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Article

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Farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihoods and its determinants in Takusa Woreda, North-Western Ethiopia

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ABSTRACT

Adoption of indigenous knowledge has a significant role in supporting the agricultural production system and diversification of off-farm and nonfarm livelihood activities. However, most studies focused on indigenous farming livelihoods and there is a knowledge gap in the literature and was not studied in the study area. Therefore, this study has assessed determinants of farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods in Takusa woreda, Northwestern Ethiopia. Both quantitative and narrative qualitative data were collected from both primary and secondary sources. Data were collected by using Questionnaire, key informants, focus group discussions, and other secondary sources. The study employed multistage sampling techniques. The descriptive results showed that about 17.68, 19.82, and 18.6% have adopted indigenous knowledge-based off-farm, non-farm, and both off-farm and non-farm livelihood activities respectively. Depending on their indigenous knowledge practices, farmers practiced indigenous knowledge-based off-farm and non-farm livelihood activities. Moreover, the logit model result shows that access to extension contact, having more educational level, and near to the market distance are negatively correlated. Also, more dependency ratio, more livestock ownership (TLU), and practicing livelihood diversification strategies are positively correlated. Therefore, determinants of adoption of indigenous knowledge-based off-farm and non-farm livelihoods needs attention by programs for additional livelihoods.

IMPACT STATEMENT

Indigenous knowledge is culture-constructed knowledge that is explicit to certain groups of people. In Africa, particularly in Ethiopia, there are ample indigenous knowledge practices that are used for practicing alternative livelihoods in addition to crop and livestock production. Indigenous knowledge played an indispensable role in improving socioeconomic conditions through the diversification of indigenous-based off-farm and nonfarm livelihood activities. Therefore, this study is relevant for promoting existing indigenous knowledge practices through the investigated results on the adoption of indigenous knowledge-based off-farm and non-farm livelihoods, and their determinants. Based on the results of this study, the adoption level varies depending on the indigenous knowledge level within a community. Likewise, different socio-economic, institutional, and environmental factors have determined the farmers adoption of indigenous knowledge-based livelihoods. Therefore, indigenous knowledge requires policy attention for diversifying livelihood options.

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Rural development; economics and development; sustainable development; sociology & social policy

1. Background

African indigenous knowledge systems promote constructive transformation in the personal, rational, structural, and cultural dimensions to foster good connections across cultures (Loveness & Mathew, 2017). The indigenous knowledge system is critical to preserving today's unique and abundant

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biodiversity among Ethiopia's estimated 80 ethnic groups in various agroecosystems in both the highlands and the lowlands, which are plagued by historical, social, and ecological challenges (Taye & Megento, 2017). Furthermore, many people regard indigenous knowledge as an alternate means to encourage development in underprivileged rural communities around the world (Briggs, 2005).

Since the 1980s, ethno-ecological research in Ethiopia has demonstrated the importance of indigenous knowledge (IK); yet, efforts to incorporate them into development have been delayed. The function of indigenous knowledge in diversifying off-farm and nonfarm activities for people's livelihoods was overlooked. We do not, however, demonstrate the regional variety of practices or the importance of indigenous knowledge in supporting rural livelihoods. The regional variety of indigenous practices, as well as their transmission, promotion, and integration into indigenous knowledge networks, is critical for larger-scale economic exploitation (Shiferaw et al., 2015). As a result, indigenous knowledge is a cross-cultural and interdisciplinary source of distinct local knowledge about a given culture, embracing the circumstances of special locations for the diversification of off-farm and non-agricultural livelihood activities (Tafese, 2016).

Agriculture and rural development have begun to place a greater emphasis on the revitalization of indigenous knowledge for sustainable development and the diversification of off-farm and nonfarm livelihood activities. This acknowledgment, however, does not diminish the importance of modern scientific knowledge. In the sphere of agriculture and rural development, the relevance of indigenous knowledge practices in protecting the lives of the poorest people has sometimes been overlooked (Ponge, 2011; Hainzer et al., 2022). The adoption of indigenous knowledge contributes to the sustainability of development activities because the integration process of indigenous knowledge allows for mutual learning and adaptation, which strengthens local communities. Thus, efficiency, effectiveness, and sustainability of indigenous knowledge practices are important factors of development work quality (Worku & Getamesay, 2019).

Poverty and food insecurity are major issues in Ethiopia since agriculture is the mainstay of the economy. Due to the agriculture sector's decreased sustainability and vulnerability to many forms of shocks, rural farmers seek out various types of indigenous knowledge-based off-farm and non-farm job alternatives (Sani, 2017). It has the potential to alleviate poverty if used properly in agriculture and accompanied by appropriate technical interventions that consider people's situations. As a result, employing extensive indigenous knowledge practices has been critical in diversifying off-farm and non-farm livelihood activities (Ponge, 2011).

There is a clear correlation between livelihood and the people's indigenous knowledge (IK). According to Kakati (2013), indigenous knowledge created by indigenous groups of people is crucial for producing sustainable means of subsistence. As a result, indigenous knowledge plays an important role in shaping alternative livelihood systems and improving the possibility that rural populations will accept, create, implement, and sustain innovative and intervention strategies (Worku & Getamesay, 2019). ITK plays an essential role in modifying the socioeconomic environment by facilitating the diversification of indigenous-based off-farm and nonfarm subsistence activities. However, indigenous knowledge practices are not given significant consideration in sustainable livelihood analyses (Jianchu & Mikesell, 2002). In most cases, indigenous knowledge systems have been used to address agricultural production restrictions by diversifying alternative income sources provided by indigenous off-farm and nonfarm subsistence activities (Kebede, 2014).

However, different literatures showed that adoption of indigenous farming livelihoods was influenced by socio-demographic characteristics, access to extension services, age, land size, income level, household dependency ratio, education, income diversity, market access, information access, credit access, and socio-cultural beliefs (Kakati, 2013; Kaua, 2020; Dika et al., 2022; Sergon et al.,2022; M-Buu File & Nhamo, 2023). Asmamaw et al. (2020) also found that there is significant correlation ($p < 0.05$) between a household head's age, gender, and education status and their ability to acquire local knowledge practices. More precisely, age, labor status, social networks, material availability, and market access for tourism were factors influencing rural women's understanding and adoption of indigenous knowledge-based technologies (Mudemba et al., 2021). Furthermore, scientific knowledge dominated Ethiopia's efforts to promote and use indigenous knowledge methods, with development strategies paying little attention (Kebede, 2014).

However, most of the previous studies used indigenous knowledge of farming livelihoods as a proxy to analyze the determinants of the adoption of indigenous livelihoods. But agricultural farming livelihoods are unable to reveal indigenous knowledge-based off-farm and non-farm livelihoods due to the nature of livelihoods practiced by households. As a result, this study investigates the determinants of farmers adoption of indigenous livelihoods by focusing on indigenous knowledge-based off-farm and non-farm livelihoods practiced by households. Also, the issue of indigenous knowledge-based off-farm and non-farm livelihood strategies was ignored by many policies in Ethiopia, and there is a knowledge gap in the literature about the determinants of farmers adoption of indigenous knowledge-based off-farm and non-farm livelihood strategies. Similarly, in the study area, there are ample indigenous-based off-farm and non-farm livelihood activities employed by smallholder farmers. Similarly, farmers were determined by different socio-demographic, institutional, and other factors to adopt indigenous knowledge-oriented livelihood diversification activities. However, the determinants were not scientifically investigated and recorded (Takusa Woreda Natural Resource Office, 2019).

Besides some empirical works conducted in the country by acknowledging and improving the aforementioned gaps, there is a dearth of information gap on farmers adoption and determinants of indigenous knowledge-based off-farm and non-farm livelihood strategies in the study area. Therefore, by understanding the existing research gap, this study was focused on the identification of existing indigenous knowledge-based off-farm and non-farm livelihoods[1], farmers level of adoption, and determinants of farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods in the study area.

2. Literature review

2.1. Concepts of indigenous knowledge

The term indigenous knowledge (LK) is defined in by various scholars. According to Berkes etal. (2000), indigenous knowledge is defined as 'accretive body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by artistic transmission, about the relationship of living beings (including humans) with one another and with their environment'. Indigenous knowledge practices are understood as a means of knowing, seeing and thinking that are passed down verbally from generation to generation (International Centre for Indigenous Knowledge (ICIK), 2015). So that, this study operationalized indigenous knowledge as socially constructed knowledge that is used to generate a means of living for the local farmers; indigenous knowledge-based off-farm livelihoods are defined as the living activities of natural resource-based and out-of-own farms that are practiced as a result of indigenous knowledge existing in the particular community; and indigenous knowledge-based non-farm livelihoods are the living activities outside the agricultural livelihoods that are resulted from farmers indigenous knowledge.

The cultural realities of ancient African civilizations are closely linked to elders, who are crucial in devising strategies, addressing problems, and forming local perspectives grounded in knowledge and experience. They make advantage of the historical information and experiences that have been passed down through the generations. The elders' collective wisdom is indigenous knowledge that the neighborhood has fostered. Indigenous knowledge is a reality in both urban and rural communities, where people's ability to survive depends on their ability to use particular skills and knowledge. Consequently, indigenous knowledge is an interdisciplinary and cross-cultural source of distinctive local knowledge for a particular culture that considers the circumstances of a particular setting (Tafese, 2016). In the context of Ethiopia, the country's past civilization provides proof of the breadth and logic of traditional knowledge (Gizaw et al., 2018). According to Petros et al. (2018), indigenous knowledge serves as the impoverished primary means of securing survival through the production of food, provision of food, housing, and the ability to take charge of their own lives. Indigenous wisdom has a significant role in the impoverished people's life. It is essential to the regional ecology. Indigenous knowledeg is a crucial component of the impoverished 'social capital', which is their primary resource to use in the fight to survive, to grow food, to build shelter, or to take charge of their own lives. Additionally, indigenous knowledge offers solutions for local problems.

2.2. Theoretical framework

Indigenous knowledge holds a prominent place in the livelihood framework. The second layer is occupied by tradition, religion, belief, institution, organization, and package of practices; the third or outer layer is where we discover our means of subsistence. The indigenous knowledge system is responsible for the development of various traditions, beliefs, institutions, and other things that are necessary to support a living (Kakati, 2013). Analysis of sustainable livelihoods does not consider indigenous knowledge that is situated locally (Scoones, 1998). A holistic perception of livelihood can be acquired by local understanding/nuance of the livelihood and asset requirement, without which a community is gravely misunderstood. Indigenous perception of livelihoods tends to rest on a sense of egalitarianism where all factors (physical, natural, economic, social, and human) in the sustainability wheel are perceived in the form of one bond or relationship (Kamal et al., 2015). Local people tend to value indigenous knowledge as something that suits them and local conditions best. This is because such knowledge is based on a particular material culture and its particular technologies that support specific livelihood objectives (Cassidy et al., 2011). The study conceptualized by considering the existing vulnerability contexts, livelihood asset or endowment and practicing of livelihood diversification by the household are expected to be determinants of farmers adoption of indigenous knowledge based off-farm and non-farm livelihoods. The expected determinants variables are selected by considering the identified effect level and correlation by other similar studies. So, to investigate determinants of farmers adoption the study considers these determinants as they are hypothesized to have correlation with farmers indigenous knowledge based off-farm and non-farm livelihoods. The conceptual framework is shown in Figure 1.

2.3. Emperical review on determinants of farmers adoption of indigenous knowledge practices

The results demonstrated that a variety of factors, including the availability and dependability of indigenous farming practices, the land tenure system, the landscape and proximity to farms, the availability of farm capital, and the sociodemographic traits of smallholder households, including the farmer's age, years of farming experience, gender, level of education, and sociocultural beliefs, all had varying degrees of influence on smallholder farmers' decisions to adopt indigenous farming practices (File & Nhamo, 2023). Male respondents who were older (60 years or older) and had completed primary school had a larger likelihood of acquiring LK than other respondents. There was a noticeable age divide, with elderly holding the majority of the customs. Similarly, the preponderance of male-dominated practices suggests

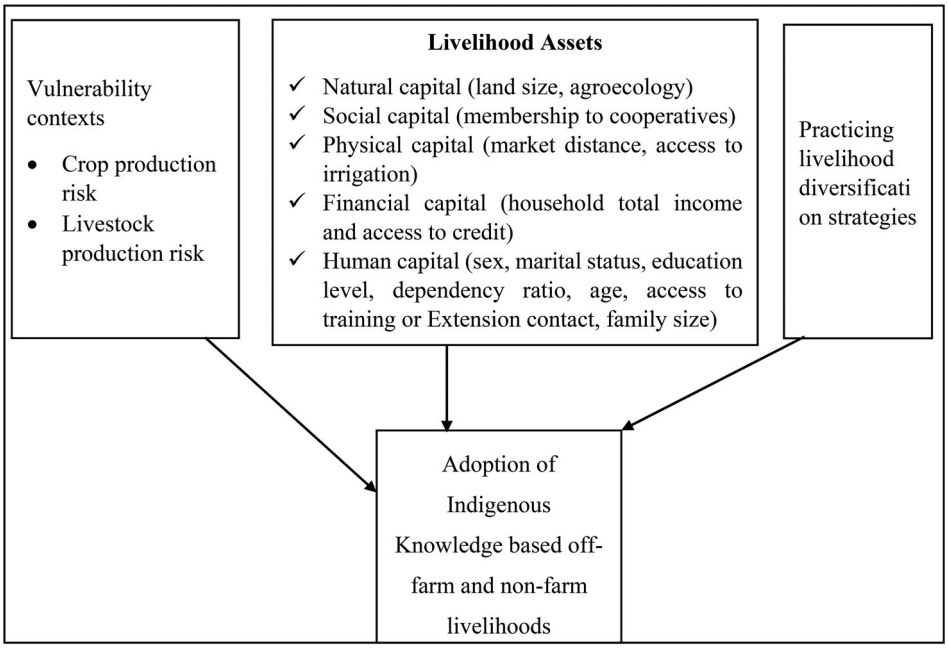

Figure 1. Conceptual framework of the study Adopted from Kakati, 2013.

the cultural effect limiting women to household responsibilities. Additionally, farmers who completed more schooling than a primary school were considered inferior in the majority of local knowledge systems, suggesting that the curriculum may have had an impact (Asmamaw et al., 2020). Farmers' adoption status was higher among educated and married individuals, and their educational and marital status also had an impact on their utilization of indigenous practices (Bulcha et al., 2022). All of the respondents expressed agreement that, due to a decline in value from the younger generation, indigenous knowledge is becoming less important in farming and reducing the risk of drought. According to Muyambo et al. (2017), the majority of respondents identified the primary challenges as being related to a lack of documentation and a decline in its implementation by the younger generation. According to Mosissa et al. (2017), the main obstacles to indigenous knowledge of land use and agricultural development in the local communities are a lack of records, a lack of trust, a lack of interest in receiving indigenous knowledge from younger generations, oral transfer of indigenous knowledge, changes in lifestyle, and a lack of recognition of indigenous knowledge. A household's decision to concurrently adopt different livelihood methods is influenced by a number of socioeconomic factors, including head sex, marital status, head literacy, skill development, microfinance, credit assessment, and livestock diversification (Dika et al., 2022). For a very long time, rural livelihoods have relied heavily on technologies and skills based on Indigenous Knowledge (IK). These methods are used by women in many different types of livelihood activities, both on and off the farm. Awareness was influenced by factors such as age, career status, social networks, material access, access to the travel industry, and workshop attendance. Adoption was affected by a number of factors, including the number of employed household members, attendance at workshops, and expertise as a craftsperson (Mudemba et al., 2021). According to Sergon et al. (2022) the study clarifies that there is located Indigenous economic knowledge and values that are important for maintaining the well-being of communities. Farmers in the area use cultural medicine mostly because it is readily available, inexpensive, and useful (Petros et al., 2018). Women engage in the local practices and offer suggestions, despite not being the leaders of the group. The people with the most community influence and familiarity with both opposing sides are the elders. Due to their age, influence within the community, and familiarity with its customs and culture, they have gained this status (Alemie & Mandefro, 2018).

3. Research methodology

3.1. Description of the study area

Takusa Woreda is situated approximately 830 kilometers northwest of Addis Ababa in the Central Gondar Zone of the Amhara National Regional State in Ethiopia. The Woreda is situated 135 kilometers northwest of Bahr Dar, the regional capital, and roughly 95 kilometers southwest of Gondar town. It is situated in the western region of Ethiopia at 12° 1′ 56.64″ N and 36° 56′ 47.76″ E (CSA, 2007). The elevation in Takusa Woreda varies from 600 to 2000 meters above sea level (Takusa Woreda Natural Resource Office, 2019). Between 900 and 1400 millimeters of rainfall between May and October. The study area experiences an annual temperature range of 18 °C to 30 °C. In addition, 153,253 people were living in Takusa Woreda, with 77,631 men and 75,622 women. 92% of the population lives in rural areas (CSA, 2013). There are various levels of indigenous knowledge practices in the study. During farming tasks like plow work, seeding, harvesting, and storing agricultural products, farmers put their local knowledge into practice. The variety of on-farm, off-farm, and non-farm activities that farmers engage in encourages them to use indigenous technical knowledge practices (Mengistu, 2022). The study area location is shown in Figure 2.

3.2. Research design

The study employed a cross-sectional survey design to collect the required data at a point in time. This approach made data triangulation and different data collection techniques possible. Operationalizing the data collection involved focus groups, in-depth interviews with key participants, survey administration

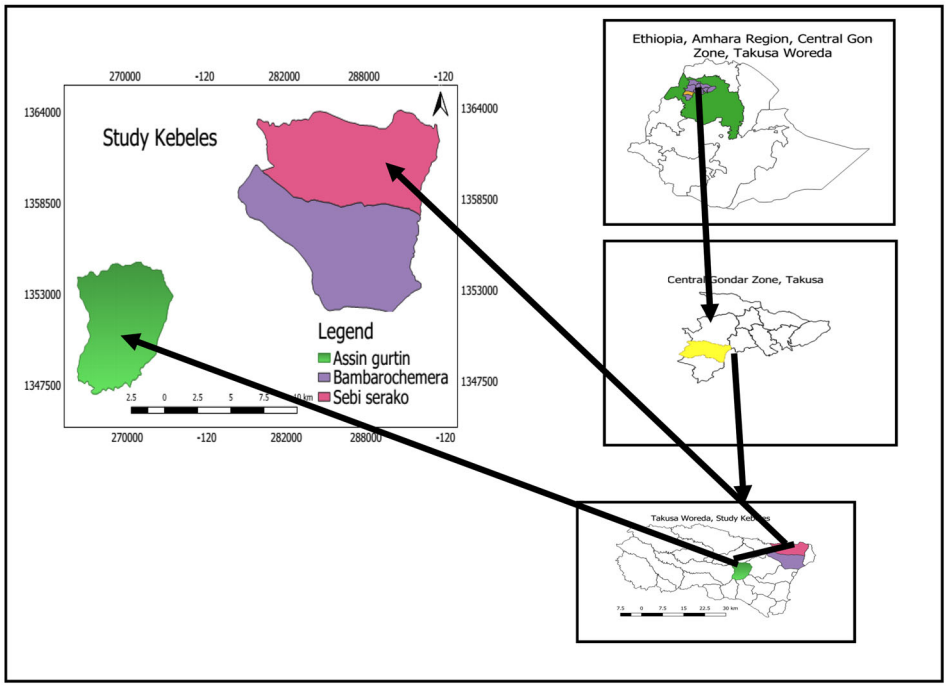

Figure 2. Map of the study area.

Table 1. The distribution of sample households in the study area.

Name of kebeles	Total number of households	Total number of sample households
Sebi serako	846	126
Banbarua-Chemera	724	108
Assin gurtin	622	94
Total	2192	328

Source: own computation, 2020.

(i.e. giving questionnaires to specific household heads), and field observations of various farming practices.

3.3. Sampling methods and procedures

To conduct the study, a multistage sampling procedure was applied to select the sample farmers and selected *kebeles* of the *woreda*. In the first stage, *Takusa Woreda* was selected purposively by considering the existence of indigenous-based off-farm and nonfarm livelihood activities, and the area is well known by indigenous practices in the surroundings for diversifying means of livelihoods. In the second stage, based on agroecology, the *woreda* was divided into midland and lowland agroecology. Based on the proportion of *kebeles that* existed in each agroecology, two *kebeles* from the midland and one *kebele* from the lowland were selected randomly for the study. In the third stage, from selected *Kebeles,* samples were selected through a purposive sampling technique. In the fourth stage, proportions to population size were used to determine the size of the sample taken from each selected *kebeles*. The population and the selected sample size is indicated in Table 1.

The sample size was determined based on the sample size determination formula of Kothari (2004).

$$n = \left[\frac{\left[\left(A^2 * p(1-p)\right) + e^2\right]}{\left[e^2 + A^2 * p(1-p)/N\right]}\right] \quad (1)$$

Where, *N* is the required sample size, p refers to the expected proportion (probability to be selected, 0.5)A refers depends on the 95% desired significance level (in this case 1.96), E is margin of error (5% margin of error), N is Population size (Total number of Household heads (2192).

3.4. Data types, sources, and collection methods

This study used both quantitative and qualitative data. Both primary and secondary data sources were used in the study. Both data sources were used to get the representative data and to triangulate the collected data for addressing the study objectives. Primary source data were collected from respondents using interview schedules, focused group discussions, and key informant interviews. Household interview schedule was applied for all of the 328 sampled households to collect both quantitative and qualitative data. Each questionnaire was answered by the sampled respondents of the selected Kebeles. Before starting the actual field work or data collection, pre-testing of the questionnaire was conducted. Data enumerators were selected and trained for a brief understanding about the questionnaire. The data enumerators have collected the data in the sampled Kebeles through rounding from January to April 2020. At same time, the researcher was mutually involved in the data collection to collect data, guide and supervise the data enumerators. Focus group discussions was undertaken to generate in-depth information for supporting quantitative data which was collected in May 2020. In this particular research a total of three focus group discussions (FGDs), and one from each sampled Kebele was conducted. The focus group discussions were assisted by the researcher through checklists/guiding questions for the interview, and to monitor the active participation of members. Key informant interview was also conducted in the sampled Kebeles and Woreda level in May 2020. To manage the interview, it was conducted by the researcher through the interview guiding questions for each key informant. On the other hand, secondary source data were collected from internal documents and reports.

3.4.1. Consent of human participation

For this study, farmers are participated by responding research survey questions, willing to participated in focused group discussions, and individuals for key informant interviews to address research objectives. Hence, the consent was through oral agreement with the discussion of Takusa Woreda office of Agriculture and Kebele level development agents to respond research questionaries' without any fear of exposing their personality and family conditions. This study agrees to take the response of farmers specifically for study by informing them the objectives of conducting the research. However, no human health-related issues are incorporated into the study rather than giving data on indigenous knowledge based off-farm and non-farm livelihoods and determinant factors that determines their adoption level. Ethical committee of Head of Takusa Woreda agricultural office and kebele development agents approved the oral agreement with the participants. I have used documentation as an instrument to record verbal consent from the participants.

3.4.2. Ethical approval of the study

This study was approved by ethics committee of graduate school of Faculty of Environment, gender, and Development Studies, College of Agriculture, Hawassa University, Ethiopia. The research questions were also approved by the graduate research and community service coordinator office for collecting the relevant research data.

3.5. Method of data analysis

Quantitative data were analyzed using descriptive statistics. Qualitative data were analyzed through narration of words. Descriptive analysis and binary logit model were conducted using STATA 14 software.

3.5.1. Econometric model

This study employed a binary logistic regression model to identify the determinants of farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. The dependent variable is the farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihoods, which is equal to 1 for farmers that have adopted indigenous knowledge-based off-farm and non-farm livelihoods and 0 otherwise. Different independent variables were selected based on the findings of emperical literatures and hypothesis of the study to determine their effect on farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihoods (Table 2).

Table 2. The relationships between the dependent and independent variables of the study.

Independent variables	Description for a reason of choosing explanatory variables	Sources	Nature	Measurement	Expected sign
Age of household head (AGEHH)	farmer's age influence on decisions to adopt indigenous farming practices	File and Nhamo (2023), Alemie and Mandefro (2018)	Continuous	In year	-ve
Sex of household head (SEXHH)	Sex determines household's decision to adopt indigenous knowledge-based livelihood	Dika et al. (2022)	Dummy	1 if female and 0 otherwise	+ve/-ve
Marital status (MSHH)	Adoption of indigenous knowledge-based livelihoods was is higher for married households	Bulcha et al. (2022)	Dummy	1 if married and 0 otherwise	-ve
Family size (FAMSZHH)	Having more working family member have more likely to adopt indigenous livelihoods	Mudemba et al. (2021)	Continuous	In Adult Equivalent	+ve
Education level of household head (EDUHH)	Farmers low level of education and completed primary school are more likely adopt indigenous knowledge livelihoods	File and Nhamo (2023), Asmamaw et al. (2020); Bulcha et al. (2022)	Dummy	1 for able to read and write and above, and 0 otherwise	+ve/-ve
Dependency ratio (DPRTHH)	Farmers having more dependency ration are more likely adopting indigenous knowledge-based livelihoods	Kaua (2020), File and Nhamo (2023),	Continuous	The ratio of dependent age groups (adult equ.)	+v/-ve
Livestock holding (TLUHH)	household's decision to concurrently adopt different livelihood methods is influenced by livestock ownership	Kaua (2020); Dika et al. (2022)	continuous	Size of Livestock holding in TLU	+ve
Membership to cooperatives (MEMCOHH)	Households membership to cooperatives influence adoption of indigenous knowledge-based livelihoods	Dika et al. (2022)	Dummy	1 if farmers are members of cooperatives and 0 otherwise	+ve
Land size (LDSZHH)	Having more land size are helpful to adopt indigenous livelihoods	(File & Nhamo, 2023)	Continuous	In hectare	-ve
Access to irrigation (IRRIGHH)	Access to industry and modern production system leads to low adoption to indigenous livelihoods	Mudemba et al., 2021)	Dummy	1 if farmers have access to irrigation and 0 otherwise	+ve
Market distance (MKTDSHH)	Farmers far from the market center are more likely adopting indigenous livelihoods	Kaua (2020); File and Nhamo (2023)	Continuous	In kilometers	-ve
Agroecology (AGROECOHH)	Farmers in lowland agroecology are more adopter of indigenous knowledge practices, because mid land and high land are probability to get scientific education	(File & Nhamo, 2023)	Dummy	1 if mid-land and 0 otherwise	+ve
Access to extension contact (EXTCO)	Farmers access to extension services are less likely adopting indigenous knowledge practices because of extension system give less emphasis for indigenous knowledge system	Kaua (2020); Dika et al. (2022)	Dummy	1 if farmers have access to extension contact and 0 otherwise	+ve
Access to credit (ACCCRHH)	Farmers accessed to credit are mostly engaged scientific knowledge-based	(Dika et al., 2022)	Dummy	1 if access to credit and 0 otherwise	-ve

(*continued*)

Table 2. Continued.

Independent variables	Description for a reason of choosing explanatory variables	Sources	Nature	Measurement	Expected sign
	livelihoods and give attention for indigenous knowledge livelihoods				
Total income (INCOMEHH)	Farmers having more farming capital are less likely adopting indigenous knowledge livelihoods	File and Nhamo (2023)	Continuous	The total income of farmers (in ETB)	-ve
Practicing livelihood diversification strategies (LDSTR)	Practicing diversified livelihoods are helpful for adopting indigenous based livelihoods	Mudemba et al. (2021). Dika et al. (2022).	Dummy	1 if farmers practiced livelihood diversification strategies and 0 otherwise	+ve

Own computation.

Following Gujarati (2003), the functional form of the logistic regression model was specified as equation 2:

$$\mathrm{Pi} = \mathrm{E}(\mathrm{Y} = 1/\mathrm{X_i}) = \beta_1 + \beta_2 \mathrm{xi} \tag{2}$$

where Xi is a vector of independent variables, and Y is the dependent variable, farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Equation 2 can be rewritten as equation 3.

$$\mathrm{Pi} = \mathrm{E}(\mathrm{Y} = 1/\mathrm{Xi}) = \frac{1}{1 + e^{-(\beta 0 + \beta Xi)}} \tag{3}$$

For ease of exposition, equation (3) can be transformed to obtain equation 4.

$$\mathrm{Pi} = \frac{1}{1 + e^{-Zi}} = \frac{e^{z}}{1 + e^{z}} \tag{4}$$

where $\mathrm{Zi} = \beta 1 + \beta 2\mathrm{Xi}$.

It can be linearized, which can be shown as follows:

If Pi is the probability of farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods, then $1 - \mathrm{Pi}$, the probability of not adopting indigenous knowledge-based off-farm and non-farm livelihoods, can be expressed as equation 5.

$$1\text{-P} = \frac{1}{1 + e^{Zi}} \tag{5}$$

Therefore, for the sake of simplicity, equation 5 can be written as per equation 6.

$$\frac{Pi}{1 - Pi} = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{Zi} \tag{6}$$

$\mathrm{Pi}/(1 - \mathrm{Pi})$ is simply the odds ratio in favor of farmers adoption of indigenous knowledge-based off-farm and non-farm livelihoods and the ratio of the probability that farmers will adopt indigenous knowledge-based off-farm and non-farm livelihoods to the probability that it will not adopt indigenous knowledge-based off-farm and non-farm livelihoods. Now, if we take the natural log of (6), we obtain a logit model, L, as expressed by equation 7.

$$L_i = \ln\left(\frac{Pi}{1 - Pi}\right) = Z_i = \beta 1 + \beta 2\mathrm{Xi} \tag{7}$$

That is, L, the log of the odds ratio, is not only linear in X but also (from the estimation viewpoint) linear in the parameters.

Before estimating the model, multicollinearity among the continuous variables (variance inflation factors (VIF)) and the associations (computing contingency coefficients) among discrete variables were checked. The coefficients were estimated, and the results were interpreted in terms of marginal effects. Based on the literatures and the context of the area, we have selected explanatory variables to assess

the determinants of farmers adoption of indigenous knowledge based off-farm and non-farm livelihoods. We have proposed a hypothesis by focusing their expected correlation with dependent variable of adopting or non-adopting indigenous knowledge based off-farm and non-farm livelihoods.

4. Result and discussion

4.1. Demographic characteristics

The descriptive results showed that the average age of the household heads shows that the minimum and maximum age can able to sow the linkage of age and practicing indigenous knowledge based off-farm and non-farm livelihoods. Moreover, the results revealed that the mean family size of sampled households is higher compared to the national average family size of 4.6 adult equivalent (CSA, 2017). Similarly, the mean dependency ratios of sampled respondents were lower as compared with the national average dependency ratio of 79.5% (World Bank, 2018). Moreover, the demographic characteristics of households showed different possibilities of engagement in the diversification of off-farm and nonfarm livelihood activities. According to the result, in the study area, the majority were male-headed, this tells us the proportion of sex of households may influence the diversification of off-farm and non-farm livelihood activities. While households also do not have a fixed marital status and the average age of households is an active working force. Thus, it helps them to diversify livelihood activities by applying indigenous knowledge practices to improve their living. Later, the higher family size and lower average dependency ratio revealed that households can be able to utilize their family labor and engage in indigenous knowledge-based diversification of off-farm and nonfarm livelihood activities. The details of demographic characteristics are shown in Table 3 below.

4.2. Farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihood activities

Different livelihood activities pursued by farm households by using their indigenous knowledge practices in the study area were categorized under off-farm, non-farm, and off-farm plus non-farm livelihood activities. As shown in Figure 3, farmers were highly engaged in indigenous knowledge based non-farm livelihoods as compared to indigenous knowledge based off-farm livelihoods, and off-farm plus non-farm livelihoods. Even though agriculture is still the dominant livelihood activity for rural households in the study area, farmers have adopted different combinations of indigenous knowledge-based livelihood diversification activities. However, about 56.1% of the respondents have adopted indigenous knowledge-based off-farm and non-farm livelihood activities in addition to agricultural production. The engagement in off-farm and non-farm activities has resulted from their indigenous knowledge practices. Hence, the results further showed that households adopted indigenous-based off-farm and non-farm activities as a recovery mechanism for vulnerabilities and helped them to fulfill agricultural inputs for further

Table 3. Demographic characteristics of sampled respondents.

Demographic Characteristics		Frequency(N = 328)	Percentage (%)	
Sex	Male	291	88.7	
	Female	37	11.3	
Marital status	Single	9	2.74	
	Married	276	84.15	
	Divorced	36	10.98	
	Widowed	7	2.13	
Educational Level	Unable to read and write	131	39.9	
	Non-formal education /alternative	151	46	
	Grade 1-4	34	10.4	
	Grade 5-8	12	3.7	
	Mean	Std.Deviation	Min	maximum
Age	48.8	6.87	30	66
Family size	5.6	1.39	1.35	9.55
Dependency ratio	0.48	0.24	0	1.43

Source: own survey, 2020.

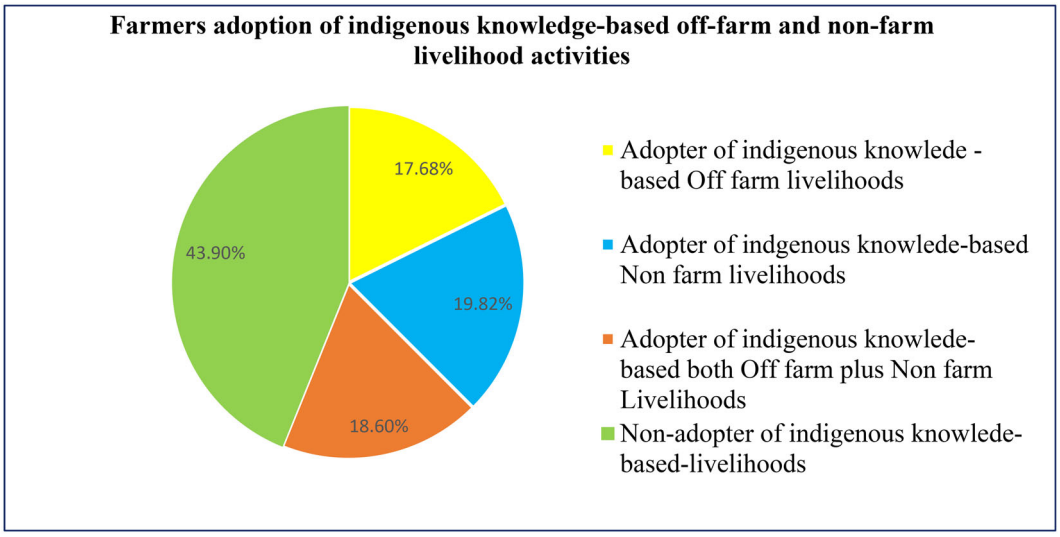

Figure 3. Farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihood activities.
Source: own survey, 2020.

production. *The focused group discussants also confirmed that indigenous knowledge-based livelihoods are significantly contributed to the improvement of livelihood security. Indigenous knowledge emanates from ancestors and is continued by farmers in addition to crop production and livestock husbandry (FGD discussion, 2020).* Other similar studies also showed that households are engaged in indigenous knowledge-based off-farm and non-farm activities. The studies include: Dessalegn and Ashagrie (2016) about 39.3% of households combined off-farm and non-farm livelihood activities, Gecho et al. (2014) about 57.7%, Yizengaw et al. (2015) about 61%, Tizazu et al. (2018) about 57.6% had combined off-farm and non-farm livelihood activities, and Kassegn and Abdinasir (2023) about 64.1% of total respondents said non-farm as their livelihood strategy and 59.1% of respondents said off-farm as their livelihood strategy in addition to common agricultural activities. According to the findings by Mosissa et al. (2017), indigenous knowledge plays a major role whenever there is change and growth follows a complex field. Promoting indigenous knowledge-based diversification of off-farm and non-farm livelihood activities is a critical point in improving income and the transformation of the agricultural sector in Ethiopia. Additionally, the majority of sample households (83.1%) were able to diversify into off-farm and non-farm livelihood activities, whereas 16.9% were unable to adopt indigenous knowledge-based off-farm and non-farm livelihoods. It is worth noting that, despite the government's lack of attention, indigenous knowledge-based nonfarm activities play an important role in the context of insufficient and rain-fed-dependent subsistence agricultural income areas (Gebru et al., 2018).

4.3. Indigenous knowledge-based off-farm and non-farm livelihoods

4.3.1. Indigenous knowledge-based off-farm livelihood activities

Off-farm livelihood activities in rural regions have the potential to significantly contribute to rural poverty reduction and decent rural employment. Agriculture is widely regarded as a factor in rural poverty alleviation. Non-farm livelihood activities in rural regions are also a significant contributor to rural poverty reduction in emerging nations (Cheng et al., 2019). Correspondingly, in the study area, based on their level of indigenous knowledge practices, farmers perform indigenous knowledge-based off-farm activities outside their farm but within agricultural activities. Off-farm activities were taken as a means of livelihood for generating income, fulfilling agricultural inputs, and other amenities. Accordingly, the existing indigenous knowledge-based off-farm activities were the sale of firewood and charcoal selling, selling of farm implements (like Morph (Mofer), Yoke (Qeniber), Choke (Maneqiya), Drill (Digir), etc.), selling of sweet pleasing plant leaves (Mantegna enichet & tinijit), rent of pack animals, and selling of grinding material prepared from wood and stone (like; locally named as Muqecha, Ye dingay Weficho). The results

Table 4. Indigenous knowledge-based off-farm activities of households in the study area.

Indigenous knowledge-based diversification of off-farm livelihood activities	Frequency (n = 119[O])	Percentage (%)
Selling of farm implements	24	20.2
Sale of fire-wood /grass	64	53.8
Charcoal selling	27	22.7
Rent land /pack animal	27	22.7
Selling sweet pleasant plant leaves	8	6.7
Selling of house construction wood	62	52.1
Selling of grinding materials (wood and stone)	36	30.3

Source: own survey, 2020; N.B multiple answers are possible (households practiced one or more off-farm livelihood activities).

of the study in Table 4 showed that out of the total sampled households, 36.28% practiced indigenous knowledge-based off-farm activities in addition to agriculture and non-farm activities. The result assures that farmers indigenous knowledge practices are the central element in supporting their means of living. Hence, there are numerous aspects of indigenous knowledge's that are helpful for farmers to diversify their livelihoods and ensure family needs. Therefore, the identified off-farm activities were practiced differently by smallholder farmers to improve and support their living. Likewise, Mada and Menza (2015) point out that Off-farm activities are performed by approximately 52% of all households studied, and off-farm income contributes to 30% of total household income. Agricultural product marketing is the most important source of off-farm revenue, accounting for nearly all off-farm income earned by households. According to a similar study conducted by Bazezew et al. (2013), non-farm and off-farm activities include casual labor, the sale of fuel wood and charcoal, petty commerce, handicrafts, grain milling, and the sale of local drinks. The study found that off-farm and non-farm livelihood activities were critical in addressing societal issues such as job possibilities and start-up funding for agricultural tools. As a result, indigenous knowledge-based off-farm livelihood activities account for a sizable portion of household livelihood portfolios in Sub-Saharan Africa (Van den Broeck & Kilic, 2018).

In cognizant of the quantitative findings, the in-depth interview of key informants and FGD discussants indicated that

> I am a farmer engaged in crop production and animal husbandry practices. Moreover, I have learned the way how to prepare farm implements by using trees from my father. Based on my father's experiences and indigenous knowledge, I have engaged in selling farm implements in the local market. The work is part-time work when I have a free break from doing agricultural activities. For doing farm implements, I get wood from my farm and around the area. I have commonly needed selected trees for acceptance of the work. I have been preparing different farm implements like Morph (Mofer), Yoke (Qeniber), Choke (Maneqiya), Drill (Digir), and others for farmers. As the work needs special skills, any farmer can't be able to prepare these farm implements unless they have indigenous knowledge, and experience from family, friends, and from others in their community. Additionally, I have also engaged in the installation of farm implements for farmers, in turn, they give me a payment of labor service for my agricultural work through weeding, plowing, etc. I have sold farm implements and they support my family's needs and supplement agricultural activities. Therefore, my father's indigenous knowledge helped me to administer my family member's requirements in addition to the agricultural production system. (key informant interview, 2020)

Similarly, a focused group discussion at the woreda level confirmed that

> indigenous knowledge of farmers was the main source of off-farm livelihood activities. Off-farm activities could help households to generate additional income. Indigenous knowledgeable households with small landholding sizes and large families were more likely to be involved in diversifying non-agricultural livelihood activities in their area and went to other nearby areas to access the demanded markets. (focused group discussion, 2020)

4.3.2. Indigenous knowledge-based non-farm livelihood activities

Non-farm activities are non-agricultural livelihood activities that are practiced outside agricultural activities. Similarly, farmers indigenous knowledge is highly linked with non-farm livelihoods activities that can generate income and improve farmers loving. Based on the result of the study, indigenous knowledge based non-farm livelihoods are practiced differently as per their level of catching indigenous knowledge practices in the community. In the study area, the adoption of indigenous knowledge based non-farm livelihoods are practiced through intergenerational transmission of particular knowledge in which the family kinships kept sustainably for supporting their families. A comparable study by Regasa

Table 5. Indigenous knowledge-based non-farm activities in the study area.

Non-farm activities	Frequency ($n = 126^N$)	Percentage (%)
Weaving (working clothes like Gabi, Kuta, etc.)	12	9.5
Handy crafts work (like Moseb, Sebeteria, etc.)	37	29.3
Traditional pottery works (like Mitad, Dist, etc.)	32	25.4
Selling of Alcoholic beverages like *Tella, Katikala*)	28	22.2
Masonry and Carpentry	16	12.7
Tanning	7	5.6
Blacksmith (ironwork)	11	8.7
Priest hood	10	7.9

Source: own survey, 2020; N.B multiple answers are possible (households practiced one or more non-farm livelihood activities).

(2018) discovered that the non-farm livelihood group includes households whose primary source of income is derived from activities other than agriculture. Wage labor in factories, self-employment in own business, grain trade, petty dealing, animal trade, remittance, charcoal selling, and traditional brewing are examples. Working as a guard, carrying cement, assisting in construction, gardening, cleaning, excavating ditches, and chiseling are all wage-based occupations. Masonry, carpentry, and machine operation are examples of skilled wage jobs. Approximately 38% of respondents combine agricultural and non-farm activities, and approximately 15% of households rely solely on non-farm livelihood activities. The details are presented in Table 5.

> My grandfather was known for blacksmiths (iron works) for farmers in the locality. After working farming tolls, farmers give a certain amount of food crops from their production as well as they gave him money. Otherwise, some farmers give farming services to small plots of land. However, most farmers give lower status and they said ye biret ketikachi zer. As a result, my father was ashamed and didn't want to continue his father's work and he shifted to crop and livestock production activities alone. Despite that, I have to get married and start to live independently with my wife. Hence, I am anxious to work on my grandfather's handy craft work in addition to agricultural activities. I have started to work on iron works like sickles, plow(maresha), knives, connector of plow and drill (Kerife), Axe (Metirebia), and others. In doing this work, I have also seasonally migrated to other areas. For example, last year I was working in nearby lowland areas and the work was highly profitable. Meanwhile, glory to God I am fully capable of meeting my family's requirements and purchasing basic inputs for agricultural activities (key informant interview, 2020).

4.4. Determinants of farmer's adoption of indigenous knowledge-based off-farm and non-farm livelihoods

An econometric model, binary logit regression was employed to assess the determinants of farmers' adoption of indigenous knowledge-based livelihoods. The model output revealed that total Livestock unit (TLU), market distance (MKTDST), and dependency ratio (DPRT) were found to be significant ($p < 0.05$). Also, farmers' access to extension contact (EXTENCON), educational status (EDUC), and practicing livelihood diversification strategies (LDSTR) were significant a probability level of 1% to farmers' adoption of indigenous knowledge-based livelihoods. The remaining nine variables were statistically insignificant to farmers' adoption of indigenous knowledge-based livelihoods. Other findings revealed that smallholder farmers' demographic features such as degree of education, age, gender, and years of farming experience were major factors influencing their decisions to embrace indigenous techniques (File & Nhamo, 2023). In light of the above model results shown in Table 6, possible explanations for each significant independent variable are given as follows:

The results revealed that livestock holdings were positively associated with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Households having more livestock can help themselves to diversify indigenous knowledge based off-farm and non-farm livelihoods. The probable reason for this could be that farmers with high total livestock units are more likely to adopt indigenous knowledge-based off-farm and non-farm livelihoods for supplementing their agricultural productions. On the other hand, the probable reason could be that farmers with more total livestock units could have indigenous knowledge about livestock production and integrate it into off-farm and non-farm diversification. The findings of this study are consistent with those of Kaua (2020); Dika et al. (2022), who discovered that money from livestock production boosts the adoption of indigenous-based livelihoods. This could be because higher revenue means more capacity to implement indigenous strategies and more

Table 6. determinants of farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods.

Variables	Coefficient	Std. Err	Marginal effect
MEMCOOP	−0.199	−.0400509	0.600
EXTENCON	−0.859	−.1721735	0.001***
sex	0.103	.020787	0.829
Age	0.29	.0059132	0.291
Martial	0.86	.0173002	0.783
FAMSZ	0.28	.0056556	0.772
DPRT	0.1051	.2106124	0.054**
EDUC	−0.608	−.1217863	0.006***
CPR	0.098	.0196974	0.818
TLU	0.070	.0141666	0.020**
LDSZ	−0.084	−.0169749	0.761
ACCIRRIG	−0.733	−.1469783	0.177
MKTDST	−0.031	−.0062657	0.072**
AGROECO	0.421	.0843707	0.360
INCOME	−0.000	−.0000122	0.328
LDSTR	0.617	.1235591	0.000***
LPR	0.73	.0147113	0.804
Number of obs = 328			
LR chi2(17) = 63.74			
Prob > chi2 = 0.0000			
Pseudo R2 = 0.5424			
Goodness of fit test (pseudo R-square)			
Cox and Snell	.734		
Nagelkerke	.793		
McFadden	.509		
Descriptive statistics			
	Skewness		
Variables	Statistic	Std.Error	Median
Age	−0.129	.135	48.00
Family size	−0.201	.135	5.725
Dependency ratio	.178	.135	0.5

Source: Own survey, ***, ** refers to significance at 1% and 5% probability levels respectively.

leeway in making decisions. higher income also reduces risk aversion and the discount rate, resulting in a higher propensity to adopt. Likewise, market distance has a negative association with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Farmers who are near to the market center are more access to scientific knowledge systems that inhibit their preferences on adopting indigenous knowledge-based off-farm and non-farm livelihoods. Likewise, farmers living in remote rural areas are mostly learn indigenous knowledge from their ancestors that can help them to be engaged in alternative indigenous knowledge-based livelihoods. Therefore, farmers far from the market center are less likely to adopt indigenous knowledge-based off-farm and non-farm livelihoods. Other similar study confirmed that, this outcome is comparable to one where market access and the adoption of local methods. This is so because markets provide a means of exchanging information, and increased access to resources could also imply increased access to inputs and produce markets. Thus, more access markets translate into increased adoption capacity (Kaua, 2020); File and Nhamo (2023). As well, the dependency ratio has a positive association with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Farmers that have higher dependency ratio are mostly challenged by shortage of income that enforces them to search alternative livelihoods and they are active adopter of indigenous knowledge based off-farm and non-farm livelihoods. The household heads with more dependent family members are more likely to farmers adoption of indigenous knowledge-based off-farm and non-farm livelihoods to meet family needs through increasing livelihood options. This outcome is in line with the findings of M-Buu File and Nhamo (2023), which showed that, in contrast to households with fewer labor force members, those with available labor chose a combination of improved and traditional methods. According to Kaua (2020), adoption is adversely affected by other socioeconomic characteristics such as household reliance and education. dependence on the home and adoption of local adaption techniques to climate change. Increased reliance on one's household consequently hinders the ability to embrace customs based on indigenous knowledge. Likewise, access to extension contacts has a negative and significant correlation with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Farmers are advised and enforced by extension workers to utilize scientific knowledge

based agricultural production systems and it reduces work burdens in which they are challenged in indigenous knowledge system. The extension system lacks to incorporate significant contributions of indigenous knowledge system which results little attention to the knowledge and they are less adopting indigenous knowledge based off-farm and non-farm livelihoods. Hence, Ethiopian agricultural extension service mainly focuses on scientific knowledge-based livelihood options and gives less attention to locally existing indigenous knowledge-based livelihoods. The result is consistent with Kaua (2020), and Dika et al. (2022) findings, which show a strong negative correlation with additional institutional characteristics including access to extension services. The adoption of indigenous knowledge-based off-farm and non-farm livelihood activities has decreased as a result of access to extension services. Additionally, educational level has a negative association with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. The Ethiopian educational curriculum lacks to incorporate indigenous knowledge in school teaching and learning system and that affects the confidence of indigenous knowledge owners to sustain the practices for generations. As a result, farmers having more educational status give emphasis for modern knowledge system that discourage and undermine indigenous knowledge-based livelihoods. Household heads with higher educational levels are less likely to adopt indigenous knowledge-based off-farm and non-farm livelihoods; rather, they are engaged in modern and scientific knowledge-based livelihood options. Moreover, having a higher educational level could be helpful for farmers to easily adopt modern and technology supportive non-farm livelihood activities to strengthen agricultural livelihoods. The study's findings are consistent with the result of Asmamaw et al. (2020); Bulcha et al. (2022), and (M-Buu File & Nhamo, 2023). Not attending formal education strongly encouraged them to adopt native customs. Their affinity for local traditions stems from the fact that, in contrast to science-based farm operations, understanding and applying indigenous practices do not require any formal education or training. According to Kaua (2020), adoption is adversely affected by other socioeconomic characteristics such as household reliance and education. Moreover, farmers engaged in livelihood diversification have a positive and significant correlation with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Farmers in the study area are off agricultural activities during the dry season and they engaged in diversified off-farm and non-farm livelihoods in which they learn from their families generationally. Diversified livelihood options in rural areas are mainly linked with indigenous knowledge systems that enhance their income improvement. Hence, farmers' engagement with livelihood diversification experience can be essential to adopt indigenous-based livelihood options. *The focused group discussion also confirmed that, when there is idle time in which agricultural activities are completed, farmers having indigenous knowledge are engaged in off-farm and non-farm livelihoods activities that helps to support agricultural implements and fulfilling family needs (FGD discussion, 2020)*. The result is consistent with the findings of Kaua (2020); Mudemba et al. (2021), and Dika et al. (2022). These socioeconomic characteristics, which have a substantial positive association and influence adoption, include age, local experience, land size, income level, and income diversity. This indicates that a greater diversity of incomes encourages the use of traditional methods for coping with climate change. More varied income sources provide people with more options for their way of life, more money, and therefore more adoption potential.

5. Conclusions and recommendations

According to the findings of the study, indigenous knowledge practices played a key role in the diversification of off-farm and nonfarm livelihood activities. Most commonly, off-farm and non-farm livelihood activities emanated from the indigenous knowledge experiences of rural farm households. The study results showed that about 17.68%, 19.82%, and the rest 18.6% adopt indigenous knowledge-based off-farm, non-farm, and both off-farm and non-farm livelihood activities respectively. This tells that culturally and community-oriented indigenous knowledge practices were more importantly adopted by those households having experience in the diversification of off-farm and nonfarm livelihood activities. Agriculture livelihood activities alone were not sufficient to generate the required household income. The adoption of indigenous-based off-farm and non-farm livelihood activities has been acquired generationally from families or generational transformation of technical livelihood activities. Based on their level of adoption of indigenous knowledge-based off-farm and non-farm livelihoods, 36.28% of sampled

households adopt and perform indigenous knowledge-based off-farm activities outside their farm but within agricultural activities. Moreover, the study also showed that 38.42% of households have adopted different indigenous knowledge-based non-farm livelihood activities.

The identified indigenous knowledge-based off-farm livelihood activities include; the sale of firewood, and charcoal selling, the selling of farm implements (like Morph (Mofer), Yoke (Qeniber), Choke (Maneqiya), Drill (Digir), etc.), selling of sweet pleasing plant leaves (Mantegna enichet & tinijit), Rent of pack animals, and selling of grinding material prepared from wood and stone (like; Muqecha, Ye dingay Weficho). Additionally, the study also identified the existing indigenous knowledge-based non-farm livelihood activities include; such as traditional pottery works (like; Mitad, Dist, Genibo, Gan, etc.), handy crafts work (like Moseb, Sebeteria, Ye bun kuris, Ageligil, Qelemishash, etc.), weaver (working clothes like Gabi, Qemis, Netela, Fota, Metemitemia, etc.), selling local beverages (like Tella and Katikala), tanning, blacksmith, masonry, and carpentry works. The study result assures that indigenous knowledge practices played a pivotal role in the existence of off-farm and non-farm livelihood activities.

Indigenous knowledge played a pivotal role in the diversification of off-farm and nonfarm livelihood activities. However, the adoption of indigenous knowledge-based off-farm and non-farm livelihoods was determined by different factors. A binary logit model output revealed that total Livestock unit, market distance, and dependency ratio were statistically significant at a probability level of 5%. Also, farmers' access to extension contact, educational status, and practicing livelihood diversification activities were significant at a probability level of 1% to farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods.

Based on the findings of the study, the following recommendations are forwarded:

- Indigenous knowledge practices are important for the adoption of indigenous knowledge-based livelihood off-farm and non-farm livelihood activities. Therefore, it could be advised to incorporate indigenous knowledge practices to improve the livelihoods of rural farm households.
- Households have adopted indigenous knowledge-based off-farm and non-farm livelihood activities in addition to their agricultural production system. Therefore, agricultural policymakers are advised to give attention to indigenous knowledge-based off-farm and non-farm livelihood activities to supplement the agricultural sector.
- Access to extension contacts has a negative and significant probability level of 1% correlation with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Therefore, the agricultural extension system is advised to give attention to extension services for indigenous knowledge-based off-farm and non-farm livelihoods in addition to scientific knowledge-based livelihoods.
- Farmers that have practiced livelihood diversification strategies have a positive and significant correlation with farmers' adoption of indigenous knowledge-based off-farm and non-farm livelihoods. Therefore, it is important to link indigenous knowledge to the diversification of rural livelihoods.

5.1. Limitations of the study and area of future study

The study is limited to farmers adoption of indigenous knowledge based off-farm and non-farm livelihoods and its determinants in Takusa Woreda. The study is limited to three kebeles because of budget constraints. The study didn't address farmers willingness for transferring indigenous knowledge practices, and its impact on food security and poverty. therefore, future studies should address these untouched problems.

Note

1. Refers to livelihoods emerged as a result of farmers indigenous knowledge for supporting their life, it didn't consider modern science-oriented knowledge for practicing the activities.

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Authors' contributions

The corresponding author contributes to the overall write-up of the study.

Consent for publication

The participant has consented to the submission of the case report to the journal.

Disclosure statement

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

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Data availability statement

The data will be available based on reasonable request.

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