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Article

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The determinants of livelihood diversification among small-scale rural farmers in Alfred Nzo and King Cetshwayo District, South Africa

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ABSTRACT

The determinants of livelihood diversification have been studied by several researchers globally. However, these factors are not well understood in the ANDM and KCDM, because they are given little attention. The specific objective of the study was to examine the determinants of livelihood diversification in ANDM and KCDM. The cross-sectional dataset was collected from 268 and 264 participants who were randomly selected in ANDM and KCDM, respectively. A structured questionnaire was utilized to collect data on socio-economic and demographic factors among small-scale rural farmers in ANDM and KCDM. The data collection commenced in March to April 2022 in KCDM and started in August to September 2022 in ANDM. Stata version 14.0 was employed to estimate a Quantile regression. The results show that 66.04% of participants in ANDM were female-headed households, whereas 53.79% in KCDM were headed by males. The findings from a Quantile regression show that livelihood diversification was influenced by the household head's gender, age, marital status, access to extension services, access to credit, employment status, food security, education, household size, farm size, poverty status, farm experience, and improved seeds. To promote livelihood diversification, policymakers should create policies that will target all factors that are significant in the study.

IMPACT STATEMENT

The determinants of livelihood diversification have been explored by researchers on a global scale. However, these factors are not well recognized in the ANDM and KCDM regions as they are given little attention. The primary focus of the study was to analyze the determinants of livelihood diversification in ANDM and KCDM. A Quantile regression show that livelihood diversification was influenced by the household head's gender, age, marital status, access to extension services, access to credit, employment status, food security, education, household size, farm size, poverty status, farm experience, and improved seeds. To enhance livelihood diversification, policymakers should design policies that focus on all significant factors outlined in the study.

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1. Introduction

The concept of livelihood diversification has been the subject of interest to researchers and has been widely accepted by several development theorists because of its theoretical assumption of reducing rural poverty and improving food security status (Bryceson, 2000; Ellis, 1998). Arguments related to the livelihood approach have predominantly targeted rural areas, since most households in those areas are involved in farming (Krantz, 2001).

It has been postulated that a household's livelihood is sustained if it can adequately manage and elude strain and pressure while maintaining its resources and capacities (Ellis, 1998; Goldman et al., 2000). To secure their livelihoods, households adopt multiple approaches, including securing permanent positions that pay salaries which in turn assists them in supporting their families and participating in livestock rearing and crop cultivation (Chambers & Conway, 1992).

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Research has demonstrated that income acquired from non-agricultural sources supplements farm income, which in turn enhances the standard of living of marginalized and rural poor households (Reardon, 1997). Additionally, residents in rural areas have devised multiple strategies to sustain their way of living. Those with little access to resources face obstacles such as food insecurity and livelihood uncertainty (Purvis & Smith, 2006; Smith, 2012).

Diversifying one's livelihood is generally seen as an adaptive measure in times of hardship (Ghosh & Bharadwaj, 1992). The pull and push factors play a significant role in determining whether households should expand their income sources. Echebiri et al. (2017) noted that pull factors can be perceived as opportunities that provide individuals or households with the potential to extend their income sources.

Steady demand for products and services, as well as the potential for significantly higher returns, has been regarded as the primary factor that drives households to undertake non-agricultural activities (Khapayi & Celliers, 2016). Considering the potential of generating extra income through alternate sources, households are becoming significantly more engaged in various income-generating activities beyond agriculture (Cervantes-Godoy & Dewbre, 2010).

Push factors are classified as circumstances in which households are compelled, by their situation, to take up multiple livelihood activities for them to survive (Barrett et al., 2001). Households that struggle financially are obliged to invest in resources with low returns because they are unable to obtain the necessary assets due to a lack of funds (Ellis, 1998, 2000). Thus, the poverty status could serve as one of the factors that may push small-scale farmers to engage in various livelihood activities to gain a living.

Among the studies that investigated the determinants of livelihood diversification, Habib et al. (2023) found that livelihood diversification was positively influenced by the level of education, family labour, and social connections. Conversely, there was a negative relationship between livelihood diversification and farm organizations, access to new farming equipment, credit accessibility, and natural disasters. Onuwa et al. (2022) found that education level, household size, credit access, and productive assets have a positive impact on livelihood activities. However, the age of the household head was found to have a negative effect. Kumar and Umesh (2020) assert that extension services and membership in farming organizations have a positive effect on livelihood diversification. Workie (2023) indicated that on-farm and off-farm livelihoods are positively influenced by the gender of the household head, while household head age, and livestock ownership, had a negative impact.

The determinants of livelihood diversification have been investigated extensively around the globe. However, the determinants of livelihood diversification have been given little attention in the Alfred Nzo District Municipality (ANMD) and King Cetshwayo District Municipality (KCDM). Additionally, most studies did not include poverty status as one of the predictor variables that could explain the participation in multiple livelihood activities. To the researchers' knowledge, this is the first study to incorporate poverty status as an independent variable and this is the original contribution to the existing literature.

The primary objective of the study is to examine the determinants of livelihood diversification in ANDM and KCDM. This will shed light on policymakers to understand the factors that require an urgent response to enhance livelihood diversification among small-scale rural farmers in the study areas. The determinants of livelihood diversification may vary based on different household characteristics and geographical areas. This is one of the reasons it was important to conduct this investigation in the ANDM and KCDM.

2. Literature review

This section provides a summary of previous empirical research on the determinants of livelihood diversification. Dinku (2018) investigated the determinants of livelihood diversification using a multinomial regression. In the first model, the age of the household head, farm input, and livestock extension contact were found to be positively associated with on-farm and off-farm livelihood activities. The second model revealed that the age of the household head, farm input, livestock extension contacts, and access to remittances, were positively associated with a combination of on-farm and non-farm livelihood activities. In the third model, the ownership of cattle, farm input, and market distance were found to have a positive relationship, with a combination of on-farm, off-farm, and non-farm livelihood activities. Conversely, credit access was negatively related to a combination of livelihood activities such as on-farm + off-farm + non-farm.

Etuk et al. (2018) found that household size has a negative impact on livelihood diversification, meaning that larger households tend to have lower levels of diversification. However, the study also found that marital status, farm size, and total household income have a positive influence on small-scale farmers' engagement in various livelihood activities. Tyenjana and Taruvinga (2019) discovered a positive correlation between livelihood diversification and education level, livestock ownership, and household size. They also observed that the gender of the household head negatively affects participation in different livelihood activities.

Aweke et al. (2023) conducted a study and found a positive correlation between off-farm work and factors such as soil erosion, livestock ownership, and proximity to markets. On the other hand, they found a negative association between livelihood diversification and total household income, male-headed households, education level, and training. Similarly, Guite et al. (2022) discovered that proximity to markets, affiliation with farming and non-farming organizations, size of operational wetlands, and availability of forest resources positively influence livelihood diversification. However, they found a negative association between average educational level, participation in multiple income-generating activities, and operational cash crop land.

Roy and Basu (2020) found that diversifying livelihoods was associated with higher government donations, increased household members with income, and greater involvement of social workers. Alemu (2023) discovered that various factors significantly influenced the extent of livelihood diversification, including household head age and gender, level of education, farm size, land quality, soil conservation methods, access to extension services, distance to markets, exposure to shocks, and availability of infrastructure. Ayana et al. (2021) found that the level of education of the household head, dependency ratio, access to irrigation, credit availability, and urban connectivity significantly impacted livelihood diversification.

Abera et al. (2021) showed that the combination of agricultural and non-farm activities in livelihoods was influenced by factors such as the age and gender of the household head, household size, education status, livestock ownership, land size, credit access, distance to markets, and income level. Another model revealed that agriculture supplemented with off-farm work was influenced by variables like the age of the household head, household size, education attainment, livestock ownership, land size, and proximity to markets. The third model demonstrated that engagement in agriculture, non-farm, and off-farm activities in livelihoods was influenced by factors including the gender and age of the household head, household size, education level, livestock ownership, land size, credit access, and distance to markets.

According to Washo et al. (2021), access to credit, ownership of livestock, and household size had a positive impact on combining agriculture with off-farm activities. However, a second model revealed that household size had a negative influence on combining agriculture with non-farm activities. Additionally, a third model indicated that combining agriculture, off-farm, and non-farm activities in livelihoods was negatively affected by the age of the household head. The study also found that marital status, level of education, land ownership, livestock holding, and access to credit positively influence a combination of agriculture, off-farm, and non-farm livelihood activities.

A research study conducted by Akyoo (2021) used a multinomial logit to examine the predictor variables that impact the livelihood diversification of small-scale farmers, in two different areas of Tanzania: Kilombero Sugar Company Limited (KSCL) and Kilombero Plantation Limited (KPL). The findings from KSCL, indicated that household size and land size had a negative impact on on-farm and non-farm livelihood activities, while marital status showed a positive correlation. Furthermore, there was a negative relationship between livelihood diversification (on-farm and off-farm) and household size, land size, and access to credits. The second model revealed that household size, land size, and credit access were negatively associated with a combination of on-farm, off-farm, and non-farm livelihood activities. The third model, from KPL, demonstrated that the combination of on-farm, off-farm, and non-farm livelihoods was positively related to land size and total household income.

The literature review indicates a lack of studies that have incorporated poverty as an independent variable in the regression model, highlighting a gap in the existing research that requires attention.

3. Conceptual framework

This research paper utilized the sustainable livelihood framework (see Figure 1) as a theoretical foundation to support the study's findings and conclusions. Maintaining a sustainable livelihood requires the

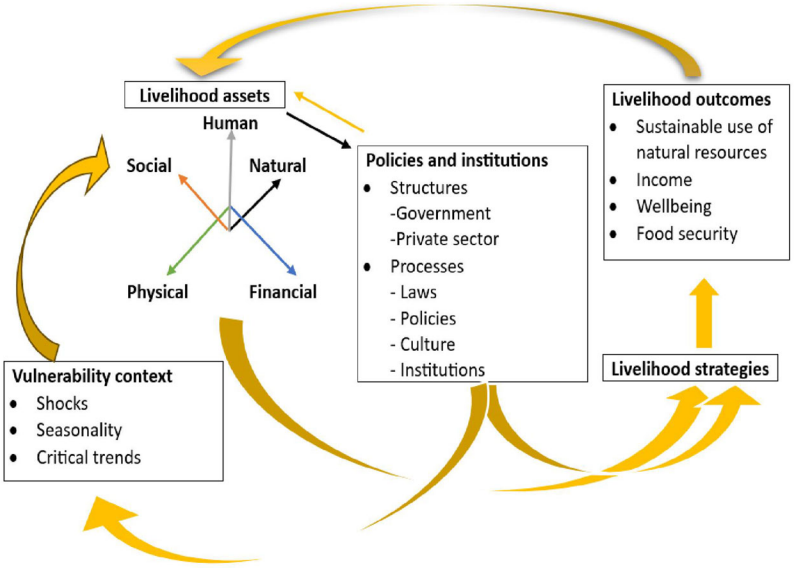

Figure 1. Sustainable livelihood framework. Source: Ellis (2000).

capacity to effectively adapt to external shocks or pressures without compromising the productivity of natural resources or harming others (Sneddon, 2000). The framework has five livelihood assets which include human capital, social, financial, natural, and physical capital. These livelihood assets directly affect the livelihood strategies and could be used to address the vulnerability context such as external shocks, seasonality, and trends.

The sustainable livelihood framework has institutions that are responsible for implementing policies and laws that could be used as a responsive major when sudden shocks take place. This would protect the livelihood strategies which could lead to a positive livelihood outcome. Being involved in various income-generating activities can help small-scale farmers increase their overall household income. This could ultimately lead to an enhanced food security status and improved dietary intake for rural small-holder farmers. The Sustainable Livelihoods Framework was employed in this research to rationalize the various livelihood activities undertaken by rural small-scale farmers in both ANDM and KCDM.

4. Materials and methods

4.1. Description and justification of study areas

Alfred Nzo District Municipality (ANDM) is situated in the north-eastern part of the Eastern Cape Province and has four local municipalities: Mbizana, Ntabankulu, Umzimvubu, and Matatiela (ANDM [Alfred Nzo District Municipality], 2017). This is the smallest district, covering an area of 10,731 square kilometers, which accounts for 6% of the geographical area in this region. Almost 70% of the population and households in the ANDM are situated in rural areas. This municipality has a population of 867,864 with 195,975 households. The said district is dominated by maize small-scale farmers who have organized projects which are registered with the Department of Agriculture and more than 1000 cooperatives deliver their maize to the Dyifani milling plant every year (Miti, 2017). Small-scale farmers in the ANDM who participated in commercial farming accounted for 1.4% of the total. This was the lowest percentage compared with other regions in the Eastern Cape Province (Stats SA [Statistics South Africa], 2020).

The Eastern Cape is the reference where poverty and unemployment rates are among the highest in the country since this province is characterized as the second poorest in South Africa (NDA [National Development Agency], 2014). Additionally, the Alfred Nzo District Municipality (ANDM) is declared as worse off compared to other districts within the Eastern Cape province (ANDM, 2020). This is what makes the ANDM to be unique in the Eastern Cape and targeted as a study area. The findings of the study would inform policymakers about the determinants that promote or hinder the participation of

small-scale farmers in different livelihood activities. Thus, the appropriate majors would be taken to address the poverty issues that prevail in the district which will encourage the participation of small-scale farmers in multiple income-generating activities.

King Cetshwayo District Municipality is situated in the northern part of KZN, with its administrative headquarters in Richards Bay. This district covers an area of 8213 square kilometers. It has five local municipalities: uMhlathuze, Mthonjane, uMlalazi, uMfolozi, and Nkandla. Approximately 80% of King Cetshwayo District households and the population are regarded as rural. This district has a total population of 982,726, with an estimated 222,000 households, with an average of 3.95 persons per household (Stats SA, 2016). According to Statistics South Africa (Stats SA, 2020), the number of commercial farms in the King Cetshwayo District constituted 5.1% of the total farmers in the province.

KwaZulu-Natal (KZN) is described as the third poverty-stricken area that follows the Eastern Cape (Stats SA, 2019). Despite the efforts that have been put in place by the government such as 'One Home One Garden' to fight the incidence of hunger it has never worked out because food shortages still exist in rural KZN (Ngema et al., 2018). The KZN is dominated by households whose livelihoods are derived from agricultural activities (Hornby et al., 2018). This was particularly observed in the northern part of the region, where the King Cetshwayo District Municipality (KCDM) was identified to have more farming potential than the other districts within the province. Given this background, the KCDM was purposively chosen in KZN as the study area.

4.2. Ethical considerations

On the 19th of January 2022, the Research Ethics Committee of the University of Zululand issued the ethical clearance certificate with reference number: UZREC 171110-030 PGD 2021/65. The participants were informed that they may stop answering the questions at any time, without any consequences.

4.3. Data collection instrument and sampling method

A questionnaire was used as the data collection instrument because it is easy to analyse, provides anonymity to the participant, and produces a comparable result. Each copy of the questionnaire was accompanied by informed consent approved by the University of Zululand Research Ethics Committee. In KCDM, data collection commenced on the first week of March to 30 April 2022, whereas in ANDM it started on the first week of August to 30 September 2022. Systematic random sampling was used to select participants because it is the easiest method to draw a sample from a larger population. One starts by selecting a starting point from the sampling frame, and consistently maintaining the same interval while skipping households or individuals (Mkonda et al., 2018).

4.4. Instrument design

In preparation for the face-to-face interview, open-ended and closed-ended questions were developed. Respondents were asked to identify their sources of income and specify the amount generated from each livelihood strategy through the open-ended questions. Conversely, participants were given only two options with the closed-ended questions, requiring them to choose either 'yes' or 'no'. Before gathering data, a pilot study was conducted with 20 randomly selected farmers to determine if they would understand the questions.

4.5. Sample size

The data collection process for this study was conducted in two districts, which required the sample size to be calculated separately. Krejcie and Morgan's sampling formula was used to determine the appropriate sample size for this study. JUSTIFY

$$s = \frac{x^2 NP(1-P)}{d^2(N-1) + x^2 P(1-P)}$$

4.5.1. The sample size for the ANDM and KCDM

According to a study conducted by Sifundza (2019), it was found that a total of 787 households from the KwaMkhwanazi community were engaged in farming and delivered their sugarcane produce to Felixton Mill. Therefore, the calculation showed that the sample size for KCDM was 258. A total of 300 questionnaires were printed and delivered to fieldworkers in the KCDM. After data were collected in the KCDM, 264 questionnaires were completed by the enumerators. The response rate was calculated by dividing the questionnaires that were returned by fieldworkers against the number that was printed out. For the KCDM the response rate was 88% which was very close to 100%.

The first author approached the Department of Agriculture in Mbizana which is situated in ANDM to request access to the database to get the total number of small-scale farmers in the area. The officials convened a meeting in February 2022, where all representatives from different maize projects were present. The meeting aimed to request access to their information and the permission was granted. Then after, one of the officials printed the Excel spreadsheets with details of the farmers which also revealed the total number of registered small-scale farmers. This spreadsheet revealed a total of 1457 farmers which assisted in a sample size determination of 304. In the ANDM, 350 questionnaires were delivered to field workers. After data were collected in the ANDM, 268 questionnaires were returned by field workers. The response rate in ANDM was 77%. This validates the findings of the study because the response rate was more than 50% in both districts.

4.6. Analytical approach: quantile regression model

The objective of this study was to assess the determinants of livelihood diversification in ANDM and KCDM. The authors wanted to explore how the dependent variable (livelihood diversification) was influenced by the predictor variables at different levels of quantiles. Thus, the Ordinary Least Squares technique was not applicable in this situation because it provides only one coefficient for each variable. However, the objective of the study can only be achieved if a quantile regression model is utilized. This model was first introduced by Koenker and Bassett (1978) as an alternative to overcome ordinary least squares (OLS) shortfalls.

Quantile Regression (QR) is used to predict the median rather than the mean, which is normally estimated by OLS. QR is an extension of OLS, and it is used when the normality and homoscedastic assumptions are violated. QR can be expressed as follows:

$$y_t = x_t'\beta_t$$

where x_t' represents the vector of household characteristics of the sampled population, and β_t denotes the parameters that should be estimated in the QR model.

The QR equation minimizes:

$$\sum_t q|e_t| + \sum_t (1-q)|e_t|$$

Where $q|e_t|$ represents under-prediction and $(1-q)|e_t|$ denotes over-prediction. The estimator of the *qth* predicted β minimizes the following objective function:

$$\min_{b\varepsilon R} K\left[\sum_{t\varepsilon R(t:y_t \geq x_t'\beta)} q\left|y_t - x_t'\beta_q\right| + \sum_{t\varepsilon R(t:y_t < x_t'\beta)} (1-q)\left|y_t - x_t'\beta_q\right|\right]$$

where $0 < q < 1$.

The standard conditional quantile can be expressed in the following linear form:

$$Q_q(y_t|x_t) = x_t'\beta_q$$

For the *K*th predicted coefficient, the marginal effect can be expressed as:

$$\frac{\partial Q_q(y_t|x_t)}{\partial x_k} = \beta_{qk}$$

4.7. Model specification

This study employed Simpson's Diversity Index (SDI) as the dependent variable, which is a proxy for livelihood diversification. The Quantile Regression model was specified as:

$$SDI = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_k x_k + u_i$$

where β_0 denotes the slope of the regression model; β_1, β_2, and β_k represent the coefficients that will be estimated; x_1, x_2, and x_k represent the characteristics of the sampled households; and u_i signifies the error term.

4.8. Measurement of the dependent variable

The Simpson's diversity index (SDI) was calculated using the formula derived by Warwick et al. (2008). The SDI equation is expressed as:

$$SDI = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

where the small letter n represents individual income (i.e. pension or remittances, farm income, salaries from employer), while the capital letter *N* represents the sum of all individual income, from different livelihood strategies. If the household head has only one source of income, the SDI is equal to zero. Conversely, if a household head has several sources of income, the SDI will be closer to or equal to one, suggesting that a particular smallholder farmer, in the surveyed population has multiple sources of income. This implies that the dependent variable ranges from 0 to 1.

4.9. Measurement of independent variables

The measurement scales for the independent variables depicted in Table 1 were utilized by the previous researchers which examined the determinants of livelihood diversification in different countries or regions. For example, Tyenjana and Taruvinga (2019) used a binary measurement scale to code the variable for the household head gender (1 = male and 0 female), access to credit (1 = yes and 0 = no), and access to extension services (1 = yes and 0 = no).

Mudzielwana et al. (2022) used a binary measurement scale in education status (1 = formal and 0 = no formal education), and marital status (1 = married and 0 = single), while household head age was measured as continuous variable. Etuk et al. (2018) measured family size as the number of persons living in the same household, farm size was measured as the number of hectares, and farm experience was measured as the number of years spent in farming. Abera et al. (2021) measured the variable for improved seeds as a binary (1 = yes and 0 = 0). The employment status was coded as a binary variable (1 = employed and 0 = unemployed).

Table 1. Measurement of independent variables.

Variables	Type	Description
HHG	Dummy	1, Male-headed 0, Female-headed
HHMS	Dummy	1, Married 0, Otherwise
HHEXT	Dummy	1, Access to extension services 0, Otherwise
CREDACC	Dummy	1, Access to credits 0, Otherwise
HHEMP	Dummy	1, Employed, self-employed, and part-time 0, Otherwise
FSEC	Dummy	1, Food secure 0, Otherwise
HHED	Dummy	1, Formal education 0, Otherwise
HHAG	Continuous	Age in years
HHFEXP	Continuous	Experience in years
HS	Discrete	Number of family members living together
IMSEEDS	Dummy	1, Utilising improved seed 0, Otherwise
FARMS	Continuous	Number of hectares
POVST	Dummy	1, non-poor 0, Otherwise

Getahun et al. (2020) coded the food security status as 1 when the household was found to be food-insecure and 0 when they were food-insecure. But in this study, the focus was on the food-secure category and hence, the said variable was coded as 1 if the household is food-secure and 0 otherwise. The variable for poverty status was coded as a binary outcome in the current study where non-poor households were coded as 1 and 0 otherwise.

5. Results and discussion

5.1. Demographic characteristics of respondents

The demographic attributes of the households, including gender, age, marital status, educational level, and employment status, are displayed in Table 2. A total of 66.04% ($n = 177$) of female-headed households participated in the study in ANDM and 46.21% ($n = 122$) in the KCDM. Male-headed households in the ANDM accounted for 33.96% ($n = 91$) of the total sample, whereas KCDM accounted for 53.79% ($n = 142$). It was thus observed that most of the participants were female in the ANDM and male in the KCDM. Each gender was represented in the study, and it was noted that women's participation in agricultural activities was significantly higher in both districts, even though it was highest in ANDM.

The age group of 18–30 years accounted for 4.10% ($n = 11$) of the total sample in ANMD, while nobody from KCDM was captured in this age category. The household heads in the age group of 31–40 years, accounted for 11.57% ($n = 31$) and 2.65% ($n = 7$) of the total surveyed population in the ANDM and KCDM, respectively. The age categories show that the sample was dominated by household heads who were 65 years and above, in both districts, as they accounted for 51.12% ($n = 137$) in ANDM and 58.71% ($n = 155$) in KCDM. This was followed by the age group of 41–50 years, which was 16.79% ($n = 45$) in ANDM, and 20.08% ($n = 53$) in KCDM.

Both districts were dominated by married couples, accounting for 52.24% ($n = 140$) in the ANDM and 52.27% ($n = 138$) in the KCDM. Never-married household heads were slightly higher in KCDM (28.79%; $n = 76$) than in ANDM (22.39%; $n = 60$). The widow-headed households accounted for 23.51% ($n = 63$) in

Table 2. Demographic characteristics of participants.

	ANDM ($n = 268$)		KCDM ($n = 264$)	
Variables	Frequency	%	Frequency	%
Gender				
Females	177	66.04	122	46.21
Males	91	33.96	142	53.79
Total		100		100
Age categories				
18–30	11	4.10	0	0
31–40	31	11.57	7	2.65
41–50	45	16.79	53	20.08
51–59	44	16.42	49	18.56
60+	137	51.12	155	58.71
Total		100		100
Marital status				
Married	140	52.24	138	52.27
Never married	60	22.39	76	28.79
Divorced	5	1.87	8	3.03
Widow	63	23.51	42	15.91
Total		100		100
Education status				
No schooling	36	13.43	5	1.89
Primary	112	41.79	83	31.44
Secondary	95	35.45	150	56.82
Tertiary	25	9.33	26	9.85
Total		100		100
Employment status				
Employed	6	2.24	29	10.98
Part-time	5	1.87	8	3.03
Self-employed	8	2.99	29	10.98
No economically active	137	51.12	155	58.71
Unemployed	112	41.79	43	16.29
Total		100		100

Source: survey data.

the ANDM and 15.91% ($n = 42$) in the KCDM. Divorced household heads accounted for 3.03% ($n = 8$) of the sample in KCDM and 1.87% ($n = 5$) in ANDM.

In terms of their educational status, it was observed that a significantly higher proportion of small-scale farmers in ANDM (13.43%; $n = 36$) did not receive any formal education, compared to those in the KCDM (1.89%; $n = 5$). Likewise, a larger percentage of small-scale farmers with primary education were found in the ANDM (41.79%; $n = 112$) than in the household heads in the KCDM (31.44%; $n = 83$). Alternatively, secondary education was more prevalent in KCDM (56.82%; $n = 150$) than in ANDM (35.45%; $n = 95$). Interestingly, no significant differences were observed among the small-scale farmers who had tertiary education in ANDM (9.33%; $n = 25$) and KCDM (9.85%; $n = 26$).

The sampled population was dominated by non-economically active participants, which constituted 51.12% ($n = 137$) in the ANDM and 58.71% ($n = 155$) in the KCDM. This was followed by the unemployed household heads, which accounted for 41.79% ($n = 112$) in ANDM and 16.29% ($n = 43$) in KCDM. The percentages of employed, self-employed, and part-time small-scale farmers were very low in both districts, accounting for 2.24% ($n = 6$), 2.99% ($n = 8$), and 1.87% ($n = 5$) in ANDM, respectively. These households accounted for 10.98% ($n = 29$), 10.98% ($n = 29$), and 3.03% ($n = 8$), respectively, in the KCDM.

5.2. Quantile regression results and discussion

The quantile regression model was preferred because it was able to show how the independent variables influenced the dependent variable (livelihood diversification) at the 10th, 25th, 50th, 75th, and 95th percentiles. We depicted only the coefficients and parentheses to indicate whether the variable was significant at the 1%, 5%, or 10% probability levels. Tables 3 and 4 show the results from the Quantile regression model.

The coefficients for gender were not significant across all quantiles in the KCDM, while they were positively related to livelihood diversification at the 25th, 75th, and 95th percentiles in the ANDM. If

Table 3. Determinants of livelihood diversification for the ANDM.

Variables	10th	25th	50th	75th	95th
HHG	0.043621	0.0983225**	0.0526837	0.0985903**	0.115024***
HHMS	−0.0744264	−0.1248995	−0.0990128	−0.0881729	−0.233587***
HHEXT	0.01999	0.066379	0.022389	0.0816764	0.202709***
CREDACC	0.0582664	0.1276799**	0.1204794*	0.1450529**	0.0862804***
HHEMP	0.0576475	0.0986145	0.1762656***	0.1668509**	0.0790278***
FSEC	0.0033914	0.1208108**	0.1604421***	0.2711821***	0.1302215***
HHED	−0.0139122	0.018672	−0.022774	−0.0540154	0.0452099*
HHAG	0.0006169	0.0008383	−0.0019547	−0.0011792	−0.0037198***
HHFEXP	−0.0007898	−0.0034896	−0.0013427	−0.0029537	0.0002498
HS	0.0009486	0.0044008	0.0087387*	0.0055136	0.0055635**
IMSEEDS	0.0008461	0.0102943	0.0933724	0.0375546	−0.0224918
FARMS	0.0021625	0.0284414	0.057168**	0.0702043**	0.0638287***
POVST	0.0204111	0.0235669	0.0607739	−0.0152337	0.0940735***
_cons	−0.0143427	−0.0652639	0.0691958	0.2175381	0.4380777

***, **, *: significant at 1%, 5% and 10%, respectively.

Table 4. Determinants of livelihood diversification for the KCDM.

Variables	10th	25th	50th	75th	95th
HHG	−0.0026348	0.0220019	0.0250341	0.0067616	0.0552755
HHMS	0.0194365	0.0352124	0.0207446	−0.0408486	−0.0529315
HHEXT	0.0069605	0.0185363	0.0669459	0.0938804*	0.0166056
CREDACC	0.031627	0.0430725	0.0833656	0.1390019**	0.1991958***
HHEMP	0.0083388	0.0077813	0.0588175	0.0642277	0.2741647***
FSEC	0.0287691	0.1583261***	0.1357005*	0.128913*	−0.0529424
HHED	−0.0034246	0.0061867	−0.0176867	0.0136266	0.0552703
HHAG	0.0013967	0.0019149	0.0020644	0.0003312	0.0028914
HHFEXP	0.0007285	0.0000978	0.0048798*	0.0093821***	0.0081329***
HS	−0.0010113	−0.0024012	0.0003137	0.0004255	−0.0023125
IMSEEDS	0.0362472	0.0373809	0.0875882	0.143445	0.2205109**
FARMS	−0.0017434	0.0008472	−0.0037178	−0.0165417	−0.0419993***
POVST	−0.0067757	0.0095867	0.053402	−0.010965	0.0031818
_cons	−0.0984834	−0.1119562	−0.1727556	−0.0250797	−0.0337163

***, **, *: significant at 1%, 5% and 10%, respectively.

other variables remain the same, the predicted values of livelihood diversification are 0.098, 0.099, and 0.1150 units higher for male-headed households than for their female counterparts. This means that when the household is headed by a male is more likely to diversify the livelihood activities. Workie (2023) reported a positive relationship between livelihood diversification and the gender of the household head.

The coefficients for marital status were not statistically significant across all quantiles in the KCDM, while they were found to have a negative influence on livelihood diversification at the highest quantile (95th) in the ANDM. If other factors are held constant, the predicted value of livelihood diversification is 0.234 units lower for married household heads than for single-headed households. The ANMD and KCDM samples were dominated by married household heads, and it was observed that more than half of the participants were 60 years of age and above in both districts. As age increases among married partners, it could prevent them from taking risks to start new livelihood activities, as a livelihood strategy to generate additional income. These results differ from those of Mudzielwana et al. (2022), who reported a positive relationship between livelihood diversification and marital status.

The coefficients for extension services were statistically significant at the 75th and 95th percentiles in the KCDM and ANDM, respectively. If other variables are held constant, the predicted values of livelihood diversification are 0.094 and 0.203 units higher for household heads who enjoy access to extension visits than for those who do not receive such services. These results imply that household heads who have access to extension services are more likely to engage in multiple income-generating activities. The findings of the current study correspond with that of Danso-Abbeam et al. (2020), who reported a positive relationship between livelihood diversification and extension services.

The coefficients for credit access were found to have a positive effect on livelihood diversification at the 75th and 95th percentiles in the KCDM, while this variable was statistically significant at the 25th, 50th, 75th, and 95th percentiles in the ANDM. If other factors are held constant, the predicted values of livelihood diversification in KCDM are 0.139 and 0.199, while in ANDM were 0.128, 0.120, 0.145, and 0.086 units higher for household heads who enjoy access to credit, versus small-scale farmers who do not have access to credit in KCDM and ANDM. These findings suggest that access to credit increases the probability for household heads to diversify their livelihood activities. Teshager et al. (2019) and Adem and Tesafa (2020) posit that access to credit increases income sources and improves a household's livelihood.

The coefficients for employment status were positively correlated with livelihood diversification at the 50th, 75th, and 95th percentiles in the ANDM, whereas this variable was only statistically significant in the one quantile in the KCDM (95th percentiles). If other factors are held constant, the predicted values of livelihood diversification are 0.176, 0.167, and 0.079 units higher for employed household heads than for unemployed or economically inactive groups in the ANDM. In the KCDM, the predicted value of livelihood diversification increased by 0.274 units. This implies that households headed by employed persons are more likely to diversify their livelihood activities. Mathebula et al. (2017) and Morrissey et al. (2023) reported that wage employment increases livelihood diversification among small-scale rural-based farmers, which is in line with the findings of this study.

The coefficients for food security status were positive and significant at the 25th, 50th, 75th, and 95th percentiles in ANDM. This variable was significant and positively linked to the livelihood diversification at the 25th, 50th, and 75th percentiles in the KCDM. When other variables are held constant, the predicted values of livelihood diversification are 0.121, 0.160, 0.271, and 0.130 units higher for food-secure households than the food-insecure counterparts in ANDM. In the KCDM, the predicted value of livelihood diversification increased by 0.158, 0.136, and 0.129 units, respectively. The results suggest that being food-secure increases the chances for the households to engage in several livelihood activities. Food-secure small-scale farmers may be concerned about potential food shortages within their households. Getahun et al. (2020) reported that food-insecure small-scale farmers were more likely to diversify their sources of income than food-secure groups.

The coefficients for household head age were not significant across all quantiles in the KCDM, while one coefficient was found to be negative and statistically significant at the uppermost end of the quantile (95th percentile) in the ANDM. If other variables are held constant when the age of the household head increases by one year, this results in a decrease of 0.004 units in livelihood diversification. The results show that

when the age of the household head increases leads to a decrease in the probability of participation in multiple income-generating activities. Older household heads might be unable to participate in several livelihood activities, as they could have psychological issues and lack energy as they age. The findings of this study are consistent with those of Kumar and Umesh (2020) and Onuwa et al. (2022).

The coefficients for farm experience were not significant across all quantiles in ANDM, while this variable was positive and statistically significant at the 50th, 75th, and 95th percentiles in KCDM. If other variables are held constant, when farm experience increases by 1-year result to 0.005, 0.009, and 0.008 units, an increase in livelihood diversification is seen at the median (50th), and upper quantiles (75th and 95th), respectively. The findings indicate that when farming experience increases lead to an increase in the probability of participating in off-farm and non-farm livelihood strategies. Mudzielwana et al. (2022) and Habib et al. (2023) find a positive correlation between livelihood diversification and farming experience.

The coefficients for household size were not statistically significant across all quantiles in the KCDM, while we found a positive relationship between livelihood diversification and the number of family members at the median (50th) and upper quantile (95th) in the ANDM. If other variables remain the same, when household size increases by one person, it results in a 0.009 and 0.006 units increase in livelihood diversification in ANDM. This means that when household size increases may lead to an increase in the probability of diversifying the livelihoods. The findings of this study concur with Abebe et al. (2021), Abera et al. (2021), and Alemu (2023), who posited that household size has a positive impact on livelihood diversification, indicating that larger families are more likely to have multiple sources of income than their counterparts.

The coefficients for improved seeds were not significant across all quantiles in the ANDM, whereas they were positive and statistically significant at the upper quantile (95th percentile) in KCDM. If other factors remain constant, the predicted value of livelihood diversification is 0.221 units higher for household heads who utilized improved seeds than for those who did not employ drought-tolerant seeds. These findings suggest that the use of improved seeds increases the chances of households engaging in various livelihood activities. Nabuuma et al. (2022) posit that the application of improved seeds leads to an increase in livelihood diversification, which concurs with the findings of this study. These findings are supported by Feliciano (2019) who reported a linear correlation between livelihood diversification and improved seeds.

The coefficients for the size of cultivated land (farm size) were statistically significant at the median (50th) and highest quantiles (75th and 95th) in ANDM. The results show a positive correlation between livelihood diversification and farm size in ANDM, whereas we found an inverse relationship in KCDM. If other factors remain the same, when farm size increases by 1 ha, there is a 0.057, 0.070, and 0.064 units increase in livelihood diversification in ANDM. These results indicate that when farm size increases lead to an increase in the probability of participating in other activities outside farming. Khan et al. (2020) state that an increase in the size of cultivated land increases the probability of small-scale farmers to participating in different income-generating activities, which corresponds with the findings of this study.

Contrary to these findings, a nonlinear relationship between livelihood diversification and cultivated land size was observed in KCDM. If other variables are held constant when farm size increases by 1 ha, livelihood diversification in the KCDM decreases by 0.008 units. Similar findings were reported by Das and Ganesh-Kumar (2018). Based on these contradictory findings, an increase in farm size does not automatically translate into non-income diversification. This means that an increase in farm size could lead to an increase in livelihood diversification.

The coefficients for poverty status were not significant across all quantiles in KCDM, while this variable was positive and statistically significant at the 95th percentile in ANDM. If other factors are held constant, the predicted value of livelihood diversification is 0.094 units higher for non-poor households than for poor in ANDM. These findings imply that non-poor households are more likely to diversify their livelihoods.

6. Conclusions and recommendations

The objective of the study was to investigate the determinants of livelihood diversification among small-scale rural farmers in ANDM and KCDM. The results of the study have policy implications and therefore, the appropriate recommendations were made for each determinant.

The coefficients for household head gender were not significant across all quantiles in KCDM, whereas they were positive and statistically significant at the 25th, 75th, and 95th percentile in ANDM. This means that when the household is headed by a male is more likely to diversify the livelihoods. The government and private stakeholders must implement women's empowerment programs that will educate women about the importance of multiple income-generating activities. This would increase gender equality and promote livelihood diversification between males and females.

The coefficients for the household head marital status were not significant across all quantiles in KCDM, whereas this variable was negative and only significant at the 95th percentile in ANDM. These results indicate that when the household is headed by the married person it is less likely to diversify the livelihoods. It was observed that the majority of respondents were households who were 60 years and above in both ANDM and KCDM. This corresponds with the results obtained from the age variable which confirms that when age increases by 1 year reduces the chances for the households to participate in multiple livelihood diversification strategies. Thus, the government and non-governmental agencies must create initiatives such as education programs to enlighten small-scale farmers about the importance of combining the assets in the household.

The coefficient for extension services was only significant in the 75th percentile and positively associated with livelihood diversification. Similarly, the coefficient for extension services was only significant in one quantile (95th percentile) in ANDM. Thus, the household heads with access to extension services were more likely to diversify their livelihoods than those who did not enjoy such benefits. The government and non-government agencies should intensify entrepreneurial training programs to ensure that all farmers in rural areas take advantage of the existing opportunities outside farming.

The coefficients for credit access were positive and significant at the 75th and 95th percentile in KCDM. Conversely, the coefficients for credit access in ANDM were positive and significant at the 25th, 50th, 75th, and 95th percentile. The results imply that access to credit increases the chances for households to invest in different livelihood activities. The government and non-governmental organizations should create the institutions that will make credit to be easily accessible and officer lower interest rates to encourage rural smallholder farmers to engage in several livelihood activities.

The coefficients for employment status were positive and statistically significant at the 50th, 75th, and 95th percentile in ANDM, whereas it was only significant at the 95th percentile in KCDM. This means that employed household heads were more likely to diversify their sources of income. The government and non-government agencies should create more programs that are similar to the expanded public works program (EPWP) to create more job opportunities for skilled and semi-skilled workers in rural areas. This would enhance the participation of small-scale farmers in several income-generating activities.

The coefficients for food security status were positive and significant in three quantiles (25th, 50th, and 75th) in KCDM. In ANDM, the coefficients for food security status were significant in four quantiles (25th, 50th, 75th, and 95th) and positively associated with livelihood diversification. These results imply that food-secure households are more likely to diversify their livelihoods than the food-insecure group. The government and non-government organizations should implement policies that will strengthen the food security programs and encourage smallholder farmers to participate in non-agricultural related business opportunities.

The coefficients for household head education status were not significant across all quantiles in KCDM, while it was positive and statistically significant at the 95th percentile in ANDM. This means that when household heads have formal education are more likely to diversify their livelihoods. The study suggests that the government and its private partners should implement or intensify education programs such as ABET which would target old household members to access formal education.

The coefficients for the household head age were not significant across all quantiles in KCDM, whereas it was positive and statistically significant at the 95th in ANDM. These results imply that when the age of the household head increases by 1 year leads to a decrease in the probability of taking an additional livelihood strategy. Most household heads rely on government social grants, and they do not have access to business funding opportunities. The study suggests that the government and non-government agencies should create a funding scheme that will target older household heads to access funding to start businesses. This would increase the livelihood diversification strategies among small-scale rural farmers.

The coefficients for the household size were not significant across all quantiles in KCDM, whereas they were positive and significant at the 50th and 95th percentile in ANDM. The findings indicate that when household size increases lead to an increase in livelihood diversification. The government and private stakeholders should create entrepreneurial programs that would target households with many family members to equip them with the necessary skills. These programs could assist the households in knowing business management.

The coefficients for poverty status were not significant across all quantiles in KCDM, whereas it was significant in one quantile (95th percentile) and positively associated with livelihood diversification in ANDM. The results show that non-poor households are more likely to diversify their livelihoods than the poor. The government and its partners should implement poverty alleviation programs such as one home one garden and educate small-scale rural farmers about the importance of diversifying their livelihood activities.

The coefficients for farm experience were not significant across all quantiles in ANDM, whereas they were positive and significant at the 50th, 75th, and 95th percentile in KCDM. These findings indicate that when farm experience increases by 1 year leads to an increase in livelihood diversification. The government and its partners should strengthen the extension support by offering training on agricultural and non-agricultural related business opportunities. Thus, this would encourage rural smallholder farmers to participate in several livelihood activities to generate more income.

The coefficients for improved seeds were not significant across all quantiles in ANDM, whereas it was positive and statistically significant at the 95th percentile in KCDM. This means that the household heads who used improved seeds in their farms were more likely to diversify their livelihoods. The study suggests that the government and its partners should intensify the extension support services that would advise small-scale farmers to produce and sell more of their products and invest the profits in non-agricultural businesses.

The coefficients for farm size were positive and significant at the 50th, 75th, and 95th percentile in ANDM, whereas a negative correlation was observed at the 95th percentile in KCDM. For the ANDM, the results imply that when farm size increases by 1 hectare leads to an increase in livelihood diversification. Thus, the government and non-governmental agencies should implement policies that could encourage local authorities to increase the size of farmland in rural areas.

7. Limitations of the study

The ANDM and KCDM cover a large geographic area, so it was not feasible to include all Wards. The study was conducted in two districts because of the financial constraints, and time limitations. Although the study seems to have produced valid results, it is important to recognize that incorporating more rural areas would have led to a bigger sample size and more robust findings. However, for greater representation and to get robust findings, the researchers have included 5 different rural areas in the uMhlathuze local municipality which falls under the KCDM, and the other 5 rural areas in Mbizana which falls under the ANDM. The study was confined to farmers who produce two types of crops: maize and sugarcane. Further studies are required to investigate the determinants of livelihood diversification among small-scale rural farmers who produce sweet potatoes or vegetables.

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Author's contributions

Vusi Mbewana was responsible for coding, data analysis, and reference formatting, whereas Irrshad Kaseeram was responsible for the introduction and methodology of the article.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The first author can provide the data upon request. Please contact Vusi Mbewana at MbewanaV@unizulu.ac.za if you need access to the data.

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