Agriculture & Food Security

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Determinants of rural livelihood diversification strategies among Chewaka resettlers' communities of southwestern Ethiopia

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Abstract

Background: Livelihood diversification plays a decisive role for the reduction of poverty, food insecurity and to improve the welfare of rural communities. However, inadequate research attention has been given to explore the determinants of livelihood diversification strategies in resettlement areas of Ethiopia. This study attempts to investigate determinants of livelihood diversification strategies among the resettler households in Chewaka district of Ethiopia.

Methods: The study utilized both primary and secondary data which are qualitative and quantitative in their nature. Through multistage sampling procedure, a total of 384 households were selected from seven sample kebeles of Chewaka district. Data were collected using interview schedule, focus group discussions and field observations. The collected data were analyzed quantitatively and qualitatively. Descriptive and inferential statistics along with multinomial logit model have been employed to analyze the data.

Results: The results showed that agriculture (43.2%), agriculture plus non-farm (25.5%), agriculture plus off-farm (19.3%) and a combination of agriculture plus non-farm plus off-farm (12%) activities are the most pertinent livelihood strategies in the study area. It was found that agriculture has a leading contribution to the total households' income (72.5%) followed by non-farm (20%) and off-farm activities (7.5%). Multinomial logit model result revealed that land holding size, educational status, livestock holding, sex, age, market distance, credit access, annual income, access to training and household sizes were the major determinants of livelihood diversification strategies. Moreover, poor infrastructural development, lack of working capital, absence of technical support, inadequate skill training and lack of awareness are constraints to livelihood diversification in the area.

Conclusions: The study concludes that agricultural sector alone cannot be relied upon as the core activity for rural households and as a means of reducing poverty, achieving food security and improving livelihoods in the study area. Thus, a comprehensive development plan that enhances successful livelihood diversification is found to be imperative and most urgent. Policies and actions directed towards improving livelihood of the resettlers' communities should focus on expanding rural infrastructures, enhancing awareness creation activities and cooperation of stakeholders to bring sustainable livelihood outcome in the area.

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Background

In developing countries, agriculture is an important sector for majority of the rural populations' livelihood as it is a source of income, employment and foreign exchange [1–3]. It has been the predominant activity for most rural households in Sub-Saharan Africa (SSA) which offers a strong option for spurring growth, overcoming poverty and enhancing food security as stressed by the World Bank Report [4]. However, the sector has been continually blamed for its failure to guarantee sufficient livelihood for smallholder farm households in the region because of decreasing farm sizes, low productivity and high degree of subsistence farming [5]. As pointed out by Owusu et al. [6], reducing hunger and food insecurity has, therefore, remained an essential part of international development agenda since the World Food Summits in 1996 and 2001. Godfray et al. [7] have also noted that ensuring food security is the challenge of feeding 9 billion people, and it is a major issue in academic and international debates [8]. Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life [9]. The growing demand of food with raising population has worsened the problem of food insecurity which is found to be the most prevalent in Africa countries [10]. Although enhancing agricultural production is conceived to improve and sustain the lives of rural people, agriculture on its own is unable to provide sufficient means to escape out of poverty for majority of the poor rural households [11]. In view of this, studies conducted by Barrett et al. [12] and Winters et al. [13] indicate that diversifying rural economy is one of the pathways out of poverty and to ensure food security for the rural inhabitants. Nevertheless, the contribution made by livelihood diversification to rural livelihoods has often been ignored by policy makers who have chosen to focus their activities on agriculture [14].

Ethiopia is one of the Sub-Saharan Africa countries where majority of the population lives in the rural areas mainly depending on agriculture for their livelihoods. Agriculture is the mainstay and backbone of the country's economy as it accounts for nearly 41% of GDP, employs about 85% of the labor force and contributes around 90% of the total export earnings [15, 16]. Despite its high contribution to the overall economy, the sector is overwhelmingly dominated by small-scale and still predominant subsistence agriculture with traditional farming systems [17]. As pointed out by [18], agricultural activities in rural Ethiopia are highly characterized by rainfed, traditional, low productive, fragmented land size, subsistence oriented and dominated by smallholders where majority cultivating less than 0.5 ha. Besides, agricultural production and productivity is being challenged by recurrent drought occurrence compounded with poor usage of improved agricultural inputs, land degradation and high population growth. Hence, most rural households of the country are exposed to food insecurity and chronic poverty [19].

Today, agricultural sector alone cannot be relied upon as the core activity for rural households as a means of improving livelihood and reducing poverty [20, 21]. Consequently, rural people partake in a number of strategies including agricultural intensification and livelihood diversification which enable them to fulfill livelihood requirements and attain food self-sufficiency. Livelihood diversification is a process by which household members construct a diverse portfolio of activities and social support capabilities in their struggle for survival and to improve their standards of living [14, 22]. It is an important survival strategy for the rural households that augment sustainable livelihoods, reduce vulnerability, improve income and well-being. Sources revealed that the diversification of livelihood strategies enables the farm households to have better incomes, enhance food security and better cope with environmental stresses [23–25]. There is growing evidence that in rural Ethiopia households are participated in diverse livelihood strategies away from merely agriculture towards non/off-farm activities that are undertaken to generate additional income for survival and cope with different livelihood shocks, trends and seasonality associated with agricultural production [26–30]. Nevertheless, their participation is determined by various contextual factors at different areas. Empirical studies indicate that the determinants of livelihood diversification strategies vary at different locations according to the contexts, local settings and asset holding of households [31–34]. This implies that there is disparity in the effect of factors at different locations with different livelihood outcomes. In Ethiopia, various factors that influence the choice of livelihood diversification strategies have been examined in several research works [28, 35–40]. However, the condition of livelihood diversification in resettlement areas of the country has received less attention and little is known of what determines the livelihood strategies adopted by resettled households. In most resettlement areas of the

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country, peoples are deprived in terms of development opportunities, infrastructure and services. Hence, rural households are obliged to engage in different income generating activities to expand their household income.

Chewaka district is one among the resettlement sites of Ethiopia that hosted large number of settlers since 2003. The government resettled massive number of people from drought-hit areas of East and West Hararge zones to Chewaka area as a response to the recurrent droughts, scarcity of farmlands and food insecurity problems [41]. As common in most rural areas of Ethiopia, households of Chewaka district are mainly dependent on small-scale subsistence agriculture to derive their livelihoods. In this district, rural households are producing crops and livestocks which have low economic returns and are highly dependent on the rain-fed agricultural production systems. The uncontrolled population growth coupled with low return from farming activities has forced the resettlers' households to engage in diverse livelihood activities to supplement and sustain their livelihood/well-being. Although considerable number of households are participated in non/off-farm and/or combination of activities, the choice of each livelihood strategy is determined by complex and yet empirically unidentified factors. Thus, lack of rigorous investigation about the determinants of rural livelihood diversification strategies among the resettler households has initiated the researchers to conduct this study. A thorough understanding of determinant factors that influence the choice of household livelihood strategy is decisive in any attempt to improve the response mechanisms related to poverty, food insecurity and to bring sustainable livelihood outcome in the study area. Besides, the study would contribute to literature related to livelihood diversification strategies and helps concerned stakeholders to come up with development programs, policies and strategies that enable resettler households to easily reconstruct their livelihoods. Cognizant to this fact, this study was conducted to investigate determinants of rural livelihood diversification strategies among the resettlers' households in Chewaka district of Ethiopia.

Materials and methods
Description of the study area
Chewaka district is located in Buno Bedelle administrative zone of Oromia Regional state. The district is situated at about 552 km southwest of Addis Ababa, the capital of Ethiopia. Geographically, it lies between 8°43′30″ N and 9°5′30″ N latitude, and 35°58′0″ E and 36°14′30″ E longitude (Fig. 1), and covers a total area of 618.7 km². Relatively, it is bordered by Gimbi in the north, Dabo Hana Woreda in south, East Wollega in east and Mako woreda in the west direction. Since 2003 population resettlement

in the area, it was recognized as one administrative *Woreda*[1] of Oromia Regional state [41]. The topography of Chewaka district comprises undulating terrain and gentle sloping lowlands which cover about 76.4% and the remaining 23.6% is highland area [42]. Its altitude ranges between 1130 and 2053 m above mean sea level (Fig. 1).

The district lies in moist *Woina-Dega* (cool sub-humid) and *Kolla* (warm semi-arid) agro-ecological zones and experiences both high temperatures and rainfall. Rainfall and temperature records for the years (2004–2017) are computed based on data obtained from National Metrological Service Agency (Fig. 2). The district has mono-modal rain and it attains the maximum precipitation during the summer season (June–August) and small rainy season occurs from February to April. The dry season covers the remaining months of the year. The mean minimum and maximum annual temperatures of the district range from 14.5 to 28.5 °C and the average annual rainfall varies from 800 to 1200 mm [43]. As pointed out by [44], Cambisols, Luvisols, Lithosols are the dominant soils that exist in the locality and the current land use/land cover of the district comprises broad-leaved dense forests, woodlands, grasslands, cultivated lands, barelands and built-up areas [45]. The dominant tree species that are grown in the area include: *Cordia africana*, *Albizia gummifera*, *Ficus vasta*, *Podocarpus falcatus*, *Boswellia papyrifera*, *Combretum terminalia* and *Acacia commiphora*. Currently, the district is inhabited by 96,446 people distributed within twenty eight *Kebeles*[2] [46]. Agriculture is the main economic activity and basis of livelihood for the people of the area. The farming system is mixed crop–livestock production on a subsistence level. The major crops that are grown in the area include maize (*Zea mays*), sorghum (*Sorghum bicolor*), rice (*Oryza sativa*), sesame (*Sesamum indicum*) and soybean (*Glycine max*). In addition, livestock production is an important means of livelihood next to crop production in the district.

Sampling techniques and procedures
This study was carried out in Chewaka district of Ethiopia. In this study, multistage sampling procedure was employed to select the study district and the sample households. In the first stage, the study area was selected purposively as a research site because it is the largest resettlement scheme that hosts huge number of settlers in southwestern Ethiopia. Besides, so far, no study has been conducted regarding determinants of rural livelihood diversification strategies among the resettlers' communities of the area. In the second

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[1] *Woreda* is an administrative unit in Ethiopia equivalent to a district.

[2] *Kebele* is the smallest administrative unit/structure in Ethiopia.

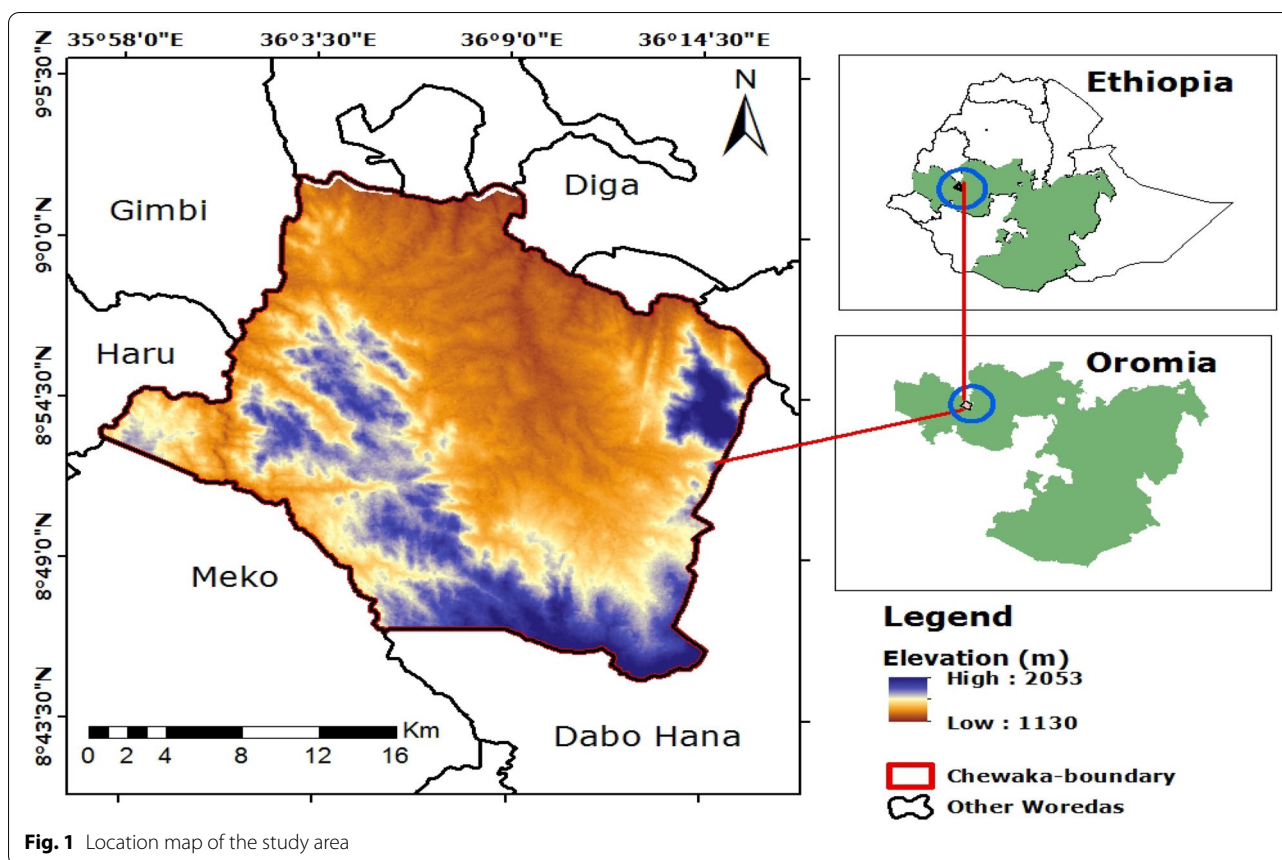Abera *et al. Agric & Food Secur*   (2021) 10:30

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Fig. 1 Location map of the study area

stage, the district has seven resettlement sub-sites and the total kebeles of the district were grouped according to these sub-sites. Then, from each sub-site, one kebele was selected purposively based on the engagement of households on the diversified rural livelihood activities. In the third stage, systematic random sampling technique was employed to obtain respondents from the available lists of each sample kebeles (Chokorsa, Gudure, Waltasis, Walda Jalala, Tokkuma Harar, Urji Oromiya and Jagan) and sample households were selected from each kebele proportionally.The total household heads of the sample kebeles are 3,340 and sample size was determined by using the formula given by [47]

$$n = \frac{P * (1 - P) * Z^2}{e^2},$$ (1)

where n = sample size, P = estimated proportion of respondents. As the proportion is not known, 0.5 was used as p value to obtain maximum number of the respondents. Z = the number of standard error corresponding to 95% confidence interval which is 1.96 and e = margin of error that the researchers tolerate is 0.05.

Therefore, a total of 384 households were selected proportionally from sample kebeles (Table 1).

$$n = \frac{0.5 * (1 - 0.5) * (1.96)^2}{(0.05)^2} = 384.$$

Data sources and methods of data collection

The study utilized both primary and secondary data which are qualitative and quantitative in their nature. Primary data were gathered from selected households, kebele managers, development agents (DAs), agricultural and natural resources experts of the district as well as officers at kebele, woreda and zonal levels. Household survey questionnaires, key informant interviews, focus group discussions and field observations were employed to collect the data. The survey questionnaires were composed of both open- and close-ended types to collect reliable data about the demographic and socio-economic characteristic of respondents; the existing livelihood strategies and factors that influence the diversification of livelihood choices in the area. The questionnaires were administered by researchers and trained enumerators.
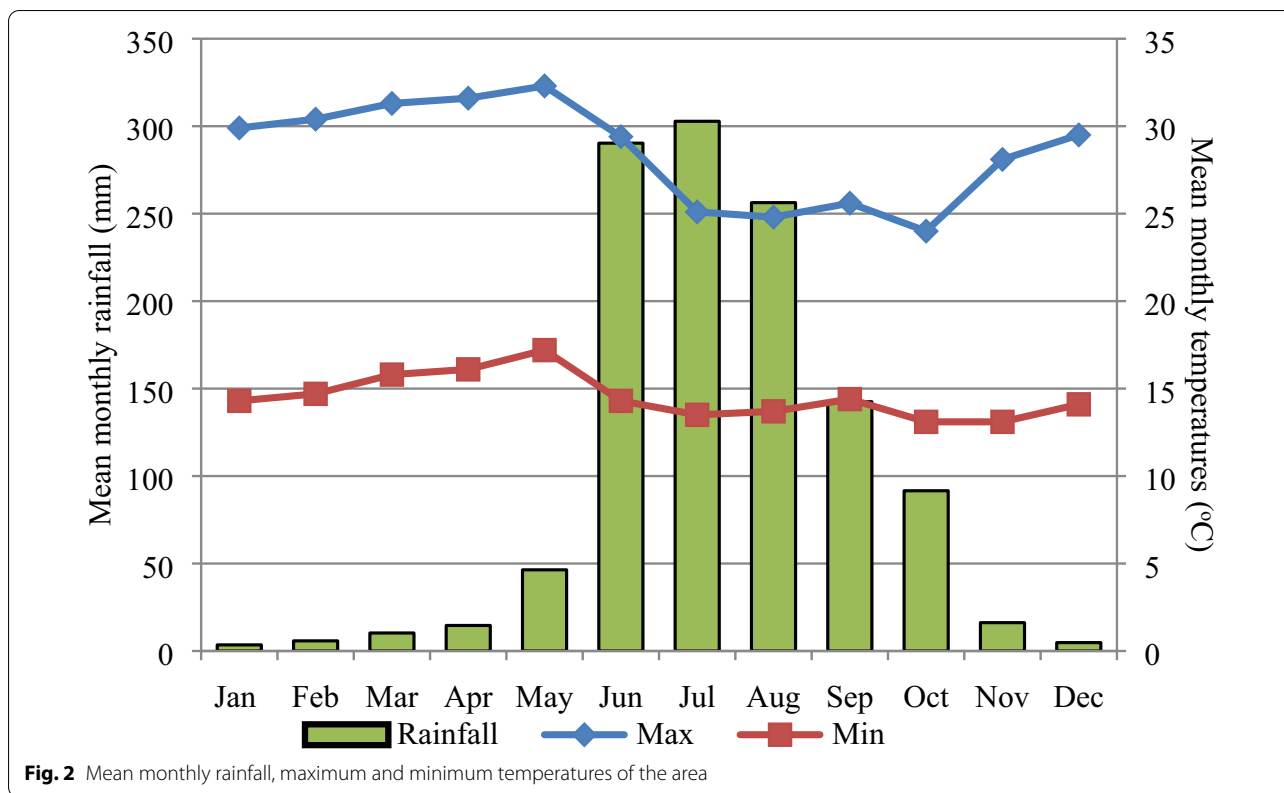
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Fig. 2 Mean monthly rainfall, maximum and minimum temperatures of the area

Table 1 Distribution of total and sample households in the sample kebeles. Source: survey data (2018)

Site no.	Sample kebeles	Household size of sample kebeles			Sample size		
		M	F	Total	M	F	Total
1	Chokorsa	449	123	572	52	14	66
2	Gudure	385	96	481	44	11	55
3	Waltasis	410	97	507	47	11	58
4	Jagan	368	117	485	42	14	56
5	Walda Jalala	193	78	271	22	9	31
6	Tokkuma Harar	427	134	561	49	16	65
7	Urji Oromiya	369	94	463	42	11	53
Total		2601	739	3340	298	86	384

In-depth interview was conducted with agricultural extension workers (development agents), kebele managers, farmers, woreda and zonal level officials from agricultural and rural development offices of the area to get detail information about the issue under-study. Field observation was also carried out through transect walk with development agents to crosscheck data collected via other data collection instruments. Besides, to supplement the primary data, secondary data were collected from published and unpublished materials.

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Method of data analysis

The data collected from both primary and secondary sources were analyzed, summarized and presented via qualitative and quantitative data analysis techniques. Data generated through questionnaires were analyzed using descriptive and inferential statistics along with multinomial logit model. Quantitative categorical types of data were analyzed using percentages, frequency distributions, cross-tabulation and chi-square tests; while quantitative continuous data were analyzed using means, standard deviations and one-way ANOVA. Chi-square test (χ^2) and *F*-test were used to see whether there were significant differences among different livelihood strategies in relation to dummy/categorical and continuous variables, respectively. Multinomial logistic regression model was employed to investigate the determinants of households' livelihood diversification strategies and data analysis was conducted using SPSS (Statistical Package for Social Science) version 20 and Stata version 16. Furthermore, data collected from key informant interviews, field observations and focus group discussions were described, narrated and analyzed qualitatively.

Multinomial logit model specification

Multinomial logistic (MNL) regression is a popular and most commonly applied model for nominal outcomes that are often used when dependent variable has more than two choices [48]. As noted by [49], when there is a dependent variable with more than two alternatives among which the decision-maker has to choose (i.e., unordered qualitative or polytomous variables), the appropriate econometric model would be either multinomial logit or multinomial probit regression model. However, multinomial probit is rarely used in empirical studies owing to estimation difficulties imposed by the need to solve multiple integrations related to multivariate normal distributions [50, 51]. Hence, this study utilized multinomial logit model to identify the determinants of rural household livelihood diversification strategies in the study area. This model was preferred not only because of its computational ease but also it exhibits a superior ability to envisage livelihood diversification and picking up the differences among the livelihoods strategies of rural households [52]. The assumption is that in a given period at the disposal of its asset endowment, a rational household head chooses among different income sources that offers maximum utility and leads to livelihood diversification. Following the work of [49], for the *i*th respondent faced with *J* choices of household livelihood diversification options, the utility choice *j* can be specified as:

$$U_{ij} = Z_{ij}\beta + \varepsilon_{ij}. \tag{2}$$

If the sample household makes choice *j* in particular, then we assume that U_{ij} is the maximum among the *J* utilities. So that the statistical model is derived by the probability that choice j is made which is:

$$\text{Prob}\,(U_{ij} > U_{ik}) \text{ for all other } K \neq j, \tag{3}$$

where U_{ij} is the utility to the *i*th respondent from livelihood strategy *j*. U_{ik} is the utility to the *i*th respondent from livelihood strategy *k*.

If the household maximizes its utility defined over income realizations, then the household's choice is simply an optimal allocation of its asset endowment to choose livelihood that maximizes its utility [53]. Thus, the *i*th household's decision can be modeled as maximizing the expected utility by choosing the *j*th livelihood strategy among *J* discrete livelihood strategies, i.e.,

$$\max_j = E(U_{ij}) = f_j(x_i) + \varepsilon_{ij};\ j = 0\ldots J. \tag{4}$$

In general, for an outcome variable with *J* categories, let the *j*th livelihood strategy that the *i*th household chooses to maximize its utility take the value 1 if the *i*th household chooses *j*th livelihood strategy and 0 otherwise. The probability that a household with characteristics "*x*" chooses livelihood strategy *j*, p_{ij} is modeled as:

$$P_{ij} = \frac{\exp\,(X_i\beta_j)}{\sum_{j=0}^{J} \exp\,(X_i\beta_j)},\ J = (0\ldots 3). \tag{5}$$

With the requirements that $\sum_{j=0}^{J} P_{ij} = 1$ for any *i* where $P_{ij} =$ Probability representing the *i*th respondent's chance of falling into category *j*; $X_i =$ Predictors of response probabilities and $\beta_j =$ Covariate effects specific to *j*th response category with the first category as the reference.

As pointed out by [49, 54], a convenient normalization that removes indeterminacy in the model is to assume that $\beta_1 = 0$ (this arise because probabilities sum to 1, so only J parameter vectors are needed to determine the $J+1$ probabilities). Hence, $\exp(X_i\beta_1) = 1$, implying that the generalized Eq. (5) above is equivalent to:

$$Pr\left(y_i = j/X_i\right) = P_{ij} = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^{J} \exp(X_i\beta_j)},\ \text{for } j = (0, \cdots J) \text{ and}$$
$$Pr\left(y_i = 1/X_i\right) = P_{i1} = \frac{1}{1 + \sum_{j=1}^{J} \exp(X_i\beta_j)}, \tag{6}$$

where $y =$ A polytomous outcome variable with categories coded from 0... *J*. Note: The probability of P_{i1} is derived from the constraint that the *J* probabilities sum to 1. That is, $P_{i1} = 1 - \Sigma P_{ij}$. Thus, similar to binary logit model, it implies that we can compute *J* log-odds ratios which are specified as:

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Table 2 Sample households' livelihood strategies and wealth category cross-tabulation. Source: survey data (2018)

Livelihood strategies	Households' wealth category							
	Poor ($N=173$)		Less poor ($N=141$)		Better-off ($N=70$)		Total ($N=384$)	
	N	%	N	%	N	%	N	%
Agriculture only	41	23.7	78	55.3	47	67.1	166	43.2
Agriculture + non-farm	48	27.7	40	28.4	10	14.3	98	25.5
Agriculture + off-farm	59	34.1	9	6.4	6	8.6	74	19.3
Agriculture + non-farm + off-farm	25	14.5	14	9.9	7	10	46	12.0
χ^2							71.207	
P value							0.000***	

*** indicates significant at < 1% probability level; *N*: number

$$\ln \left[\frac{P_{ij}}{P_{iJ}} \right] = x' \left(\beta_j - \beta_J \right) = x' \beta_j, \text{if } J = 0. \qquad (7)$$

Multicollinearity diagnosis

Multicollinearity occurs when two or more independent variables are highly correlated with each other in the model [55]. When collinearity is perfect linear, it is impossible to obtain a unique estimate of the regression coefficient with all the independent variables. Thus, Variance inflation factor (VIF) was used to test the multicollinearity problem among continuous variables and contingency coefficient was employed to check the degree of association among categorical or discrete variables. The larger value of VIF, usually values that exceed 10, shows a serious multicollinearity problem. The value of contingency coefficient ranges between 0 and 1. A value close to 0 indicates weak association and a value close to 1 shows the presence of strong association. Therefore, contingency coefficient value of 0.75 or above indicates a stronger relationship between explanatory variables and shows presence of multicollinearity [56].

Description of variables used in multinomial logit model
Dependent variable

A dependent variable is a variable that is thought to be affected by changes in an independent variable. The polytomous-dependent variable in this study was the choice of livelihood strategies by the households which are identified by categorizing the sample respondents into livelihood strategy groups. Hence, the dependent variable was hypothesized to have the following values: $Y=0$, if the choice lies in agriculture (AG) strategy alone which is considered as base/reference category; $Y=1$, if the choice lies in agriculture and non-farm combination (AG + NF); $Y=2$, if the choice lies in agriculture and

off-farm combination (AG + OFF); $Y=3$, if the choice lies in agriculture, non-farm and off-farm combination strategy (AG + NF + OFF).

Independent variables

These are explanatory or predictor variables that are assumed to determine an outcome variable/the livelihood strategies of the resettlers' households. In this study, important explanatory variables (socio-economic, demographic and environmental related factors) which were hypothesized to influence households' decision to participate into different livelihood diversification strategies are considered and selected on the basis of the existing empirical literatures. Accordingly, sex of the household head, agro-ecology, land holding size, age of the household head, livestock holding size, educational status, distance from the market, access to credit service, fertilizer use, frequency of extension contact, membership to cooperatives, participation in leadership, household size, access to agricultural training, improved seed use and total income are assumed to affect the diversifications of resettlers' livelihood strategies. The description of independent variables and their hypothesis are presented in Appendix Table 7.

Results and discussions
Livelihood strategies of the resettler households in Chewaka district
Households' livelihood strategies and wealth category

Livelihood strategies are the combination of activities that people undertake to survive and fulfill their livelihood requirements. In their day-to-day struggle, rural people pursue a number of strategies to attain their livelihood

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Table 3 Summary of statistics for continuous explanatory variables by choice of livelihood strategies. Source: survey data (2018)

Variables	Livelihood strategies of the households					
	AG	AG + NF	AG + OFF	AG + NF + OFF	Total	*F*-value
	Mean	Mean	Mean	Mean	Mean	
Age of household head	52.60	43.63	40.26	41.02	46.75	38.724***
Household size (AE)	4.71	5.71	4.78	5.23	5.04	12.517***
Land holding size (ha)	2.01	1.16	1.01	1.03	1.48	126.530***
Livestock owned (TLU)	4.62	3.69	3.49	3.53	4.04	77.845***
Extension contact	9.07	8.66	8.61	8.17	8.77	2.512
Market distance	3.54	2.49	2.34	1.50	2.79	74.462***
Total annual income	7046.68	5930.10	4776.35	5308.69	6116.02	23.138***

*** indicates significant at < 1% probability level

goals. Understanding the local context of household livelihood strategy is crucial to pinpoint appropriate development intervention strategies and assess potential for replication in other contexts. In Chewaka district, large proportions of the sample households (43.2%) are solely engaged in agriculture (crop–livestock production), whereas 25.5% of the households combined agriculture plus non-farm activities. Among the surveyed households, about 19.3% pursued agriculture plus off-farm and the remaining 12% of the respondents practiced a combination of agriculture, non-farm and off-farm activities as their livelihood strategies (Table 2).

As pointed out by [53], there are different approaches of characterizing household livelihood strategies such as asset, activity and income approaches. Most commonly, economists group households by shares of income earned from different sectors of the rural economy. Because this approach is simple one and it effectively delineates households into different livelihood categories [12]. Likewise, this study considered income shares of each livelihood activity to conceptualize livelihood strategies of the resettlers' households. Besides, community wealth ranking was conducted and households were categorized into different wealth groups such as poor, less poor and better-off households with the help of an in-depth interview with key informants and focus group discussants as well as using secondary sources as a base (see Appendix Table 8). In this regard, poor households were pursuing non-farm and off-farm activities in addition to agriculture as their primary livelihood strategies; while more proportion of less poor and better-off households derive their livelihoods from agriculture alone. Conversely, only 8.6% of the better-off households were engaged in agriculture plus off-farm activities (Table 2). This implies that poor and less poor households tend to concentrate more on off-farm and non-farm activities compared to the better-off households. As survey result indicates, farm

households in the study area obtained their income from agriculture, non-farm, off-farm and/or combination of activities.

Agriculture that embraces both crop production and animal rearing is the dominant livelihood source or means of survival strategies in the district. Some of the major crops grown in the area include maize, sorghum, rice, sesame and soybean. The result of field observation also indicated that vegetables like chillies, pepper, cabbage, carrot, tomato as well as fruits like papaya, mango and orange are also cultivated. In addition, cattle, sheep, goats, donkey and poultry are major livestock reared by the community of the area for both income and consumption purpose. In this study, non-farm refers to those activities that take place outside agricultural sector such as petty trade, rural craft and remittances. Off-farm refers to those agricultural activities which take place outside the person's own farm area (wage laborer, land rent, environmental gathering/firewood and charcoal selling).

Analysis of livelihood strategy choice using one-way ANOVA
One-way analysis of variance (*F*-test) was conducted to scrutinize whether there are significant differences in the mean scores of continuous explanatory variables across the livelihood groups and the result of post hoc test was included for multiple comparisons. The compared *F*-test results showed the existence of a statistically significant mean difference between rural households falling in the four livelihood strategies in terms of land holding size, livestock ownership, market distance, total annual income, age and household size at less than 1% levels (Table 3).

It was found that the land holding sizes of the respondents' ranges from 0.5 to 3 hectares and the average land holding size of the sample households

was 1.48 ha. As can be seen in Table 3, those households who were pursuing agriculture alone as their livelihood strategy had relatively better land holding size than their counterparts. The mean value of farm size owned by households who relying on agriculture alone was 2.01 ha, while it was nearly one hectare for each of the rest groups. A one-way between-groups analysis of variance was run to explore the impact of land holding size on the choice of livelihood strategies. Household livelihood strategies were categorized into four groups (Group 1: AG alone; Group 2: AG + NF; Group 3: AG + OFF and Group 4: AG + NF + OFF). There was a statistically significant mean difference in land holding size between groups as demonstrated by One-way ANOVA [$F(3, 380) = 126$, $p = 0.000$]. A Tukey post hoc test indicated that the mean score for Group 1 (M = 2.01, SD = 0.56) was significantly different from Group 2 (M = 1.16, SD = 0.39); Group 3 (M = 1.01, SD = 0.36) and Group 4 (M = 1.03, SD = 0.37) at $p < 0.01$ level.

The total mean livestock ownership of the households was 4.04 *TLU*[3] with a standard deviation of 0.83 (see Appendix Table 9 for conversion factors of TLU). The average livestock holding of households who choose the livelihood strategy of agriculture alone, agriculture plus non-farm, agriculture plus off-farm and a combination of agriculture plus non-farm plus off-farm were 4.62, 3.69, 3.49 and 3.53, respectively. This implies that those households who rely on agriculture alone owned more TLU as compared to the rest groups and thus, the mean livestock owned by the households significantly vary across different livelihood strategies choices at $p < 0.01$ (Table 3). A one-way between-groups analysis of variance was conducted to investigate the impact of livestock ownership on the choice of livelihood strategies. There was a statistically significant mean difference in livestock holding size between groups as indicated by One-way ANOVA [$F(3, 380) = 77$, $p = 0.000$]. Post hoc comparisons using the Tukey HSD (Honest Significant Difference) test revealed that the mean score for Group 1 (M = 4.62, SD = 0.79) was significantly different from Group 2 (M = 3.69, SD = 0.56); Group 3 (M = 3.49, SD = 0.51) and Group 4 (M = 3.53, SD = 0.52) at $p < 0.01$ level of significance.

Household size in this study is considered as the number of individuals or household members living together in the respondent's home. Household sizes of the sample respondents range from 2 to 10 with mean

of 5.61 and standard deviation of 1.62. However, when the crude collected data of households' family members including sex and age were converted into their respective adult equivalents (AE), the average household size was 5.04 (see Appendix Table 10 for conversion factors of adult equivalents). Based on their livelihood strategies, the average adult equivalents of the households who chose agriculture alone, agriculture plus nonfarm, agriculture plus off-farm and agriculture plus nonfarm plus off-farm livelihood strategies were 4.71, 5.71, 4.78 and 5.23, respectively. A one-way between-groups analysis of variance was carried out look at the impact of household size on the choice of livelihood strategies. There was a statistically significant mean difference in household size for the livelihood groups as indicated by one-way ANOVA [$F(3, 380) = 12$, $p = 0.000$]. Post hoc comparisons using the Tukey test showed that the mean score for Group 1 (M = 4.71, SD = 1.09) was significantly different from Group 2 (M = 5.71, SD = 1.47) and Group 3 (M = 4.78, SD = 1.49) at $p < 0.01$ level of significance. Group 4 (M = 5.23, SD = 1.66) did not differ significantly from either Group 1, 2 or 3.

Similarly, total annual income variation was observed among the households who practice various livelihood strategies. A one-way between-groups analysis of variance was carried out to scrutinize the effect of income on the choice of livelihood strategies. It was found that there is a statistically significant mean difference in annual income for the livelihood groups as indicated by one-way ANOVA [$F(3, 380) = 23$, $p = 0.000$]. Post hoc comparisons using the Tukey test indicated that the mean score for groups being compared are significantly different from one another at the $p < 0.01$ level. The result of this study also indicated that on average, those households who reside nearest to the market center were more engaged in non/off-farm and/or combination of activities than those who live far from the market. A one-way analysis of variance was run to explore the effect of market distance on the choice of livelihood strategies. There was a statistically significant mean difference in market distance for the livelihood groups as indicated by one-way ANOVA [$F(3, 380) = 74$, $p = 0.000$]. Post hoc comparisons using the Tukey test indicated that the mean score for groups being compared is significantly different from one another at the $p < 0.01$ level. Furthermore, the mean age comparison showed that there was statistically significant difference among the households in their choice of livelihood strategy which indicates that younger households' were participated more in non/off-farm and/or combination of activities than older households (Table 3). A one-way between-groups analysis of variance was conducted to explore the impact of age on the choice of livelihood

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[3] TLU refers to Tropical Livestock Unit, which is equivalent to 250 kg live animal weight.

Table 4 Descriptive analytical results for dummy explanatory variables by choice of livelihood strategies. Source: survey data (2018)

Variables	Livelihood strategies of the households						
	Response	AG	AG + NF	AG + OFF	AG + NF + OFF	Total	χ2-value
Sex	Male	109 (28.4%)	82 (21.3%)	63 (16.4%)	44 (11.5%)	298 (77.6%)	26.733***
	Female	57 (14.8%)	16 (4.2%)	11 (2.9%)	2 (0.5%)	86 (22.4%)	
Credit access	Yes	32 (8.3%)	53 (13.8%)	33 (8.6%)	28 (7.3%)	146 (38.0%)	47.024***
	No	134 (34.9%)	45 (11.7%)	41 (10.7%)	18 (4.7%)	238 (62.0%)	
Educational status	Literate	31 (8.1%)	35 (9.1%)	20 (5.2%)	20 (5.2%)	106 (27.6%)	15.661**
	Illiterate	135 (35.2%)	63 (16.4%)	54 (14.1%)	26 (6.8%)	278 (72.4%)	
Improved seed	Yes	65 (19.9%)	38 (9.9%)	32 (8.3%)	23 (6.0%)	158 (41.1%)	2.122
	No	101 (26.3%)	60 (15.6%)	42 (11%)	23 (6.0%)	226 (58.9%)	
Fertilizer use	Yes	139 (36.2%)	66 (17.2%)	49 (12.8%)	27 (7.0%)	281 (73.2%)	17.866***
	No	27 (7.0%)	32 (8.3%)	25 (6.5%)	19 (5.0%)	103 (26.8%)	
Agro-ecology	Highland	38 (9.9%)	23 (6.0%)	16 (4.2%)	13 (3.4%)	90 (23.4%)	0.760
	Lowland	128 (33.3%)	75 (19.5%)	58 (15.1%)	33 (8.6%)	294 (76.6%)	
Cooperatives	Yes	65 (16.9%)	30 (7.8%)	17 (4.4%)	15 (3.9%)	127 (33.1%)	6.459
	No	101 (26.3%)	68 (17.7%)	57 (14.9%)	31 (8.1%)	257 (66.9%)	
Leadership	Yes	22 (5.7%)	11 (2.9%)	5 (1.3%)	5 (1.3%)	43 (11.2%)	2.178
	No	144 (37.5%)	87 (22.6%)	69 (18.0%)	41 (10.7%)	341 (88.8%)	
Training	Yes	46 (12.0%)	43 (11.2%)	22 (5.7%)	17 (4.4%)	128 (33.3%)	7.969**
	No	120 (31.2%)	55 (14.3%)	52 (13.6%)	29 (7.6%)	256 (66.7%)	

***, ** indicates significant at < 1% and 5% probability levels, respectively

strategies. There was a statistically significant mean difference in age between groups as demonstrated by one-way ANOVA [$F(3, 380) = 38$, $p = 0.000$]. Post hoc comparisons using the Tukey test indicated that the mean score for groups being compared are significantly different from one another at the $p < 0.01$ level.

Analysis of livelihood strategy choice using chi-square test

A chi-square test was conducted to examine whether there was association between discrete variables and livelihood strategies of the sample respondents. As indicated in Table 2, the chi-square test result showed the existence of significant differences in the choice of livelihood strategies among the wealth groups at less than 1% level (χ2-value = 71, df = 6, $p < 0.01$).

Moreover, there is a statistically significant difference among the livelihood groups in terms of dummy/categorical variables such as sex composition, credit access, fertilizer use, participation in agricultural training and educational status of the households at less than 1% and 5% probability levels (Table 4).

Income composition of the livelihood strategies

In the study area, rural households are engaged in various agricultural, non-farm and off-farm income generating activities such as crop sale, livestock and livestock product sale, handcrafts, petty trade, daily wage, remittance,

land rent as well as environmental gathering/exploitation of natural resources like fire wood and charcoal selling. The income portfolio analysis indicated that agriculture has a leading contribution to the total income of sample households which accounts for about 72.5%, whereas the share of non-farm and off-farm activities accounts 20% and 7.5% of total household income, respectively (Table 5).

The survey result showed that only 27.5% of the total household income was obtained from a combination of non/off-farm activities. This is in agreement with national estimate of the country on the contribution of off-farm and non-farm combination to rural households' income which accounts 20–25% [57]. As the finding of the study indicates agricultural activities are dominantly pursued by all wealth categories with more proportion by less poor and better-off households; while non/off-farm activities are survival mechanisms mainly by poor groups.

Determinants of livelihood diversification strategies: the econometric model results

A multinomial logistic regression was performed to model the relationship between predictors and the livelihood diversification strategies of the resettlers' households in the study area. Accordingly, this section presents the results obtained from multinomial logit

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Table 5 Income composition of the sample households by wealth category. Source: survey data (2018)

Income sources (%)	Households' wealth category			
	Poor (*N* = 173)	Less poor (*N* = 141)	Better-off (*N* = 70)	Total (*N* = 384)
Crop	29.2	43.1	44.6	42
Livestock	18.4	28.4	40	30.5
Agriculture subtotal	47.6	71.5	84.6	72.5
Petty trade	15	13.5	5.5	10.3
Remittance	1.5	4.3	4.6	4.7
Handcraft	11.5	3.0	2.3	5.0
Non-farm subtotal	28	20.8	12.4	20
Environmental gathering	9.8	4.5	2.2	2.5
Daily wage	14.6	2.8	0.6	4.0
Land rent	0.0	0.4	0.2	1.0
Off-farm subtotal	24.4	7.7	3.0	7.5
Total annual Income	755,400	932,650	660,500	2,348,550
Mean	4366.474	6614.539	9435.7143	6116.0156

Table 6 Multinomial logit model result on determinants of livelihood diversification strategies. Source: survey data (2018)

Variables	Households' livelihood diversification strategies								
	Agriculture + non-farm			Agriculture + off-farm			Agriculture + non-farm + off-farm		
	Coef	Std. Err	Odds ratio	Coef	Std. Err	Odds ratio	Coef	Std. Err	Odds ratio
Intercept	26.089	5.856		29.780	5.970		33.583	6.189	
SEX	− 1.412	0.865	0.244	− 1.457	0.889	0.233	− 2.589**	1.181	0.075
AGE	− 0.227***	0.057	0.797	− 0.212***	0.057	0.809	− 0.260***	0.063	0.771
HHSZ	1.881***	0.400	6.562	1.560***	0.405	4.759	1.894***	0.431	6.644
EDUST	− 3.742**	1.176	0.024	− 3.782*	1.205	0.023	− 4.323**	1.244	0.013
AGECO	− 0.512	0.782	0.599	− 0.378	0.812	0.685	− 1.049	0.889	0.350
FERTLZ	− 0.449	0.795	0.638	− 0.659	0.830	0.517	− 0.272	0.894	0.764
LIVSTK	− 2.284**	0.727	0.102	− 2.704***	0.752	0.067	− 2.518**	0.825	0.081
LANDSZ	− 4.658***	1.084	0.009	− 5.204***	1.140	0.005	− 5.444***	1.227	0.004
IMSEED	0.699	0.736	2.013	0.724	0.758	2.062	0.529	0.824	1.697
CRDT	− 1.957**	0.901	0.141	− 1.917	0.929	0.147	− 2.337*	0.989	0.097
EXTCON	0.244	0.172	1.277	0.342	0.177	1.408	0.196	0.194	1.216
MKTD	− 1.554***	0.365	0.211	− 1.549***	0.374	0.212	− 3.069***	0.466	0.046
TRAIN	− 2.199**	0.887	0.111	− 1.873	0.917	.154	− 1.865	0.975	0.155
MCOOP	1.160	0.752	3.189	1.136	0.776	3.113	0.691	0.844	1.997
LEADR	− 0.866	1.382	0.421	− 0.811	1.427	0.444	− 1.759	1.527	0.172
INCOM	1.000**	0.000	1.001	0.000	0.000	1.000	0.000	0.000	1.000
Reference category:	Agriculture alone								
Dependent variable:	Livelihood diversification strategies								
Number of observations:	384								
− 2 Log likelihood model fitting:	Intercept only—985.023, Final—446.243								
LR chi-square test:	538.780								
Degrees of freedom:	48								
Significance:	0.000***								
Pseudo R^2:	0.817								

***, **,* indicates significant at < 1%, 5% and 10% probability levels, respectively

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model indicating the significant factors that determine the choice of households' livelihood strategies. Before running the model, multicollinearity tests among the hypothesized explanatory variables were checked using variance inflation factor for continuous variable and contingency coefficient for the discrete variables. The multicollinearity test results have shown no serious problems among explanatory (dummy and continuous) variables (see Appendix Tables 11 and 12). Besides, the model was run and tested for the validity of independence of irrelevant alternatives (IIA) assumption using Hausman test. On examining the output from Hausman test (Prob > chi2 = 0.9485), we see that there is no evidence that the IIA assumption has been violated (see Appendix Table 13). Therefore, we try to present the major findings on factors that affect the choice of households' livelihood strategies. The result of multinomial logit model indicates that among the hypothesized variables, age of the household head (AGE), land holding size (LANDSZ), sex (SEX), education status (EDUST), size of livestock holding (LIVSTK), distance to the market (MKTD), access to credit service (CRDT), agricultural training (TRAIN), total annual income (INCOM) and Household sizes (HHSZ) were the major determinants of livelihood diversification strategies (Table 6). The model result is presented using agriculture alone strategy as a base/reference case scenario and the interpretations of only statistically significant variables are presented as follows.

The model result indicated that sex had negatively and significantly affected the probability of diversifying livelihood into agriculture plus non-farm plus off-farm activities at less than 5% significance level. The negative coefficient implies that female headed households are less likely diversifies livelihood strategies compared to the male counterparts. If other factors remain constant, the likelihood of female headed households to diversify into agriculture + non-farm + off-farm livelihood strategy is less by a factor of 0.075 relative to the base case. Conversely, male headed households have more tendency of engaging in various livelihood options. The probable reason is that female households have difficulty of participation in non/off-farm activities due to cultural barriers and have more responsibilities in home management activities. In other words, men and women have differentiated social roles in the community. The key informants also stated that culture-based gender role discrepancy forces the female households to less engage in diverse livelihood activities and females were busy in domestic roles such as childcare, cooking, washing cloth and fetching water in the study area. This result is in agreement with previous studies conducted by [20, 39].

As hypothesized, age of the household head negatively and significantly influences the choice of agriculture + non-farm, agriculture + off-farm and combination of agriculture + non-farm + off-farm livelihood strategies equally at less than 1% probability level. Keeping the influence of other factors constant, the likelihood choice of agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm activities decreases by a factor of 0.797, 0.809 and 0.771, respectively, as age of the household increases by one year relative to the base agriculture only. This implies that the participation of households in diverse livelihood strategies decreases as age increases. In other words, younger households are relatively more engaged in non/off-farm and/or combination of activities than older households. The possible explanation is that younger households cannot get enough land to support their livelihoods compared to the older households. Focus group discussion participants also mentioned that as age of the farm household increases, the farmer will be getting older and could not be capable of diversifying livelihoods and more likely concentrate on agricultural activities for their subsistence. This result is consistent with the findings of [16, 37, 58, 59].

The study found that household size had positively and significantly affected the choice of agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm activities equally at less than 1% significance level. The odds ratio depicted that ceteris paribus, the likelihood of households to diversify into agriculture + non-farm, agriculture + off-farm and combination of agriculture + non-farm + off-farm livelihood strategies increases by a factor of 6.562, 4.759 and 6.644, respectively, as household size increases by one relative to the base agriculture only. Hence, households' with large family sizes are more likely participate in non/off-farm and/or combination of activities. The positive association between household size and diversification might be due to the relation between large family size and household labor as well as corresponding demand for food. The result of this study is in line with the findings of [60, 61].

As prior expectation, livestock ownership in TLU had negative and significant influence on the decision of households' participation into agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm livelihood strategies at less than 5%, 1% and 5% probability levels, respectively. The negative coefficient implies that the probability of engagement in livelihood diversification decreases as livestock holding size increases. The odds ratio revealed that given all other factors being kept constant, an increase in livestock

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holding by one TLU decreases the likelihood choice of agriculture + non-farm, agriculture + off-farm and combination of agriculture + non-farm + off-farm livelihood strategies by a factor of 0.102, 0.067 and 0.081, respectively, relative to the base agriculture alone. In other words, households' having large size livestock are less likely diversify livelihoods compared to those who have small number of TLU. The possible explanation for this could be attributed to the fact that households with more TLU have better opportunity to earn more income from livestock production which enables them to fulfill their livelihood requirements. Consequently, farm household who can get the required income from livestock may not engage in other income generating activities. Conversely, households with less number of livestock endeavor to diversify their income sources by participating in a range of livelihood activities. This is because small number of livestock holding does not enable them to generate enough income to support family needs which cause them to participate in other alternative livelihood options. Consistent with this finding, study conducted by [62] in East Gojjam zone of Ethiopia found that livestock holding has negative and significant relationship with non/off-farm livelihood diversification strategies. In contrast, Dinku [37] reported that livestock holding positively influences the choice of household's combinations of pastoral, non-farm and off-farm livelihood strategy at $p < 0.01$ significance level. According to his justification, households with higher livestock holdings are more capable of affording the cost of strategic livelihood diversification which aims at the accumulation of wealth.

Distance from the nearest market had negatively and significantly affected households' choice of agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm livelihood strategies equally at less than 1% significance level. The negative association between market distance and diversification indicates that livelihood diversification decreases as distance from the market center increases. The odds ratio showed that keeping other factors constant, a 1% increases in the time taken from the nearby market distance decreases the likelihood choice of agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm activities by a factor of 0.211, 0.212 and 0.046, respectively, relative to the base agriculture only. In other words, farm households closer to the market center are more participated in various livelihood activities. The possible explanation for this could be attributed to the fact that households far from market center have no easy and quick physical access to the market to transport the amount produced. FGD participants mentioned that proximity to the market

center creates access to additional income by providing non/off-farm employment opportunities, ease access to input and transportation. Similarly, previous studies conducted by [59, 63] reported that as market distance increases from home, households' non/off-farm income diversification will be discouraged due to transportation costs.

Land holding size had negatively and significantly influenced livelihood diversification into agriculture + non-farm, agriculture + off-farm and agriculture + non-farm + off-farm activities equally at less than 1% level of significance. The odds ratio indicated that keeping other variables constant in the model, a one hectare increase in the farm size of household decreases the likelihood choice of agriculture plus non-farm, agriculture plus off-farm and agriculture + non-farm + off-farm activities by a factor of 0.009, 0.005 and 0.004, respectively, relative to the base case. This implies that households with large land holding size less likely diversify livelihoods compared to those who have small land size. Consequently, households having large farm sizes rely on agriculture than diversifying livelihood activities to meet their livelihood requirements. The possible reason can be large land holding size enables the farm households to follow agricultural extensification to produce more and increase farm income. In agreement to this result, study conducted by [60] in Tigray Region of Ethiopia also found that the probability of engaging in various livelihood strategies decreases as land holding size increases and the researcher argued that farmers with larger land size were encouraged to involve more on farming activities.

Educational status was found to have negative and significant influence on the decision of the households' participation in agriculture plus non-farm, agriculture plus off-farm and agriculture plus non-farm plus off-farm livelihood strategies at less than 5%, 10% and 5% significance levels, respectively. The negative coefficient indicates that illiterate households are less likely diversifies livelihood strategies into non/off-farm and/or combination of activities compared to the literate counterparts. The odds ratio showed that given all other factors being kept constant, the probability of illiterate households to choose agriculture + non-farm, agriculture + off-farm and combination of agriculture + non-farm + off-farm livelihood strategies is less by a factor of 0.024, 0.023 and 0.013, respectively relative to the base case. Therefore, the chance of livelihood diversification is low for illiterate households; whereas educated farmers are more likely diversify their income portfolio by participating in various activities. The possible reason can be illiterate household lacks knowledge, skills and experiences of demanding livelihood options and may concentrate

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merely on agriculture for the purpose of maximizing subsistence consumption needs. Key informants also reported that improvement in literacy status increases the possibility of engagement in non/off-farm activities. This finding is similar to that of [27].

Household income has positive and significant influence on the choice of agriculture plus non-farm activities at less than 5% probability level. The positive coefficient indicates that households having large income were more likely to diversify livelihood into non-farm activities compared to those households with low income. The odds ratio depicted that keeping the influence of other factors constant, the probability of diversifying into agriculture + non-farm livelihood strategies increases by a factor of 1.001 for those households with more income relative to the base agriculture only. The probable reason for this could be attributed to the fact that farm households with adequate annual income can overcome financial constraints and invest on a range of livelihood options. In agreement to this finding, previous study conducted by Gecho et al. [21] in Wolaita zone of southern Ethiopia also found that annual income of the households have positive and significant relationship with on-farm plus non-farm activities.

Credit use was found to have significant and negative effect on the likelihood choice of agriculture + non-farm and agriculture + non-farm + off-farm livelihood strategies at less than 5% and 10% probability levels, respectively. The negative coefficient indicates that households who have no credit access are less likely diversifies livelihood options and they rely on agriculture. The interpretation of odds ratio showed that given all other factors constant in the model, the probability households' participation in agriculture + non-farm and agriculture + non-farm + off-farm livelihood strategies is less by a factor of 0.141 and 0.097, respectively, for those households who do not have access to credit services relative to the base case. Conversely, those households who have access to credit facilities are more engaged in different livelihood activities. This is because credit access and utilization allow the possibility to invest in non/off-farm activities. The key informants mentioned that providing credit for resource poor farmers will enhance the livelihood diversification. This result is similar with the findings of [26].

The study found that agricultural training has negatively and significantly affected the choice of agriculture plus non-farm activities at less than 5% level of significance. This implies that households who were not participated in agricultural training are less likely diversifies their livelihood activities, whereas farm households who participated in agricultural training were

practiced diverse livelihood strategies. If other factors remain constant, the probability of livelihood diversification into agriculture plus nonfarm activities for households who do not participate in agricultural training is less by a factor of 0.111 relative to the base case. Thus, training enhances and improves knowledge, skills and experiences of the farmers which support them to expand income generation options. This finding is in agreement with that of [58].

Constraints of rural livelihood diversification strategies in the study area

Diversification of rural livelihood has important implications on rural poverty and food insecurity in the context of inadequate and rain-fed-dependent households. Information obtained from the key informants indicated that livelihood diversification plays a vital role to attain food self-sufficiency at household levels, to improve living standards of the local community as well as to reduce poverty and vulnerability to food insecurity in the study area. This idea has been also reflected in focus group discussion sessions. Similarly, study conducted by [64] found that livelihood diversification have different roles such as improvement in household consumption, increased income and well-being as well as for efficient and effective utilization of rural labor forces at household and national level. Although livelihood diversification is an important survival strategy for the rural households to sustain livelihoods and reduce vulnerability, there are many bottlenecks to engage in successful livelihood diversification in the district. According to focus group discussants, some of the major constraints that affect livelihood diversification in the area include: lack of infrastructural development, road and transportation problems, farmland scarcity, absence of technical support from concerned bodies, limited access to credit services, poor rural–urban linkage, lack of access to market, lack of working capital, inadequate skill training, lack of awareness as well as poor coordination and collaboration among stakeholders. Therefore, gaining insight about the determinants and constraints of livelihood diversification strategy is crucial to pinpoint the challenges of rural development for intervention so as to improve the livelihood and food security situation of the rural communities. In this regard, concerned stakeholders should give due attention and incorporate those factors and constraints in planning rural development.

Conclusions and recommendations
The study analyzed the rural livelihood strategies adopted by resettlers' households and major determinant factors that influence the choice of livelihood

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diversification strategies in Chewaka district of Ethiopia. It was found that agriculture is the main economic activity and basis of livelihoods for the rural households of the study area. The farming system is predominantly rain-fed, traditional, subsistence oriented and it is mixed crop–livestock production. The uncontrolled population growth coupled with smaller farm size, rainfall dependency, erratic rainfall pattern and low return from farming activities has forced the resettlers' households to pursue different income generating activities for their survival and livelihood improvement as well as to cope with the challenges of their livelihoods. The survey results revealed that agriculture alone (43.2%), agriculture plus non-farm (25.5%), agriculture plus off-farm (19.3%) and a combination of agriculture plus non-farm plus off-farm (12%) activities are the most pertinent livelihood strategies in the area. The income portfolio analysis indicated that agriculture has a leading contribution to the total income of the households which accounts for about 72.5%, whereas the share of non-farm and off-farm activities accounts for 20% and 7.5% of total household income, respectively. Multinomial logit model result showed that that among the hypothesized variables, age of the household head, land holding size, educational status, sex, size of livestock holding (TLU), distance to the nearest market, access to credit service, agricultural training, total annual income and household sizes were the major determinants of livelihood diversification strategies. Moreover, it was found that lack of infrastructural development,

road and transportation problems, poor rural–urban linkage, absence of technical support from concerned bodies, farmland scarcity, lack of working capital, limited access to credit facilities, lack of access to market, inadequate skill training and lack of awareness as well as poor coordination and collaboration among different stakeholders are constraints to livelihood diversification in the area. The study concludes that agricultural sector alone cannot be relied upon as the core activity for rural households and as a means of reducing poverty, achieving food security and improving livelihoods in the study area. Thus, a comprehensive development plan that enhances successful livelihood diversification is found to be imperative and most urgent. Policies and actions directed towards improving the livelihood of resettlers' communities should focus on the development and expansion of rural infrastructures like road network, market center, strengthening rural–urban linkage and the provision of credit services and trainings, awareness creation activities as well as institutional arrangements and cooperation to bring sustainable livelihood outcome in the area.

Appendix 1
See Tables 7, 8, 9, 10, 11, 12, and 13.

Table 7 Description of explanatory variables used in multinomial logit model. Source: own articulation (2018)

Variables	Description of explanatory variables	Nature	Expected sign
SEX	Sex of the household head (1 if male; 0 otherwise)	Dummy	+
AGE	Age of the household head in years	Continuous	−
LIVSTK	Total livestock owned by the household in TLU	Continuous	−
HHSZ	Total household size of the household in adult equivalent	Continuous	+
LANDSZ	Land holding size of the household in hectare	Continuous	−
MKTD	Distance of household's home from the market in hour	Continuous	−
EDUST	Educational status of the household (1 if literate; 0 illiterate)	Dummy	+
CRDT	Access to credit services(1 if yes; 0 otherwise)	Dummy	+
FERTLZ	Chemical fertilizer use of the household (1 if yes; 0 otherwise)	Dummy	+
EXTCON	Frequency of extension agent contact with household in a year	Continuous	+
INCOM	Total annual income of the household head in Birr	Continuous	+
ISEED	Household use of improved seed (1 if yes; 0 otherwise)	Dummy	−
AGRECO	Agro-ecology where household lives (1 if highland; 0 lowland)	Dummy	+
MCOOP	Household membership in cooperative (1 if yes; 0 otherwise)	Dummy	+
TRAIN	Access to agricultural training (1 if yes; 0 otherwise)	Dummy	+
LEADR	Household participation in local leadership (1 if yes; 0 otherwise)	Dummy	+

Table 8 Criteria used in classifying the wealth category of the households in the study area. Source: modified from Ellis and Bahiigwa (2003); Ellis and Tassew (2005) cited in Berlie [65]

Criteria	Poor	Less poor (medium)	Better-off
Farm size (ha)	≤ 1.0	1.0–1.75	1.75–3.00
Cattle owned	≤ 1.0	2.0–4.0	4 and above
Goats and sheep	3.0–5.0	10.0–20.0	≥ 20
Oxen owned	≤ 1.0	1.0–2.0	2 and above
Other assets owned	Poor quality of grass thatched roof and no significant perennial trees	Good quality of grass thatched and tin roof houses, have trees production	Own tin roofed house, fruits and trees production
Food security status	Consume from own produce not more than 3 months	Consume from own produce from 6 to 8 months	Consume from own produce throughout the year
Livelihood activities	Selling fuel wood, charcoal and daily or causal labor	Farming and some form of trade	Farming, petty trade, sell livestock and crop production
Household head	Dominated by female headed households	Male/female headed	Dominated by male headed

Table 9 Conversion factors used to estimate Tropical Livestock Unit. Source: Fekadu [66]

Types of livestock	TLU	Types of livestock	TLU
Cow/ox	1	Calf	0.2
Heifer	0.5	Sheep/goats	0.15
Mule	1.15	Poultry	0.005
Horse	1.1	Donkey	0.65

Table 12 The variance inflation factors of continuous independent variables. Source: survey result, 2018

Variables	Collinearity statistics	
	Tolerance	VIF
AGE	0.552	1.812
HHSZ	0.969	1.032
LANDSZ	0.552	1.811
LIVSTK	0.680	1.471
EXCON	0.897	1.114
MKTD	0.838	1.194
INCOM	0.734	1.362

Table 10 Conversion factors used to estimate adult equivalent (AE). Source: Storck et al. (1991) cited in Yizengaw et al. [62]

Age categories	Male	Female
< 10	0.6	0.6
10–14	0.9	0.75
15–50	1	0.8
> 50	1	0.8

Table 11 Contingency coefficients for categorical/dummy independent variables. Source: survey result, 2018

Variables	SEX	LEADR	CRDT	COOP	AGRECO	IMSEED	FERTLZ	EDUST	TRAIN
SEX	1.000								
LEADR	− 0.009	1.000							
CRDT	− 0.003	0.011	1.000						
COOP	0.028	− 0.049	0.026	1.000					
AGRECO	− 0.014	0.061	0.015	0.045	1.000				
IMSEED	− 0.050	0.076	0.023	− 0.033	0.069	1.000			
FERTLZ	0.060	− 0.091	− 0.001	− 0.072	− 0.028	0.066	1.000		
EDUST	− 0.072	0.040	− 0.248	− 0.150	− 0.091	− 0.032	0.083	1.000	
TRAIN	− 0.023	− 0.029	− 0.024	− 0.051	− 0.021	− 0.038	0.146	− 0.125	1.000

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Table 13 Hausman IIA test result. Source: stata output from field survey data (2018)

	Coefficients			
	(b)	**(B)**	**(b−B)**	**sqrt(diag(V_b−V_B))**
		Allcats	**Difference**	**SE**
AG_NF				
SEX	1.686715	−1.41175	0.2749646	0.4322963
AGE	− 0.273165	− 0.2270614	− 0.0461036	0.0544277
FAMAE	1.914234	1.881283	0.0329511	0.2229151
LANDSZ	− 4.515155	− 4.657918	0.1427626	0.4648468
FERTLZ	1.102421	0.4494411	0.6529802	0.5222354
IMSEED	− 0.0742946	− 0.6993862	0.6250916	0.2755833
EXTCON	0.3290749	0.2441645	0.0849104	0.081823
MEMCOOP	− 1.45052	− 1.159611	− 0.2909084	0.4930758
MKTDS	− 1.741174	− 1.55422	− 0.1869534	0.2316093
AGRECO	0.4327891	0.512057	− .0792679	0.2817749
LIVSTK	− 2.526624	− 2.283552	− .2430713	0.4378659
INCOME	− 0.0000448	− 0.000028	− 0.0000167	0.0000606
CREDT	2.129106	1.957358	0.1717479	0.2897373
EDULEV	3.862181	3.742426	0.1197552	0.4898837
AGTRAIN	2.558605	2.198839	0.359766	0.5138313
LEADER	− 1.525392	0.8661315	− 2.391524	0.6936465
_cons	18.48063	16.81024	1.670389	2.614605
AG_NF_OFF				
SEX	2.951288	2.588965	0.3623227	0.5351626
AGE	− 0.3075577	− 0.2603474	− 0.0472103	0.0570517
FAMAE	1.887072	1.893744	− 0.0066718	− 0.2378839
LANDSZ	− 5.285936	− 5.444487	− 0.1585514	− 0.5452906
FERTLZ	0.9669938	0.2716289	0.6953649	0.6018771
IMSEED	0.0214613	− 0.5288783	− 0.5503396	0.3576673
EXTCON	0.3158669	0.1957605	0.1201064	0.0968022
MEMCOOP	− 0.8689963	− 0.6913966	− 0.1775998	0.5482829
MKTDS	− 3.234083	− 3.069483	− 0.1646002	0.2606028
AGRECO	0.8810604	1.048685	− 0.1676249	0.3851951
LIVSTK	− 2.884798	− 2.517755	− 0.3670429	0.4942243
INCOME	− 0.0000667	− 0.000028	− 0.0000387	0.0000843
CREDT	2.797798	2.336985	0.4608132	0.3922781
EDULEV	4.679637	4.323131	0.3565055	0.5523793
AGTRAIN	2.213946	1.864912	0.3490349	0.5883015
LEADER	− 0.9181255	1.75850	− 2.676631	0.7209297
_cons	22.45826	20.60995	1.848313	2.888274

b = consistent under Ho and Ha; obtained from mlogit

B = inconsistent under Ha, efficient under Ho; obtained from mlogit

Test: Ho: difference in coefficients not systematic

chi2(32) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 20.16

Prob>chi2 = 0.9485

(V_b-V_B is not positive definite)

Abbreviations

ANOVA: Analysis of variance; AE: Adult equivalent; BZARDO: Buno Bedelle zone agriculture and rural development office; CSA: Central statistical agency; GDP: Gross domestic product; FGD: Focus group discussion; ha: Hectares; MNL: Multinomial logit; NMSA: National meteorological service agency; SPSS: Statistical package for social science; SSA: Sub-Saharan Africa; TLU: Tropical livestock units; WFP: World food program; VIF: Variance inflation factor.

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Declarations

Ethics approval and consent to participate
An effort was made to conduct the research in an ethical manner. A research site permission letter was obtained from the concerned institutions and the participants' consent was asked before commencing the interviews and discussions.

Consent for publication
All authors agreed and approved the manuscript for publication.

Competing interests
The authors declare that they have no competing interests.

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