follow-up work because it can combine habitat management for natural enemies with crop-stage monitoring and species-specific deterrence of damaging animals (Gurr *et al.,* 2003; Gurr *et al*., 2016). Such an approach would also reduce the risk of overestimating the yield benefits of wildlife biodiversity while still recognising the ecological functions reported by farmers.

This interpretation is consistent with agroecological research showing that diversified farm habitats can support regulating services such as pest suppression, nutrient cycling, and microclimate moderation, but these services are not automatic and may depend on spatial scale, vegetation composition, and management intensity (Kremen & Miles, 2012; Ponisio *et al.,* 2015). In the present study, the coexistence of beneficial and harmful faunal groups suggests that biodiversity management should aim to maintain service-providing organisms while reducing specific crop-raiding or pest species through targeted, locally acceptable practices rather than through broad removal of wildlife.

4. Conclusion

Farmers in Dargué perceived wildlife biodiversity as having both beneficial and harmful influences on crop production. Beneficial effects were mainly associated with predation on crop-damaging insects and with ecological functions linked to soil fertility, whereas harmful effects were associated with crop feeding and damage at different stages of crop development. The findings therefore indicate that wildlife in agricultural fields should not be considered uniformly beneficial or detrimental. Instead, management should distinguish species or functional groups that support crop protection from those that are perceived to cause substantial crop damage. The reported association between plant diversity, assisted natural regeneration, and wildlife presence further suggests that maintaining field vegetation may contribute to the persistence of faunal diversity, while targeted measures are needed for damaging species. Because this study represents a preliminary, farmer-centred assessment in Dargué, broader regional investigation is required to clarify the relative influence of wildlife groups on agricultural yields and to support locally appropriate conservation and crop-protection strategies.

5. Limitation

This study was based primarily on farmers' perceptions obtained through questionnaires and focus-group discussions and therefore did not directly quantify species-specific effects on crop yield. The assessment was limited to Dargué and may not represent conditions in other localities or across different seasons. The findings should therefore be interpreted as a preliminary local account of perceived wildlife benefits and damages. Wider regional studies that combine farmer knowledge with direct field measurements would strengthen evaluation of wildlife–crop relationships.

Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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