

## RESEARCH ARTICLE

# Community willingness to contribute to nature-based solutions around Budongo Central Forest, Uganda

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**Abstract**

1. Communities are important stakeholders in implementing nature-based solutions (NbS). Therefore, understanding their practices and contributions is essential for the implementation of NbS.
2. This study applied both qualitative and quantitative approaches to collect data from 156 respondents in a household survey using a semi-structured questionnaire with open- and close-ended questions. Data were analysed using descriptive statistics, correlations and regressions.
3. Majority of the respondents applied cover cropping, forest/streamside buffering, tree planting (to reduce dependence on neighbouring Budongo Central Forest Reserve (CFR) for fuelwood), wetland restoration, minimum tillage and agroforestry on their lands. NbS were more practiced on customary land compared to other land tenures in the area. Results reveal an attitude-behavioural gap in willingness to expand/have NbS and implementation of NbS on household land. Households who were willing to contribute to the management of NbS were likely to have a lesser proportion of land maintained as NbS zones. As such, willingness to expand/have NbS does not necessarily translate into implementation of the NbS. This community attitude-behavioural gap could be caused by competing land use practices, such as commercial sugarcane agriculture, that require big chunks of homogenous land and the incomes accrued therefrom. This suggests that NbS ought to directly benefit host communities; else, they risk being outcompeted by other economically viable land uses.
4. *Practical implication.* Therefore, future policy should be designed to facilitate win-win scenarios for NbS and other community land use practices. Facilitating NbS at a national scale using the bottom-up approach would offer opportunities for community buy-in and sustainability of such NbS. National Land Use Policy should consider local landscape zoning to include NbS and/or the aspect of 'nature' as a key zone amidst the other land uses. This could be brought off by raising awareness on the benefits NbS could yield for conservation and humanity. This would encourage more households to strike a balance between competing land uses, such as commercial sugarcane growing, that require big chunks of

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homogenous land, and the implementation of NbS to degraded landscapes around the Budongo Central Forest Reserve, Uganda.

#### KEYWORDS

Budongo, community willingness, local community, nature-based solutions, sustainable land management practices, Uganda

## 1 | INTRODUCTION

Land degradation has affected the ability of the environment to sustainably support economic and societal needs (Banadda, 2020). It is one of several pressures that are threatening ecosystem services provision, thereby posing a risk to the sustainability of the livelihoods of communities that depend on the affected land (Banerjee et al., 2024). Land degradation has been responsible for the continuous reductions in multiple ecosystem services (Gourevitch et al., 2016), biodiversity habitat loss (World Bank, 2021) and declines in productivity of agricultural landscapes (Turyasingura et al., 2022). With this, it is evident that both functioning of ecosystems and community livelihoods are threatened by land degradation (Gourevitch et al., 2016; IUCN, 2016).

Unsustainable agricultural practices, among other anthropogenic factors, are cited among the drivers of land degradation (Opedes et al., 2023; World Bank, 2021). Agriculture has been responsible for the conversion of biodiverse habitats, such as tropical forests, into agricultural lands (Omeja et al., 2012), for both subsistence and commercial purposes (Kusiima et al., 2022). Tropical forests in Sub-Saharan Africa are surrounded by immensely degraded landscapes on the frontiers of protected forest zones (Mwavu et al., 2018; Twongyirwe et al., 2015). This has caused consequences to society and ecosystems within these degraded landscapes around forests (Kusiima et al., 2022; Twongyirwe et al., 2015).

Land degradation in Uganda has affected about 88% of the rural population that depend on land for subsistence purposes (Banadda, 2020) around protected areas, including forest reserves (Kusiima et al., 2022). The unprecedented land degradation requires urgent responses for restoration (Jalal et al., 2023). These responses ought to balance between community livelihood needs and minimizing land degradation (Lai & Zoppi, 2024; Turyasingura et al., 2022). Responses include nature-based solutions (NbS) (Lai & Zoppi, 2024), including practices such as agroforestry, cover cropping, minimum tillage and streamside buffer stripes, which address land degradation impacts (Kusiima et al., 2022; Sanz et al., 2017).

However, NbS require the involvement of local communities as key stakeholders as they are the land owners and primary users (Doss et al., 2013; Feng et al., 2022; Jalal et al., 2023; Kizza et al., 2016; Montoliu et al., 2024; World Bank, 2021). Local communities in Uganda are also the most vulnerable to land degradation impacts (Tibasiima et al., 2023). Involving local communities, therefore, is of great importance in protecting community livelihoods while

addressing land degradation issues (Banerjee et al., 2024). In striving to protect community livelihoods and achieve land degradation neutrality, Uganda embarked on implementing the National Land Use Policy 2013. This notwithstanding, communities still face several barriers which ought to be addressed (Banadda, 2020), including the gap between science, policy and practice (Tibasiima et al., 2023).

It is vital to address this gap by involving communities, understanding their sustainable land management practices and willingness to adopt and contribute to NbS (Sanz et al., 2017; Vikih & Kaufmann, 2024). Ascertaining community willingness to contribute to NbS is associated with more sustainable and inclusive transformation of landscapes (Heindorf et al., 2024). This study therefore examined NbS practices on household land, household willingness to restore degraded landscapes through practicing NbS and quantified the proportion of households' land likely to be maintained for NbS, especially as natural vegetation succession zones, in local communities around the Budongo Central Forest in Uganda.

## 2 | METHODS

### 2.1 | Study area

The study was conducted in communities living around one of Uganda's central forest reserves, the Budongo Central Forest. The forest is a medium altitude moist, semi-deciduous tropical rainforest located at the top of the Albertine Rift in the midwestern part of Uganda and is situated between 1°37'–2°03'N and 31°22'–31°46'E (Figure 1). This landscape is characterized by a bimodal rainfall pattern, with peaks in March–May and September–November for the two seasons (Budongo Conservation Field Station, 2016). On average, the landscape receives between 1150 and 1500 mm of rainfall annually, whereas the mean daily temperatures during wet seasons oscillate between 17°C in April and 20°C in October. However, in the drier seasons, the mean daily temperatures range from 28°C in July to 29°C in January (World Weather Online, 2024).

The Budongo Central Forest has 435 km<sup>2</sup> of continuous forest cover (FAO, 2016; Obua et al., 2010) and is surrounded by several agro-pastoral ethnic groups of Sudanic and Congolese immigrants and refugees who joined the local inhabitants, the Banyoro (Twongyirwe et al., 2015). The majority (76.7%) of the working population in this area are engaged in agriculture, while approximately 11% are engaged in trade, and about 12% of the population are engaged in other economic activities (Uganda Bureau of

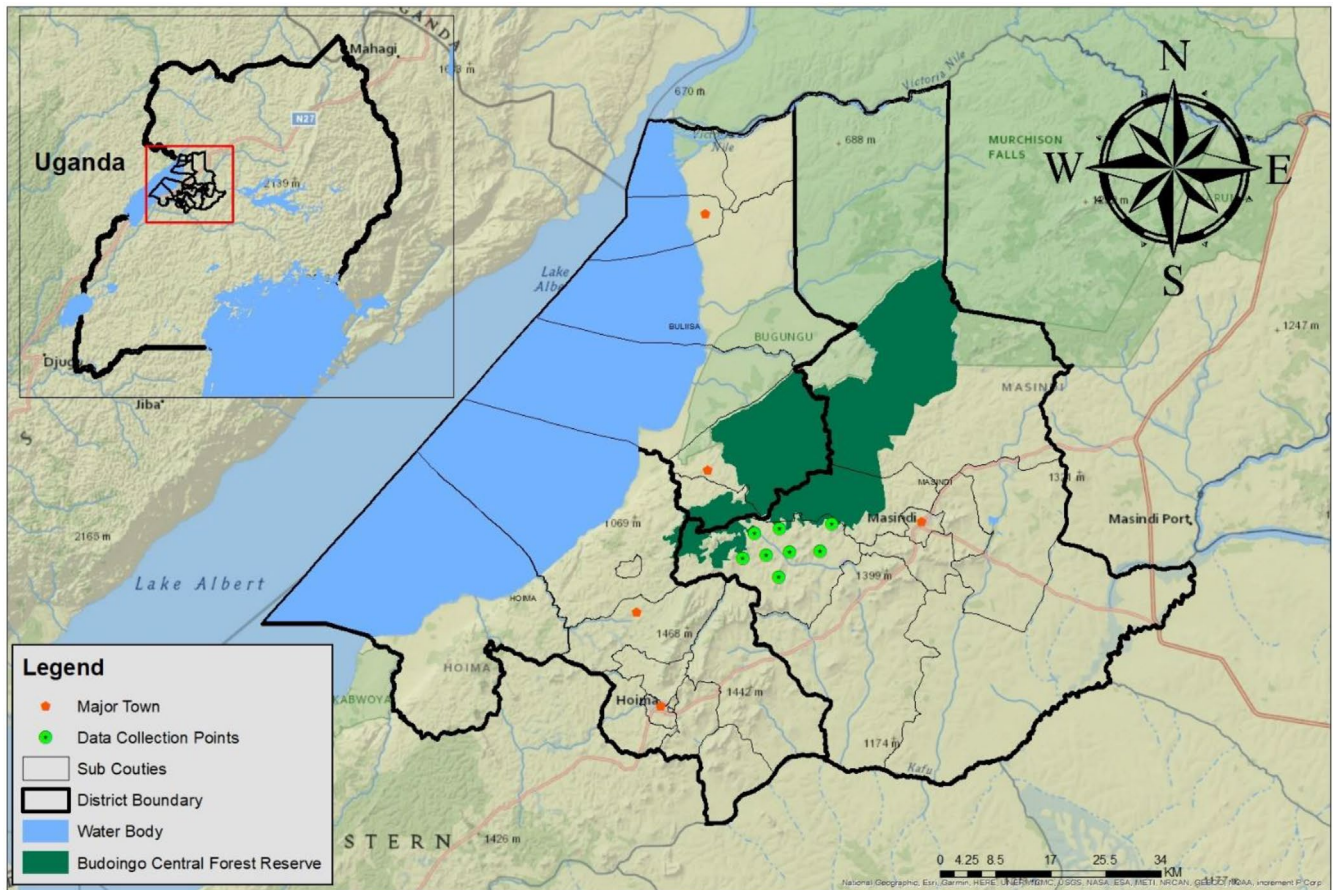


FIGURE 1 Study area location (Basemap source: National Geographic et al., 2012).

Statistics, 2020). Commercial sugarcane growing in these communities is the main agricultural practice, dating back to the late 1960s when sugarcane growing was first introduced in the region (Giregon et al., 2016; Guloba et al., 2023; Mwanika et al., 2021), but in recent years, the practice has expanded (Kusiima et al., 2022). Therefore, commercial sugarcane agriculture is the mainstay of local communities around the Budongo Central Forest.

## 2.2 | Research design and data collection

A case study research design was adopted by considering communities with extensive commercial sugarcane growing around the Budongo Central Forest (Twongyirwe et al., 2015). A case study design is preferred for this study because it was necessary to draw upon context specific, local understanding and interpretation of the studied phenomena (Yin, 1999). Data were collected using a mixed-methods approach (Creswell, 2014). Both qualitative and quantitative data collection methods were used within a semi-structured questionnaire with both open- and closed-ended questions (Connor Desai & Reimers, 2019). The questionnaire was used to gather information from households using a door-to-door collection method within the study area in June and July 2024. Questions were interpreted to community members in the local dialects by the data

collectors, owing to the fact that most community members are not well conversant with English. Data from open-ended questions were triangulated with data from quantitative findings from the closed-ended questions in the questionnaire (Mack et al., 2011). Besides collecting data on the study objectives, the questionnaire also included questions on socio-demographic characteristics of respondents.

## 2.3 | Sample size determination and sampling procedure

According to the Uganda Bureau of Statistics population estimates, the study area has 104,019 inhabitants (Uganda Bureau of Statistics, 2020). Using the Taro Yamane statistical formula of sample size determination ( $n = N / [1 + N(e)^2]$ ), a sample of 156 respondents were sampled (Oribhabor & Anyanwu, 2019). In this formula:  $n$  represents the sample size,  $N$  is the population under study,  $e$  is the margin of error. Stratified random sampling technique was used to sample the target households (Hay & Cope, 2021). These were selected based on their ownership and use of land in the study area, knowledge and experience in the community, following the example of Nyumba et al. (2018). The study targeted households that own and/or use land in the study area.

## 2.4 | Data analysis

The filled questionnaires from the field were processed, coded and entered into MS Excel. Statistical summaries were generated and other analyses were carried out in both MS Excel and R statistical software with RStudio programming language for statistical analysis. Summaries were used to present frequencies, percentages, means, and standard deviations of the study variables. Summaries provided a glimpse of the likely relational analysis including correlation coefficients ( $r$ ) and logistic regressions. Binomial logistic regression was used to ascertain respondents' likelihood of applying NbS and willingness to contribute to NbS (Dlamini et al., 2021). Multivariate regression analysis was performed to test the influence of socio-economic characteristics of the respondents on land proportion size likely to be set as natural vegetation succession zones (Kleinbaum & Klein, 2010).

Data from the open-ended questions were used to interpret some of the findings from the closed-ended questions (Creswell, 2014) so as to provide an understanding of community perceptions towards implementing NbS. These analyses helped in determining how the socio-economic characteristics influence the respondents' attitudes towards NbS (Dlamini et al., 2021). In these analyses, domicile, gender, age, education level, size of land and dominant land use were used to understand community's willingness and perceptions to NbS in their area. These socio-economic characteristics of respondents were used because they have been found to be associated with land use choices taken by land owners in the study area (Kusiima et al., 2022; Kuule et al., 2022).

## 3 | RESULTS

### 3.1 | Socio-economic characteristics of respondents

The results from the socio-economic characteristics indicated that about 60% of the respondents were males. The majority (95%) of the interviewed males were heads of household, while only 17.5% of the interviewed females were heads of household. In terms of marital status, the majority (84%) of the respondents were married. Those who were not married included the divorced (2.6%), single (9%) and widowed (4.5%). About 64% of the respondents were heads of household, while 30% were spouses and about 6% were other adult persons found in the households during the data collection period. About half (51%) of the respondents had attained primary education, while about 21% did not have any formal education, 22% had attained secondary education and only 6% attained tertiary education. Approximately 31% of the respondents were aged 28–37, while about 26% were in the category of 38–47 years (See Table 1).

### 3.2 | Household land access, ownership and use

The study asked respondents about the total land size owned or which they had access to for the different production activities.

TABLE 1 Social demographic characteristics of respondents.

| Parameter                 | Category            | Number (%) |
|---------------------------|---------------------|------------|
| Sex                       | Female              | 62 (39.7)  |
|                           | Male                | 94 (60.3)  |
| Marital status            | Single              | 14 (9)     |
|                           | Married             | 131 (84)   |
|                           | Divorced            | 4 (2.6)    |
|                           | Widowed             | 7 (4.5)    |
| Position in the household | Household head      | 100 (64.1) |
|                           | Spouse              | 47 (30.1)  |
|                           | Others              | 9 (5.8)    |
| Highest qualification     | No formal education | 32 (20.5)  |
|                           | Primary education   | 79 (50.6)  |
|                           | Secondary           | 35 (22.4)  |
|                           | College             | 8 (5.1)    |
|                           | University          | 2 (1.3)    |
| Age                       | 18–27               | 26 (16.7)  |
|                           | 28–37               | 48 (30.8)  |
|                           | 38–47               | 40 (25.6)  |
|                           | 48–57               | 17 (10.9)  |
|                           | 58 and above        | 25 (16)    |
| Total                     |                     | 156 (100)  |

The respondents generally owned a small size of land with an average of 6.1 ha (SD=22.9 ha). The minimum size of land owned was 0.25 ha, while the maximum land size owned by respondents was 280 ha. For the total land size owned or accessed, respondents were asked to indicate the different categories and sizes of the land owned or accessed. The first category of land owned/accessed was land purchased from other community members. Respondents had generally purchased small sizes of land, with an average of 2.5 ha (SD=18.5 ha) and a maximum of 230 ha. Respondents had rented smaller land sizes, with an average of 1 hectare (SD=4.1 ha) and a maximum of 48 ha.

Customary land size owned was on average 2.4 ha (SD=4.5 ha), minimum of 0.25 ha, maximum of 34 ha. Some respondents also indicated that they had access to gazetted land under the Collaborative Forest Management Program between the National Forestry Authority and the local communities around Budongo Central Forest Reserve. Under this arrangement, government through the National Forestry Authority co-manages the forest with community members by allocating them land for engaging in NbS to degraded landscapes of government gazette land. This, however, was the smallest land size accessed by respondents with an average of 0.02 ha (SD=0.1 ha) and a maximum of 0.5 ha. Results revealed that food crop growing for subsistence purposes was the dominant land use on the household land owned and/or accessed by the respondents (52%). The second dominant land use was commercial sugarcane growing (43%). Other land uses included settlement (4%), coffee and other cash crops (1%).

However, a binomial logistic regression model showed that owning or having access to more land was associated with a higher likelihood of having sugarcane as the dominant land use ( $\chi^2(1)=100.384$ ,  $p=0.000$ ). Bigger land size owned explained a significant proportion (63.7%) of variance in the likelihood of practicing sugarcane growing as a dominant land use of the respondents (Nagelkerke  $R^2=0.637$ ). Conversely, smaller land sizes owned indicated a higher likelihood of practicing food crop growing as a dominant land use on the respondent's household land ( $\chi^2(1)=72.996$ ,  $p=0.000$ ). Smaller land size explained a significant proportion (49.9%) of variance in the likelihood of practicing food crop growing as a dominant land use of the respondents (Nagelkerke  $R^2=0.499$ ). Details of the two binomial regression models are presented in [Table 2](#).

### 3.3 | Nature-based practices on household land

The majority (89.7%) of the respondents indicated that they practice NbS on their land to counteract land degradation. Respondents who were not practicing NbS mainly attributed it to small land sizes (8.3%) and the fact that NbS were not conforming with their sugarcane growing practices on the fields (1.3%). Sugarcane growing is oftentimes an extensive monocropping practice that does not do well with other plant species (Mwanika et al., 2021; Mwavu et al., 2018). The majority (94%) of the respondents indicated that they would wish to have or expand NbS on their lands. NbS mostly used on the household land included cover cropping (37%) and forest/streamside buffering (35%). Other NbS practices included Indigenous tree planting (13%), wetland restoration (7%), minimum tillage (4%), agroforestry (2%) among others. Indigenous tree planting in the context of the study area is advocated as an alternative fuelwood source from the neighbouring Budongo CFR (Kasolo & Temu, 2008). This practice is done to protect and conserve the natural ecosystems while effectively and adaptively addressing the community fuelwood needs. This is in tandem with the fifth session of the United Nations Environment Assembly (UNEA-5)'s resolution on the definition of NbS (United Nations Environment Programme, 2022). In terms of preference of which NbS practice could be applied on household land, tree planting was the most preferred (64.7%). Other preferred practices were agroforestry (16%), minimum tillage (8.3%), forest and streamside buffering (8.3%) and crop rotation (1.9%) among others.

Using multivariate binary logistic regression, the study examined the influence of socio-demographic characteristics on the likelihood of applying NbS on the respondents' household land. The model was significant ( $\chi^2(4)=18.361$ ,  $p=0.003$ ) explaining about 23% variance (Nagelkerke  $R^2=0.23$ ) in the likelihood of applying NbS on respondents' household land. Age of respondents was positively associated with the likelihood of practicing NbS ( $p=0.008$ ). Young respondents were more likely to practice NbS on their household land compared to the older respondents. Similarly, the education level of the respondents was positively associated with their likelihood of practicing NbS ( $p=0.012$ ). Educated respondents were more

likely to practice NbS compared to the less educated respondents. On the other hand, the length of practicing sugarcane growing as a dominant land use was negatively associated with the likelihood of practicing NbS ( $p=0.047$ ). Respondents who had spent a while practicing sugarcane growing as the dominant land use were less likely to practice NbS. Details of the multivariate logistic regression for the influence of socio-demographic characteristics on the likelihood of applying NbS on household land are summarized in [Table 3](#).

In addition, respondents were asked to indicate reasons for having/practicing NbS on their land. About 37% of the respondents indicated that they practice NbS as a way of protecting the environment. Approximately 29% of the respondents mentioned aesthetic values as the major reason of practicing NbS. Some respondents (about 15%) indicated source of income after sale of trees from nature-based practices like agroforestry, others (12%) indicated that NbS was a source of forest products including herbal medicine and fuel wood for household use. Over 97% of the respondents were willing to contribute to NbS in the future. These potential contributions included ideas and organization of the NbS, as well as labour on establishing the NbS.

### 3.4 | Proportion of land likely to be maintained as natural succession vegetation zones

The study also assessed the proportion of land that respondents were likely to maintain as natural succession vegetation zones. About 26% of the respondents indicated that they would set aside their farm boundaries as natural succession vegetation zones. Approximately 25% indicated that they would practise homestead greening, while 17% of the respondents indicated that they would set aside  $\frac{1}{4}$  of their household land as natural vegetation succession zones. Other proportions included setting aside  $\frac{1}{2}$  of household land (7%), growing trees on household crop land (13%) and setting aside less than  $\frac{1}{4}$  of household land (3%). About 5% of the respondents were not sure if they would maintain any proportion of their land as natural vegetation succession zones.

Respondents' willingness to maintain a proportion of their household land as natural succession zones was transformed using central tendencies and subjected to correlation coefficient tests. Customary land size and proportion of household land likely to be maintained as natural vegetation succession zones were positively and significantly correlated ( $r=0.179$ ,  $p=0.026$ ,  $n=156$ ). Respondents who owned bigger sizes of customary land were more likely to maintain a bigger proportion of their land as natural vegetation succession zones. Similarly, the length of time spent practising sugarcane growing as a dominant land use and proportion of land likely to be maintained as natural vegetation succession zones were positively and significantly correlated ( $r=0.191$ ,  $p=0.017$ ,  $n=156$ ). However, respondents' willingness to contribute to NbS and proportion of land likely to be maintained as natural succession vegetation zones were negatively correlated ( $r=-0.288$ ,  $p=0.000$ ,  $n=156$ ). Details of the correlation coefficient analysis are presented in [Table 4](#).



$F=3.846$ ,  $p=0.001$ ) and explained about 13% variance in proportion of land likely to be maintained as natural vegetation succession zones. Willingness to have/expand NbS negatively influenced the proportion of household land likely to be maintained as natural vegetation succession zones ( $p=0.007$ ). Respondents who had/were willing to expand NbS on their household land were rather likely to have less proportion of land maintained as natural vegetation succession zones. Similarly, willingness to contribute to the management of NbS influenced the proportion of household land likely to be maintained as natural vegetation succession zones ( $p=0.009$ ). Respondents who were willing to contribute to the management of NbS were likely to have less proportion of land maintained as natural vegetation succession zones. These results reveal a disparity between willingness to expand/have NbS and actual implementation of the NbS. As such, willingness to expand/have NbS does not necessarily translate into implementation of the NbS. Details of the multivariate linear regression model on the proportion of household land likely to be maintained as natural vegetation succession zones are presented in Table 5.

**TABLE 4** Correlations for proportion of land likely to be maintained as natural succession vegetation zones.

| Correlations  | 1        | 2       | 3      | 4   |
|---|----------|---------|--------|-----|
| Land be to maintained as greenbelts (1)             |          |         |        |     |
| <i>r</i>  | 1        |         |        |     |
| Sig.  |          |         |        |     |
| Customary land size (2)                             |          |         |        |     |
| <i>r</i>  | 0.179*   | 1       |        |     |
| Sig.  | 0.026    |         |        |     |
| Time practiced sugarcane as a dominant land use (3) |          |         |        |     |
| <i>r</i>  | 0.191*   | 0.213** | 1      |     |
| Sig.  | 0.017    | 0.008   |        |     |
| Contribution to NBS (4)                             |          |         |        |     |
| <i>r</i>  | -0.288** | -0.077  | -0.076 | 1   |
| Sig.  | 0.000    | 0.342   | 0.343  |     |
| <i>N</i>  | 156      | 156     | 156    | 156 |

\* and \*\* indicate the different strengths of the different correlations.

**TABLE 5** Portion of household land likely to be maintained as natural succession vegetation zones.

| Coefficients                                   | Unstandardized coefficients |       | Standardized coefficients |          |       | 95% confidence interval for B |             |
|--|-----------------------------|-------|---------------------------|----------|-------|-------------------------------|-------------|
|  | B                           | SE    | $\beta$                   | <i>t</i> | Sig.  | Lower bound                   | Upper bound |
| (Constant)                                     | 8.149                       | 1.290 |                           | 6.319    | 0.000 | 5.601                         | 10.698      |
| Gender   | 0.247                       | 0.327 | 0.060                     | 0.756    | 0.451 | -0.398                        | 0.892       |
| Age  | -0.004                      | 0.011 | -0.029                    | -0.373   | 0.710 | -0.026                        | 0.018       |
| Education                                      | 0.092                       | 0.196 | 0.039                     | 0.467    | 0.641 | -0.296                        | 0.479       |
| Land size                                      | 0.001                       | 0.007 | 0.010                     | 0.129    | 0.897 | -0.013                        | 0.015       |
| Willingness to have/expand NbS                 | -1.888                      | 0.690 | -0.220                    | -2.737   | 0.007 | -3.251                        | -0.525      |
| Willingness to contribute to management of NbS | -2.709                      | 1.024 | -0.214                    | -2.645   | 0.009 | -4.733                        | -0.685      |

## 4 | DISCUSSION

### 4.1 | Community implementation in NbS to land degradation

Food crops and commercial sugarcane growing were the dominant land uses on the household land owned and/or accessed by the respondents. However, these land uses were influenced by the size of land owned/accessed. Bigger land sizes were associated with sugarcane growing as a dominant land use compared to small land sizes, which were dominated by food crop growing and other land uses. A study by Kusiima et al. (2022) noted an increase in the dominance of commercial sugarcane growing in the Budongo landscape from the early 1990s, and this has led to intensively converting biodiversity hotspots (Montoliu et al., 2024) especially on privately owned lands and in sugarcane growing areas (Twongyirwe et al., 2015).

This increasing dominance of monocrop commercial sugarcane growing is propelled by what Mwavu et al. (2018) refer to as the associated economic benefits of sugarcane growing. This clearly denotes the need for NbS to strike a balance between environmental benefits and the economic needs of communities. Just like the European Commission points out, NbS ought to help societies to sustainably address not only environmental but also societal and economic challenges (European Commission, 2020). NbS practices on the household land included cover cropping as the most applied sustainable land conservation practice. Cover cropping has been found to be a common sustainable land conservation practice in many sub-Saharan landscapes (Addisie et al., 2022; Kuule et al., 2022).

Cover cropping has been known as a cost-efficient sustainable practice that enhances nutrient cycling, soil fertility, reduces climate change effects and in due course, better crop yields (Bishal, 2023). Other sustainable land conservation practices included forest/streamside buffering as the second most applied sustainable land conservation practice on household land, tree planting, wetland restoration, minimum tillage, agroforestry, among others. In terms of the preference of conservation practices applied on household land, tree planting was the most

preferred practice by the respondents. Others were agroforestry, minimum tillage, forest and streamside buffering, crop rotation and wetland restoration. These results are similar to findings by Bwalya et al. (2023) who found out that cover cropping, agroforestry and minimum tillage are among the most common sustainable land conservation practices in Eastern Zambia.

NbS, especially through investing in the restoration and effective conservation of nature, are key for securing future sustainable development (Agus et al., 2023). Promoting NbS such as agroforestry and habitat restoration is paramount for achieving land degradation neutrality (Kusiima et al., 2022). NbS have been found to be important in striking a balance between the increasing and emerging environmental, social and economic needs (United Nations Environment Programme, 2022). The majority of the respondents indicated that they are contributing to NbS on their household lands. Respondents who were not practicing NbS on their household land mainly attributed it to having small land sizes and the uncertainty of NbS being counterproductive with their sugarcane growing practices on the fields. Similar to these results are the findings from a literature synthesis study by Perrault (2022) who categorized 13 (interrelated) barriers to the adoption of NbS, among which were performance uncertainty, fear of negative consequences, contextual uncertainty, fear of operational unknowns and spatial and temporal constraints.

This notwithstanding, respondents were willing to have and/or expand NbS on their lands. These contributions included idea generation, organization of the NbS and labour on establishing the NbS. Community implementation of NbS has been noted for not only strengthening social outcomes including livelihoods but also diversifying outcomes including social learning such as peer-to-peer learning, enhanced sense of belonging, environmental stewardship, inclusiveness and equity (Kiss et al., 2022).

This study examined the influence of socio-economic characteristics of respondents on the likelihood of contributing to NbS on respondents' household land. The young and educated respondents were more likely to practice NbS compared to the older and less educated respondents. Respondents who had spent a long time practicing sugarcane growing as a dominant land use form were more likely to practice NbS. These findings differ from those by Ferreira et al. (2022) who did not find any significant influence of socio-economic characteristics on the perception and uptake of NbS.

Respondents indicated that they practiced NbS as a way of protecting the environment, aesthetic values and a source of income after the sale of trees from nature-based practices like agroforestry, and NbS being a source of forest products. These results relate to the findings by O'Donnell (2021) and Khatimah et al. (2019) who cited the economic component as a critical and vital driver of community contribution to NbS. NbS are an efficient ecosystem-based approach that mitigates the effects of land degradation, improves the livelihoods of communities as well as the ecosystems function (Cousins, 2021; O'Donnell, 2021).

## 4.2 | Proportion of land likely to be maintained as natural succession vegetation zones

Effective stakeholder engagement is important for the long-term success of implementation of any NbS (Khatimah et al., 2019). Successful implementation of NbS have been noted for being an effective tool in recovery of degraded landscapes and natural ecosystems (Fernandes & Guiomar, 2018). This, however, requires community engagement if sustainability of the NbS is to be attained. This study assessed the proportion of household land that respondents were likely to maintain as natural succession vegetation zones. Communities were willing to use farm boundaries as natural regeneration zones, practice homestead greening, set aside a proportion of their land and practice agroforestry as and for NbS. These proportions of land likely to be maintained as NbS lead to 'partnership' and 'citizen/community control' of NbS (Puskás et al., 2021).

Respondents' willingness to maintain a proportion of their household land as natural succession zones was correlated to the size of customary land owned by respondents. Respondents who owned bigger sizes of customary land were more likely to maintain a bigger proportion of their land as natural vegetation succession zones. Customary land ownership and socio-cultural capital are the main contributions from households to the implementation and maintenance of NbS (Hagedoorn et al. 2021). Similarly, the length of time spent practicing sugarcane growing as a dominant land use was positively correlated with the proportion of land likely to be maintained as natural vegetation succession zones.

However, respondents' willingness to contribute to NbS was negatively correlated with the proportion of land likely to be maintained as natural succession vegetation zones. Respondents who indicated that they were willing to contribute to NbS were likely to set aside smaller proportions of their household land for NbS. Similarly, willingness to have/expand NbS also negatively influenced the proportion of land likely to be maintained as natural vegetation succession zones. This could be attributed to a community attitude-behavioural gap caused by land use practices such as commercial sugarcane agriculture that require big chunks of homogeneous land (Mwanika et al., 2021) and the perceived financial benefits from commercial sugarcane growing (Mwavu et al., 2018). Fear of negative consequences of NbS, fear of operational uncertainties, spatial and temporal constraints are barriers to adoption of NbS are also cited by Perrault (2022). However, according to a study by Hagedoorn et al. (2021) contributions from households to the implementation and maintenance of NbS can reduce the financial needs substantially in form of availing land and labour to work on the NbS. This, according to Hagedoorn et al. (2021), is more likely to ensure sustainability of NbS in communities where household contributions are high and could be increased or maintained over time through the preservation and encouraging of more households to contribute to the NbS.

## 5 | CONCLUSIONS AND RECOMMENDATIONS

Commercial sugarcane growing on household owned and accessed land is not only the dominant land use on relatively big land sizes but also a driver of land degradation in the study area. Commercial sugarcane growing in this landscape dates to the early 1990s and has led to intensified conversion of biodiversity hotspots into extensive homogenous sugarcane farms (Kusiima et al., 2022; Montoliu et al., 2024; Twongyirwe et al., 2015). On the other hand, small land sizes owned and/or accessed by households are dominated by food crop growing. Respondents prefer tree planting, agroforestry, minimum tillage, forest and streamside buffering, crop rotation and wetland restoration as sustainable land conservation practices.

Promoting sustainable land conservation practices and NbS such as restoration, cover cropping, minimum tillage and agroforestry are paramount for abetting land degradation impacts. Community implementation of these practices is very important for their success and sustainability. The majority of the respondents indicated that they are contributing to the NbS on their household lands. However, some of the respondents who were not practicing NbS on their land mainly attributed it to small land sizes and the uncertainty of NbS being counterproductive with their sugarcane growing practices on the fields. This suggests a notion that community NbS ought to benefit humans locally; else, they risk being outcompeted by other economically viable land uses. The study suggests that National Land Use Policy ought to consider not only the ecological prospects of NbS but also the socio-economic impacts. The socio-economic dimension of NbS can be considered more holistically when humans are considered as a part, rather than as apart of nature (Folkard-Tapp et al., 2021). This notwithstanding, most respondents were willing to have and/or expand NbS on their lands. Their willingness to implement NbS was mainly centred around giving ideas, organizing the NbS and labour on establishing the NbS. Once consolidated, these contributions are likely to yield the success of such projects that apply NbS within the study area.

Socio-economic characteristics of respondents, particularly age, education and time spent practicing commercial sugarcane growing, influenced their likelihood of contributing to NbS. These characteristics ought to be explored in future implementation of NbS within the study area as well as similar landscapes. The majority of the respondents indicated a high level of awareness of the advantages of NbS, citing environmental protection, aesthetic values and source of complementary income. These advantages could be used to encourage more households to practice NbS.

Effective stakeholder engagement is important for the long-term success of the implementation of NbS. This, however, requires community engagement and involvement of local communities if the sustainability of the NbS is to be attained. Respondents were willing to use farm boundaries as natural regeneration zones, practice

homestead greening, set aside proportions of their land and practice agroforestry as and for NbS. This was, however, positively correlated with the size of customary land owned by respondents and the length of time spent practising sugarcane growing as a dominant land use. Other forms of land ownership as well as other land users in the study area can be encouraged to practice NbS if land degradation impacts are to be effectively abetted. Therefore, future policy should be designed to look into win-win scenarios for NbS and other community land use practices. Facilitating NbS at a national scale using the bottom-up approach would offer opportunities for community buy-in and sustainability of such NbS. National Land Use Policy should consider local landscape zoning to include NbS and/or the aspect of 'nature' as a key zone amidst the other land uses. This could be brought off by raising awareness of the benefits NbS could yield for conservation and humanity. This would encourage more households to strike a balance between land use practices such as commercial sugarcane growing that require big chunks of homogenous land and the implementation of NbS to degraded landscapes around the Budongo Central Forest Reserve, Uganda.

The small sample size and limited number of variables assessed in the study could limit the generalizability of the findings therein. We note, for example, that traditional, cultural, Indigenous knowledge may influence perceptions on NbS. However, these and others should be assessed in a bigger survey with more households to understand how they influence the uptake of NbS. More so, the study assessed the community's willingness to have/expand NbS, which may differ among other communities due to a variety of unrelated factors. The study therefore provides a building block upon which NbS can be construed but requires tailoring to specific communities before adopting and rather not be treated as a one shoe fits all.

### AUTHOR CONTRIBUTIONS

Cosmus Kule conceived the ideas, designed methodology, analysed the data and led the writing of the manuscript. Johanna Raudsepp guided the methodology, analysis and writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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### CONFLICT OF INTEREST STATEMENT

Authors of this paper have no conflict of interest.

### PEER REVIEW

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## DATA AVAILABILITY STATEMENT

No supplementary data were collected for the study.

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## REFERENCES

- Addisie, M. B., Molla, G., Teshome, M., & Ayele, G. T. (2022). Evaluating biophysical conservation practices with dynamic land use and land cover in the highlands of Ethiopia. *Land*, *11*, 2187.
- Agus, S., Till, P., Bunafsha, M., & Sarah, E. (2023). *Study on nature-based solutions (NbS) in Association of Southeast Asian Nations (ASEAN)*. GIZ.
- Banadda, N. (2020). Gaps, barriers and bottlenecks to sustainable land management (SLM) adoption in Uganda. *African Journal of Agricultural Research*, *5*, 3571–3580.
- Banerjee, S., Ho, L. H., & Pal, I. (2024). *Policy implications to encourage the adoption of nature-based solutions in Vietnamese Mekong Delta (VMD)*. <https://meetingorganizer.copernicus.org/EGU24/EGU24-512.html>
- Bishal, C. (2023). Cover crop as approach for sustainable agriculture: A review. *Russian Journal of Agricultural and Socio-Economic Sciences*, *137*, 44–55.
- Budongo Conservation Field Station. (2016). *Blending research and conservation for sustainable natural resource management*. Budongo Conservation Field Station (BCFS) Masindi. <http://www.budongo.org/media/1282/bcfs-newsletter.pdf>
- Bwalya, B., Mutandwa, E., & Chiluba, B. C. (2023). Awareness and use of sustainable land management practices in smallholder farming systems. *Sustainability*, *15*, 14660.
- Connor Desai, S., & Reimers, S. (2019). Comparing the use of open and closed questions for Web-based measures of the continued-influence effect. *Behavior Research Methods*, *51*(3), 1426–1440. <https://doi.org/10.3758/s13428-018-1066-z>
- Cousins, J. J. (2021). Justice in nature-based solutions: Research and pathways. *Ecological Economics*, *180*, 106874.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage.
- Dlamini, S., Tesfamichael, S. G., & Mokhele, T. (2021). Socio-demographic determinants of environmental attitudes, perceptions, place attachment, and environmentally responsible behaviour in Gauteng province, South Africa. *Scientific African*, *12*, e00772.
- Doss, C., Meinzen-Dick, R., & Bomuhangi, A. (2013). Who owns the land? Perspectives from rural Ugandans and implications for land acquisitions. *Feminist Economics*, *20*, 76–100.
- European Commission. (2020). *Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities*. Final report of the Horizon 2020 expert group on 'nature-based solutions and re-naturing cities'.
- FAO. (2016). *Guidelines on urban and peri-urban forestry*. FAO forestry paper no. 178.
- Feng, S., Zhao, W., Zhan, T., Yan, Y., & Pereira, P. (2022). Land degradation neutrality: A review of progress and perspectives. *Ecological Indicators*, *144*, 109530.
- Fernandes, J. P., & Guiomar, N. (2018). Nature-based solutions: The need to increase the knowledge on their potentialities and limits. *Land Degradation & Development*, *29*, 1925–1939.
- Ferreira, V., Barreira, A. P., Pinto, P., & Panagopoulos, T. (2022). Understanding attitudes towards the adoption of nature-based solutions and policy priorities shaped by stakeholders' awareness of climate change. *Environmental Science & Policy*, *131*, 149–159.
- Folkard-Tapp, H., Banks-Leite, C., & Cavan, E. L. (2021). Nature-based solutions to tackle climate change and restore biodiversity. Nature-based solutions to tackle climate change and restore biodiversity. *Journal of Applied Ecology*, *58*, 2344–2348.
- Giregon, O., Antonia, N., Doreen, M., Enock, S., Kellen, A., Vincent, B. M., Esaete, J., & Tabuti, J. R. S. (2016). Soil carbon and nitrogen distribution under contrasting land cover types in Kibale National Park Uganda. *International Journal of Restoration on Land-Use Sustainability*, *2*, 101–112.
- Gourevitch, J. D., Hawthorne, P. L., Keeler, B. L., Beatty, C. R., Greve, M., & Verdone, M. A. (2016). Optimizing investments in national-scale forest landscape restoration in Uganda to maximize multiple benefits. *Environmental Research Letters*, *11*, 114027.
- Guloba, M. M., Mbowa, S., Nakazi, F., David, M., & Bryan, E. (2023). *Sugarcane production and food security in Uganda*. Michigan State University.
- Hagedoorn, L. C., Koetse, M. J., Van Beukering, P. J. H., & Brander, L. M. (2021). Reducing the finance gap for nature-based solutions with time contributions. *Ecosystem Services*, *52*, 101371.
- Hay, I., & Cope, M. (2021). *Qualitative research methods in human geography*. Oxford University Press.
- Heindorf, C., Schüller, S., & Plieninger, T. (2024). Poetic inquiry to explore the relational values of a transforming peat landscape. *People and Nature*, *3*, 10629–11205.
- IUCN. (2016). *Forest landscape restoration opportunity assessment report for Uganda*. Ministry of Water and Environment.
- Jalal, R., Mahamud, R., Arif, M. T. A., Ritu, S., Kumar, M. F., Ahmed, B., Arif, M. T. A., Kabir, M. H., Rana, M. S., Huda, H. N., DeGaetano, M., Agnew, P. J., Ghosh, A., Mushtaq, F., Martín-Ortega, P., Vollrath, A., Finegold, Y., Franceschini, G., d'Annunzio, R., ... Henry, M. (2023). Restoring degraded landscapes through an integrated approach using geospatial technologies in the context of the humanitarian crisis in Cox's Bazar, Bangladesh. *Land*, *12*, 352.
- Kasolo, W. K., & Temu, A. B. (2008). Tree species selection for buffer zone agroforestry: The case of Budongo Forest in Uganda. *International Forestry Review*, *10*, 52–64.
- Khatimah, F. H., Fauzi, D., Chandra, A., & Wicaksono, S. A. (2019). Benefits over threats: Understanding community's motivation to participate in restoration initiatives in Gunung Leuser National Park, Sumatra. *IOP Conference Series: Earth and Environmental Science*, *298*, 012027.
- Kiss, B., Sekulova, F., Hörschelmann, K., Salk, C. F., Takahashi, W., & Wamsler, C. (2022). Citizen participation in the governance of nature-based solutions. *Environmental Policy and Governance*, *32*, 247–272.
- Kizza, C. L., Majaliwa, J. G. M., Kunihira, R., Gabiri, G., Zizinga, A., Sebulla, E., Nampijja, J., & Tenywa, M. M. (2016). Soil and nutrient losses and the role of gender in land degradation in Southwestern Uganda. In R. Lal, D. Kraybill, D. O. Hansen, B. R. Singh, T. Mosogoya, & L. O. Eik (Eds.), *Climate change and multi-dimensional sustainability in African agriculture: Climate change and sustainability in agriculture* (pp. 185–200). Springer Publishing.
- Kleinbaum, D. G., & Klein, M. (2010). *Logistic regression: A self-learning text* (3rd ed.). With contributions by Erica Rihl Pryor. Springer.
- Kusiima, S. K., Egeru, A., Namaalwa, J., Byakagaba, P., Mfitumukiza, D., & Mukwaya, P. (2022). Anthropogenic induced land use/cover change dynamics of Budongo-Bugoma landscape in the Albertine region, Uganda. *The Egyptian Journal of Remote Sensing and Space Science*, *25*, 639–649.
- Kuule, D. A., Ssentongo, B., Magaya, P. J., Mwesigwa, G. Y., Okurut, I. T., Nyombi, K., Egeru, A., & Tabuti, J. R. S. (2022). Land use and land cover change dynamics and perceived drivers in rangeland areas in Central Uganda. *Land*, *11*, 1402.
- Lai, S., & Zoppi, C. (2024). Sustainable spatial planning based on ecosystem services, green infrastructure and nature-based solutions. *Sustainability*, *16*, 2591.
- Mack, N., Woodsong, C., Macqueen, K. M., Guest, G., & Namey, E. (2011). *Qualitative research methods: A data collector's field guide*. Family Health International.

- Montoliu, J., Guzmán, G., Lora, Á., Mora, J., Soriano, M. A., & Gómez, J. A. (2024). *Vegetative barriers as a nature-based solution for agricultural landscapes diversification: design and management of this green infrastructure in a Mediterranean climate*. <https://meetingorganizer.copernicus.org/EGU24/EGU24-3052.html>
- Mwanika, K., State, A. E., Atekyereza, P., & Österberg, T. (2021). Colonial legacies and contemporary commercial farming outcomes: Sugarcane in Eastern Uganda. *Third World Quarterly*, 42, 1014–1032.
- Mwavu, E., Kalema, V., Bateganya, F., Byakagaba, P., Waiswa, D., Enuru, T., & Mbogga, M. S. (2018). Expansion of commercial sugarcane cultivation among smallholder farmers in Uganda: Implications for household food security. *Land*, 7, 73.
- National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC. (2012). *National Geographic World Map, digital topographic basemap of the world*. <http://www.arcgis.com/home/item.html?id=b9b1b422198944fbbd5250b3241691b6>
- Nyumba, T. O., Kerrie, W., Christina, D. J., & Nibedita, M. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 9, 20–32.
- Obua, J., Agea, J. G., & Ogwal, J. J. (2010). Status of forests in Uganda. *African Journal of Ecology*, 48, 853–859.
- O'Donnell, M. (2021). *Nature-based solution in the community: An analysis of perceptions towards nature-based solutions in Ireland*. [Master's thesis, The University of Dublin].
- Omeja, P. A., Obua, J., Rwetsiba, A., & Chapman, C. A. (2012). Biomass accumulation in tropical lands with different disturbance histories: Contrasts within one landscape and across regions. *Forest Ecology and Management*, 269, 293–300.
- Opedes, H., van Eupen, M., Mücher, C. A., Baartman, J. E. M., & Mugagga, F. (2023). Park conservation or degradation? iCLUE modelling of land use change projections in the upper Manafwa watershed on Mount Elgon, Uganda. *Journal for Nature Conservation*, 76, 126493.
- Oribhabor, C. B., & Anyanwu, C. A. (2019). Research sampling and sample size determination: A practical application. *Federal University Dutsin-Ma Journal of Educational Research*, 2, 47–56.
- Perrault, R. (2022). Problems with nature-based solutions: A literature review of the barriers to implementing nature-based solutions in urban areas. *Potentia: Journal of International Affairs*, 13, 128–147.
- Puskás, N., Abunnasr, Y., & Naalbandian, S. (2021). Assessing deeper levels of participation in nature-based solutions in urban landscapes—A literature review of real-world cases. *Landscape and Urban Planning*, 210, 104065.
- Sanz, M. J., de Vente, J., Chotte, J. L., Bernoux, M., Kust, G., Ruiz, I., Almagro, M., Alloza, J. A., Vallejo, R., Castillo, V., Hebel, A., & Akhtar-Schuster, M. (2017). *Sustainable land management contribution to successful land-based climate change adaptation and mitigation*. United Nations Convention to Combat Desertification (UNCCD).
- Tibasiima, T. K., Bwambale, B., Ekyaligonza, D. M., Dietrich, P., Jumba, F., Kagorora, J. P. K., & Freyer, B. (2023). Re-assembling land degradation: Toward a nature-society inclusive soil erosion management strategy. A case of the Rwenzori region, Uganda. *Frontiers in Sustainable Food Systems*, 7, 2571581X.
- Turyasingura, B., Ayiga, N., & Benzougagh, B. (2022). *Re-thinking on land degradation and its impacts on livelihoods of the farmers in Kanungu District, Uganda*. <https://doi.org/10.21203/rs.3.rs-1966742/v1>
- Twongyirwe, R., Bithell, M., Richards, K. S., & Rees, W. G. (2015). Three decades of forest cover change in Uganda's Northern Albertine Rift Landscape. *Land Use Policy*, 49, 236–251.
- Uganda Bureau of Statistics (UBOS). (2020). *Statistical abstract Uganda Bureau of Statistics, Kampala, Uganda*. [https://www.ubos.org/wp-content/uploads/publications/11\\_2020STATISTICAL\\_ABSTRACT\\_2020.pdf](https://www.ubos.org/wp-content/uploads/publications/11_2020STATISTICAL_ABSTRACT_2020.pdf)
- United Nations Environment Programme (UNEP). (2022). *5/5. Nature-based solutions for supporting sustainable development: resolution/adopted by the United Nations Environment Assembly*.
- Vikih, E. V., & Kaufmann, H. R. (2024). Evaluating the potential of vertical farming business models for sustainable agriculture and food security in Cameroon. *Proceedings from REAL CORP 2024* (pp. 285–297). <https://doi.org/10.48494/REALCORP2024.2047>
- World Bank. (2021). *From crisis to green resilient growth: Investing in sustainable land management and climate smart agriculture*. World Bank.
- World Weather Online. (2024). *Budongo Weather Forecast—Hoima, UG*. <https://www.worldweatheronline.com/budongo-weather/hoima/ug.aspx>
- Yin, R. K. (1999). Enhancing the quality of case studies in health services research. *Health Services Research*, 34, 1209–1224.

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