The extent of livelihood diversification on the determinants of livelihood diversification in Assosa Wereda, Western Ethiopia

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Abstract This study was conducted to examine the determinants of diversification of livelihoods to investigate the degree of diversification of households' livelihoods in Assosa wereda, Benshangul Gumuz Regional State, in western Ethiopia. A total of 320 sample rural households were selected by using systematic sampling technique from four kebeles. Both qualitative and quantitative data collected through a structured questionnaire, key informant interview, focus group discussions and observation. The data were analyzed using descriptive statistical tools, the multinomial logit regression model, and Simpson Diversification Index. The result of the study show, of the 14 determinants of diversification of livelihoods identified: level of education, dependency ratio, access to irrigation, and household urban linkage were significant predictors of diversification of livelihoods. Whereas household age and sex, road distance, credit access, and household media access were insignificant predictors of diversification of livelihoods. Meanwhile, land hold size, livestock holding

size in Tropical Livestock Unit, extension contact, cooperative member and total household income couldn't have any association with household diversification of livelihoods in real conditions on the ground. Ultimately, the Simpson Diversity Index result showed that there was no diversification rather than "specialization" in livelihood. The study therefore urges more diversification opportunities in poverty alleviation and development.

Keywords Livelihood diversification · Livelihood · Odd ratio · Capitals/assets · MNL regression

Introduction

Livelihood is a means of living, skills required, property/assets, and activities (Chambers and Conway 1992; Carney 1998). A lifestyle includes employment, social structures, gender roles and property rights required to achieve and maintain a certain standard of living also included in livelihood (Ellis 1998). It also includes access to and benefits derived from state-provided social and public services such as education, health services and other infrastructure. Following Chambers and Conway (1992), a livelihood is deemed sustainable if it can cope with and recover from stress and shocks, and maintain or enhance its capabilities and assets both in the present and in the future, without

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undermining the livelihoods of future generations (DFID 1999).

On the other hand, diversity and diversification in livelihoods is used to include growing, multiplying sources of revenue. Diversity refers to the existence at one time of multiple sources of income (Scoones 2009); whereas diversification refers to the growth of diversity as the dynamic economic and social process of the farm household (Ellis 2000a, b). Livelihood diversification is, hence, one of the livelihood strategies (coping mechanisms) and defined as “the process through which rural families build a diverse portfolio of activities and social support capacities in their struggle for survival and improving their living standards” (Ellis 1997: 5). Similarly, Scoones (1998: 9) defined diversification of livelihoods as “developing a large portfolio of earnings to cover all types of shocks or stresses jointly or the strategy may include concentrating on developing responses to a specific form of common stock or stress through well-developed coping mechanisms”. Furthermore, livelihood diversification is a continuous adaptive cycle in which household’s add new practices, maintain existing once or drop other one, thus retaining diverse and evolving livelihood portfolios (Admiral 2012).

However, there are different views on the strategic rationales of diversification of livelihoods among farm households. Some argue that diversification of livelihoods occurs as a survival technique against a high susceptibility to disasters and shocks, scarcity of resources and poverty. Whereas, other authors find widening options and incentives to boost income and living conditions to be the reason behind livelihood diversification (Ellis 2000a, b). Whatever the case, livelihood diversification is the main strategy by which people in many parts of the world seek to reach ends and enhance their well-being.

Nevertheless, for diversification of livelihoods resources are very crucial. These are the capital/assets from which individuals draw in order to convey out their strategies for their livelihood. Policies, institution and processes (PIP) are also important social, political, economic and environmental factors that decide the choices of individuals, existing ways of doing things, and thus help to shape livelihoods. On the other hand, the ecological or social or economic or political vulnerability faced by individuals or communities in the form of sudden shocks, long term patterns or seasonal cycles determines the types of livelihoods

(DFID 1999; Scoones 2005). Hence, livelihood diversification as the strategy it is the part and went around the five components (capitals, livelihood strategies, vulnerability, PIP, and livelihood outcomes) of sustainable livelihood framework.

Capitals/assets are encompassing financial, human, social, physical, and natural capital. These people’s assets or resources to make a living are further divide it into sub components: human (skills, knowledge, health, and job skills), social networks (membership of formalized groups and trust relationships that facilitate cooperation and economic opportunities), natural (Land, soil, water, forests, and fisheries), physical (roads, water and sanitation, schools, ICTs, and manufacturing goods, including tools and equipment), and financial (savings, credit, employment, trade, and remittances) (DFID 1999; Ellis 2000a, b; Alinovi et al. 2010). These capitals/properties are boost livelihoods. Farmers with good assets may therefore follow better resource management practices (example market-oriented, agronomic approaches or intensification) and seek a high yield/winning strategies of livelihood that lead to positive livelihood outcomes (DFID 1999; Scoones 2005; Shiferaw et al. 2007; Liyama et al. 2008).

On the other hand, PIP that impacts people’s ability to use these assets to achieve positive livelihood outcomes (UNDP 2009; Serrat 2008; Alinovi et al. 2010) is a significant influence on the livelihood strategies chosen by citizens. While, livelihood outcomes are the outputs of livelihood strategies, and these outcomes are diverse and result from the combined impact of other components of the livelihood system on assets and livelihood strategies (DFID 1999; Farrington et al. 2002). Improved livelihood outcomes (less poverty, less unemployment, stronger food security and a stable natural resource base) strengthen the stock of capital/assets that can be used for efficient farming and subsequently for managing natural resources (Shiferaw et al. 2007). Therefore, household wellbeing is the product of household’s adoption of livelihood strategies such as livelihood diversification. A survival strategy is an interconnected array of biophysical, political, economic, social, cultural, and psychological components (CSA and WFP 2014) influencing lifestyle preferences, goals, beliefs, and life threatening behaviours.

Hence, different social, economic, and environmental factors are identified by factors as determinants

of the diversification of the activities of farm households' livelihood. For instance, the determinants of non-farm diversification of livelihood strategy are: (1) human capital variables (household size and composition, such as age, gender, education, dependency ratio, extension contact); (2) Location variables (road access, distance to markets and towns, availability of electricity); (3) Initial household resources and social organization (sustainable assets, access to irrigation, access to media and cooperation); (4) Financial assets (total revenue, deposits and access to loans, and livestock holdings in Tropical Livestock Unit (TLU)); and (5) Risk measures (exposure to shocks) (Reardon et al. 1998; Barrett et al. 2001; Woldehanna and Oskan 2001; de Janvry and Sadoulet 2001; Mollers and Buchenrieder 2005; Lanjouw et al. 2007; Kimsun and Sokcheng 2013; Khatun and Roy 2012; Adugna 2012; Yenesew et al. 2015). These determinants of livelihood diversification are on one way or others decide the diversification of livelihoods.

On the other hand, household livelihood activities are may be income generating activities, risk reduction strategies, and loss management strategies. Household livelihood activities are not beyond these three activities. Households can generate income by taking part in wage labor and self-employment. Wage labor may be local or migratory labor, formal employment or daily labor, and payment in cash or in kind. Income generating activities are also discerned by whether they are formal or informal and legal or illegal. Self-employment activities on the other hand, can be sorted into: (1) agricultural production, (crops, aquaculture, and livestock); (2) agro or other processing; (3) small-scale manufacturing; (4) service provision; and (5) trading. Meanwhile, risk reduction and loss management strategies are risk exposure, resilience, and sensitivity (Scoones 2009; UNDP 2009). Of these agriculture is one of the major self-employment activities in less developed world.

Agriculture sector is accounts for a relatively small share of the global economy, but remains central to a vast number of people's lives. For example, an estimated 1.3 billion or 19% of the world's 7.1 billion population were directly engaged in agriculture in 2012, but agriculture (including the comparatively small hunting/fishing and forestry sectors) accounted for just 2.8% of total income (World Bank 2012). Looking beyond direct employment, about 2.6 billion people worldwide in 2010 relied on agriculture for

their livelihoods, either as actively engaged workers or as dependents. In the meantime, around half of the world's population lives in rural areas, of which about 75% of the economically active extreme rural poor are mainly engaged in agriculture (FAOSTAT 2013). However, that's not uniform all over the world. For instance, in a poor country like Ethiopia and Madagascar, more than three -quarters of the labor force is employed in agriculture. Whereas, only one in 100 citizens works in agriculture in rich countries such as Germany or the United Kingdom (Castaneda et al. 2018).

Likewise, over half of the developing world's population 3.1 billion people or 45% of all humanity live in rural areas. Around 2.5 billion of them derive their livelihoods from agriculture. Agriculture can be an engine of economic growth for many economies particularly for those developing countries. Approximately two-thirds of the world's agricultural value added is produced in developing countries, with the agricultural sector contributing up to 30% of GDP in many of them and providing two-thirds of the labor force with jobs (FAO 2009). According to the World Bank, development in the agricultural sector can be up to 3.2 times more effective at reducing US\$1/day poverty than growth in other sectors. Importantly, agriculture may provide a refuge of resilience, even more successful than other industries, against global economic and financial turmoil (FAO 2009; World Bank 2012).

Thus the agriculture sector is critically important for maintaining livelihoods. It accounts for up to 80% of jobs in the poorest African countries and over 40% of the national economies, and up to 25% of the Asian and Latin American economies. Moreover, for the majority of the poorest, agriculture remains the primary source of livelihoods. It is important to increase agricultural productivity to tackle hunger and food insecurity (Chisholm and Crowley 2005). In the meantime, agriculture remains the cornerstone of the economy and the main source of livelihood for sub-Saharan Africa, which employs about 70% of the workforce and has almost 33% of GDP (Waughray 2011). Nevertheless, in sub-Saharan African countries, agriculture (rain-fed farming) as the primary source of income has not secured adequate livelihood for most farming households (Babatunde 2013). This is because in sub-Saharan African countries, the agricultural sector is highly characterized by small

sized farm land, low production per crop, high subsistence farming (Jirstrom et al. 2011) and vulnerable to a range of stresses, including those related to human-induced climate change (Challinor et al. 2007).

Likewise, the economy of Ethiopia is dominated by smallholder farming, which employed 89% of the population and contributed 56% of GDP and 67% of export earnings in 1997 (Bollinger et al. 1999); and about 41% of GDP, 85% of employment, and 90% of exports in 2014 (CSA and WFP 2014). The Plan for Growth and Transformation (Five Year Plan for the Country 2010–2015) places particular focus on agriculture as the lead fuel development sector in Ethiopia. Nevertheless, under optimal weather conditions agriculture does not satisfy the well-being and food needs of the household. In Ethiopia; therefore, the proportion of poor people in 2012/13 was estimated at 26% (MoFED 2014; CSA and WFP 2014). Recent figures show that 26.8% of the populations below the

poverty line are in rural areas and 22% in urban areas (MoFED 2014). Consequently, in years of low or intermittent rainfall, the majority of households face seasonal hunger, starvation and famine.

Furthermore, as the MoFED (2004) study shows the incidence of poverty in the Benshangul Gumuz Regional State (BGRS) was 54%, which was one of the highest in the country's regions. Further studies also show that the region was one of the most vulnerable areas in the country (World Bank 2003; Guyu 2016). Thus, to reduce the incidents of this poverty, households livelihood diversification is thus, very important. To make decisions, hence, it is very important to know the status of household livelihoods diversification. Therefore, the aim of this study is to assess the degree of diversification of livelihoods by examining the determinants of diversification of livelihoods in the context of Assosa *wereda*, BGRS, Ethiopia. Finally, the study draw up some policy

Fig. 1 Conceptual Framework of Livelihood Diversification. Source: Adapted from DFID 1999; Scoones 2005

recommendations that could help smallholder farmers to diversify their livelihoods out of natural resource based, reducing poverty, maintain food security, mitigate vulnerabilities and optimizing their well-being.

Conceptual framework

One more significant feature of livelihoods is their interdependency. Very few livelihoods exist in isolation. A livelihood offered may be dependent on other means of subsistence for accessing and exchanging properties. Traders rely on farmers for example to produced goods, prepare them for processors and sell them for consumers. Livelihoods also fight to get access to assets and markets. Consequently, in turn, positive and negative impacts on any given life could affect others (UNDP 2009). Livelihood strategies, for example, combine agronomic strategies (such as agricultural intensification versus extensification) with diversification of livelihoods (Scoones 2005).

Therefore, the linkages between them were forward and backward. As indicated in sustainable livelihood Framework (DFID 1999; Scoones 2005) the livelihood of a given household is dependent up on its asset endowments mainly human, social, physical, financial, and natural capitals which together enable households to pursue a sustainable livelihood. In the meantime, as Reardon et al. (1998); Barrett et al. (2001); Woldehanna and Oskan (2001); de Janvry and Sadoulet (2001); Mollers and Buchenrieder (2005); Lanjouw et al. (2007); Kimsun and Sokcheng (2013); Khatun and Roy (2012); Adugna (2012) and Yenesew et al. (2015) disclose the determinants of livelihood diversification (age of household head, sex of household head, education level, dependency ratio, landholding size, road distance, livestock holding size, extension contact, access to irrigation, access to mass media, access to credit, urban linkage, cooperative and total income) are emerged from these capitals.

On the other hand, livelihood strategies are the combination of activities (livelihood diversification, natural resources based, market based) that people choose to undertake in order to achieve their livelihood goals (Ellis and Allison 2004). Whereas, livelihood activities are actions taken by the household to obtain household income. Therefore, the concept of livelihood includes the assets needed for a means of life (livelihood diversification determined) and

activities (livelihood diversification) and is sustainable when it can cope with and recover from shocks and stresses and retain or boost its assets now and in the future. This highlights the interplay that tends to be dynamic and contextual between the various components of the Livelihood Framework Approach.

For this study thus, Sustainable Livelihood Approach was used as an empirical tool to examine what were the determinants of diversification of livelihoods? Which determinants of diversification of livelihoods were essential for households' livelihood diversification? How these determinants were used by strategies? And how PIP and vulnerabilities affected households' livelihood diversification determinants in the study area? Finally, the framework starts out from the perspective of vulnerability and concludes with the outcome of the livelihood (see Fig. 1).

Literature review

The concepts of livelihood diversification and livelihood framework approach

As far as the definition is concerned, livelihood is based on multidimensional definitions and could be regarded from various viewpoints. Therefore, the definition of livelihood encompasses people's ecological, economic, and social well-being. Accordingly, livelihood is defined as comprising 'the assets (natural, physical, human, financial and social), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household' (Ellis 2000a, b: 10); or shortly, livelihood is as capabilities, assets and activities required for means of living (Scoones 1998; Ellis 2000a, b). Livelihood has become a popular concept in a development discourse.

Whereas, diversification of livelihoods is a mechanism by which rural households in their struggle for survival and improvement in their living standards develop a diverse portfolio of activities and social support capabilities (Ellis 1998). In addition, diversification of the livelihoods has always existed in rural areas, and its growing importance in rural life calls for renewed attention. As far as on-farm diversification is concerned, farmers have increasingly set up alternative or non-conventional farms outside the traditional approach of mixed farming (Diez et al. 2000). In the

same way, diversification of livelihood conditions implies a phase of dynamic change and constant adaptation (Ellis 2000). Individuals and households have sought to find new ways of raising incomes and minimizing risk, which vary harply by the degree of freedom of choice and the reversibility of the consequence.

Similarly, diversification of livelihoods entails both on and off-farm activities (Losch et al. 2010). On-farm diversification means maintaining a wide range of activities in the development of crops and livestock that interlock with each other in different ways. A traditional example is a mixed crop or intercropping which refers to growing two or more crops on the same piece of land to take advantage of complementarities between crops when using soil nutrients, sunlight and other resources (Ellis 2000). Non-farm diversification refers to finding opportunities for business or jobs other than conventional production of crops and rearing of livestock. Agriculture is also linked to non-farm diversification since it requires the processing and trading of agricultural produce. Non-farm practices often include the provision of utilities, commerce, business and manufacturing, the selling of wage labor or self-employment in small businesses, and other risk-minimization techniques (Losch et al. 2010).

However, risk and seasonality are two classic factors for diversification of livelihoods. Rural communities have undertaken various income activities with different risk profiles in order to reduce risks and ensure a steady inflow of income amid different harvesting seasons. In preparation for a loss in a certain operation, obtaining a variety of income sources is a traditional wisdom expressed in the saying, 'don't put all your eggs in one basket.' It is particularly important in a rural context where volatile weather conditions and harvest output make a fixed amount of daily income difficult to secure (Ellis 2005).

Furthermore, different social, economic, and environmental factors are identified by factors as determinants of the diversification of the activities of farm households' livelihood. As Ellis and Freeman (2004) revealed, these factors of determinants are asset and insurance based theories of diversification. For instance, resource based diversification theories say that the degree and nature of diversity of a farm household's income mix is representative of the degree of diversity of the resources or assets that the

organization accesses or owns. It's believed, for example, that a household owning a large plot of land compared to the amount of labor would engage in cultivation. Whereas, the insurance based theory of diversification argues that income failures and shocks dictate and push farm households to diversify their activities (Ellis and Freeman 2004).

On the other hand, in developing world of rural areas in particular, diversification of livelihoods has been of significance in literature and study since the 1990s with the introduction of livelihood frameworks, the spectrum of rural subsistence strategies in the late 1990s (Reardon 1997), the determinants of diversification (Smith et al. 2001), favorable and unfavorable factors for diversification (Hussein and Nelson 1999), and their distributional effects and their connection to agricultural productivity (Ellis 2000a, b) received attention in several fields. The analysis of livelihood is thus, based on the premise that the existing livelihoods represent the rational choices made by individuals. It focuses on marginalized people's resilience and builds upon their initiatives. It is therefore seeks to identify the poor's asset bases, livelihood strategy and desired objectives in order to create an atmosphere that can sustain them (Kim 2011).

Therefore, the sustainable livelihoods framework is a tool that seeks to enhance the understanding of the causes of poverty and the livelihoods of the poor, and the relation between the two by integrating elements that were not taken into account in the traditional poverty study method (CARE 1999; DFID 1999). The sustainable livelihoods framework offers a wide and systematic understanding of the factors restricting or enhancing livelihood opportunities and explains how they relate to each other (DFID 1999; Krantz 2001). Sustainable livelihoods approach also focus on livelihood assets such as natural capital, social capital, human capital, physical capital and financial capital that are useful for local communities' livelihoods (Rakodi 2002).

In addition, the framework is versatile which allowing researchers the freedom to measure the outcome they want and integrate any new elements into each part. Also, the concept can be applied in any context including studies on sustainable rural development. However, a sustainable livelihood framework is an analytical framework, not a study or collecting information or gathering methodolgy (DFID 1999; Farrington et al. 2002). It is a checklist of collecting

information for a poverty study (DFID 1999). The sustainable livelihood analytical framework therefore needs both quantitative and qualitative data, which in turn requires quantitative and qualitative data collection instruments (DFID 1999; Farrington et al. 2002; Rakodi 2002; Prowse 2008).

The framework has five key components, including assets, the vulnerability context, PIP, livelihood strategies and outcomes of livelihoods, and each component has backward or forward ties to one or more other components of the framework. There are subcomponents also to every major component of the framework. According to Rakodi (2002) livelihood approach require a clear understanding of the assets first in order to identify the opportunities they offer and the constraints to livelihoods as many agreed assets are the core of livelihoods.

Livelihood assets

Livelihood assets are essential for poor households' livelihood strategies and performance, that is, livelihood strategies and outcomes are entirely dependent on livelihood assets (Chambers and Conway 1992; Scoones, 1998). Livelihood assets are tools that people use to develop their livelihoods and these assets augment revenue (Rakodi 2002). Various architects and modifiers of the sustainable livelihoods framework, such as Chambers and Conway (1992), DFID (1999) and Carney et al. (1999), proposed various numbers and types of livelihood asset. However, DFID (1999) defined assets as human assets, natural assets, social assets, physical assets and financial assets. It is possible to store, accumulate, exchange or deplete these assets and bring them together to build income or other benefits (Rakodi 2002). The determinants of households livelihood diversification are emerged/extracted from these assets,

Human Assets include the skills, knowledge, availability of workforce and capacity to labor, good health and physical capability of individuals or members of households including the size of household, age and sex of household members. The most significant assets of the poor for both efficient and reproductive tasks are the quantity and quality (skills and knowledge) of labor in the household (Rakodi 2002). Together, these help the poor to engage in different livelihood operations and meet the effects of the livelihood. Human assets are valuable not only for their own

reasons, but also for their contribution to the mobilization of other assets in order to achieve positive livelihood results.

Physical assets Consisting of physical resources such as equipment and machinery, household jewelry and sustainable goods, accommodation, livestock and infrastructure (affordable transport, highways, sufficient water and energy supply, sanitation, communications, banking and education) that are typically important to sustainable livelihoods (Mickle et al. 2001; Rakodi 2002). For example, infrastructure can enhance labor productivity by providing fertilizer and health services, and enhance the mobility of products and the interaction between individuals (Rakodi 2002).

Natural Assets Include stocks of natural resources such as land, soil, water, air, trees, forests, pasture, wildlife, and wild foods that are useful for livelihoods through resource flows and services. These natural resources are important for the livelihoods of rural people. Households can depend directly or indirectly on the urban and rural natural resources (Rakodi 2002).

Social Assets include the social resources such as vertical (patron/client) or horizontal. (individuals of shared interests) networks and interconnectedness, relatives, friendships, neighborhoods, partnership and collaboration, and membership of formal and informal associations/groups (such as *idir*, *ekub*, *mahiber*, *senbetie*, *jigi*, *debo* and *wonfel* in Ethiopia) from which people drawn in the pursuit of their livelihood outcomes. Trust, reciprocity and trade relationships promote collaboration, minimize transaction costs and can provide the framework for informal association between the poor (DFID 1999).

Financial Assets include financial resources such as financial stocks (income from productive activity or employment and sale of labor, credit, cash and savings) and transfers (from government such as pensions and family such as remittance) which are essential in the adoption of livelihood strategies and achieve livelihood outcomes (DFID 1999). Credit and remittances from friends and family who live in rural or urban areas. Financial assets can be translated into other asset forms (houses, vehicles, land, etc.) and can be used to achieve direct effects (when buying food to minimize food insecurity).

Vulnerability context

Vulnerability is characterized as instability in the wellbeing of individuals, households and communities in the face of changes in their external environment (ecological, social, economic, and political) in the form of sudden shocks, long-term patterns or seasonal cycles (Mickle et al. 2001). The concept of vulnerability best measures the dynamics of poverty in the household through tracing the history of household vulnerabilities (Rakodi 2002). Vulnerability has both external and internal aspects (Chambers and Conway 1992; DFID 1999).

Hence, vulnerability impedes livelihoods. Vulnerabilities in living conditions (conflict, economic shocks, health shocks and natural shocks such as earthquakes, patterns such as economic trends, resource trends and seasonality such as seasonal price fluctuations, development, health, job opportunities interfere with livelihoods caused either anthropogenically or naturally (DFID 1999; Scoones 2005; Shiferaw et al. 2007; Liyama et al. 2008). Vulnerability therefore, has social, cultural, geographical, economic, and political dimensions that influence how hazards impact people in various ways and with varying intensities (Khurshid 2005).

Therefore, households can diversify in addition to other strategies undertaken to reduce vulnerability or risk by assembling other agricultural and non-agricultural goods and services, selling waged labor, or self-employment. Income from farm livelihoods includes both off-farm income (wage or labor exchange on other farms within agricultural) and non-farm income (rural wage jobs, rural self-employment, property income, urban-to rural remittances, and foreign remittances (Barrett et al. 2001).

PIP

PIP within the framework are the most important factors that shape livelihoods of the poor. They include political, social, environmental and economic factors that can limit or enhance access to various types of assets, livelihood strategies and decision-making bodies, and operate from the household to the international arena at all levels (Scoones 1998; DFID 1999; Farrington et al. 2002). They also determine access to the terms of exchange between different types of assets and returns to any given livelihood

strategy (Scoones 1998; DFID 1999; Farrington et al. 2002). PIP are essential to deciding access to the different types of assets in pursuing livelihood strategies either by acting as conduits for making assets accessible to them, or as obstacles to their access (Farrington et al. 2002).

Livelihood strategies

Livelihood strategies are operations that contribute to the desired results. In several cases, researchers in the field have listed subsistence methods. The most generally accepted categorization, however, is that provided in Scoones (1998), Mickle et al. (2001) Krantz (2001), and Farrington et al. (2002). There are coping strategies and adaptive ones which are respectively reactive and proactive livelihood strategies. Coping strategies often referred to as survival strategies are a short-term reaction to shocks or immediate strain, and adaptive strategies are a long-term change in behavioral habits due to stress and shock (Scoones 1998; Krantz 2001; Mickle et al. 2001). Various empirical/analytical studies have established various methods for livelihoods strategies that can be classified under these broad categories.

Livelihood outcomes

Livelihood outcomes are results or outputs of livelihood strategies, and these outcomes are complex and are the product of a cumulative impact of assets and livelihood strategies of other components of the framework (DFID 1999; Farrington et al. 2002). By reducing vulnerability and improving food security without degrading/depleting their properties, the poor need to increase their income, well-being and livelihood security or sustainability.

Overall, the reasons for diversification sought by individuals and households as a livelihood strategy are frequently split into two overarching factors, which are necessity or choice. This is often viewed as a contrast between accumulation and survival (Lucal et al. 2010). It corresponds to the migration literature of push versus pull reasons to migrate (UNDP 2009). Necessity refers to involuntary and desperation reasons for diversifying. Examples may be the dispossession of a tenant family from access to property, fragmentation of farm holdings on inheritance, degradation of the environment leading to decreasing crop

yields, natural or civil disasters such as drought, floods or civil war resulting in dislocation and abandonment of previous assets or loss of the capacity to carry out harsh agricultural practices due to accident or ill health (Scoones 2009; Lucal et al. 2010).

Choice, by contrast, refers to voluntary and constructive motives for diversification. For instance, looking for opportunities to earn seasonal salaries, traveling to find work in remote areas, educating children to increase their chances of gaining non-farm jobs, saving money to invest in non-farm companies such as trading, utilizing money obtained off the farm to buy fertilizers or capital equipment for the farm enterprise (Luca et al 2010). Finally, by spreading it through many companies, diversification works to minimize risk. Diversification was long established in agriculture.

Hence, popular forms of diversification include enterprises (planting various crops or inter-cropping), spatial diversification (planting across different fields), temporal diversification (staggered planting) and diversification of varieties (low risk, varieties resistant to drought). Other types of diversification involve diversification of inputs (using low risk or lower cost inputs), business diversification (alternative sources for purchasing inputs and selling outputs) and vertical integration (diversification into own production of inputs and own processing outputs) (Start and Johnson 2004).

On the other hand, majority of the population in rural sub Saharan Africa practices subsistence agriculture, supplementing food stores with consumer purchases (Baiphethi and Jacobs 2009). A hungry season also occurs when food stores are insufficient to bring a household to the next harvest, and individuals are especially dependent on market purchases. Therefore, by participating in non-farm operations, such as wage jobs, households diversify their income (Barrett et al. 2001). Understanding the food security of households requires situating it in the sense of livelihoods.

Likewise, in Ethiopia, the agricultural sector supports more than 83% of the population's livelihoods, and this proportion has remained consistent with no indication of decline for several years (CSA 2011). For instance, in 2014 the estimated percentage economic GDP contribution of agriculture, service and industry were 45.3, 42.9, and 11.8%, respectively. The percentage of total employment of agriculture, industry

and services were 85%, 5%, and 10%, respectively (KPMG 2015). Moreover, the main food source in Ethiopia is the agricultural sector. Recently, the sector's contribution to the national economy is estimated at 41.6% of the total GDP of the country. More than 70% of Ethiopia's overall foreign exchange earnings have also been contributed by the agricultural sector with little diversification of export commodities (CSA 2011).

However, the agricultural sector depends on seasonal rains and is highly vulnerable to shocks despite such contributions (CSA 2011). For example, as the Ethiopian Agricultural Research Organization (EARO 2000) points out, poverty, a rapidly increasing of population and a low-productivity agriculture sector exacerbate the food insecurity situation in Ethiopia. Diversifying the livelihood of households is thus, very important to sustaining life. Therefore, both push and pull factors that households in rural Ethiopia have been found to diversify their sources of income. The causes of diversification of livelihoods are commonly cited as push factors such as growth of the rural population, fragmentation of the farm and declining agricultural productivity (Degefa 2005). On the other hand, pulling factors such as urban or local demand can lead to non-farm activity which enhances the economic status of the household (Yared 1999). Therefore, rural households continue to participate in a variety of non-farm activities including food for work schemes, grain trade, small-scale farming, migration, liquor sales, and sales of handicrafts (Yared 1999; Degefa 2005). Hence, it is very important to know the status of the diversification of household livelihoods in BGRS to make decisions.

Motivation for the selection of Assosa *Wereda*

Assosa administrative zone agro- ecology is the most severely affected and fragile ecology of the total BGR potential arable land (BGRS 2004). This is due to, in the military regime, Assosa *wereda kebeles* that surrounding Assosa town are occupied by state farm. Besides, due to famine, the households from the former Wollo province were also settled by surround the state farm. In the meantime, the jungle natural forests surrounding Assosa town were cleared away by bulldozer and human labors for the expansion of farm land. Furthermore, the culture of less/no concerns for the natural resource management of the settlers,

backward agricultural practices (slash and burn or shifting cultivation by axe and hoe) of indigenous households, and wild land firing dependent of livelihoods (hunting, wild honey and fire wood collection) of the societies have also perpetuated the deforestation after the collapse of state farm.

Consequently, physically the soil was strongly eroded. The soil eventually became infertile and then the products and productivities of the farmland of food crops were reduced/disappeared. The estimates of the loss of soil crop nutrients and the foregoing crop production for the Assosa area are, therefore, the highest (1057 tons) of all areas in the region. As a result, the projected cumulative annual decrease in crop production (tons of grain) in the Assosa area from 2000–2020 as a result of soil losses on cultivated land at critical soil depth increases from 310–2742 tons of the total 509–5087 tons of the region in the 20-year forecast (CSA 2013). Besides, as the expansion of desertification, climate is not conducive for life. Consequently, animal diseases (Trypanosomiasis, Fasciollosis, Lung worm, Intestinal worm, Tick and Tick-Born Diseases and other sudden causes of death), human diseases (malaria), food crops disease and pests are perpetuated.

Moreover, the study area *wereda* has a total territory of 1,991.41 km² (the third largest of the seven *weredas*) and 108,194 population (the largest from the zone) inhabited in the *wereda*. It has rural population density of 54.3 persons per km², the second highest population density next to Pawe *wereda* (CSA 2008). On the other hand, Assosa town's population density is 2353 individuals per km². This demonstrates that with its fragile ecosystem, Assosa *wereda* has the highest population pressure on natural resources than the other seven *weredas* (CSA 2012). Therefore, this high population pressure in rural area and from the town of Assosa, the backward agricultural practices of the indigenous (Berta) societies and the absence or less tradition of resource and environment management of the settler (Amhara) population, and wild land fire dependent livelihoods of the societies of the *wereda* are the main factors that escalating the degradation of the area with its lowland agro-ecology.

As the result, livelihood option (crop production, livestock production, and other non-farm) decreased or disappeared throughout production time. These situations put the households in chronic poverty, food insecurity and destitute life. These worst life

conditions of the households were motivated the researcher for the selection of Assosa *wereda*.

Materials and methods

Description of the study area

BGRS is one of the ninth regional states of Ethiopia located in the western part of the country (Fig. 2). The total area of the BGRS is 4,928,946 hectares (49,289.46 Km²) (CSA 2008). The region is divided into three zones, 20 *weredas*, including one special *wereda* (Mao-Komo) and 427 *kebeles* (the lowest administrative unit in Ethiopia). The altitude of the region varies from 580 to 2731 m above sea level (masl). Agro-ecologically, the region divided into Kolla (lowlands below 1500 masl) about 75%, Woina Dega (midland between 1500–2500 masl) about 24% and Dega (highland above 2500 masl) about 1%. Annual rainfall varies from 800 to 2000 mm. The daily maximum temperature reaches 20 °C–25 °C in the rainy season and rises to 35 °C–40 °C in the dry season (February to May). Whereas, the minimum daily temperatures range from 12 °C–20 °C, (BGRS 2004). The study area *wereda* agro ecology is mainly Kolla or lowland.

On the other hand, 460,459 population inhabited in BGRS according to population census of 1994. Of these 50.60% are male and 49.40% are female. The population density is 9.13 persons per km². While according to 2007 population census; the region's total population is 784,345. In which 50.82% are male, and 49.18% are female. From 1994 to 2007, the amount of population growth was 70.3% (the highest of all other regions). In two census periods the average number of household size was 4.5 persons (CSA 2007). Between 1994 and 2007, the population increased at a rate of 3% per annum, which is higher than the 2.6% average national population growth rate. 86.50% of the total population lives in rural areas, and 13.5% live in urban areas (CSA 2007). With an average, the population density of the region is low as 13.3 persons per km² (CSA 2008),

Although according to CSA (2013), the population projection of 2014 of the region is 975,998. 50.72% of them are males and 49.28% females. Of the overall population, 80.64% live in rural areas and 19.36% lived in urban areas. In the meantime, the total

Meanwhile, the total population of Assosa *wereda* according to population projection of 2017 is 151,075. Of which 50.86% of are male and 49.14% of are female. In the same year 65.19% population lived in rural area and 34.81% of population were lived in urban area (CSA 2013). In all period and places, the rural dweller population were decreased and urban dweller population were increased..

including Berta (28.79%), Gumuz (22.98%), Shinasha (7.55%), Mao (1.9%) and Komo (0.96%). Whereas, 37.82% of are the other non-native ethnic groups including Amhara (18.48%), Oromo (11.87%), Agew-Awi (3.96%), Tigre (0.68%), and (2.83%) other very few different ethnic groups are existed in the region. BGRS is, therefore, distinguished by its ethnic diversity. These ethnic diverse communities also have numerous cultural and traditional customs that rule their lives. In Assosa *wereda*, the indigenous Berta and the settler Amhara are the dominant ethnic groups.

Of the region's total territory, the region has 9120 km² of potentially cultivable land and just only 18.5% of cultivated land (BGRS 2010), in comparison, Assosa zone has a total area of 14,166.12 km² (the second largest zone next to Metekel) and a population of 150,430 which is the largest of the three regions. The zone population density is 20.9 persons per km² which is greater than the region's average population density (CSA 2008). In addition, Assosa *wereda* has a

total surface area of 1991.41 km² (the third largest of the seven *weredas*) and has population of 108,194 (the largest from the zone). The *wereda* population density is 54.3 people per km², the second highest population density in the region (CSA 2008). From this one might infer that there was a high demand from the population on established resources. As a result, with Kolla agro-ecology, the ecosystem was weak, degraded, and desertification is expanded.

The regional economy depends on agriculture, which accounts for 93.2% of the economically active population. Except the Shinasha who are predominantly plow cultivators; the other indigenous population taking part in economic activities such as shifting cultivation, hunting, gathering, and mining. Whereas, the other non-native population are engaged in food crop production and livestock rearing.

The subsidiary sources of livelihood include livestock raising, wild food collection, fishing, production and collection of honey, traditional gold mining, hunting, handicrafts, petty trade, preparation and trading of charcoal (BGRS 2004). The livelihood of the region's population was largely dependent without option on the natural environment.

Agriculture is a primary cause and indirect casualty of farmland degradation, with different agricultural aspects contributing to this process in a variety of ways. Soil erosion is caused by overcutting of vegetation (clearing for farmland), along with improperly orchestrated fallow periods, crop rotations, and livestock overgrazing.

Research design

Various factors influence the selection of research methods. These concerns are also related to the purpose and form of issues to be studied, not to mention a clear epistemological role adopted by researchers. In their study, the kinds of beliefs held by individual researchers frequently contribute to the adoption of a qualitative, quantitative or mixed approach methods (Creswell 2009). Research on mixed methods is formally described here as the research class in which the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single analysis. Philosophically, by providing a reasonable and realistic alternative, it is the third wave

or third research movement which moves past the paradigm wars.

Philosophically, mixed analysis allows use of philosophy's rational approach and framework. Its inquiry logic involves the use of inference (or pattern discovery), deduction (testing theories and hypotheses), and abduction (uncovering and depending on the best of a collection of explanations to understanding one's results) (Johnson and Onwuegbuzie 2004). Mixed methods study is also an effort to legitimize the use of various approaches to address research questions, rather than restricting or limiting the choices of researchers (i.e., it rejects dogmatism). It is an expansive and inventive type of analysis, not a restrictive form of study. It is inclusive, pluralistic, and complementary, indicating that researchers take an eclectic approach to the selection of methods and study thought and behaviour. Many research questions and combinations of question are best and most thoroughly answered by mixed research solutions (Johnson and Onwuegbuzie 2004).

These explanations for mixing methods have led writers from around the world to establish procedures for investigative techniques for mixed methods and to take the various words contained in the literature, such as multi-method, integration, convergence, and combined and formed study procedures (Tashakkori and Teddlie 2003). Therefore, for the researcher of mixed methods, pragmatism opens the door to various approaches, different world views, and different assumptions, as well as different ways of collection and interpretation of data in the study of mixed methods. Since livelihoods and their diversification are multi-dimensional issues, this study would use both qualitative and quantitative (mixed or pragmatic) approaches and the sequential explanatory mixed method model to understand and examine the degree of diversification of livelihoods in Assosa *wereda*.

Sampling techniques

According to the CSA (2013) population projection, there were 409,227, 319 and 200 households existed in Abramo, Abendemengida, Megele 38 and Megele 39, respectively. Purposely selected these *kebeles* had total of 1155 households. The sample size was determined by using Watson (2001) simple calculation. Accordingly, approximate population variance is 0.5 for 50–50, the required precision as a decimal is

0.05 for 5%, the confidence level is 1.96 for 95%, and the estimated response rate as a decimal is 0.9 for 90%. Ultimately, the total sample size is 320. The procedure is here under.

$$n = \frac{\left[\frac{Ev[1-Ev]}{Pd^2 + \frac{Ev[1-Ev]}{N}} \right]}{Er}$$

where **N** Number of people in the population, **n** Sample size required, **Ev** Estimated variance in population, **Pd** Precision desired, expressed as a decimal, **Cl** confidence level, **Er** Estimated response rate, as a decimal

$$n = \frac{\left[\frac{0.5[1-0.5]}{0.05^2 + \frac{0.5[1-0.5]}{1155}} \right]}{0.9} = 320$$

The sample size of each *kebele* was subsequently calculated by multiplying the percentage of each *kebele* household to the previously determined total sample (320) size. When the sample of each *kebele* household was determined (112, 64, 90 and 54), systematic sampling would pick them proportionally. This could be done by dividing the total eligible households listed (409, 227, 319 and 200) to the sample size of each *kebeles* households (112, 64, 90 and 54), respectively to determine the *n*th sampling. The sample sizes for each *kebeles* were picked from the total eligible households listed by always *n*th. In this fashion, sampled households were selected for each *kebeles*.

Methods of data collection

Data were drawn out from both primary and secondary sources. The primary data collection consisted mainly of field observation, questionnaire survey, and key informant interview. Purposively selected key informant interview with four development agents (three male and one female) one per *kebele*; three experts (three of them are male) who concerned with issue from region office, zone office, and *wereda* office, and three officials (two male and one female) from region, zone and *wereda* each concerned with the issue were conducted two times (a head of main data collection and at a time of main data collection). In addition, focus group discussions (FGD) of 12 households (seven males and five females) were conducted which

deliberately selected from different socioeconomic status of the households. Moreover, for identifying livelihood assets that determine diversification of livelihoods, a pilot data collection survey conducted a field ahead of main data collection. The main data gathering was undertaken in two seasons. In dry season (crop harvested and crop land preparation) and rain season (crop production). Secondary data were also gathered for the study from various unpublished and published papers, reports, and statistical abstracts.

Methods of data analysis

The study analysed both the qualitative and quantitative data and presented them. The sequential mixed explaining approach is used in this analysis. This means collecting quantitative data first, then collecting qualitative data to further explain the quantitative findings. Primary data sources were first interpreted for this study, and secondary data sources were represented by their themes (human, natural, physical, Financial and social capitals/assets) as empirical.

Determinants of the households' livelihood diversification (which were tested in advance of the final survey of the study area) are: humans capitals (household head age, sex, education level, dependency ratio—the ratio of young under 15 years age and old aged above 65 years to adult between 15–64 years age population, and extension contact), natural capitals (land hold size), Physical capitals (road distance, and urban linkage), Social capital (access to irrigation, access to mass media, and member of social organization) and Financial capitals (access to credit, livestock size in TLU, and total household income) were identified first. An independent variable is the attribute or trait that influences or affects a result or dependent variable. Hence, these livelihoods assets were treated as independent variable. As well as, these independent variables were naturally categorical or dummy, and continuous (see Table 1). Thus, they met the multinomial logit (MNL) regression criteria with selected sample size. Meanwhile a dependent variable is an attribute or trait that dependent on or influenced by the independent variable. Therefore, diversification of the livelihood treated as dependent variable. MNL regression model was thus, fitted using SPSS version 23 to identify the significant determinants of diversification of livelihoods, and the Simpson Diversification Index

(SDI) was used to identify the status of diversification of livelihoods of the households.

Hypothesizing the determinants

Among these determinants of livelihood diversification, educational level, extension contact, access to irrigation, access to credit and media, urban link, household cooperative membership, and total income of the households were hypothesized as statistically significant predictors of livelihood diversification. This means that households with better levels of education, better communication with extension agents, engaged in irrigation activities, better access to credit and media, better urban ties, better cooperative participation, and high average annual income in the study area are expected to better diversify their livelihoods.

On the contrary, majorities of the age and sex of household heads are younger and male which lacked experiences and resources such as lands, the household dependency ratio is high, household land holding size is very small, household access to all weather road distance is far from homestead, and livestock holding size was absent or very small. Therefore, household head age and sex, household dependence ratio, household land size, road distance and household livestock holding size in TLU were hypothesized as statistically insignificant predictors of livelihood diversification (Table 1).

The SDI, recommended by Shiyani and Pandya (1998), and Khatun and Roy (2012), were used in this study to identify the diversification status of households' livelihoods described as:

$$SDI = 1 - \sum_{i=1}^N Pi^2$$

where SDI is the Simpson Diversification Index, N is the total number of revenue sources and P_i is the proportion of revenue that comes from source i . The value would vary from 0 to 1. The index value is zero when there is a full specialization, and reaches one as the level of diversification increases. When a single source of income exists, $P_i = 1$, then $SDI = 0$.

$$SDI = 1 - \sum_{i=1}^9 \left(\left(\frac{A}{Ti} \right)^2 + \left(\frac{B}{Ti} \right)^2 + \left(\frac{C}{Ti} \right)^2 + \left(\frac{D}{Ti} \right)^2 + \left(\frac{E}{Ti} \right)^2 + \left(\frac{F}{Ti} \right)^2 + \left(\frac{G}{Ti} \right)^2 + \left(\frac{H}{Ti} \right)^2 + \left(\frac{I}{Ti} \right)^2 \right)$$

where: A = food crop income; B = Cash crop income; C = Natural resource income; D = Livestock income; E = Farm wage income; F = Non-farm income; G = Self-employed income; H = Remittance; I = other sources of income; and T_i total income of the household.

Table 1 Determinants of livelihood diversification.

Source: Field survey of November, 2018

Variables	Nature	Value	Expected Sign
Age of household head	Continuous	Actual age in the year	–
Sex of household head	Dummy	1 if male and 0 otherwise	–
Education level	Dummy	1 if literate and 0 otherwise	+
Dependency ratio	Continuous	The ratio of dependent and independent	–
Landholding size	Continuous	Total land size in a hectare	–
Diversified livelihood	Dummy	1 if diversified and 0 otherwise	±
Road distance	Continuous	Distance to nearest road in km	–
Livestock holding size	Continuous	Livestock holding size in TLU	–
Extension contact	Continuous	Total number of contacts in a year	+
Access to irrigation	Dummy	1 if yes and 0 otherwise	+
Access to mass media	Dummy	1 if yes and 0 otherwise	+
Access to credit	Dummy	1 if have and 0 otherwise	+
Urban linkage	Dummy	1 if yes and 0 otherwise	+
Cooperative	Dummy	1 if yes and 0 otherwise	+
Total income	Continuous	Total income of the household	+

Results

As a result of the MNL regression, the odds ratio of age, sex, education level, dependency ratio, land holding size, road distance, livestock holding size, extension contact, access to irrigation, access to media, access to credit, urban link, cooperative member and total household income were: 0.999, 0.982, 1.089, 2.801, 1.007, 0.972, 1.002, 1.002, 1.176, 0.999, 1.304, 1.386, 1.001 and 1.000, respectively (Table 2).

Similarly, fitting information for the MNL regression model shows that for the null model-2 log-likelihood was 403.624 and for the final 348.848, X^2 was 54.777, degree of freedom 14, and significant at 0.000. The overall prediction accuracy rate of livelihood diversification was 66.5% and diversification of household livelihood was the reference category. Moreover, the SDI result of total food crop revenue, cash crop income, natural resource income, livestock income, remittance income, non-farm wage income, farm wage income, self-employment income, and other household income sources was found to be 0.02. The household's incomes were in Ethiopian Birr (one US dollar equivalent to 27.23 Ethiopian Birr).

$$SDI = 1 - \sum_{i=1}^9 \left(\left(\frac{962938.88}{1333300} \right)^2 + \left(\frac{222216.68}{1333300} \right)^2 + \left(\frac{74072.22}{1333300} \right)^2 + \left(\frac{37036.11}{1333300} \right)^2 + \left(\frac{4317.55}{1333300} \right)^2 + \left(\frac{9259.03}{1333300} \right)^2 + \left(\frac{4629.51}{1333300} \right)^2 + \left(\frac{13888.54}{1333300} \right)^2 + \left(\frac{4941.47}{1333300} \right)^2 \right)$$

$$SDI = 0.02.$$

Discussions

The chi-squared distribution has the -2 log-likelihood (sometimes called, deviance) computed by subtracting from intercept null -2 log-likelihoods of the final model: $403.624 - 48.848 = 54.777$. For this study the chi-square test of independency has been used. It is used whenever we have two or more independent variables and we want to test whether the variables are connected or not (Tavakoli 2012). A larger chi-square, thus, implies that the independent variable adds more to the dependent variable than the intercept-only model (Cramer and Howitt 2004; Tavakoli 2012). But, for this analysis the chi-square was small, and the

independent variable's contributions to dependent variables were less. In addition, the p -value for the result of likelihood ratio test to the model was 0.000. It was less than the conventional significance level of 0.05. It was significantly different here from the intercept model $p < 0.001$ as seen from the final model. Therefore, as a group, the independent variables contribute less likely to the outcome prediction. Apart from the classification table, overall predictive accuracy of dependent variable was 66.5%. And we would conclude that the model was statistically significant. These variables do not explain variations in turnout, in other words. Consequently, statistical significance at < 0.05 means that a strong model fits.

Hence, the regression coefficients used for this analysis often symbolized as b (unstandardized) or β (standardized and referred to as *beta*), are the line slope, or the amount of change in the dependent variable (symbolized as Y), based on a single-unit change in the predictor or independent variable (symbolized as X) (Abu-Bader 2006; Dunn and Clark 2001; Howell 2002). However, since independent variables are categorical, the regression coefficients are difficult to interpret. Instead, odds ratios are a very beneficial option (Dunn and Clark 2001; Howell 2002; Rosenthal 2001). Thus, the odd ratio was used for this analysis to describe the MNL regression.

In regression coefficient the $\text{Exp}(B)$ is the *beta* exponential or the odds ratio. Odds ratios can be used if the dependent or outcome variable has two categories, such as success or failure, and two or more groups of customers were present. Odds ratios were easily calculated by using the exponent function on any calculator using the *beta* coefficients in logistic regression and MNL regression (Hosmer and Lemeshow 2000). When evaluating odds ratios, it was important to distinguish between the event or outcome variable (success/failure) and the individual or group variable (treatment/comparison groups). The odds ratios of less than one, according to Petrucci (2009), indicate a lower likelihood of success for the scenario. Whereas, odds ratios greater than one suggest a higher likelihood for the interest case, and one odds ratio implies that there was no relationship between the variables.

Thus, as shown on Table 2, the odd ratio for predictor variables were less likely than one and insignificant were: age of head of household, sex of head of household, road distance of household, and

media exposure of household. This means that the likelihood of household livelihood diversification increased by one unit; livelihood determinants decreased by 0.999 (household head age), 0.982 (household sex), 0.972 (household road distance), and 0.999 (household media access), respectively. Whereas, the education level of household heads, dependency ratio, access to irrigation, access to credit, and households' urban link odd ratios were greater than one and significant. This implies that the probability of household livelihood diversification increased by one unit as livelihood determinants increased by 1.089 (education level of household head), 2.801 (household dependency ratio), 1.176 (household access irrigation), 1.304 (household access credit), and 1.386 (household urban connection).

In other words, if the exposure rate of such independent variables increases accordingly, the likelihood for households' to diversify their livelihood would be greater than that of households' with undiversified livelihoods. This means that, for instance, as educational attainment level of household head increases, there would be a corresponding increase in livelihood diversification as corroborated

the hypothesis of the study and the studies carried out in West Bengal (Khatun and Roy 2012), pastoral societies of Southern Ethiopia (Adugna 2012), Western Ghana region (Agyeman et al. 2014), Mekong River Delta (Nghiem 2010) and Ambachew and Ermiyas (2016), in South Gondar Zone, Ethiopia. In all these studies, the educational attainment levels of household heads were found to be a significant predictor of livelihood diversification.

As the studies show that education is one of the key socio-economic factors that affecting an individual behavior and attitude (CSA and ORC Macro 2006). For instance, education allows the households' exposure to mass media that provides the opportunity to be acquainted with new concepts and information that is beneficial in different area of daily life. According to CSA and ORC Macro (2006), the percentage of men exposed to particular media on a weekly basis in BGRS according to background characteristics in 2005 showed that, only 1.9% of men read a newspaper at least once a week, 6.8% watch television at least once a week, 35% of men listen to the radio at least once a week, and 61.9% of men have no media at least once a week. These shows that households have no

Table 2 Parameter estimates of MNL regression result. *Source:* Field survey November 2018

Independent variables	B	SE	Wald	Df	Sig	Exp(B)	95% Confidence interval for exp(B)	
							Lower bound	Upper bound
Age of household	−0.001	0.019	0.006	1	0.939	0.999	0.963	1.036
Sex of household	−0.019	0.555	0.001	1	0.973	0.982	0.331	2.911
The education level of household	0.086	0.447	0.037	1	0.848	1.089*	0.454	2.614
Dependency ratio of household	1.030	1.687	0.373	1	0.541	2.801*	0.103	76.365
Land hold size of a household	0.007	0.130	0.003	1	0.957	1.007	0.781	1.299
Road distance of household	−0.028	0.115	0.059	1	0.808	0.972	0.776	1.219
Livestock hold size in(TLU)**	0.002	0.048	0.001	1	0.970	1.002	0.912	1.101
Extension contact of a household	0.002	0.011	0.020	1	0.887	1.002	0.980	1.023
Irrigation access to household	0.162	0.867	0.035	1	0.852	1.176*	0.215	6.428
Media access to household	−0.001	0.885	0.000	1	0.999	0.999	0.176	5.664
Credit access to household	0.266	0.652	0.166	1	0.684	1.304*	0.363	4.681
Urban link of household	0.326	0.693	0.222	1	0.637	1.386*	0.357	5.387
Cooperative member of the household	0.022	0.391	0.003	1	0.956	1.001	0.474	2.200
Total income of the household	0.000	0.000	2.417	1	0.120	1.000	1.000	1.000

*Statistically significant

**TLU is a convenient method for quantifying a wide range of different livestock types and sizes in a standardized manner. For calculating TLU used Ox = 1.10, Cow = 1.00, Goat/Sheep = 0.1, Donkey = 0.50, Poultry = 0.01

fortune in the field of study to acquire new ideas, skills and information that allow households to improve their livelihoods, health status, family planning, access to assets, poverty reduction, and well-being. The status of diversification of livelihoods in the study area was however, very low. It was found that household heads that have attained some level of education in the study area have diversified their livelihood options through salaried work, self-employment activities and employment in different occupations. Investing in education and increasing access to higher education therefore, would also help rural households obtain alternative incomes.

Likewise, as the research conducted by Khatun and Roy (2012) in West Bengal and as the hypothesis of the study, the ratio of dependency was found to be negatively related for livelihood diversification. However, as the result of MNL regression revealed, household's dependency ratio was significant. As Reardon (1997) has noted, the dependency ratio has a positive impact on diversification of livelihoods. Large family size maximizes household welfare and secures livelihoods through the deployment of active household members in other employment opportunities. In Ethiopia, even though, the numbers of old age (above 65 years old) population were low; the numbers of young age population (below 15 years old) were high. In 2000, for example, according to BGRS (2003), the dependency ratio was 88 at the regional level, 71 at the urban, and 91 at the rural. This implies that BGRS dependency ratio is very high. In the study area, however, members of adult-dependent households took part in activities such as cattle-keeping, small-scale trade, holding farmland crops and collecting farmland crops, harvesting crops, collecting fire woods, fetching water and carrying light-weighted materials as needed. The dependency ratio was therefore, significant for the diversification of households' livelihoods in the study area.

Similarly, household access to irrigation was also important, as corroborated by the research hypothesis and the study conducted by Khatun and Roy (2012) in West Bengal and contrary to the study conducted by Ambachew and Ermiyas (2016) in the South Gondar Zone in Ethiopia. Irrigation incentives allow multiple crops to grow which would generate surplus farming. This surplus might be used to participate in non-farm operations, in particular self-employment. This could be seen in two adjacent *kebeles* Megele 38 and Megele

39 where the settler communities dominantly inhabited. In particular, few households were engaged in irrigation at Megele 39. These households largely produced tomato for sale. From the tomato sales, very few households bought three-wheeled vehicles. Meanwhile, they engaged in other livelihood besides their farm. Afterward, they diversify their source of income. Nevertheless, as farmland scarcity and infertility in settlers households, yet undeveloped in indigenous households, wet or swamp land drying, and stream fluctuations or drying, household irrigation access practice in the study area was not sustainable at all.

Likewise, as the Agyeman et al. (2014); Khatun and Roy (2012); Ambachew and Ermiyas (2016) studies showed, household credit access has increased the degree to which farm households have diversified their income. As converged to these studies and the hypothesis of the study, household access to credit was significant for diversifying the household's livelihoods. Nevertheless, leave alone accessing credit service, in the study area, majority of households hadn't any information about the existence of this opportunity. In the meantime, very few informed households hadn't awareness what, where, how, and when might did by credit as the actual situation on the ground. Moreover, they also afraid of how to return the credit and the credit rate of interest. Similarly, the commitments of credit provide officers of the *wereda* were very low. As well as, the officers were feared the households in returning the credit with interest. Because, the households hadn't any tangible assets at home or capital on their hands as a guarantee. In the study area, as aforementioned reasons, the households lack access to credit and not benefited from this opportunity. Therefore, as real situation on the ground in the study area, as contravening the result of MNL regression result, household credit access was negligible for the diversification of household's livelihood.

Likewise, the proximity of households to a nearby town is another factor that has a positive impact on the diversification of household's livelihood. The households were five to 20 km away from nearby town in the study area. Consequently, every household member has town contacts twice a week (Saturday and Wednesday) and taking part in daily labor, engages in small business, sell what they had, purchased what they need, and shares ideas that improve their livelihoods. Hence, the urban linkage of the household was significant as it converged to the research

hypothesis and positively influenced the diversification of household living conditions in the study field.

On the contrary, household head age, household head sex, road distance, and media access of household odd ratio were less than one. This implies that there was an inverse or negatively associated among these variables and diversification of the livelihood. As converged to the studies carried out by Agyeman et al. (2014) in western Ghana region, Adugna (2012) in pastoral societies of Southern Ethiopia, and as diverged from the hypothesis of the study and the study carried out by Khatun and Roy (2012) in West Bengal and Ambachew and Ermiyas (2016), South Gondar Zone Ethiopia; as the head age of households increases, revenue diversification decreases. Since they lack both physical strength and financial capital to apply to their farm or non-farm activities. As several of these tasks have been found to be labor intensive.

In the study area, 10.62% of households heads were female who have not physically capable as male. Nevertheless, female heads of Berta households were capable and committed than male head households. Meanwhile, 49.6% of households head were young males and their age rages from 20–35. They have no experience how to diversified their livelihoods and lack assets such as land, remittance that inherited from their family as the prevalence of poverty. On the other hand, 11.4% of the household heads were old aged (above 65 years). They were physically not strong. The rest 28.38% of the household heads were adult age and they were physically fitted and experienced. However, in indigenous household heads, the commitments, interest, and working culture were very low. Age of households head therefore, not significant determinant for livelihood diversification.

Likewise, as contrary to the findings of Agyeman et al. (2014) in the western Ghana region, Ambachew and Ermiyas (2016), in the South Gondar Zone of Ethiopia, and as a corroborated hypothesis of the study and research conducted by Adugna (2012) in pastoral societies in Southern Ethiopia; household sex was negligible for diversification of livelihoods. Even though, in Berta ethnic groups females are tend to venture into both farm and non-farm activities than males. They have been engaged in various livelihood opportunities (small trade, crop cultivation, husbandry of animals, preparation and sale of charcoal, collection of wild food and firewood) and maintain the household income. These natural resource based livelihoods are

not restricted to indigenous households but also settlers' households. However, lately, these practices have been inefficient, cumbersome, unavailable (restricted to only in pocket of inaccessible area) with the degraded natural resources followed by climate change. Females engagement in these activities hence, declined.

In comparison, the numbers of female household heads were only 10.62%. Whereas, the remaining 89.38% of household heads were male. As contrary to Berta female heads households, male heads Berta households have no interest and commitments of working habit in engaging in different activities to diversify their household's income. Furthermore, these male head households were young that have no experience in diversifying their income and have no capitals and remittance that they inherited from their parents. Hence, sex of the household head was also insignificant determinant for diversification of livelihoods.

The road distance exposure of household was also negligible as it converged to the hypothesis of the study and contravened the finding of Agyeman et al. (2014) in the western region of Ghana. In the study area, 54.07% and 45.93% of households accessed less than 5 km and 5–10 km of dry weather road, respectively. And 55% of households have access to 10–15 km and 45% of households have access to 15–20 km of all-weather road. However, due to constraints on natural, human, financial and physical assets or as the prevalence of poverty, the role of road accessibility of households in diversifying livelihoods was insignificant.

Access to media of household is yet another independent variable that has a positively affects diversification of households' livelihood. Media access can enhance the household capacity for diversification of livelihoods by introducing emerging technology for livestock rearing and crop harvesting, acquiring market and weather information, how to prevent disease, how to diversify the diet and maintain well-being. Nevertheless, media exposure of household has been a positive contribution for diversification of livelihoods; with declining household income and poverty prevailing, very few households accessed only audio radio from rudimentary radio and mobile phone. They were accessing single media. Besides, media sources (FM radio, TV, newspapers,

magazines, Internet and so on) of the households were very limited as fringe of the region.

Similarly, household's media inaccessibility mainly emerged from households or community's educational exposure limit. Education exposure limit of the communities are due to low or lack of interest of both parents and children in schooling, the absence of the culture of sending children to school, the absence of model families or students from their homestead or families, the schools are far from the students' residential area, malaria and other related problems are responsible for the dropout and repetition rate especially in indigenous community, and the intensified poverty of the households' to support their children at all necessary levels of schooling was very low. Consequently, they were not read, write, and couldn't pursue knowledge and skills. Therefore, as a real situation on the field, media access to the household was negligible for household livelihood diversification.

On the other hand, household land hold size, livestock holding size in TLU, household extension contact, household cooperative member, and total annual income of households were less likely to be equal to one and had no association with diversification of livelihood. For example, 40.31% of the total sample households own less than one hectare (the majorities were settlers), 38.44% of households occupy between one and two hectares, and 21.25% of households own more than two hectares (the majority were indigenous). Around 80% of households in the settler's area occupied less than one hectare. It was characterized by the most fragile, degraded and infertile soil. Whereas, comparatively, as an indigenous right, the indigenous households own large land (about 85% of the households occupied more than two hectares). Even some households occupy up to ten hectares. However, in indigenous households, the cultures of agricultural practice were a slash and burn of axe and hoe, hunting and gathering. As well as, lack of dedication and participation in land plow and harvesting of food crops becomes a major constraint. As a result, regional crop production provides a daily calorie supply per capita of 1850 kcals or 92% of the requirements. It was a daily shortfall of around 150 kcals per adult equivalent. This was equivalent to an annual grain deficit for an average 98 kg farm family (BGRS 2004). This was quite typical, therefore, as corroborated by the research

hypothesis and as the study conducted by Ambachew and Ermiyas (2016), in South Gondar Zone Ethiopia; household land hold size was negligible and has no connection with the study area's household diversification of livelihood.

Likewise, household livestock size was also negligible for diversification of livelihoods as contravened the research conducted in Southern Ethiopian pastoral societies by Adugna (2012), and as converged to the hypothesis of the study and the study conducted by Ambachew and Ermiyas (2016), in South Gondar Zone Ethiopia. Due to livestock diseases, lack of modern livestock hybrid varieties, lack of modern fodders, long dry season, unfavourable and harsh climatic conditions, and other social constraints were the most restrictive of livestock production in the study area. Consequently, according to Helina and Schmidt (2012) in BGRS in 2007/2008, there were only 363,600 cattle, 371,500 goats, and 85,300 sheep population. Regional total livestock share was just only 0.8%. However, the relative mean herd mortality incidence of Trypanosomiasis in 2003 was 33% (BGRS 2010). On the other hand, animal direct mortality was estimated at 46% of herds of cattle and 38% of flocks of sheep and goats per year, respectively (BGRS 2010). Consequently, BGRS livestock production was the most inefficient and less productive operation compared to other parts of the country. As these survey shows, lack of assets from livestock leaves households in extreme poverty/vulnerability.

This is due to; livestock means everything in Ethiopian society. Livestock contributes by a number of direct and indirect forms to household life. Firstly, livestock provide in-cash or in-kind income for households by renting the Oxen for plowing, by selling animals, selling their products (milk, meat, eggs, hide and skin, dung, and other animal products). Secondly, livestock was a form of savings (capital growth through herd growth) and insurance, since animal sales provide immediate cash to cover significant or unforeseen expenses (such as school or medical fees). Thirdly, livestock provide manure, power draft and transportation facilities that could be used on the household farm or traded on the market. Not only has promoted access to financial services, both on formal and informal markets, but also livestock can add the social status. Ultimately being a source of abundance. Households use their livestock

in two different ways, financially as a buffer stock, and materially as a farm input to enhance productivity.

That means if there were livestock, there was land plowing (by oxen or donkey or horse), soil fertility was maintained by their dung, fire fuel from their dung (destruction of forests for fire wood was reduced), and income from livestock products was also generated. These livestock benefits have been accustomed by the households particularly by settler's household. Nevertheless, the study area households were not fortunate. They could not benefit from livestock products and productivity. While they tried to practice livestock rearing as a livelihood by investing what they had at hand, they were not successful. For instance, of the total household sample, 62.5% of households had one to ten livestock, and 37.5% of them do not have livestock. Consequently, majority of households in the study area that failed in livestock production were feared to access credit with interest rate, declined annual income, very low food crop production (as the absence of plowing animals and farmland infertility), and finally the main cause for household's undiversified livelihood and poverty prevalence in the study area. The size of household livestock holdings was therefore, negligible and has no connection with diversification of livelihoods in the study area.

Meanwhile, as the other studies by various researchers revealed, household extension contacts had increased the degree of farm households to diversified their incomes. This may be due to the fact that the role of extension agents in farming communities had helped farm households engage in certain income-generating activities, assisted them how to apply selective and emerging technology of crops and livestock production, offering agricultural services such as how and when to apply fertilizers, pesticides, herbicides, implement and exposure to emerging technology, and how to access and apply mechanized farming facilities (Agyeman et al. 2014; Khatun and Roy 2012; Ambachew and Ermiyas 2016). However, the outcome of the MNL regression in the research area contravened the findings of those studies and the hypothesis of the study. Since after the frailer of state farm in the area, food crop production has been declined year round as the result of soil infertility, the prevalence of human and animal diseases, and unaffordability of medicines for both humans and herds, inadequacy, unaffordability and inaccessibility (sometimes) of agricultural inputs (chemical fertilizers,

pesticides, herbicides), crop pests, crop weeds such as *Striga* (widely referred to as witch weeds and *akenchera* locally) that extremely attacking sorghum and maize varieties, limited or no fallow periods (as farmland shortages in settler household), absence or death of yoked oxen unexpectedly by unknown causes of animal disease, and lack of care on the part of the concerned bodies.

In the meantime, the households practiced agriculture in traditional and backward way of slash and burn by axes and hoes in indigenous area. Such agricultural practices contribute to relay on non-surplus products such as root crops, shoot or bud food crops, leaves crops, stem crops, flower crops, and fruit crops. These agricultural practices, on the other hand, evolved and developed an adaptive strategy as the absences of plowing oxen and to mitigate the effects of adverse climatic conditions on food crop production. Therefore, such agricultural practices, despite having adequate and fertile land in the area of native households, declined food grain production and absent livestock rearing. In addition, absence of government-launched initiatives that are still under implementation in various parts of the country, such as the Productive Safety Net Program and the Household Asset Building Program are discourages both households and extension agents in study area. In the study area thus, household's miserable and destitute life was continued. All these considerations were outside the capacity control of extension agents at all locations in the field of study. These discouraging factors hence, kept away the households from approaching the agents of extensions. Therefore, as divergent to the research hypothesis, an extension contact of the household was marginal and has no connection with diversification of the livelihood of the household.

Likewise, as Khatun and Roy (2012) attest in their analysis of West Bengal, membership of cooperative household is essential for diversification of the livelihoods. Similarly, the traditional economic and social institutions in Ethiopia, such as *Edir*, *Ekub*, *Wenfel*, *Debo*, *jigi*, and *Sanbate* are played their role in dealing with emergencies, precarious circumstances, or in vulnerable situations in rural and urban areas of the country. In the event of a conditional or unconditional crisis or juncture, by supplying in-cash or in-kind or in other support such as taking part in labor, lending oxen for farm and donkey for transportation and so on, the households have been cooperating. The position of

these economic and social institutions in native and settler households, however, was not the same. Participation in membership of the household in the settler household was better than that of indigenous household. In the area of indigenous households these forms of social and economic cooperation were not well established as settler households. Hence, household membership has no relationship, and is negligible as diverging to the hypothesis of the study for diversification of household's livelihood.

Ultimately, in contravention of the research hypothesis and the study conducted by Agyeman et al. (2014) in the western Ghana region, total household income was negligible for diversification of household's livelihood. This was due to, the deterioration of household income sources and consequently the prevalence of poverty, as described above. According to the outcome of the MNL regression thus, an odds ratio of the household's overall income was one. This indicates that, the total income of the households had no association with households' livelihood diversification in the study area. This is due to; the annual income of the households of Assosa *wereda* is low. For example, as population surveyed of 2003 revealed, the average annual income per household and per person in BGRS was 6111 Birr and 1358 Birr, respectively. In the meantime, with 9657 Birr per household and 2146 Birr per person in Kamash zone has the highest average annual income, and with 3810 Birr per household and 847 Birr per person in Assosa zone has the lowest average annual income (BGRS 2004). Hence, the total annual income of household had no association with livelihood diversification of households in the study area. Finally, there was much lower contribution of the determinants of livelihoods diversification for livelihoods diversification and the associations among the determinants of livelihoods diversification were also lower.

At long last, the SDI result of nine income variables computed was 0.02. This means that, as the number of sources of income rises, the shares of (P_i) decrease, as does the total squared shares. So that, SDI reaches one. If the revenue sources are i then SDI falls between zero and one. Households with the most diversified income would have the highest SDI, and the least diversified income has been linked with the smallest SDI. As could be seen from the above, the total income of households in the study area was lower than the other area of the region. The SDI result of the study area was

the smallest (near to zero). Hence, there was no diversification of the livelihoods. Instead, livelihood “*specialization*” existed.

Conclusion and recommendation

Among the fourteen determinants of livelihood diversification, statistically significant predictors of household livelihood diversification were household head education level, household dependency ratio, household irrigation access, household credit access and household urban linkage. According to the MNL regression, credit access of the household was significant; nonetheless, as real conditions on the ground in the study area, it was negligible. Similarly, the ages of household heads, sex of household heads, road distances from households' homestead and media exposure of the households have been found to be marginal predictors of households' livelihood diversification. On the other hand, the relation between these predictive variable and livelihood diversification has been an inverse or negative correlation.

Meanwhile, household livestock keeping size in TLU, household extension contacts, household cooperative, and total household income had no association with diversification of livelihoods. That means the relationship between these predictive variables and livelihood diversification has been invalid. In the meantime, as SDI indicates, the statuses of livelihoods in the study area were not diversified rather “*specialized*.” It meant that the households in the study area were engaged only in subsistence agriculture and this was hand-to-mouth.

Furthermore, the contributions of the determinants of livelihoods diversification for household livelihood diversification were very low and not sustainable. As well as, the association among these determinants were also very less. Consequently, food was not secured, poverty was highly prevalent, vulnerabilities (animal death, pest, hailstorm, weeds, and other vulnerabilities related with the expansion of desertification) are perpetuated, over exploitation of natural resources or unsustainability were highly prevailed in the study area. Moreover, natural resource based livelihoods were the only option availed without alternatives. Consequently, natural resource depletion is a common phenomenon, and natural resource based livelihoods were declined and even disappeared.

Ultimately, livelihood was not secured and household's unwell-being or destitute lives were thus widely observed in the study area.

Finally, the policy implications of this study are help to: in improving natural resource management, developing resilience against vulnerability such as the consequences of expansion of desertification, developing adaptation of livelihoods beyond natural resources basis to secure households livelihoods, reducing poverty and improving food security of the households, building economic capacity of the households, and kept well-being of the households. Lastly, this study recommends:

- Greater concern should be given to give up natural resource-based livelihood by providing alternative livelihoods and supplying start-up credit, training, market access and household follow-up.
- Promote public awareness of the contribution of livelihood diversification for food security, better nutrition, poverty alleviation and better well-being;
- Providing equal opportunities and chances for all households in access to emerging technology, credit, properties, and services from government or NGO.
- Conserving and preserving natural resources throughout the region as a campaign as the other regions of the county.
- Controlling wild land firing by creating alternatives for wild land fire based livelihoods and community based natural resources managements and conservation.

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Availability of data and materials The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with ethical standards

Conflict of interest On the behalf of all authors, I hereby corresponding author justify that there is no conflict of interest.

Ethical approval Ethical approval was granted, and official approval would be sought at all levels from the concerned bodies. All participants (humans) were given full informed consent individually using voice recorder, present and published their images in the research report with no identification of respondents at the time of recruitment. Every respondent was explained the potential risks and benefits of participation, as was their right not to answer any question if they didn't want to and stop taking part at any point. Participation in the study would be posed only minimal risk of discomfort, and no research participant was forced against his/her will to provide information. All information obtained through this research has been kept confidential, and access to the data would be limited to research team members. In order to maintain confidentiality, information described using codes, data was analysed without disclosing individual identity and no participant names were included in the reports or presentations. The data storage requirements would remain until the full report could be written, published, and all possible datasets would be carefully communicated to the concerned bodies.

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