SOCIO-ECONOMIC AND ECOLOGICAL IMPACTS OF LARGE SCALE AGRICULTURAL INVESTMENT: THE CASE OF SIBU SIRE DISTRICT, OROMIA, ETHIOPIA

MSc. THESIS

BY

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SEPTEMBER, 2018

JIMMA, ETHIOPIA

SOCIO-ECONOMIC AND ECOLOGICAL IMPACTS OF LARGE SCALE AGRICULTURAL INVESTMENT: THE CASE OF SIBU SIRE DISTRICT, OROMIA, ETHIOPIA

A Thesis

Submitted to the Department of Natural Resource Management, School of Graduate Studies, College of Agriculture and Veterinary Medicine, Jimma University, in Partial Fulfillment of the Requirements for the Degree of Masters in Natural Resource Management (Forest and Nature Management specialization (NRM-621)

By

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September, 2018

Jimma, Ethiopia

APPROVAL SHEET

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Thesis Submission Request Form (F-08)

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Program of Study: **Degree of Master of Science (MSc) in Forest and Nature Management**

Title: **Socio-economic and ecological impacts of large scale agricultural investment. In the case of Sibu Sire district, Oromia, Ethiopia**.

I have completed my thesis research work as per the approved proposal and it has been evaluated and accepted by my advisors. Hence, I hereby kindly request the Department to allow me to present the findings of my work and submit the thesis.

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We, the thesis advisors have evaluated the contents of this thesis and found to be satisfactory, executed according the approved proposal, written according to the standards and format of the University and is ready to be submitted. Hence, we recommend the thesis to be submitted.

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DEDICATION

This thesis is dedicated to my parents, Ato Ararso Tolera and W/ro Qanatu Misikir, who nursed me with care and affection, and thought me the value of education thereby enabling me to reach this stage of education, the opportunity of which, they themselves have never had.

STATEMENT OF THE AUTHOR

I undersigned and declare that this thesis entitled *Socio*-economic and Ecological Impacts of Large Scale Agricultural Investment: The case of Sibu Sire District, Oromia-Ethiopia. My original work has not been presented or submitted for any degree in any other university and that all sources of material used for this thesis have been duly cited and acknowledged. The thesis is deposed at the Jimma university library to make available to borrowers under the rules of the library.

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BIOGRAPHICAL SKETCH

The author was born to his father Ato Ararso Tolera and mother W/ro Qanatu Misikir in October 1988 in Oromia Regional State, Horro Guduru Wollega zone, Abay Chomen District. He attended his elementary school at Acane, Ganji Qexala and Finchawa Primary and Junior Secondary School, completed his secondary school at Finchawa Senior Secondry School, and Preparatory at Finchawa Preparatory school. After successful completion of University Entrance Examination, he joined Hawassa University, Wondo Genet College of Forestry and Natural Resource in 2001 and graduated with Agro forestry in 2003. Soon after graduated he was first employed by Oromia Agricultural Research Institute, Haro Sabu Center and served for one year; second employed by Ethiopian Agricultural Research Institute, Ambo center and served for two years and third employed by Ethiopian Environment and Forest Research Institute, Jimma Center and served for two years until he joined Jimma University for studying Post Graduate Program. Then after, he joined Jimma University as a postgraduate student in the College of Agriculture and Veterinary medicine, Natural Resource management studies to pursue his MSc. Degree in Natural Resources Management (Forest and Nature Management) September 2016.

ACKNOWLEDGEMENTS

Above all, thanks to my Almighty God for his help in passing me through the complicated situations I faced for pursing my study (from Elementary School to University) and for his help and courage during my whole life time. I would like to express my sincere gratitude to my main advisor Dr. **Alemayehu Negassa Ayana** for his comment, close inspection and encouragement all along from research proposal formulation to its successful execution. His all-encompassing knowledge and logical way of thinking have been of a great value for me. I deserve special appreciation for the input he added on my work from the initial to the final thesis writing. I owe my deepest thanks to my co-advisor **Professor Debela Hunde** for his generous cooperation, suggestions, guidance and all input provided in my work. My heartfelt appreciation and great thanks goes to my sister Bilise Ararso for her care, psychological support, and tolerance throughout my study. I also appreciate for my sister Chaltu and my brother Hunde Ararso for their advice, encouragement and pray in my life and academic progress. I wish to mention my indebtedness to my brother Abdisa Ararso who assisted me financially, I don't forget him forever. I have no words to thank and appreciate the farmers for their hospitality and patience to answer questionnaire and interviewers for their willingness to participate in the study. I express my deepest and sincere gratitude to my mother Qanatu Misikkir and my Father Ararso Tolera, and all my brothers and sisters for being the pillar for my academic progress. I didn't forget to thank Natural Resource Management department and Jimma University for arrangement of schedule from proposal preparation to final thesis defense.

LIST OF ACRONYMS AND ABBREVIATIONS

ADLI	Agricultural Development-led Industrialization
AILAA	Agricultural Investment and Land Administration Agency
BA	Basal Area
DBH	Diameter at Breast Height
ETB	Ethiopian Birr
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
GDP	Growth and Domestic Product
GTP	Growth and Transformation Plan
HSD	Honestly Significant Difference
IE	Investment Establishment
IVI	Important Value Index
KII	Key Informant Interview
LSAI	Large Scale Agricultural Investment
MoARD	Ministry of Agriculture and Rural Development
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
SDPRP	Sustainable Development and Poverty Reduction Programme
SSA	Sub-Saharan Africa
SSAO	Sibu Sire Agricultural Office
SSFEA	Sibu Sire Forest and Environment Authority

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ABSTRACT

Large-scale agricultural investment is expanding in western Ethiopia. However, its socio-economic and ecological impacts on implemented area is given less attention. Hence, this study examines the impacts of large-scale agricultural investment on socio-economics and ecology in Sibu Sire District, western Ethiopia. Purposive sampling, Simple random sampling and systematic random sampling were used to collect data. A total of 70 quadrats measuring 40 m × 40 m (for ecology) and 180 household (for socio-economics) were used to collect data. Data was collected via household interview, key informants interview and focus group discussion for socio-economics while measurement of DBH and height of woody species collected for ecology. Descriptive analysis, chi-square, paired sample T test and one way ANOVA were used for socio-economics data analysis while diversity and similarity indices were used for ecological data analysis. A total of 44 woody species representing 27 families were recorded in the study area. The result revealed that the value of diversity indices in subsistence and commercial farm site were 0.00, 3.05, 0.83 and 0.09, 2.64, 0.83 for Simpson, Shannon and Evenness respectively. The total density was 69.38 stem/ha in subsistence and 25.63 stem/ha in commercial, total basal area was 16.48 m^2/ha in subsistence and 14.08 m^2/ha in commercial. These findings showed low diversity, low density, low basal area, low regeneration and low frequency in commercial farm, indicating that investment has affected the ecological systems in the area. Income of insider and outsider decreased; most insiders didn't compensate for most of resource they lost; Insider (83.3%), outsider (86.7%) and control (94.0%) confirmed that no any social services provided by company in their area; crop and animal production of insider and outsider decreased than control; water and agrochemical related risks was highest in insider and none in control; scarcity of fuelwood and going long distance to get resources were the major problems in insider and outsider as compared to control group. These indicated that investment is affecting socio-economic of close groups (especially, insider) than further group (control) and it is not practicing environment friendly. Therefore, strong and continuous government intervention through evaluation and monitoring of investment activities on ground is important to improve local socio-economic, diversity and population structure of vegetation as well as natural resources in general.

Keywords: Investment Establishments, Commercial Farm, Subsistence Farm, Woody Species, Species Diversity and Population Structure.

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1. INTRODUCTION

1.1. Background and justification

Ethiopia is endowed with potential Agricultural land resources. Out of 111.5 million hectares of the country, about 70% of the land is estimated to be suitable for annual and perennial crop production (MoARD, 2010). Agriculture contributes nearly half of the gross domestic production (GDP), 85 percent of exports and 85 percent of total employment (Tamrat, 2010) indicating that Ethiopian economy heavily depends on agriculture. However, Agricultural sector is suffering from various problems such as fragile soil and environmental degradation, declining size of holdings, fragmentation of farm plots, poor farm management, population pressure, poor infrastructure networks and weak market linkages (Bishaw, 2001). Farm size per household is small, which is estimated as 0.81 hectare in average. Large-scale agricultural investment land deals may involve >2000 ha (Schoneveld, 2013), >500 ha (World Bank, 2009) or from 1,000 to 500,000 hectares and the transaction take place in the form of purchases or long-term leases with terms of 50 to 99 years (Cotula *et al.*, 2009). However, what qualifies as large scale varies among countries depending on local contexts (e.g. average farm size).

Modern farming in Ethiopia had initially blossomed in the 1960s and early 1970s during which professionals in agriculture and other entrepreneurs joined hands and started a significant number of small-scale and medium sized modern farms. This was followed by the experience of post-1975, during which state owned farms were largely unsuccessful (Stebek, 2011). Recently, rush for land in Africa by investors from the Gulf countries, India, China and South Korea has been driven by the assumption that land is abundant in the continent, land rents and labor costs are low. Additionally, they faced with domestic resource constraints, in particular land and water, and hence look for opportunities to meet their rapidly growing demands internationally. At the end of 2009, more than a dozen countries in Africa, including Ethiopia, had given out millions of hectares of farm land to investors believing that large-scale investments will provide opportunities for rapid agrarian development and serve as an important instrument for tackling persistent rural poverty (Von-Braun and Meinzen-Dick, 2009). Ethiopia is one of the top five countries in SSA (Schoneveld 2013) to welcome/accept investment in large-scale farming in a bid to modernize its agricultural sector. In 2008, the government actively promoted and facilitated transfers of farmland to investors by establishing the Agricultural investment Support Directorate (FDRE, 2010). This is manifested in the rapid rise in agricultural FDI flows into the country (Weissleder, 2009). However, some investments have generated positive outcomes, while others have generated negative outcomes and most exhibit a mixture of positive and negative impacts. Green revolutions that depend on unsustainable intensive agri-business rather than broad based modernization of sustainable agriculture usually show an initial period of boom in production. This is followed by the period of stagnation and then the ultimate tragedy of a steady rise in fertilizer needs per hectare at a magnitude that is greater than the rise in agricultural production (Stebek, 2011). Additionally, major important livelihood sources for the rural community like fuel wood collection, grazing land, and medicinal plants are undervalued. These situations have their own drawback and could trigger conflict in the investment area and have damaging effect on the social, economic and environmental aspect of the country (Jiru, 2010). However, effects of the large scale land acquisitions vary from place to place and country to country due to diverse socio-economic, political and environmental factors (Andersson and Belay, 2008).

Plant species diversity is a key component of biological diversity. The woody species diversity is fundamental to total biodiversity, because it provide resources and habitats for almost all other forest species (Huange*et al., 2003)*. Human population growth and the demand for natural resources have put great pressure on the biodiversity wealth of the world through deforestation and habitat fragmentation (Terborgh*et al., 1997);* historical anthropogenic degradation has compromised forest ecosystem structure and functioning, despite high value diversity of native tree and shrub species. Hence, plantations should be carried out with a high-diversity of native species in order to create biologically viable restored forests, and to assist long-term biodiversity persistence at the landscape scale (Rodrigues *et al.*, 2009). Conversely, the land investments are not carried out in a manner that safeguards the ecological/environmental, social, and food needs of local populations (Araya, 2013). The Environmental Protection Authority (EPA) in Ethiopia, an agency mandated to oversee environmental issues, has developed policies, laws, regulations and administrative frameworks to ensure that environmental issues are taken into account before any project is launched, but EPA was too weak to monitor large-scale farm (EPA 2012). To reduce the impacts of several anthropogenic disturbances on the composition and diversity of plant species, the management and conservation issues are great concern today (Zimudzi *et al.,* 2013). However, vast portion of native biodiversity has become severely endangered (MEA, 2005) which is particularly true in developing countries, where 26 of the 34 global biodiversity hotspots are located (Mittermeier *et al.,* 1999). Therefore, challenges generated by the reduction and degradation of forest cover can be adequately halted only if serious efforts are made through maintaining the remaining forests and restoring deforested and degraded areas. This requires understanding of the diversity and natural dynamics of woody species. i.e. causes, mechanisms and factors that drive the process (Go-mez-pompa *et al.,* 1991; Teketay, 1996). Additionally, the integration of ecological restoration within the context of environmental and social certification is an important strategy in large landholdings of monoculture-based and export-oriented agro-industry companies (Wunder, 2006).

1.2. Statement of problem

Several studies indicated that attempts to examine large-scale land transfers and their economic, social and environmental impacts in Ethiopia have been quite limited. Hitherto (still now) there is little empirical evidences that showed the impacts of large scale agricultural investment (LSAI) in SSA about the benefit it offers to poor people (Cotula *et.al,* 2009). Little is known about the terms, conditions and benefit that will come out of land that has been leased to foreign and domestic investors in Ethiopia. Even though more research has been done in the acquisition of large farmland, impact study has been given less attention (Tamirat, 2010). Moreover, there is little information on the impacts that land deals have brought on the livelihood of the implemented area and country at large (Jiru, 2011). Studies by Dauvergne & Neville (2010), Rahmato (2011) and Shete (2011) indicated the possible negative impacts of land-use change driven by large-scale farming on the environment, but do not quantify actual effects.

There were no detailed studies done to scientifically examine the impacts of LSAI on local socio-economic and ecology (woody vegetation diversity, composition, population structure and regeneration). As a result of LSAI, forests have been degrading and loss of woody species diversity is given less attention despite their enormous importance in the study area. This offered changes on household’s socio-economic activities because of lost resources, decreased income, dissatisfaction, conflicts and others. Studies in other countries and in Ethiopia have indicated the risks of large-scale commercial farming on the local population and the environment, asserting that the benefits of investment do not compensate losses. Hence, investigating the complex reality has significant contribution to understand the rural development scenario and its implication to rural people in Ethiopia. Therefore, focusing on the gap explained above, this thesis examined the socio-economic and ecological impacts of LSAI in study area.

1.3. Objective of the study

1.3.1. General objective

The general objective of the study was to examine the impacts of large scale agricultural investment on woody species vegetation (ecology) and socio-economic of local people in the study area.

1.3.2. Specific objectives

- To assess the impacts of large scale agricultural investment (LSAI) on socio-economic of local people in the study area.
- To assess the impacts of large scale agricultural investment (LSAI) on woody species diversity, composition and population structure and compare its variation with subsistence farm in the study area.

1.4. Research questions

Given above objectives, this study attempted to answer the following questions:

- Are there impacts of LSAI on income and employment, social provisioning, crop and animal production to influence local socio-economic?
- Are there Agrochemical risks, lost resources and compensation by LSAI that influence local socio-economic?
- What people satisfaction level and their perception looks like on LSAI?
- Are there natural resource related impacts of LSAI that affect local socio-economic as a result?
- Are there difference between commercial and subsistence farm in woody species diversity, composition and population structure?

1.5. Significance of the study

The large scale of agricultural investment (LSAI) is displacing people from their original residential places and forces them to resettle. This resettlement caused serious destruction of forests and loss of trees/shrubs species diversity, which directly or indirectly affects living condition of people. In order to alleviate such type of critical problems, both the government and the local people should be aware of the problem and have the mechanisms to solve it. Such awareness can be created by conducting researches and generating empirical information that can clearly show the impacts and consequences of the problem on different aspects. By providing clear picture and information on the status of LSAI and its impact on the woody species diversity and local livelihood living in the study areas, this study provided basis to understand the contribution of LSAI to the country in general and study area in particular. The study paved ways and directions for further research, extension and development schemes. In addition, the outcomes of this study identified areas of intervention for policy makers and other stakeholders such as none government organizations (NGOs) and environmentalist to address the LSAI impacts on local livelihood and woody species diversity in the study area.

1.6. Scope of the study

This study was conducted to analyze the socio-economic and ecological impacts of large scale agricultural investment. The study emphasized in examining the current status of local socio-economic and woody species composition, diversity and population structure in the study site. Moreover, it assessed the variation in the woody species composition, diversity, population structure and distribution in the commercial and subsistence farm as well as the change occurred on local socio-economic and impact variation between household groups as result of the investment was assessed.

2. LITERATURE REVIEW

2.1. Definition of some key concepts

Socio-economic impact assessment: is a systematic appraisal of the potential social and economic impacts on different sectors of society, including local communities and groups, civil society organizations, private sector and government. It analyses and manages the social and economic impacts, both positive and negative, of planned interventions, policies, programs, projects, and any change processes invoked by the interventions (Appiah-Opoku, 2001). The socio-economic impacts must include compliance costs, human health benefits, environmental benefits and equity considerations (OECD, 2002).

Livelihood: is comprehensive and central concept and can be possibly influenced by socio-economic activities. Comprises the assets (natural, physical, human, financial and social capital), the activities and the access to these (mediated by institution and social relations) that together determine the living gained by individual or households (Ellis, 2000). Livelihood is the set of capability, assets and activities that furnish the means for people to meet their basic needs and support their wellbeing. Livelihood are not simple phenomena for local people rather it is connected with the environment, economic, political and cultural processes to wider regional, national and global area (Dejenie, 2011).

Investment: Investment is the purchase of a financial product or other items of value with an expectation of favorable future returns. In general terms, investment means the use of money in the hope of making more money (Nwanne, 2014). Investment is defined as the production of new capital goods, plants and equipments. Investment is a conscious act of an individual or any entity that involves deployment of money (cash) in securities or assets issued by any financial institution with a view to obtain the target returns over a specified period of time (Keynes, 2007).

Investment impact: is investments that made into companies, organization, and funds with the intention to generate a measurable social and environmental impact alongside a financial return. Actively placing capital in enterprises that generate social or environmental goods, services, or benefits such as creating good jobs, with expected financial returns (Brest and Born, 2013).

Species diversity: is the variety of species and a measurement of species richness combined with evenness, meaning it takes into account not only how many species are present but also how evenly distributed the numbers of each species are (Schroth & Sinclair, 2003). Is defined as the number and abundance of different species that occupy a location. To accurately determine species diversity, both the species richness, which is the number of different species, and the relative abundance, which is the number of individuals within each species, must be considered (Beres *et al.,* 2005).

2.2. Overview of agriculture and its investment in Ethiopia

It is widely accepted that agricultural growth is the primary source of poverty reduction in most agriculture-based economies, and is the case in Sub-Saharan Africa (SSA). Gross and Domestic Production (GDP) growth originating in agriculture is five times more effective in reducing poverty in low income countries than growth in other sectors. In SSA, it is 11 times more effective (Vorley *et al.,* 2012). Hence, the Ethiopian government adopted Agricultural Development-led Industrialization (ADLI) in 1993 as the overall development strategy. The government believed that agriculture as a leading economic sector and that the developments of the other sectors depend upon achievements of the agricultural sector. These beliefs has enabled the government to formulate four consecutive development plans that make agriculture as a base for other sectors: the sustainable development and poverty reduction programme (SDPRP), which covered the years 2002/03- 2004/05; the plan for accelerated and sustained development to end poverty (PASDEP) for 2005/06-2009/10; and the growth and transformation plan (GTP I) for 2010/11-2014/15, and GTP II for 2015/16 – 2019/20 (MoARD, 2010; FDRE, 2015).

Large scale agricultural investment in Ethiopia is based on two assumptions. First, agriculture has powerful impact in reducing poverty. The Second, the Ethiopian agriculture is at subsistence level and the majority of the small-holders are using backward agricultural practices (traditional technologies) for cultivation, harvesting and storage. To drag the Ethiopian poor agricultural production and productivity out of backwardness, capital and investment flow have crucial importance. However, LSAI can be useful if the land acquisition processes, the socio-economic and environmental vulnerability assessment is handled in the right way (Araya, 2013).

Agricultural investments are part of a wider trend of very rapidly increasing foreign investment in Ethiopia, constituting approximately one-third of all foreign investment, which has increased from a total of US $ 45 million in 2000 to over US $ 3200 million in 2008 (Mousseau and Mittal, 2011). The GTP predicts that by 2028, Ethiopia will become what it calls a “middle income” country. One of the strategies for rapid agricultural growth is privatization of investment in large scale farms for which the government will provide support and encouragement (MoFED, 2010 as stated in Rahmato, 2011).

2.3. Land allocation to investor

Ethiopia is often highlighted as a country in which a lot of foreign land transaction is occurring (Butler, 2010). This is because of the existence of hundreds of different agreements with foreign governments and private sector companies from India, China, Saudi Arabia, Korea, Qatar, Libya, Israel and the European Union (Bues, 2011). The government assessed, and identified suitable land and registered it in the land bank, establishing an effective land-administration system and implementation agency and providing the necessary support to attract local and foreign investors (MoARD, 2010).

The allocation of farm land to investors in various parts of the country has been going on since the second half of the 1990s, but in the period up to the end of 2002, those requesting land were Predominantly local investors and the land granted was for the most part small in size, less than 500 hectares (Rahmato, 2011). The area of land allocated for agricultural investment projects was estimated as 10 million hectares in 2008. In 2009 and 2010, lesser figures between 3 to 3.5 million hectares were stated (Stebek, 2011). Foreign investors began to show keen interest following the enactment of the investment proclamation and floriculture business success in winning a growing market in Europe and elsewhere. The demand for land by investors, particularly foreign ones, began to increase sharply from 2006 to 2008 for production of rice, floriculture, cotton and biofuels. Many applicants were allocated large tracts of land up to 10,000 ha and more. In the period between 2003 and 2009, there was some 500 foreign investors granted land either on their own or as part of joint ventures with local business. The largest foreign holding is by Karuturi (Indian Company) which has been given 300,000 hectares of land in Gambella Region and 11,000 in Bako woreda in Oromia. As a rule, the size of land allocated to foreign investors is much bigger than that of domestic investors; the justification given by public officials is that the foreign ones are much better endowed in terms of capital and technology and thus much better placed to make a success of their operations (Rahmato, 2011).

Regional governments were mandated to transfer farmlands less than 5000 ha and continued to hand out land to investors. Nevertheless, there was no clear demarcation of land under the mandate of regional states and land reserved for transfer by the federal agricultural investment and land administration agency (AILAA). As a result, some parcels have been transferred twice, to different investors, by the regions and by the AILAA. This practice caused conflicts and resulted in inefficiency in the administration of large-scale farmlands. In early 2012, the federal government embargoed economically emerging regions like Gambella and Benshangul Gumuz from making land deals, even for parcels less than 5000 ha. This was justified by pointing at corrupt and poor management of land resources, reflected partly through double-allotment of lands to different investors (Bekele, 2016). The most recent information available at the AILAA shows that the government decided to transfer land to investors indifferent phases based on demonstrated investors’ performance. In the first phase, a maximum of 5000 ha can be given to an investor (Sethi, 2013). This is contrary to the practices of early 2008, when parcels up to 100,000 ha were transferred to a single investor. While it is clear that large areas of land have been acquired by investors, estimates of the magnitude of large-scale land transaction and numbers of land deals are inconsistent – largely due to the poor access to reliable information, the time periods the different estimations covered and land size considered. Scoones *et al.* (2013) discussed the problem of data discrepancies and the difficulties of reconciling the various figures. He advises researchers not to be ‘overwhelmed’ by the quantification of the size of land transferred for large-scale farming and recommend examining the ‘quality and reliability’ of data.

2.4. Socioeconomic impacts of large scale agricultural investment

Recently the debate on the expansion of large scale land investment is hot issue in academic, development and aid organizations, politicians and the community at large. There is a mixed view whether the investment brings meaningful benefit to the local community or not (Jiru, 2011). Proponents of large scale land investment argue that, the investment flow increases capital in agriculture sector particularly in the developing world, enhances infrastructures expansion, creates more jobs and skill, bring capital and technology, increases the availability of domestic food supply, increases access to market and foreign exchange. These contributes to sustained and broad based development (Deininger and Byerlee, 2011), but other critics reject these views by claiming that large agricultural investment may result in local people losing access to the resources on which they depend for their food security and their entire livelihood (Grain, 2008). Empowering small holder farmers with tiny plots of land in China and Vietnam reduced rural poverty. In China, rural poverty was reduced among 200 million smallholders with an average holding of 0.65 hectares, and in Vietnam 0.46 hectare (FAO, 2006). However, large agricultural investment can be useful if the processes of the socio-economic and environmental impact assessment are conducted according to the set standard of national and international rules (Liu, 2014).

The government of Ethiopia argued that large scale agriculture expansion is part of the country's strategy and policy to achieve the national food security objective. As a result, various goals and benefits are documented by MoARD. Large-scale, particularly foreign investment will: a) produce export crops and hence increase the country's foreign earnings; it is also expected to expand production of crops needed for agro-industry such as cotton and sugar cane; b) create employment opportunities in the localities concerned; c) benefit local communities through the construction of infrastructure and social assets such as health center, schools, access to clean water; d) provide the opportunity for technology transfer; and e) promote energy security (MoARD, 2010). However, according to Ramatho's (2011) studies in Gambella, there is no evidence that many of these objectives have been met. On the contrary, the evidence gathered from both field work and in written documents, indicates that the damage done at present by the projects outweighs the benefits gained. Huge number of wildlife disappeared due to large-scale deforestation by Saudi Star in the area, which people hunted occasionally for consumption. Loss of the woods, grass and other vegetation in the process of clearing the land by investment projects, is causing hardship to the local communities. Similar studies by (Bossio *et al.*, 2012), indicated the impacts of foreign direct investment (FDI) on local people include: displacement from their land, loss of access to resources, and lack of adequate compensation. Moreover, land which used for investments are called free and unutilized but it is not free. For example, some of the land allocated for foreign investors in Benshangul-Gumuz and Afar regions of Ethiopia were previously used for shifting cultivation and dry-season grazing. These directly affect the livelihood of the farmers and pastoralists (Cotula *et al.*, 2009).

The other common negative effect is conflict, instability and food insecurity. Some deals have caused political conflicts, such as Madagascar in which 1.3 million hectares land deal with South Korea company led to the overthrew of the government in 2009 (Jiru, 2011). Human beings are often killed in conflicts and it ruins infrastructures and hampers (hinder) the desired development benefits. Other critics argue that rather than promoting rural development, it neglects the local rights, exploits the natural resources of the host country and impoverishes farmers not bringing about the promised benefits (Grain, 2008). Large scale agricultural investment impact (LSAI) is labeled as ´´land grabbing`` as most of the land transaction are not growing crops for domestic market but rather to food and energy security for the investors' country. This seriously affects the food security of the host countries, and exacerbates the problem (Robertson and Pinstrup-Andersen, 2010). Similarly, large tracts of land which were taken for biofuels production in Ghana implied that the plantations pose a potential threat to food security of the people (Action Aid Ghana, 2009). However, a study which examined the effects of the biofuels African project in the northern Ghana rather found improved livelihoods as well as increased food production through employment at least initially until the project was abandoned (Boamah, 2011).

Current studies conducted in East Africa countries (Tanzania and Mozambique) shows that the large scale agriculture expansion did not bring the promise of building infrastructures, and job creation (Jiru, 2011) and the number of workers were much reduced due to the mechanized operation of the farm. In addition, little attention is given on the gender dimensions of large scale farmland transaction for example women have lost their source of income from "Shea tree" which used for making "Shea butter" in Ghana. The financial compensations do not take into account this gender specific role (Tsikata and Yaro, 2014). Since women make up half of the agricultural production in Africa, short of addressing their role from key resources and income arising from it could jeopardize development (Cotula *et al.*, 2009).

2.5. Impact of large scale agricultural investment on environment/ecology and species diversity

Soil degradation &damage of soil structure & change of soil properties (alkalization, soil acidification, salinization, reduction of fertility, water logging and erosion) are the major problems caused by large scale irrigation of state sugar factories such as Fincha and Wonji in

Ethiopia Ruffeis *et al.* (2007). Fertile lands will lose their trees, topsoil, natural habitats and rivers, to be rendered barren as a result of exposition to chemicals in the fertilizers, insecticides and pesticides as a result of large scale farmland investment. Rivers and Lakes are likely to be poisoned by toxic materials and become undrinkable and health hazard. Therefore, government should protect its national reserve resource bearing in mind future generations (Stebek, 2011). Similarly, the conversion of woodlands to agricultural land is likely to cause large-scale impacts on the hydrology, soils and climate change unless the dynamics are fully understood, and mitigation measures are designed (Gwali *et al.*, 2010). Environmental impacts of agricultural intensification like Large scale investment include changes in local groundwater and downstream water availability, for example losses of access to drinking water for livestock (Abbink, 2011), aquatic and freshwater ecosystems and their services for humans (Bossio, 2012). As a result of Fincha valley sugar estate establishment, valuable ecosystems have been cleared and sanctuary for wild animals already lost Ruffeis *et al.* (2007). However, to say the investment is good or bad it all depends on the context. For example if the land was given to the investor in degraded area that could be redeveloped by the investor for agricultural purpose, it is good. Hence we need to have thorough understanding of the area and the specific situation. In addition, the effects of large agricultural investment projects may differ from place to place and country to country due to diverse socio-economic, political and environmental factors (Jiru, 2011).

Greater diversity is associated with greater ecosystem stability. The reliable, efficient and sustainable supply of some foods (for example, livestock fodder), biofuels and ecosystem services can be enhanced by the use of biodiversity. Greater ecosystem stability at higher diversity mean that there is lower proportional change in the annual production of biomass and this showed that the highest diversity is more stable than monocultures (Tilman *et al.*, 2006). This indicates that LSAI in which monoculture practiced such as oil palm tree can affect the diversity and ecosystem stability. It is possible, but not necessarily easy to restore biodiversity and ecosystem services in the highly human-modified landscapes (Rodrigues *et al.,* 2009), which likely occur in LSAI. In highly fragmented forest landscapes, single species or low diversity tree plantations are not sufficient to catalyze forest restoration (Kanowski *et al.,* 2003). This forest fragmentation mostly occurred where LSAI is practiced and this affect tree and shrub diversity in that area. Hence, improving the tree cover in the farming systems through both natural regeneration and planting is crucially needed to reverse the continued degradation of the ecosystem, increase resilience and improve local people's livelihood. Diversifying the composition of farm tree species also enhances the stability and productivity of agro-ecosystems (Kindt and Coe, 2005) and combines the objectives of attaining gains in food security and in conservation of biodiversity (Atta-Krah *et al.*, 2004), but in LSAI, the available farm tree species are almost monoculture plantation. This affects diversity of that area and lead to food insecurity of the local people.

2.6. Factors affecting woody species diversity in agricultural landscape

Humans for so long have a profound influence on forest ecosystems and their tree cover, and continue to do so (Schroth & Sinclair, 2003). Some activities have led to minor effects, while other have led to profound changes in the woody vegetation, or to permanent loss of tree cover (LongmanK & JeníkJ, 1987). Although the rise in human populations has caused obvious reductions in forest and tree cover, trees remain an important element of most human-dominated agricultural landscapes throughout the tropics. Diverse perennial vegetation (trees and shrubs) in agricultural landscapes has greater significance in nutrient cycling as compared to annual crops (Mulugeta and Admassu, 2014), and in addition, trees provide a wide range of important products and service functions (Abebe, 2005). The pattern of distribution of various vegetation structures and the mixture with diverse tree-based farming are interesting features with regard to floristic and eco-diversity at a landscape level (Backes, 2001). Thus, woody species diversity can contribute to ecosystem productivity and sustainability in agricultural landscapes (Kindt *et al.*, 2005).

Commercialization and access to markets often cause a decline in diversity of tree species, variability or both (Wiersum, 1982). A study in Malawi noted that increased access to natural resources (*i.e.* forests) is associated with decreased species diversity on farmland, since farmers can obtain some of their requirements, such as wood, medicinal plants, fruits, utensils, *etc.*, from the forest (Shaxson and Tauer, 1992).

The socio-economic background of farmers is known to be the major factor that affects tree/shrub species diversity management (Rocheleau *et al.*, 1988) in the agricultural landscape. Women may prefer fruit and fodder trees close to homesteads or men may prefer timber or woodlots away from the homestead; wealthy households may prefer monocultures or poor households may prefer multi strata gardens, to maintain diversity.

Farmers with little access to resources, particularly land, may focus on the production of few staple food crops, depending on their individual comparative advantage. In addition, farm size plays a role in the choice of tree species, arrangement and density, as well as overall management practices of the system (Zebene, 2003). Inappropriate land-use practices and tenure, and absence of local institutions for farm resource management brought about a rapid decline in tree cover and loss of biological diversity.

2.7. Livelihood and woody species diversity

The concept of livelihood is increasingly becoming central in the debate of rural development, poverty reduction and natural resources management. Livelihood analysis has gone beyond the narrow definition and approach to poverty reduction. It had been narrow because it was focused on certain aspect or implication of poverty such as low income and did not consider other vital aspect like shock and social factors. It is well recognized, that factors and conditions which constrain or enhance people ability to make a living needs emphasis around social, economic, and environmental aspects (Bebbington, 1999). A livelihood has the characteristics of being adapted to fit for survival. Hence livelihood is not statics but has dynamic nature. The livelihood framework helps in the analysis of a particular context (policy, history, agro-ecology and socio-economic situations), mix of livelihood resources (capitals) result in the ability to follow what combination of livelihood strategies with what outcome. A livelihood is sustainable when it can cope up with and recover from stress and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base (Scoones, 2013).

Ethiopia is becoming dependent upon species diversity of wood product imports mainly sawn wood, paper and ply wood. The demand for wood and wood products such as timber of the country is increasing as compared to demand of previous years. Import of wood products using foreign currency in 2013 (74,000 ton) is estimated to grow 10 times as compared to imported volume of forest products in 2000 (7,300 ton) **(**Pepke, 2010**)**. This indicates how much different woody species products influence the country's economy in general and the individual livelihood in particular.

Tree has provided support to local communities through enhancing income from the harvest of none timber forest products (NTFP), diversify their livelihoods (this will decrease direct dependence on forest resources), and modify agricultural practices to increase productivity. Trees improve the wellbeing of the people and the prospect of sustainable use of forest and land resources. This is why different studies also indicated that energy demand of local livelihood is highly depend on woody diversity (tree/shrub). For instance, of all the harvested wood in the tropics, 80% is used for fuel purposes, and the proportion is higher (90%) in the African tropics, where dry forests are predominant (Murphy and Lugo, 1986). A typical example is Kenya, which obtains 74% of its energy requirements from wood. The majority, 51% of the native people gets their fire wood demand from farm land as a source of household energy, while 35.8% of the resettles use wood from both natural vegetation and farm land as a source of household energy, but the rest gets from natural vegetation. All in all about 85% of the native people opposed resettlement (which can be occurred by investments, government policies, conflicts, natural disasters and others) because it has influence on their livelihood (Lamprecht, 1989). This shows the strong dependency of people on woody species diversity for their livelihood, but these woody species products are undervalued in most cases of LSAI.

3. MATERIALS AND METHODS

3.1. Description of the study area

3.1.1. Location

The study was conducted in Sibu Sire district. It is located in East Wollega zone of Oromia National Regional State, Ethiopia. It is about 280 Km from the capital city, Addis Ababa, and 50 Km from the Zonal town, Nekemte (Fig.1). Geographically it is located between 8^{o}16’20’’N to 10^{o}16’40’’N and 36^{o}47’00’’E to 37^{o}0’00’’E (Arfassa, 2015). Sibu Sire district share boundary with Gobu Seyo in the East, Wayu Tuka in the West, Gudeya Bila and Guto Gida in the North and Wama Hagalo and Billo Boshe in the South (Sibu Sire Agricultural office /SSAO, 2018).

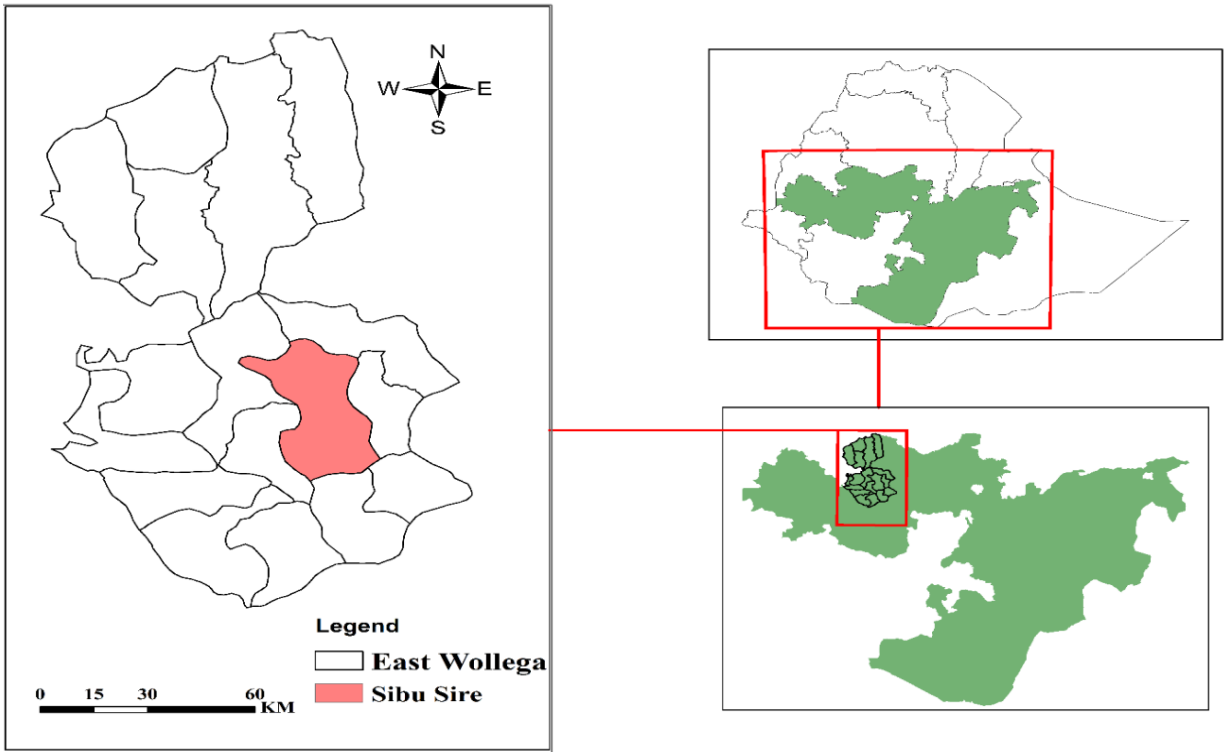

Figure 1: Study area.

3.1.2. Population

The total population estimated for the district was 102,228, of whom 50,717 were men and 51,511 were women; 10,243 or 10.02% of its population were urban dwellers. With an estimated area of 1,132.51 square kilometers, Sibu Sire has an estimated population density of 86.4 people per square kilometer (CSA, 2008).

3.1.3. Soil

The dominant soil texture found in the district are sandy loam, silt loam, clay loam and clay (Arfassa, 2015).

3.1.4. Climate

The district is divided in to three distinct geographical areas with different proportions; namely the highland 7.53 percent which is very small part of the district, midland 74.2 percent and the lowland 18.27 percent. The altitude ranges from 1360 to 2500 meters above sea level. The area is experienced with mean annual temperature between 24 to 25.5 ^{0}C and means annual rainfall between 1015 to 1050 mm (Arfassa, 2015). The area has typically two rainy seasons; a long rainy season from June to September, with the peak rainfall in July and August, and a short rainy season from April to May (Jaleta *et al.,* 2013).

3.1.5. Land use and Economic activities

The vast majority of households rely on subsistence agriculture for food and income. Of the total population in the district, 83 percent live in the rural areas, where directly sustains their life from the agricultural and other activities (Arfassa, 2015). Cattle (ox, cow, bull and heifer), shoats (sheep and goats) equines (horse, mule and donkey) and poultry are dominant livestock reared by the community (SSAO, 2018). Among the cereal crops that covered the area: wheat, maize and millet have been increasing continuously throughout the production years. Area coverage of land used for crop cultivation is 75,134 hectares whereas 8,743.5 and 19,866 hectares of land is covered by pasture/grazing land and degraded/barren land, respectively. The natural forest of the district covers the total area of 1,336 hectares of land (Arfassa, 2015). Dominant woody tree species in the district are: *Cordia africana, Ficus sycomorus, Croton macrostachyus, Albizia gumifera, Podocarps falcutus, Ficus vasta, Sysygium guineense, Prunus africana, and Acacia* species (Sibu Sire Environment and Forest Authority/ SSFEA, 20018).

3.2. Methods

3.2.1. Sample site selection and sample size determination

3.2.1.1. Social sample site selection and size determination

The district was purposefully selected due to the implementation of large-scale agricultural investment in the area and alleged impact of the investment on the ecology and socio-economic of local community. Two kebeles (Jarso wama and Wali galte) and within the kebeles three groups (area surrounding the investment, area outsider the investment and control) were selected purposively because of large part of the invested land area found in this kebeles. These groups (insider, outsider and control) were classified depending on the proximity to the invested land in this study. Insiders are those living very close to the invested land and assumed to be highly influenced by LSAI (approximately < 4 kilometer (km) from invested land border). Outsiders are households living at further away from invested land than insider and less probability to be influenced by LSAI (approximately >= 4 and < 7 km from invested land border). Controls are households living at furthest away than the two groups and assumed to be not influenced by LSAI (approximately >= 7 and < 10 km from invested land border). These distances were roughly estimated for the purpose of comparison. The comparison of groups' responses provides some additional insight in how the effects of LSAI land unfolded. In this study, classifying of households into three groups assumed that they provide important information/evidences for further understanding about LSAI impacts on local people.

From the total population (household) of two kebeles, Sample size was calculated using (Yamane, 1967).

$$n = \frac{N}{1 + N(e^2)}$$

Where n is the sample size, N is the population size, and e is the level of precision.

$n = 771/1+771\ (0.1)^2 = \approx 89$; Jarso wama kebeles.

$n = 956/1+956\ (0.1)^2 = \approx 91$; Wali galte kebeles.

From the two kebeles, one hundred and eighty (180) individuals were calculated/determined. Determined sample size was equally allocated to the stratified groups (insider, outsider and control), means sixty households for each groups (180/3 = 60) and randomly selected for data collection. To compare the differences among the groups/strata, equal sample allocation for each stratum would be more efficient even if the strata differ in sizes (Kothari, 2004).

Two focus group discussions (FGD) with five participants per group representing the variety of households were conducted following **(**schensul *et al.*, 1999). Fifteen key informant interview (KII) following **(**Keremane, 2017**)** also undertaken with agricultural development experts, investment experts, land administration experts, village level development officer, village leader, and local elder and Company managers. KII was selected for their first-hand knowledge about topic of interest and allowed a free flow of ideas and information during interview. The purpose of FGD and KII was to generate in depth information on some issues that may not have been adequately captured by individual household survey and also to crosscheck some unclear issues.

3.2.1.2. Ecological sample site selection and size determination

Commercial farm (Raj Agroindustry) and its surrounding subsistence farm was selected for woody species data collection. The distance of subsistence farm from the boundary of commercial farm was approximately two kilometer. To assess diversity, population structure and regeneration status of the woody species, parallel line transects in commercial and subsistence farm were used. Ten transect lines were laid down in both farms to cover the variation of woody plant distribution. Systematic random sampling of quadrats measuring 40× 40 m was placed at every 300 meters interval along the line transects. A total of 40 quadrats (four per transect) representing a total area of 6.4 ha was sampled from commercial farms. Similarly, a total of 30 quadrats (three per transect) representing a total area of 4.8 ha was sampled from subsistence farm. The number of quadrats in commercial farm was higher than those in subsistence farm. There was low probability to access woody vegetation in the commercial farm. Therefore, to get representative data, number of plot increased in commercial farm.

3.2.2. Data collection method

3.2.2.1. Social data collection

Primary data was collected from the sample rural households using a semi-structured questionnaire administered during January 2018 – February 2018 (appendix 1). Prior to the actual administration of the general survey, the questionnaire was pre-tested and modified/refined. Data on demographic and Socio-economic characteristics; impacts of LSAI on social provisioning, natural resources, crop and animal production, lost resources and compensation, agrochemical and etc. were collected. In addition to household survey, FGD and KII, physical observation and note taking of invested land site was done to cross check the raised issues and to analyze whether investor implementing their work in an environmentally friendly manner and as agreement with concerned bodies or not. This helped us to understand more about the environmental impacts of the LSAI.

Secondary data was collected including information on the study area, agricultural production, employment opportunity, and agrochemical application. The information was collected from district level offices and Raj Agro Industry plc (private limited company).

3.2.2.2. Ecological data collection

In each of the quadrats (40 x 40 m), the following parameters were recorded: identity of all woody species, diameter at breast height (DBH) of all woody species (with DBH > 2 cm) following Tsheboeng (2016) and height of all woody species (>= 2m) following Yemenzwork *et al.* (2017). A caliper and Diameter measuring tape and clinometer were used to measure diameter and height respectively. Plant species were identified using reference materials and with the help of local people familiar with the flora. After vernacular name known, scientific name were identified with the help of books and publications of flora of Ethiopia and Eritrea (Bekele, 2007; Edwards, *et al., 1*995).

3.2.3. Data Analyses

3.2.3.1. Social data analysis

For the analysis of social data (Table 1), descriptive analysis through (percentages and mean), chi-square, paired sample T test, one way ANOVA and multiple comparison of Tukey's honestly significant difference (HSD) analysis were applied for different variables by using SPSS version 23.0.

Table 1: Applied statistical tests for each variable.

Variables name	Description	Applied statistical tests
Income	Income of respondents between and within groups	OWA, MCT, PST and M
Social services and technology transfer	Provided social services and technology to local people by investor/company	X^2 and P
Employment	Employment opportunity of investment	M
Crop	Crop production before and after IE	X^2 and P
Livestock	Livestock production before and after IE	OWA, MCT, PST, M and P
Agrochemical	Biological and physical agrochemical related risk because of company	X^2 and P
Compensation	Replacement for lost resource by LSAI	p
Satisfaction level	Satisfaction by salary, services and etc.	p
Perception	Local people view on investment/LSAI	X^2 and P
Natural resources	Natural resource status (tree, water, etc.)	X^2 and P
Distance	Distance change to get natural resources	PST and M
Fuel wood	Fuel wood problems and its rank	X^2 and P

Note: *OWA = one way ANOVA, MCT = multiple comparison of Tukey, X^2 = chi-square, PST = paired samples T test, P = percentage, M = mean and IE = investment establishments.*

In income and livestock production variables, the analysis was done in two approaches: The first one was classifying the household by proximity to investment area as insider, outsider and control (comparison of household income and livestock number in different groups as independent sample). This approach was applied to know how investment impacts were on household income and livestock number close to investment area as compared to far household (control group) using one way ANOVA. The second one is classifying the household as before and after IE in the area (comparison of household income and livestock number in the same groups as related sample). These approaches were applied to know the household income and livestock number variation in the same group as before and after IE using paired sample T test.

3.2.3.2. Ecological data analysis

3.2.3.2.1. Species composition and diversity

Species richness (number of species) was determined by summing up the number of species identified (Whittaker, 1972). To determine the woody species diversity, diversity indexes (Shannon diversity index, Simpson diversity index and evenness) were computed following (Newton, 2007).

$H' = -\sum_{1=1}^{s} (p_i)(\ln p_i)$;

Where H´= Shannon diversity index, S = number of species, pi = proportion of total sample belonging to the i^{th} species, ln = natural log.

$SI = \sum_{1=1}^{s} p_i^2$;

Where SI = Simpson’s index of species diversity, S = number of species, pi = proportion of total sample belonging to the i^{th} species.

E’ = H’ / lnS;

Where E’ Evenness, H’= is the Shannon diversity index, S = is the number of species in particular farm.

3.2.3.2.2. Similarity in woody species composition

A large number of indices have been defined to measure similarity between two samples which are characterized by the features they contained (Hammer, 2003). However, the similarity in woody species compositions was computed by using Jaccard's Similarity Coefficient (Krebs, 1989) for comparison of two farms in this study. The coefficient value is between 0 and 1:0 indicates complete dissimilarity and 1 indicates complete similarity in species composition. In other word a value of 1 means that the two communities we are comparing share all their species, while a value of 0 means they share none.

$S_J = B / (B + S + C)$

Where $S_J =$ Jaccard's Similarity Coefficient; B = number of woody species found in both farm; C = number of woody species recorded only in commercial farm and S = number of woody species recorded only in Subsistence farm.

3.2.3.2.3. Population structure and importance value index

To describe population structure, important value index (IVI), which includes relative frequency, relative density, and relative dominance were calculated. Basal area, frequency and density were also calculated following (Mueller-Dombois and Ellenberg, 1974). Individuals of recorded species were grouped into diameter classes at increments of 10 cm and height classes at increments of 2 m. Structure was depicted using frequency histograms for both diameter and height class distributions following (Peters, 1996). The resulting frequency histograms were then interpreted as an indication of regeneration status. A collection of all species were included for analyses of population structure. This means, all recorded and measured species with DHH > 2 cm and height >= 2 m were included for density, frequency, basal area and IVI calculation. IVI enables comparison of the ecological significance of species in a given area and calculated as:

IVI *= Relative density (RD) + Relative frequency (RF) + Relative dominance (RD);*

Density of a species = number of plants of a certain species/area (number of individuals/ha),

Relative density = density of a species/total density of all species x 100,

Frequency = number of quadrats of occurrence of a species/total quadrats,

Relative frequency = frequency of a species/total frequency of all species x 100,

Relative dominance = basal area of a species/basal area of all the species x 100.

The **basal area** were calculated for all species from diameter at breast height using the formula $BA= (DBH/2)^2 *\pi$.

4. RESULTS AND DISCUSSION

4.1. Socioeconomic impacts of large scale agricultural investment

4.1.1. Impacts of large scale agricultural investment on income

Insider and outsider were getting higher income than control group before IE, but insider and outsider were getting lower income than control after IE because of crop and animal production change (Fig. 2). Sorghum was very important crop produced by insider and outsider than control group before IE. Most of insider and outsider were producing and getting high yield from this crop than control group before IE, but only few of insider and outsider was producing this crop after IE because of bird's damage that comes from Raj Agro Industries sugarcane plantation (detail of these presented under LSAI on crop production). Additionally, Loss of advantage such as decreased number and product of animals because of the land given to investor was other factor for decreasing the income of insider and outsider groups after IE. One way ANOVA indicated that there was statistically significant difference in household income before IE among the three groups ($F_{2, 177}$ = 17.409; P = 0.001), but no significant difference among three groups after IE ($F_{2, 177}$ = 0.94; P = 0.910). One way ANOVA followed by multiple comparison of Tukey's HSD to know which group was significantly different from the others. Accordingly, means comparison indicated that insider income before IE (mean = 33528 ETB) was significantly (p = 0.001) higher than control income before IE (mean = 20364 ETB). Outsider income before IE (mean = 28923 ETB) was significantly (p = 0.001) higher than control income before IE (mean = 20364 ETB). The comparisons between insider and outsider before IE was not significant (p = 0.992). However, the mean income of insider was higher than mean income of outsider before IE.

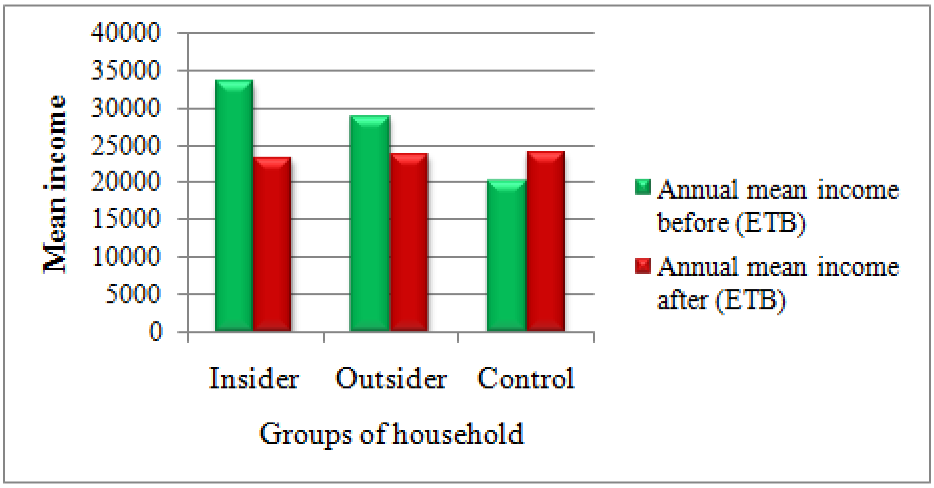

Figure 2: Estimated annual mean income.

Paired sample T test also run and indicated that there was a statistically significant difference in income before and after IE within insider, outsider and control groups (Table 2). Generally, our findings indicated that the income of control groups after IE was greater than their income before IE which may be because of agricultural input or others. In contrast, income of insider and outsider groups after IE was less than their income before IE, indicating high impact of LSAI on local people close to it. This is similar with study of (Bekele, 2016), after Karuturi's company intervention, the mean annual income of households in the affected stratum has declined as compared to their incomes before the intervention.

Table 2: Income analysis within same group as before and after by paired samples T test

Groups	Annual mean income (ETB)		t	d.f	p
	Before IE	After IE			
Insider	33528	23308	5.093	59	.000
Outsider	28923	23797	5.447	59	.000
Control	20364	24046	-5.094	59	.000

The mean difference is significant at the 0.05 level.

Note: IE = Investment establishment, ETB = Ethiopian birr.

4.1.2. Impacts of large scale agricultural investment on social services and technology transfer

Insider (83.3%), outsider (86.7%) and control (94.0%) responded that no any social services provided in their area (Fig. 3). Chi-square analysis revealed that there was statistically no significant difference in distribution of the responses related to social services among groups (chi-square = 3.242; d.f = 2; $p > 0.05$). This indicated that various goals and benefits documented by Ethiopian ministry of agriculture and rural development (MoARD, 2010) was not supported by evidence that these goals have been met; its strategy and policy on large scale agriculture expansion argued that foreign direct investment benefit local communities through the construction of infrastructure and social assets such as healthy center, schools, access to clean water and provide the opportunity for technology transfer. However, the investor has no contractual obligations to provide social services to the communities; on the contrary, it is the government that constructs some of the infrastructure such as roads and electricity used by the project.

The evidence from respondents indicated that insider (84.4%), outsider (91.7%) and control (100.0%) not introduced new technology (Fig. 3). There was statistically significant difference in technology transfer among groups (chi-square = 9.182; d.f = 2; $p < 0.05$). The company is using high technology such as land tilling by tractor, new variety of sugarcane, sugarcane harvest and process by machinery. Local farmers didn't access such technologies and other good experience of company's agricultural practices. Some of respondents from insider group considered company's canal water utilization as positive technology transfer since they were using the water. However, most of farmers were not considering as technology transfer, because they were diverting and using water for irrigation before canal water provided for them by company. These farmers explained their idea that the canal water constructions have negative impact since it took piece of their land. Few respondents in outsider group got improved maize variety only for one year with low price. However other studies indicated that large-scale investors do not necessarily improve domestic markets for agricultural inputs, outputs and financial services (probably the most important limiting factors to smallholder income growth) (OECD, 2002). Control groups were not access to any technology transfer from company. However they were using their own traditional water diverting system for irrigation and obtaining different improved crop variety from the district. Generally, our findings revealed that the average response of the three groups not introduced with new technologies by investor were 92%. This is nearly similar with the study of (Boamah, 2011); majority of the respondents (96%) said they have not been introduced with new technologies of farming as a result the investment project.

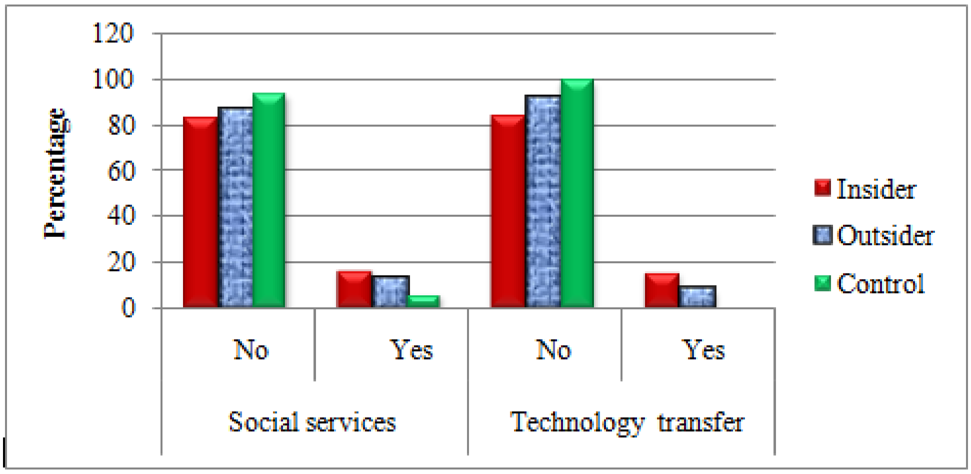

Figure 3: Social services and technology transfer in percent.

In addition to individual household interview, key informant interview was conducted in detail about social services and technology transfer with different concerned bodies. For example, Agriculture section assistant manager explained that Raj Agro Industry was providing social services such as Ambulance at emergency time (especially during child birth), allowed drinking water to people in the area (from the company's drinking water) and canal water for irrigation, maintained 11 km road from Sibu Sire town to Company, support road construction by Dozer for Dicho Abba Garmama Kebele, independently constructed 10 km road for Bikila Kebele (in Quni sub-kebele) and 5 km for Jarso wama Kebele (Guno dambi dima sub-kebele), annually pay 1000 birr on average to different religion organization and sometimes to some schools, transporting tree seedling during planting program as well as other material for government organization. To cross check these issue we discussed with Sibu Sire District's concerned professionals (seven individuals) and local KII (eight individuals). Different KII responded differently, but most of individuals said that most of these services explained above were not provided. We also conducted two focus group meetings with five participants per group representing the variety of households. Different opinions were reflected by individuals even though most of them said that many of services raised by manager were not provided for them.

4.1.3. Employment opportunity

Secondary data revealed that average salary per month for both (permanent and temporal) employees were increasing throughout the years (2009 to 2018), but number of permanent and temporal employees has no uniformity. Specially, number of temporal employees was decreasing from 2009 to 2012, increasing from 2013 to 2017 and decreasing at 2018 (Table 3). This was because of the company's most work is season dependent and changeable from year to year; for example when sugarcane planting and its harvest carried out, high number of temporal worker needed. In line with this, Rahmato (2011) reported that large scale agricultural investment projects which started operations in the country have provided employment opportunities to local people in the form of short term and seasonal employments. Some labor work replaced by machine and minimizing some worker at any time when they ask about salary to increase was also other reasons that change number of temporal employees. This showed that no work continuity and low guaranteed (no work sustainability and security) for labor worker to lead their life in confidence. The households confirmed that the average wage rate per day was very low for temporal employee as compared to the local labor work. The company's average wage rate per day was 40 ETB (minimum 30 ETB and maximum 50 ETB) while the daily wage rate per day in the area was 50 ETB and inviting lunch additionally. However, the secondary data obtained from the company bureau indicated that the average wage rate per day was 49.4 ETB in January, 2018. The permanent employees were also strongly argued that their salary was very low as compared to salary of employee in the same position in state sugary factory. The role of employment in poverty reduction and livelihood improvement has received wide attention and it is one of the arguments that are used when arguing for large scale farm expansion in Ethiopia (MoARD, 2009), but our findings indicated that it is less effective on ground. Studies by (Getnet, 2011) reported that the contribution of foreign direct investment to agricultural employment in Ethiopia is very limited.

Table 3: Employment opportunity provided by company.

Year	Number of employee		Average salary per month (ETB)	
	Permanent	Temporal	Permanent	Temporal
2009	58	650	1100	208
2010	72	558	1140	234
2011	64	486	1417	360
2012	66	450	1580	400
2013	62	491	1732	455
2014	84	657	1975	728
2015	87	770	2000	754
2016	157	800	2220	1040
2017	137	907	2475	1430
2018	113	390	2780	1482

4.1.4. Impacts of large scale agricultural investment on crop production

Sorghum was producing by insider (94.8%), outsider (89%) and control (72%)) before IE. However, number of household producing this crop was reduced as indicated by insider (3.3 %), outsider (6.7%) and control (31%) after some years of IE (Table 4). Specially, production of this crop was very small in insider and outsider than control group after IE, indicating more impact of LSAI on close households. However, we assumed the control group as free of investment impact at the beginning of this study, there was influence on their crop production. Chi-square analysis indicated significant difference between groups in the production of sorghum before IE (chi-square = 5.435; d.f = 2; P = 0.046) and sorghum after IE (chi-square = 22.151; d.f = 2; P = 0.001). In the rest of four crops diversity (Maize, Noug, Tef and Finger millet), there was no difference between groups in the production before and after IE. This showed that farmers were producing these crops after and before IE without influence of LSAI.

Table 4: Crop production in percent before and after investment establishment.

No	Crops type	Insider		Outsider		Control	
		Yes %	No%	Yes %	No%	Yes %	No%
1	Maize before	97.8	2.2	95	5	92	8
	Maize after	98.9	1.1	96.7	3.3	96	4
2	Sorghum before	94.8	5.2	89	11	72	28
	Sorghum after	3.3	96.7	6.7	93.3	31	69
3	Noug before	37.8	62.2	38.3	61.7	28	72
	Noug after	33.3	66.7	38.3	61.7	24	76
4	Tef before	83.3	16.7	84.3	15.7	85	15
	Tef after	81.1	18.9	83.3	16.7	84	16
5	Finger millet before	81.1	18.9	75	25	66	34
	Finger millet after	74.4	25.6	68.3	31.7	56	44

Household asked why they stopped producing Sorghum. They responded that there were birds called Girrisa in local name (Fig. 4) that cause great problem by feeding on this crop and they couldn’t get needed product as before IE. Most households informed that these birds came after Raj Agro Industry established while some of them argues that birds exist before project started even though it increased in number after project started. However, two opposing ideas raised from each side, they agreed that number of birds increased at alarming rate after sugarcane plantation expanded by the company. This sugarcane plantation created suitable environment for birds; it support as habitat.

Figure 4: Birds (Girrisa) in the sugarcane.

4.1.5. Impacts of large scale agricultural investment on livestock production

Livestock production is one of the fundamental agricultural practices to fulfill the basic need of rural household living in the area. Insider's livestock number was higher than the other two groups before IE. This was because of high resource access of insider than the other two groups before IE, but loss of resources such as grazing land decrease insider's livestock number after IE (Fig. 5). One way ANOVA analysis indicated that there was statistically significant difference in livestock number between groups before IE ($F_{2, 177}$ = 3.019; P = 0.049), but not significant difference in livestock number between groups after IE ($F_{2, 177}$ = 1.775; P = 0.172). Multiple comparisons of the means using Tukey's HSD procedure indicated two significant comparisons: insider livestock number before IE (mean = 28.7) was significantly (P = 0.047) higher than outsider livestock number (mean = 23.2). Insider livestock number before IE (mean = 28.7) was significantly (P = 0.041) higher than control livestock number (mean = 19.4). The other comparisons between outsider and control was not significant (P = 0.292).

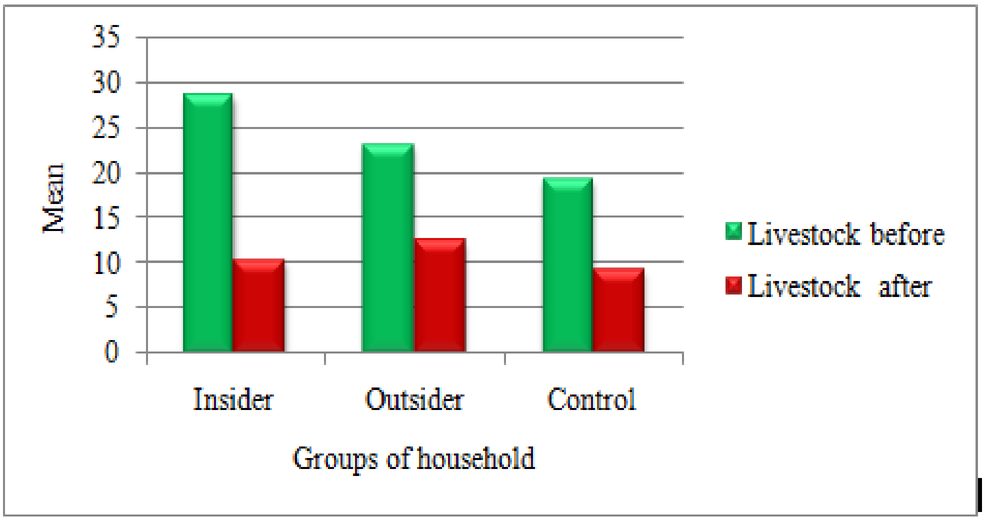

Figure 5: Livestock number production before and after investment establishment.

The paired samples T test indicated that there was statistically significant difference in livestock number before and after IE within insider (t = 7.028; d.f = 59; P = 0.001), outsider (t = 6.202; d.f = 59; P = 0.001) and control (t = 6.099, d.f = 59; P = 0.001). Even though the difference exists within all groups in livestock number production before and after IE, the reasons/factors for this difference was different. Factors such as mechanized agriculture, traditional agriculture and others (which can be diseases, climate problem etc.) influence livestock number differently (Table 5). In this case, mechanized agriculture is agricultural practice by investor, use high/advanced technology, use large area for production, produce for commercial purpose and it represent/indicate the expansion of investment while traditional agriculture is the agricultural practice by local farmers, use less/none technology, use small area for production, produce for food rather than for commercial purpose and it represents expansion of backward agriculture. Therefore, these were the main factors that decreased livestock production in the area.

Table 5: Factors influencing livestock number production in percent.

Factors	Insider	Outsider	Control
Mechanized agriculture	47.8	16.7	0
Traditional agriculture	38.9	61.7	74
Others	13.3	21.7	26

The findings revealed that the household living close to investment area greatly influenced by mechanized agriculture than other factors as indicated in the above table. Investment which practice mechanized agriculture use large area for production and narrowed local people opportunity to access the resource like grazing land. This was why the land given to Raj Agro Industry directly influencing local people livestock production and hampers their livelihood. (Gobena, 2010) reported that keeping livestock out of the grazing land (out of land given to Karuturi Agro Product Plc) was expressed by 20% household as a threat to their livelihoods. Similarly, (Bekele, 2016) reported that after the intervention of this company, households affected by 45% livestock reduction. When the land was under state, local people were using resources like grass for their livestock and remnant forest from some part of this land. After the land given to private investor, local people totally prevented to use grass even though the resource still exist in many places of the invested land. If livestock enter to company's farm boarder, farmers punished 50 to 100 ETB per livestock. This punishment rule was prepared by company itself and affecting farmers in the area. Not only protected from grass utilization, but also they forced to keep their livestock throughout year for the fear of punishment because of sugarcane presence in all year round. These factors were reducing number of livestock and cause hardship on local livelihood. In addition to number of livestock, products such as milk, butter and fattening were decreasing, especially in insider (67.8%) than outsider (60%) and control (58%).

4.1.6. Agrochemical application risk in the area

Agrochemicals were great problem to people living in the surrounding to Raj Agro Industry. In this study, biological damage is the damage occurred on plant, human and livestock including fish and bees while physical damage focused on pollution of water, soil and air. The insider group was highly affected than outsider group and no any chemical related damage on control group (Fig. 6). The biological damage presence was explained by insider (40%), outsider (26.7%) and control (0.00%) while physical damage was explained by insider (34.4%), outsider (18.3%) and control (0.00%). This indicated that how investments like Raj Agro Industry was negatively impacting socio-economic of local people. There was statistically significant difference between groups in biological damage of chemicals (chi-square = 26.750; d.f = 2; P = 0.001) and physical damage of chemicals (chi-square = 23.354; d.f = 2; P = 0.001). However, the chemicals damage on plants (biological) and soil (physical) were not raised by any respondents in all groups.

Local farmers' livestock and honey bees were killed feeding on sugar waste product called molasses. Even though this waste product use for animals as feed, it killed them because of its sugar testy that push to feed than expected amount. Chemical washes from factory entered to Jalale and Facha'a reservoirs and polluted these reservoirs. As a result, a number of fishes in the reservoirs and local farmers' livestock were killed. Specially, killed fishes odor polluted air and affected local people and because of this, they reported to concerned bodies. Sibu Sire District livestock authority heard the issue and visited the area, but no solution they set. The chemical impact also affects some workers working in the Company; they washed their face unknowingly with chemical polluted water and injured by it.

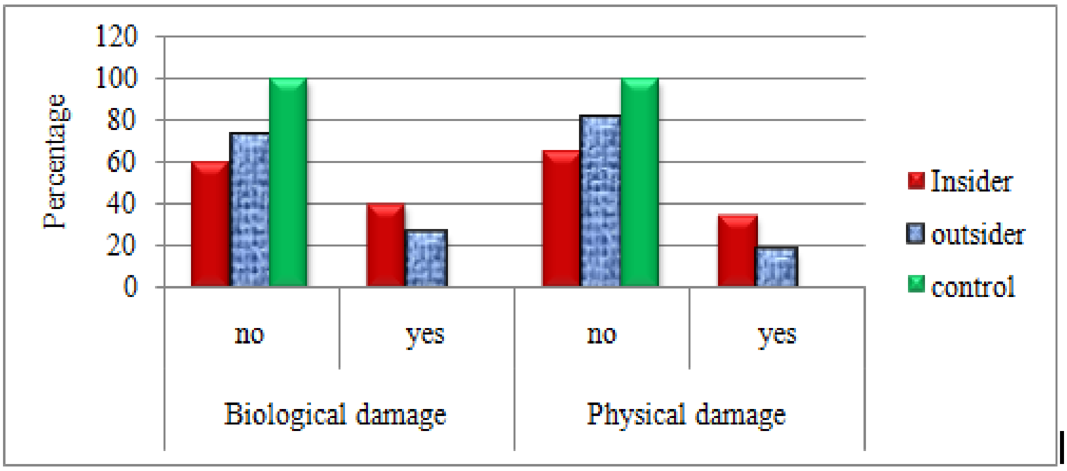

Figure 6: Biological and physical damage of agrochemicals in percent.

In addition to primary data collection and analysis, we also collected and presented secondary data of agrochemical used by Raj Agro Industry. Below (Table 6) indicated the average chemicals applied for three years (2015, 2016 and 2017) to crops in field for weeds and insect protection, to crops after harvested for insect damage protection and to dry grass before land tillage. Illegal and very dangerous chemicals such as Malathion were applied to maize in store. Even if these chemicals were small in volume, their consequence on human health may be great since the crops supplied to market and used for food. Large volume of chemicals like round up sprayed to grass to dry it before land tillage. Local people raised that chemicals application by the company affect honey bees and considered as one of reason for their honey product decreasing. However, the same chemical like 2, 4-D applied to weeds by farmers themselves, they argued that the amount and different kinds of chemicals applied by company cause more problems. With regard to the decline in honey production in the area, it is difficult to conclude that it is only the direct result of Company's chemical application. Therefore, we believe that it was the combination of both (local farmers' and Company's chemical application) as well as the deforestation might reduce the flora cover in the area and cause reduction of natural flowers, which could contribute to the honey reduction.

Table 6: Agrochemicals used by company in liter.

Years	Types of agrochemicals							
	Malath-ion	Metribuzin	Round-up	2,4-D	Primagr-am gold	Endo-sulfan	Glycel	Metolach-lor
2015	4	20	1097	0	0	0	0	0
2016	6	1529	321	3	0	0	0	0
2017	5	528	2200	890	43	15	2200	240
Average	5	516.3	1206	297.7	14.3	5	733.3	80

4.1.7. Lost resources, compensation and satisfaction

In this analysis, only the insider group was included because of other two groups not affected by these issues (not lost their resources). Out of 60 household asked, 44.5% was not compensated, 23.3% was compensated and 32.2% was neutral. In this case, neutral households were who didn't lose any resource as a result of IE in the area while others (not compensated and compensated) lost their resource. Even if most of farmers lost their resources, only some of them were compensated. As many of respondents said, compensation given only for some lost resources such as killed animals and destructed houses, but not for others like fruit, vegetables and wasted land/soil by canal excavation and overflow. Similar studies by (Bossio *et al.,* 2012), indicated the impacts of foreign direct investment on local people include: displacement from their land, loss of access to resources, and lack of adequate compensation.

Those farmers living close to invested land were lost the chance of using grazing land and remnant forest as a result of the land given to investor. During FGD and KII, farmers informed that no any compensation given to local community for lost communal resource by other investors found in the district. For instance, among fourteen domestic (small or medium scale farm) and one foreign investor (large scale farm) in the District, the communal grazing and forest land given to Shambal Kasahun Minase and Kebede Waqo domestic investors without any compensation to local community for the advantage they lost. Similar study conducted at Bako Tibe (Gobena, 2010) reported any loss or change inland holding has a considerable effect on the majority of farmers as farming activities is the main source of livelihood. Ellis (2000) stated that livelihood framework put land as an asset of the natural capital and contributes a pivotal role in enhancing improved livelihood of the rural community.

To know how people reflect their satisfaction, household asked about employment opportunity (salary payment), compensation for lost resource and services (such as safety net, medical and insurance) provided by company. Even though the company has responsibility to provide necessary services to the employees, respondents confirmed that necessary safety net was not fulfilled for them. As we can see from (Table 7), many of respondents were in the very low satisfaction level for all categories (services 34.2%, salary payment 58.8%, resource compensation 59.7% and average 50.9%) while satisfaction level in very high category was zero. In this case, average satisfaction level is the average of the three (services, salary and compensation) satisfaction level.

Table 7: Satisfaction level of local people by services, salary and compensation in percent.

Satisfaction level	Satisfaction categories			
	Services (%)	Salary (%)	Compensation (%)	Average (%)
Very low	34.2	58.8	59.7	50.9
Low	26.1	23.7	33.9	27.9
Medium	29.3	17.5	6.5	17.8
High	9.9	0.00	0.00	3.3
Very high	0.00	0.00	0.00	0.00

4.1.8. Perception of people concerning large scale agricultural investment

Households were asked as their perception was positive, negative, both (negative and positive) or neutral. The insider group was more impacted positively and negatively than outsider and control groups while the neutral response was highest in control groups. This was because of control group found at far distance and their connection with company was less as compared to the other two groups (Fig. 7). There was statistically significant difference in social perception between groups (chi-square = 10.597; d.f = 6; P = 0.014). These differences in household perception/view were determined by different factors that connect them with company. The main factors such as birds problem, chemical damage, farm boundaries problem, valued tree clearing, water resource competition, grass/forage scarcity, canal water related risks and minimum salary payment pushed the community to have negative perception on company. For example; many Animals killed by chemicals, human life lost by company's stored water, crops product decreased because of birds damage and canal water over flow affected local people house and their fruits and vegetables. Consequently, these caused very strong conflict; especially with insider groups. As a result, negatively impacted households reported many times to concerned bodies, but only some of the issues got solution. However most of farmers have negative perception on company, there were some advantage such as canal water utilization for irrigation, employment opportunity, drinking water and ambulance services. These factors pushed/led some people to see the company positively while others compare the advantage and the disadvantage of the company and consider as it has both impacts.

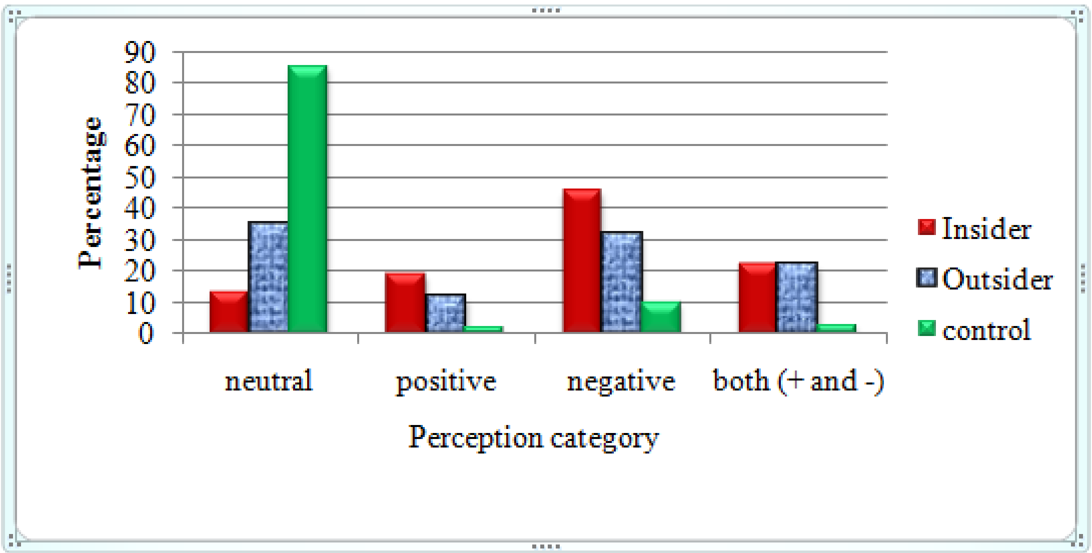

Figure 7: Perception of household in percent.

4.1.9. Natural resource related impact of large scale agricultural investment

Disturbance of natural resources by investment affects the ecology and local socio-economic directly/indirectly. Insider (65.7%), outsider (63.6%) and control (60.3%) indicated that natural resources were decreasing (Fig. 8). In opposite to this, some respondents' evidence indicated that the natural resources were increasing because of watershed management (soil and water conservation), plantation expansion by state and private, and protection of wildlife from hunting and fragmented forest conservation. As a result, insider (11.1%), outsider (8.6%) and control (17.1%) indicated as resources were increasing. Other parts of respondents responded that there were no change of resources as indicated by insider (23.3%), outsider (27.9%) and control (22.4%). There was a significant difference in resources change between groups of households (chi-square = 16.33; d.f = 4; P = 0.03). Generally, our findings revealed that the natural resources were decreasing; it was decreasing more in insider and followed by outsider and control, but its improvement were high in control as compared to the other two groups. This implies that LSAI has negative impacts on people living close to it; they lost the chance of accessing to natural resources than those living at far distance. In line with this (Jiru, 2010) reported that 90% of household confirmed increased deforestation in the investment area and 51% believe that the farm expansion was the major causes for the destruction. This sends strong signal for country like Ethiopia where the estimated deforestation rate of the country is alarming from 80,000- 200,000 hectare per annum (EPA, 2012).

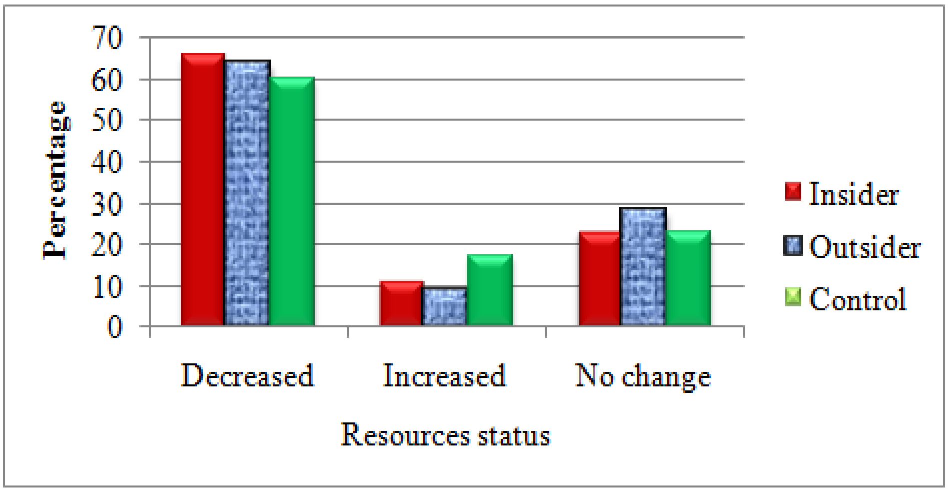

Figure 8: Resource status in percent.

Woody species (tree/shrub): During household survey, many of respondents informed that investors were clearing very important indigenous trees from the invested land. To check this raised issues we went to the place and observed different felled native tree species such as *Ficus sycomorus, Acacia etabaica, Acacia abyssinicaFicus sur* and*Ficus vasta* (Fig. 9) from the reservoir bank and at interior of the farm. *Ficus sycomorus, Ficus sur* and *Ficus vasta* have high value by the community for religio-cultural reasons. As a result, the clearance of these trees annoyed most of the local people and forced them to hate and have bad view on the company. Similar study by (Rahmato, 2011) reported that old and much valued trees such as *Ficus sur* and *Ficus vasta* uprooted by Karuturi Company in Bako district. These important trees have symbolic meaning in Oromo culture and are revered by rural Oromo communities (used as venues for community gatherings and peace-making, and have religious significance).

During KII, Company's general manager and agriculture section assistant manager was interviewed why they were destroying forest very close to reservoir. Agriculture section assistant manager believed that important trees were destroyed, but it was beyond his capacity to stop clearing of trees. He said "the company has focused only on crop plantation expansion and no plan for natural resource conservation". Similarly, Company's general manager said "our objective is industrial crop production (sugarcane) and it is our right to clear trees and plant sugarcane since the land was given for us by contract''.

Figure 9: Cleared tree species.

However, the projects have the obligation to plant native tree species covering at least two percent of project land, on the contrary, the project was totally clearing without any replacement.. Both managers confirmed that no any natural resource conservation activities such as planting program, soil/land and water conservation which is opposite to Ethiopian federal rural land administration and land use proclamation NO. 456/ 2005 (FDRE, 2005); this proclamation gives emphasis to land management and conservation.

Wild life: Some of wild Animals species such as Lion, Tiger and Buffalo totally escaped/disappeared and other species such as Hyena decreased in number from the area because of deforestation by the company. However, a bird species called Girrisa or Dale in local name and Pig is increasing many times than before and negatively affecting crops in the area. Wild animals which totally escaped and decreased in number were living for a long period of time in the currently invested land. Most community residents were not convinced that anything good will come out of the transfer of the land to the investor. Similar study conducted in Gambella (Rahmato, 2011) indicated that large-scale deforestation by Saudi Star Company will bring social and economic hardship; wildlife which used to be plentiful in the area, and which local people hunted occasionally for consumption, has now disappeared.

Water and related issues: Another most important investment impact in the area was water resource related issues which is influencing the socio-economic of local people. We measured (Fig. 10) the distance between Hambalta reservoir and edge of tilled land and found 9.7m on average. Local elder informed that the reservoir was covered with dense forest, water flow was at the top and have deep depth before some years, but it is decreasing at alarming rate recently. This was checked during field observation that the reservoir was left opened and we explained our fear that there is high probability of drying the Habalta reservoir if attention is not given for rehabilitation.

Figure 10: Closely tilled and left opened Hambalta reservoir.

Raj Agro industry is using Indiris, Jalalle, Tora, Habalta Qarsa and Oda reservoirs for irrigation. The company diverts these reservoirs to its farm by passing canal through farmers' farmland and these affected farmers in the area in four ways. (I) The Company agreed with local people as they use water by diverting from the canal as compensation means since canal passed in their farmland, but farmers couldn't use as much as they need because of company consume much amount of water and its superiority over canal as owner. Hence most of farmers confirmed that they couldn't achieve the expected product from their vegetable production as a result of high water resource competition and also explained their fear for more water scarcity in the future. (II) The canal was not constructed by concrete or with needed standard; it was simply prepared ditch which was ploughed by tractor throughout its length. These created conducive environment for water to flow (to be absorbed) where it is not needed because of soil nature in the area. The soil in the area is clay loam and it has high water absorption as well as water holding capacity. Therefore, water absorbed and flow in the soil and entered in to some of farmers' house close to the canal and affects their life. Not only house, but also *Chata idulis*, *Rhamnus prinoides and Musa paradisiaca* were important shrubs affected by high water absorption capacity of the soil. These consequences led to conflict between affected household and company. This pushed the Company to cover the canal with temporary material that prevents water absorption as a solution. However, the durability of material is very low, not cover the needed length of canal for those constructed and not done for all concerned households (Fig.11a). Other farmers forced to change their dwelling place as a result of canal broke and overflow risk and built other new house stepping at far distance from the canal. These overflow water also affected the product of their fruit trees such as *Mangifera indica* because of continues flow and siltation creation in the plantation (Fig. 11b). Still, the displaced households were explaining their fear for the next risk occurrence probability form the canal. (III) Land wastage and soil erosion was another problem we observed during our survey. The first canal diverted from Jalalle reservoir was broken at some point and creates land fragmentation as well as soil erosion (Fig. 11c); the land totally degraded and left without product. Even if the broken canal will be maintained, it may be difficult and cost to restore the land to its former feature. (IV) Some people living close to the canal said “insects came following the canal establishment; this insects were not exist before, but currently found at the edge of the canal and killed many of our hens’’ (Fig. 11d).

Figure 11a: Water entered to house and affected *chata Idulis, Rhamnus* and *Musa paradisiaca.*

Figure 11b. Destructed houses and affected *Mangifera indica* by canal broke and siltation.

Figure 11c. Degraded/wasted land and soil erosion by canal broke.

Figure 11d. Canal that affect poultry because of insects.

Figure 11(a-d): Impact of water in the area.

Fuel wood: Fuel wood is the most important energy source for rural household living in the area. The households were asked if there was fuel wood problem and to rank this problem. Insider, outsider and control indicated 90%, 85%, 66% as fuel wood problem exist and 54.3%, 51%, 43% as high problem respectively (Table 8). There were statistically significant differences in fuel wood problems between groups (chi-square =

13.195; d.f = 2; P = 0.001), but no significant difference in problem ranking (chi-square = 6.788; d.f = 6; P = 0.341). The household close to investment area were accessing to fuel wood resource before the land transfer to investor. After the land given to investor, the remaining forest was cleared and the land changed to sugarcane and other crops. This influence local socio-economic or livelihood by exposing them to fuel wood scarcity than other two groups. This forced household to find other option such as using crop residue and for domestic energy source than before. The replacement of fuel wood by crops residue may affect soil fertility since it can be used as mulching and decomposed later to improve soil.

Table 8: Fuel wood problem and its rank in percent.

Groups	Fuel wood problem		Fuel wood problem rank		
	No	Yes	High	Medium	Low
Insider	10.0	90.0	54.3	33.1	12.6
Outsider	15.0	85.0	51.0	40.3	8.7
Control	34.0	66.0	43.0	35.0	22.0

Distance and resource scarcity: Change of distance to get the resources was another emphasized issue in the study. Distance change suffered local people for different resource scarcity. Farmers went long distance than before to get some of resources, but they didn't get other resources even going far distance. Specially, construction material for fence, house and traditional hive. Consequently they changed their way of life and forced to buy other material from market such as artificial rope/plastic instead of natural. This suffered the local farmers for additional cost and challenging their livelihood. Specially, women living around and closer to investment area confirmed that they spend more time for firewood collection after the project destroyed the remnant woodlands. This wastage of time also led women to waste their energy as well and affect their income. Similarly, other studies reported that women family's primary incomes are particularly dependent on fuel wood collection due to small landholdings and lack of alternative income sources (Belay, 2014). Generally, our findings indicated that household close to LSAI (insider group) went long distance after IE than outsider and control groups and vice versa before IE (Fig. 12). The paired samples T test indicated that there were statistically significant difference in distance before and after IE within insider (t = -7.720; d.f = 59; P = 0.001), outsider (t = -5.314; d.f = 59; P = 0.001) and control (t = 1.748; d.f = 59; P = 0.009). Even though significance difference in distance occurred in all groups, the reason for change of distance was different. Investment share great role for change of distance for insider while traditional agricultural expansion share great role for outsider and control groups.

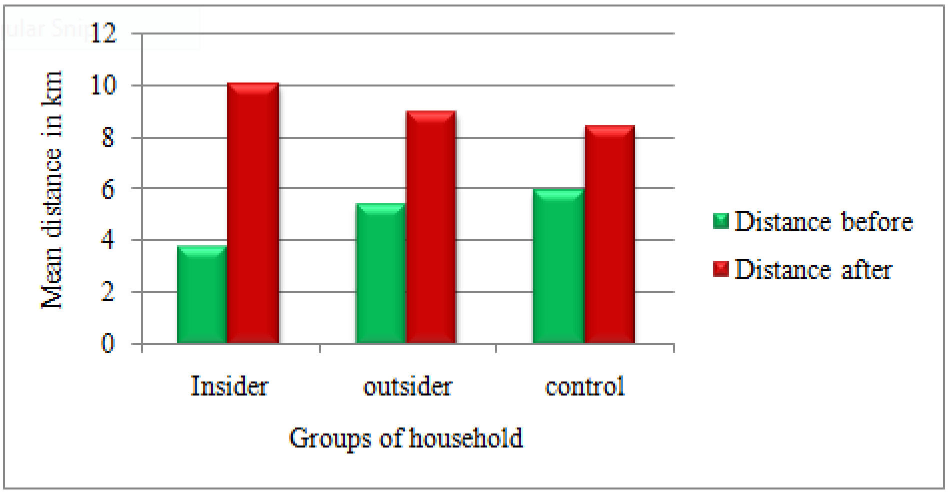

Figure 12: Distance change to get resources.

4.2. Impacts of large scale agricultural investment on species composition, diversity and population structure

4.2.1. Woody species composition

A total of 44 woody species representing 27 families were recorded and identified from the study area with 70 quadrats. From the total family, 10 families (37%) found only in subsistence croplands; 2 families (7.4%) found only in commercial croplands and 15 families (55.6%) found in both farms. Fabaceae was the most dominant family in both croplands, representing 7(15.9%) species in subsistence and 4 (9.1%) species in commercial croplands. At species level, 20 species (45.45% of total) found only in subsistence, 4 species (9.1% of the total) only in commercial and 20 species (45.45% of total) were common in both croplands.

The differences in species composition among the different communities are often explained as due to micro-site factors (Zimudzi, 2013). Frost (1996) also pointed out that tree growth in Miombo ecosystems is generally determined by edaphic factors, principally nutrient and moisture availability, the effects of fire, and anthropogenic disturbances.

Similarly, our study indicated that fire effect and anthropogenic disturbances were the great factors that cause difference in species composition between farms. In commercial farms, in addition to tree/shrub felling by tractor (Fig. 9), sugarcane burning was the most challenging on species composition. Specially, small size woody species (seedling and sapling) was highly affected because of their low resistance than large woody species (Fig. 13a and 13b). Study by Ruffeis *et al.* (2007) reported that sugar cane burning was e identified as a major cause for forest fires. This was why we could found large number of small size species per/ha (at lower height and DBH classes) in subsistence than commercial farms (Fig. 14 and 15). However, farmers were burning crop residues in their farm before some years, recently they are using it as fuel (source of energy) to overcome fuel wood scarcity.

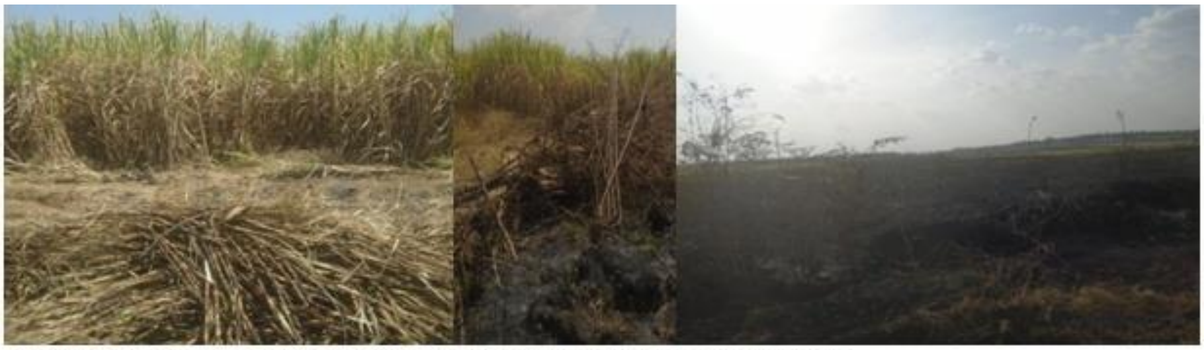

Figure 13a: Burned small size woody species during sugarcane burning.

Fig.13b. Big size woody species left after sugarcane burning.

Figure 13 (a &b): Impact of sugarcane burning on woody species.

4.2.2. Woody species composition similarity

Of the 44 woody species identified, 20 species were recorded at both sites while 20 and 4 species recorded only from subsistence and commercial sites (Appendix 4). Jaccard's similarity coefficient indicated that the similarity in species composition between

Subsistence and commercial cropland was 0.4545. The similarity coefficient was below 0.5 (maximum is 1.0), indicating that there is low similarity among the croplands and each cropland has its own characteristic species. This is mainly attributed to the extent of disturbance difference between the two farms.

4.2.3. Woody species diversity

In order to get better picture on extent of woody species diversity, several diversity indices were employed for study sites. The overall (both farms) values of diversity indices were 0.00, 3.05 and 0.807 for Simpson, Shannon and Evenness respectively. Diversity indices value in subsistence farm was 0.00, 3.05, and 0.828 for Simpson, Shannon and Evenness respectively. In commercial farm, it was 0.09, 2.64, and 0.830 for Simpson, Shannon and Evenness respectively (Table 9). Simpson and Shannon indices values indicated that the woody species were highest in subsistence than commercial croplands. However, evenness was almost similar in both croplands, indicating that there was more or less balanced distribution of individuals of different species. Similarly, other studies (Zegeye *et al.,* 2011; Worku *et al.,* 2012) indicated that individuals of different species recorded exhibited moderately similar abundance at the two sites. The reasons for high diversity in subsistence than commercial farm could be the purpose and land tillage mechanism. In subsistence farm, farmers leave different trees and shrubs on their farm for different use and this result relatively high diversity. In commercial farms, land tilling systems was by tractor which led to almost total clearance of plants and the investor focus was only for crop production. Generally, our study exhibited that the variation in the woody species diversity among farms were because of difference in degree of disturbance by anthropogenic factors. This issue is supported by Liu & Brakenhielm (1996) which stated as a change in species diversity is often used as an indicator of anthropogenic or natural disturbances in an ecosystem. Similarly, Noble and Dirzo (1997) reported that anthropogenic disturbances, such as logging or cutting trees, usually, result in an immediate decline in species diversity. The species richness, 40 woody species on 4.8 ha in subsistence farm and 24 on 6.4 ha in commercial farm, was high when compared to a similar study in central rift valley area that found 77 tree species on 76 ha of smallholders' farms (Yemenzwork *et al*., 2017). However, this difference in richness may be attributed to site characteristics, including extent of disturbance and predominant land use. In this study, we have reported that there was difference in species richness among the different land use categories. Duguma and Hager (2010) also reported significant difference in species richness and abundance among land use practices.

Table 9: Species diversity.

Land use category	Total area (ha)	No of trees ha^{-1}	Species richness	Diversity Index Values		
				Simpson	Shannon (D)	Evenness
Subsistence (n=30)	4.8	69.38	40	0.00014	3.05439	0.82800
Commercial (n=40)	6.4	25.63	24	0.08827	2.63902	0.83038
Total (n=70)	11.2	47.5	44	0.00006	3.05202	0.80652

Note: n = number of plots belonging to the category.

4.2.4. Population structure

4.2.4.1. Density, height and Diameter at Breast Height (DBH)

The overall population structure of trees/shrubs species in this study followed two general distribution patterns. The first pattern was Inverted-J-shape, which showed that the density of woody plant species was highest in the lower diameter and height classes and decreased gradually towards the higher classes. The second pattern was described as irregular shape where no defined pattern observed when one goes across the height and DBH classes. Such patterns of species population structure can indicate variation in population dynamics. Population structure of woody species yields information on the history of past disturbance of the species and its environment (Teketay, 1997b; Wale *et al.*, 2012), which can be used to predict the future trend of the population of a particular species (Wilson & Witkowski, 2003; Kalema, 2010). Hence, the density of each species was calculated and compared as the number of individuals per hectare across height and DBH classes.

The total density of woody species recorded was 69.38 stem/ha and 25.63 stem/ha in subsistence and commercial farm respectively, indicating that subsistence farm have high density than commercial farm. However, the woody species density in both cropland was much larger as compared to the study of (Yemenzwork *et al.*, 2017) which reported as 19 tree/ha in crop land, but much less than the study of (Belay, 2014) which reported as 246 individuals/ha total density of woody plants in agricultural landscape. In Belay's study, 85% or 192 individuals/ha represented by *Eucalyptus globulus* while other species were much less dense, ranging from 0.2 to 10 individuals/ha. However, other species with less density of this study (except *E. globulus)* is nearly similar with our study which has the range from 0.2 to 9.4 individuals/ha in subsistence croplands.

Height class distribution was indicated inverted J-shape in subsistence and related to irregular shape in commercial farms (Fig. 14). The density of individual was observed as highest for lower height class (class 1) in both farms, but as least for height class 8 and 9 in subsistence farm and as least for height class 8 in commercial farm. The number of individual per ha (density) of tree/shrub species was decreased continuously with increasing height class in subsistence farm. However, it was decreased from class 1 to 4, increased from class 5 to 6, decreased from class 7 to 8, and then increased at the last class in commercial farm. Even though the overall pattern created in commercial farm was irregular shape, up and down pattern form bell shaped in the middle class (from class 4 to 8). Therefore, in subsistence farm, the pattern represents good reproduction status and regeneration potential as compared to commercial farm. Feyera *et al.* (2007); Getachew and Abiyot (2006) reported that a reverse-J-shape height class distribution pattern reflects a stable population.

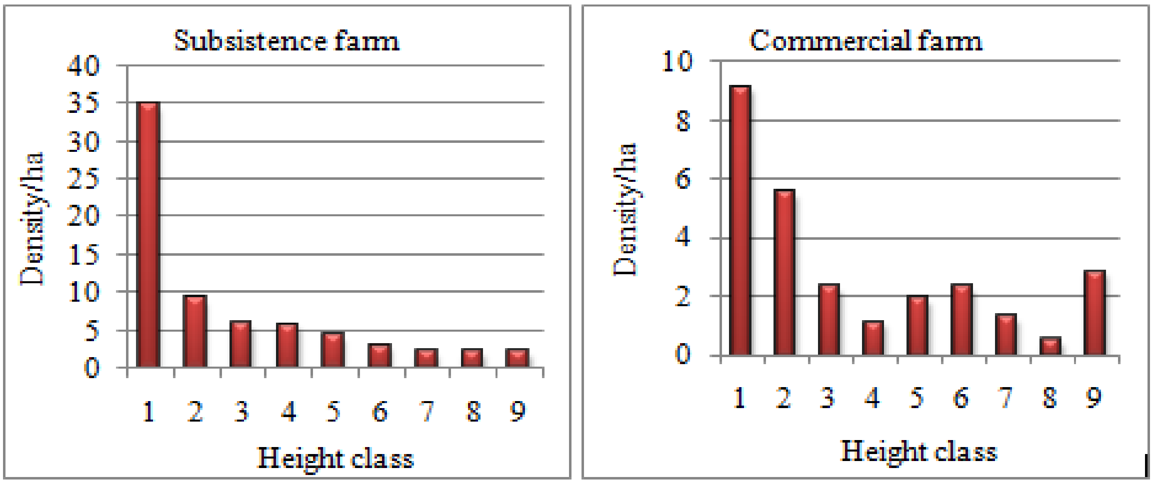

Figure 14: General Height class distribution (For all species).

Note: 1 <4 m; 2 = 4 - 6m; 3 = 6 – 8 m; 4 = 8 – 10 m; 5 =10 – 12 m; 6 = 12 – 14 m; 7 = 14 – 16 m and 8 = 16 – 18; 9 => 18m.

The general diameter class distribution pattern in subsistence farm was inverted-J-shape, but relatively irregular shape in commercial farm (Fig. 15). The highest number of individual per ha (density) was observed for DBH class 1 for both farms, the least was observed for DBH class 6, 9, 10 in subsistence and DBH class 9 in commercial farm. The general DBH class distribution pattern indicated that number of individual per ha was decreasing as DBH increasing in both farms. However, there was difference in number of woody species as DBH class increased in each farms, indicating different impacts. The first DBH class represented 64.93% and the rest share 35.1% individuals/ha in subsistence, but the first DBH class represent 55.43% and the rest share 44.57% individuals per ha in commercial farm. This was the indication of high probability of natural regeneration in subsistence (Inverted-J-shape) than commercial farm (relatively irregular shape). The subsistence farm woody species population structure is similar with other studies; the number of individuals decreased with increasing diameter class, resulting in an inverted-J-shape population, which is an indication of stable population structure or healthy regeneration status (Alelign *et al.,* 2007; Tesfaye *et al.,* 2010; Zegeye *et al.,* 2011). The irregular shape of woody species in commercial farm was similar with the study of (Zegeye *et al.,* 2006); irregular shape reflects limited regeneration, possibly due to human disturbance, livestock trampling or browsing, and other biotic and abiotic factors.

The ratio of density of individuals with DBH greater than 10 cm to density greater than 20 cm is taken as the measure of the density of different size classes (Grubb *et al.,* 1963). The density of individuals with DBH > 10 cm and DBH > 20 cm was 117 and 87 respectively in subsistence farm and the ratio of the former to the latter was 1.34, indicating the dominance of small size individuals. The density of individual with DBH > 10cm and DBH > 20cm was 75 and 66 respectively in commercial farm and the ratio was 1.14, indicating dominance of small size individuals. Even though dominance of small size individuals reflected in both farms, there was high number of individual of small size in subsistence as compared to commercial farm (comparison from the ration; 1.34 > 1.14). Generally, the overall population structure in both land use categories were characterized by a large population of small size trees and shrubs. Such patterns of community structure have been reported for different types of populations such as in natural forests (e.g. Fashing *et al.,* 2004), and in agriculture fallows (e.g. Kalaba *et al*., 2013).

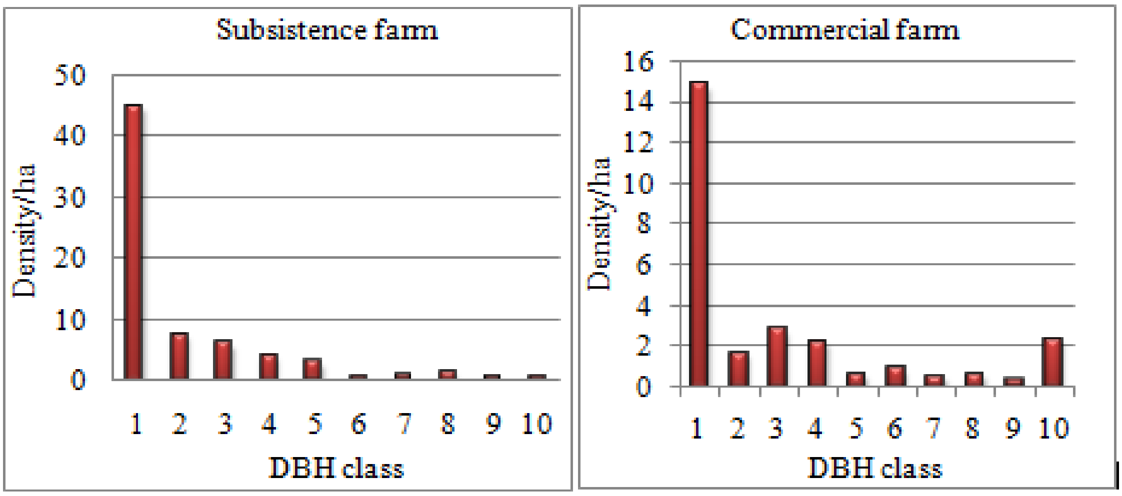

Figure 15: General DBH class distribution (For all species).

Note: 1 <10 cm; 2 = 10 - 20 cm; 3 = 20 - 30 cm; 4 = 30 – 40 cm; 5 = 40 – 50 cm; 6 = 50 – 60 cm; 7 = 60 – 70 cm; 8 = 70 – 80 cm; 9 = 80 – 90 cm and 10 >= 90 cm.

4.2.4.2. Basal Area

The total basal area (BA) of subsistence and commercial farm was 16.48 m^2/ha and 14.08 m^2/ha respectively. In this regard, woody species in subsistence cropland displayed higher BA than commercial cropland that might indicate the presence of different factors that could potentially affect the composition in the area. It was reported that BA provides a better measure of the relative importance of the species than simple stem count (Bekele, 1994). Thus, species with the largest contribution to BA can be considered as the most important species in the forest. Consequently, the most important tree species in subsistence farm (top five species) were: *Ficus sycomorus, Stereospermum kunthianum, Cordia africana, Ficus vasta and Acacia abyssinica* in decreasing order. These five species covered about 87.7% (14.45 m^2/ha) of the total basal area and the rest of all species (35) covered only about 12.3 % (2.03 m^2/ha) of total basal area. In commercial farm; *Ficus sycomorus*, *Eucalyptus camaldulensis*, *Cordia africana*, *Acacia abyssinica* and *Mangifera indica* were the top five species in decreasing order of BA. They covered about 96.93% (13.65 m^2/ha) of the total basal area and the rest of all species (19) covered only about 3.07 % (0.43 m^2/ha) of total basal area in Commercial farm (Table 10). These percentages indicated that commercial cropland is dominated by few species as compared to subsistence farm. Of the top five woody species, *Ficus sycomorus* was the highest BA contributor 63% (10.4 m^2/ha) of the total and the rest shared 37 % (6.1 m^2/ha) in subsistence farm. Similarly, among the top five species, *Ficus sycomorus* was the highest BA contributor 63.8 % (9 m^2/ha) of the total and all the rest species shared 36.2% (5.1 m^2/ha) in commercial farm. It is important to note here that species with the highest basal area do not necessarily have the highest density, indicating size difference between species (Bekele, 1994; Shibru and Balcha, 2004; Denu, 2007). For instance, *Cordia africanaa* and *Ficus vasta* has high basal area, but less density than *Acacia etabaica* in subsistence cropland (Table 10). Generally, our study in both farms exhibited that the calculated basal area were dominated by few species because of their large size (DBH). This is similar with (Zegeye *et al.*, 2012); basal area analysis across individual species revealed that very few species had high dominance. The overall as well as most of individuals' basal area seems small which was because of encountered species were small in size.

4.2.4.3. Frequency

Ficus sycomorus was the most frequent species recorded (56.67%; in 17 quadrats out of 30) and followed by *Stereospermum kunthianum* (46.67%; in 14 quadrats out of 30) and *Acacia abyssinica* (40%; in 12 quadrats out of 30) at Subsistence farm. Most of the woody species with low frequency (=< 10%) have the same frequency. Six, ten and eleven species have the same frequency of 10 %, 6.67% and 3.3% respectively in the subsistence farm (table 5). *Acacia abyssinica was* the most frequent species recorded (37.5%; in 15 quadrats out of 40) and followed by *Vernonia auriculifera* (30%; in 12 quadrats out of 40) and *Ficus sycomorus* (27.5%, in 11 quadrats out of 40) at Commercial farm. Most of the woody species with low frequency (=< 10%) have the same frequency. Two, seven and nine species have the same frequency of 7.5%, 7% and 2.5% respectively in the commercial farm (Table 10). The most frequent species in both farms were an indication of these species importance in the area/community. Similarly, other studies indicated that the higher the frequency, the more important the plant is in the community (Denu, 2007). High frequency value shows that the plant is widely distributed in the study area but abundance does not always indicate the importance of a plant community (Shibiru and Balcha, 2004). In this study, the calculation of species frequency helped to estimate how their distribution looks like (whether uniformly distributed or not). Other studies indicated that frequency measure indicates the uniformity of the distribution of the species in the study area, which again tells about the habitat preference of the species (Gurmessa *et al.*, 2012). It gives an approximate indication of the homogeneity of the stand under consideration (Kent and Coker, 1992). Generally, of twenty species commonly found in both farms, high frequency was recorded in subsistence than commercial farm; except three species *(Eucalyptus camaldulensis, Ficus vasta and Vernonia auriculifera*), seventeen species frequency was high in subsistence farm (Table10). This variation in frequency of woody species in both farms indicated that there was different degree of exploitation, disturbance, conservation and management of the species in the farms.

Table 10: Density, Frequency and Basal area of woody species with DBH > 2cm and height >= 2 m.

Scientific name of species	Local name of species	Density/ha		Frequency%		Basal area/ha	
		SF	CF	SF	CF	SF	CF
Acacia abyssinica	Laaftoo	5.42	3.91	40	37.50	0.548	0.689
Acacia albida	Garbii	0.21	---	3.33	---	0.077	---
Acacia etabaica	Doddota	7.08	3.13	30	20	0.174	0.044
Bersama abyssinica	Araarsaa	0.42	---	3.33	---	0.000	---
Calpurnia aurea	Ceekaa	2.5	---	10	---	0.004	---
Caparis tomentosa	Harangamaa	1.25	0.16	10	2.50	0.000	0.000
Carissa spinarum	Hagamsa	1.04	0.16	6.67	5	0.006	0.001
Celtis africana	Cayii	0.42	---	6.67	---	0.219	---
Clausena anisata	Ulumaayii	0.21	---	3.33	---	0.000	---
Combretum molle	Dhandhansa	0.83	---	10	---	0.001	---
Cordia africana	Waddeessa	5.21	2.5	33.33	15	1.408	1.673
Croton macrostachyus	Bakkanniisa	2.92	0.47	23.33	5	0.177	0.008
Diospyros abyssinica	Lookoo	---	0.16	---	2.50	---	0.000
Ehretia cymosa	Ulaagaa	1.04	0.16	13.33	2.50	0.168	0.000
Ekebergia capensis	Somboo	0.21	---	3.33	---	0.005	---
Erythrina abyssinica	Waleensuu	1.46	---	6.67	---	0.270	---
Eucalyptus camaldulensis	Bargamo dima	1.88	2.19	6.67	7.50	0.376	1.808
Euclea racemosa	Mi’eessaa	1.25	---	6.67	---	0.000	---
Ficus sycomorus	Odaa	9.38	4.06	56.67	27.50	10.377	8.983
Ficus thonningii	Dambii	0.21	---	3.33	---	0.028	---

Ficus vasta	Qilxuu	0.21	0.47	3.33	5	0.624	0.076
Flacourtia indica	Akuukkuu	0.63	0.16	10	2.5	0.000	0.000
Galiniera saxifrage	Mixoo	0.42	---	3.33	---	0.000	---
Gardenia volkensii	Gambeela	2.08	0.31	26.67	5	0.028	0.000
Grevillea robusta	Graviilaa	0.83	---	6.67	---	0.011	---
Grewia bicolour	Harooressa	0.42	---	6.67	---	0.070	---
Grewia ferruginea	Dhoqonuu	0.42	---	3.33	---	0.000	---
Lepidotrichilia volkensis	Gursadee	0.83	---	13.33	---	0.053	---
Mangifera indica	Maangoo	---	1.25	---	5	---	0.496
Maytenus arbutiolia	Hacaaccii	0.63	---	10	---	0.000	---
Maytenus senegalensis	Konbolcha	1.88	---	16.67	---	0.000	---
Myrsine africana	Qacamaa	0.21	0.47	3.33	2.5	0.000	0.002
Olinia rochetiana	Daalachoo	---	0.16	---	2.5	---	0.000
Phoenix reclinata	Meexxii	0.42	---	6.67	---	0.020	---
Piliostigma thonningii	Liilluu/koraa	6.88	1.09	33.33	10	0.041	0.002
Premna schimperi	Urgeessaa	0.42	0.16	6.67	2.5	0.001	0.000
Rhus vulgaris	Xaaxessaa	---	0.16	---	2.5	---	0.000
Schefflera abyssinica	Gatamaa	0.21	---	3.33	---	0.000	---
Sesbania sesban	Sasbaaniya	0.42	0.31	16.67	5	0.000	0.000
Steganotaenia araliacea	Jirma-jalee	0.63	0.16	6.67	2.5	0.000	0.000
Stereospermum kunthianum	Botoroo	6.04	0.47	46.67	7.5	1.496	0.299
Sysygium guineense	Baddeessaa	0.21	---	3.33	---	0.000	---
Vernonia amygdalina	Eebicha	0.63	0.63	10	5	0.296	0.000
Vernonia auriculifera	Reejjii	2.08	2.97	20	30	0.001	0.001
Total		69.38	25.63	533	212.5	16.48	14.08

Note: The "0" values indicate several decimal places, i.e. approaches to zero. SF represents subsistence farm and CF commercial farm.

Table 11: Relative Density, Relative Frequency, Relative Dominance and Important Value Index of woody species with DBH > 2 cm and height >= 2 m.

Scientific name of species	RD (%)		RF (%)		RDO (%)		IVI	
	SF	CF	SF	CF	SF	CF	SF	CF
Acacia abyssinica	7.81	14.76	7.50	17.65	3.32	4.890	18.63	37.781
Acacia albida	0.30	---	0.63	---	0.47	---	1.39	---
Acacia etabaica	10.21	11.81	5.63	9.41	1.06	0.310	16.89	21.917
Bersama abyssinica	0.60	---	0.63	---	0.00	---	1.23	---
Calpurnia aurea	3.60	---	1.88	---	0.02	---	5.50	---
Caparis tomentosa	1.80	0.59	1.88	1	0.00	0.000	3.68	1.786
Carissa spinarum	1.50	0.59	1.25	2.35	0.04	0.010	2.79	2.973
Celtis Africana	0.60	---	1.25	---	1.33	---	3.18	---
Clausena anisata	0.30	---	0.63	---	0.00	---	0.93	---
Combretum molle	1.20	---	1.88	---	0.01	---	3.08	---
Cordia africana	7.51	9.45	6.25	7.06	8.55	11.881	22.30	28.696
Croton macrostachyus	4.20	1.77	4.38	2.35	1.08	0.054	9.66	4.236
Diospyros abyssinica	---	0.59	---	1.18	---	0.000	---	1.786
Ehretia cymosa	1.50	0.16	2.50	1.18	1.02	0.000	5.02	1.786
Ekebergia capensis	0.30	---	0.63	---	0.03	---	0.95	---
Erythrina abyssinica	2.10	---	1.25	---	1.64	---	4.99	---
Eucalyptus camaldulensis	2.70	8.26	1.25	3.53	2.28	12.840	6.23	24.906
Euclea racemosa	1.80	---	1.25	---	0.00	---	3.05	---
Ficus sycomorus	13.51	15.35	10.36	12.94	62.97	63.791	87.10	92.586
Ficus thonningii	0.30	---	0.63	---	0.17	---	1.10	---
Ficus vasta	0.30	1.77	0.63	2.35	3.79	0.539	4.71	4.721
Flacourtia indica	0.90	0.59	1.88	1.18	0.00	0.000	2.78	1.786
Galiniera saxifrage	0.60	---	0.63	---	0.00	---	1.23	---
Gardenia volkensii	3.00	1.18	5.00	2.35	0.17	0.000	8.17	3.573
Grevillea robusta	1.20	---	1.25	---	0.07	---	2.52	---
Grewia bicolour	0.60	---	1.25	---	0.42	---	2.28	---

Grewia ferruginea	0.60	--	0.63	---	0.00	---	1.23	---
Lepidotrichilia volkensis	1.20	---	2.50	---	0.32	---	4.02	---
Mangifera indica	---	4.72	---	2.35	---	3.522	---	10.753
Maytenus arbutiolia	0.90	---	1.88	---	0.00	---	2.78	---
Maytenus senegalensis	2.7		3.13		0.00		5.83	---
Myrsine africana	0.30	1.77	0.63	1.18	0.00	0.012	0.93	3.017
Olinia rochetiana	---	0.59	---	1.18	---	0.001	---	1.787
Phoenix reclinata	0.60	---	1.25	---	0.12	---	1.97	---
Piliostigma thonningii	9.91	4.13	6.25	4.71	0.25	0.014	16.41	8.988
Premna schimperi	0.60	0.59	1.25	1.18	0.00	0.001	1.85	1.787
Rhus vulgaris	---	0.59	---	1.18	---	0.000	---	1.786
Schefflera abyssinica	0.30	---	0.63	---	0.00	---	0.93	---
Sesbania sesban	0.60	1.18	3.13	2.35	0.00	0.001	3.73	3.573
Steganotaenia araliacea	0.90	0.59	1.25	1.18	0.00	0.000	2.15	1.786
Stereospermum kunthianum	8.71	1.77	8.75	3.53	9.08	2.125	26.54	7.483
Sysygium guineense	0.30	---	0.63	---	0.00	---	0.93	---
Vernonia amygdalina	0.90	2.36	1.88	2.35	1.80	0.001	4.57	4.793
Vernonia auriculifera	3.00	11.22	3.75	14.12	0.00	0.008	6.76	25.711
Total	100	100	100	100	100	100	300	300

Note: The "0" values indicate several decimal places, i.e. approaches to zero. RD = relative density, RF = relative frequency, RDO = relative dominance, IVI = important value index, SF = subsistence farm and CF = commercial farm.

4.2.4.4. Important Value Index (IVI)

The Important Value Index (IVI) permits a comparison of species in a given vegetation/forest. Based on importance value index, *Ficus sycomorus, Stereospermum kunthianum, Cordia africana, Acacia abyssinica, Acacia etabaica, Piliostigma thonningii, Croton macrostachyus, Gardenia ternifolia, Vernonia auriculifera and Eucalyptus camaldulensis* were the top ten species in descending order of ecological importance in subsistence farm. *Ficus sycomorus, Acacia abyssinica, Cordia Africana, Vernonia* *auriculifera, Eucalyptus camaldulensis, Acacia etabaica, Mangifera indica, Piliostigma thonningii, Stereospermum kunthianum and Vernonia amygdalina* were the top ten species in descending order of ecological importance in commercial farm (Table 11). Other studies indicated that the IVI often reflects the extent of the dominance, occurrence and abundance of a given species in relation to other associated species in an area (Kent and Coker, 1992) and also it is important parameter that indicates the ecological significance of species in a given ecosystem (Senbeta and Teketay, 2003). Twelve and eight species had IVI values less than two in subsistence and commercial farm respectively, indicating that they are the least ecologically important species (Table 11). Species with high IVI values are regarded as more important than those with low IVI values (Zegeye *et al.,* 2011). The IVI values are also used in conservation programmes, where species with low IVI values are prioritized for conservation (Shibru and Balcha, 2004) and those with high IVI values need monitoring management (Gurmessa *et al.*, 2012). This study indicated both species with low and high IVI values. Therefore, conservation priority is must for species with low IVI and monitoring management need to be given for species with high IVI to improve sustainable utilization of the resources. Commercial farm has less diversity, density, basal area, and frequency and regeneration status than subsistence farm. However, of twenty species commonly found in both farms, ten species have high IVI in subsistence and ten in commercial farms (Table 11). Species relative frequency reflects the pattern of distribution and gives an approximate indication of the heterogeneity of a stand (Zegeye *et al.*, 2006; Lamprecht 1989). In this study, it can be concluded as there were fairly few species in most of the quadrats; this means most of the quadrants occupied by nearly the same species.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study generally indicated that less attentions is given for effective monitoring of the operations of investment projects. Investor has largely been given a free hand and is bound by few regulatory obligations. Even though smallholders are suffering for different challenges as a result of investment, still the greater emphasis is on the side of LSAI attraction and expansion. The loss of property does not only bring economic and social deprivation but also a sense of insecurity and the loss of voice. The government's objectives and its policy in promoting LSAI seems good, but our findings indicated that most of it have not been met on ground. For example, the local people livelihood improvement and technology transfer at the moment was very less than expected. Hence, there is no adequate evidence of government policy expectation from investment projects. However, a project created job for some people and has contribution to household income; it was characterized by temporary employment, low quality jobs and poor wage rate.

Subsistence and commercial farms have variation in species composition, diversity and population structure. The similarity in species composition among the farms was low. Subsistence farm has higher diversity, density, frequency, basal area and regeneration of woody species than commercial farm. These variations between farms occurred because of the existence of heterogeneity in site characteristics and the extent of anthropogenic factors. The IVI values revealed the most and the least ecologically important woody species in both farms. Woody species in farms provide various products such as fuel wood, construction material, timber, and etc. Despite their socioeconomic and ecological importance at present, farm woody species are under increased human pressure.

The findings of this study showed that LSAI generally undermined the ecological and social aspects in the area. Decreased income after IE, unsecured and minimum wage payment, lost resources and absence of compensation for it, woody plant and herbaceous (crops) diversity reduction, animal number and their product reduction, Agrochemical and water resource related risks, deforestation and disappearance of some wild life were the major problems reflected in the study area because of LSAI impacts. Therefore, approach of LSAI contributes little to improve local livelihood and affecting the ecology/natural resources in the area.

5.2. Recommendations

Based on the results and discussion, the following recommendations are put forward/suggested to be effective in large scale agricultural investment (LSAI) practice:

- Environmentally-friendly strategies/policies which are feasible and practical on ground are needed for effective LSAI expansion. Advantage and disadvantage of investment as well as the ability to meet the expectation of the local people and government need to be ensured before land transfer to investor.
- National and international policies, regulations and incentives should encourage local farmers. In addition to jobs creation, enhancing out grower opportunities to improve local livelihood is important and compensation options should be realistic, fair and suit for local villagers. Engagement of investors in community development activities (providing social services and technology transfer) need to be considered (unless the large-scale farms work with the local people, their sustainable operation will be unrealistic).
- Efforts should be made to provide the local communities with alternative sources of energy in order to reduce fuel wood problem or scarcity.
- Priority need to be given for conservation of low diversity, poor regeneration and low density, low frequency and low basal area in commercial farm. Developing management plan for woody species conservation and sustainable utilization is important in commercial farm. During land transfer and negotiation process with investors, natural resources (such as trees, soils, water bodies and wild life) should not be undervalued and proper resource status assessment need to be given top attention before and after EI.
- Generally, good governance, continuous monitoring and evaluation of investment project activities at different level (national, regional and local levels) are crucial for positive outcomes and for reduction of investment related problems.

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7. APPENDIX

Dear respondents: My name is Negatu Ararso, this is the research questionnaires to collect the research data from households in Sibu Sire for the objective of MSc thesis work to study **''Socio-economic and Ecological Impacts of Large Scale Agriculture Investment: The Case of Sibu Sire District, Western Ethiopia''**. This is for generating information about the system in contribution in the area. I would like to assure you that the information that you are giving used only for this study and honestly there is no any risk to you.

Thank you in advance!

Appendix 1: Questionnaires for household interview

Part one: household profile

1. Individual interviewed profile

Name	Age	Sex (A)	Education(B)	Marital status (C)	Household status (D)	Wealthy status (E)	Religion (G)

Put the following codes in the table: (A) male =1, female=2; (B) Illiterate = 1, Read and write= 2, Primary (1-6) = 3, Secondary (7-12)= 4, Above secondary = 5; (C) unmarried = 1, married = 2, divorce = 3, widow =4; (D) Head of household = 1, spouse = 2, son/daughter = 3, mother/father = 4;(E) Rich =1, medium=2, poor =3; (F) Christian =1, Muslim=2, waqeffata = 3.

2. Family status

Family size		Family Education				Family group		
		Educated		Not educated				
Male	Female	Male	Female	Male	Female	Insider	Outsider	Control

Part two: Income

3. What are your sources of income (estimate for each component)?

	Main income (average/year)					
No	Source of income before	Unit (kg/kun etc.)	Price/unit in ETB	Source of income after	Unit (kg/kun etc.)	Price/unit in ETB
1	Maize			Maize		
	Teff			Teff		
	Sorghum			Sorghum		
	Finger millet			Finger millet		
	Noug			Noug		
	Others(specify)			Others		
2	Coffee			Coffee		
3	Fruits, vegetables and chat			Fruits, vegetables and chat		
4	Livestock			Livestock		
5	Apiculture			Apiculture		
6	Others(specify)					
7	Permanently employed			Permanently employed		
Additional income (average/year)						
8	Temporary employed			Temporary employed		
9	Fuel wood			Fuel wood		
10	Wild fruit/medicinal plant			Wild fruit medicinal plant		
11	Bamboo craft/other utensil			Bamboo craft/other utensil		
12	Labor work			Labor work		
13	Forage sell			Forage sell		
14	Construction material sell			Construction material sell		
15	Others (specify)					

Part three: Impacts of LSAI on social service and technology transfer

4. Are there any social services and technology transfer provided to you/in the area by the company? A. Yes B. No. If yes; can you indicate?

Categories	Yes	No	Remark
Social services (school, health center, water, road, network etc.)			
Technology transfer (training, new variety offering, etc.)			

Part four: crop production

5. What types of crops do you commonly cultivate in your farm (indicate)?

No	Types of crops (crop diversity)			Source of crops	
	Crops	Before	After	Before	After
1					

Indicate sources as: P, G, M, I and NGO for Private, Government, Market, Investor and none government organization respectively.

6. If there are any crops that you were producing previously, but stopped to produce currently in the table above, what do you think is the reason (Please indicate)? A. loss of resource (Land) B. unfavorable climate condition because of displacement C. Disease, Insects and pests D. decrease product of those crops E. Other (specify).

Part five: livestock production

7. Do you have livestock? (Please circle) A. Yes B. No. If yes, could you mention the type and number of animals you have (indicate number)?

Types of live stock	Before	After	Types of live stock	Before	After
Sheep			Heifer		
Goat			Ox		
Donkey			Poultry		
Horse			Mule		
Calves			Others		

8. Are there any livestock that you had previously, but you hadn't currently in above table? A. Yes B. No. What do you think is the reason if yes? (Please indicate and rank)

A. Loss of resource such grazing land and other forage (1, 2, 3, 4, 5) B. Unfavorable climate condition because of displacement (1, 2, 3, 4, 5) C. Disease, insects and pests (1, 2, 3, 4, 5) D. Decrease product of those animals (1, 2, 3, 4, 5) E. Others (specify) (1, 2, 3, 4, and 5)

9. If there is a difference between previous and current number of animals and their productivity, what do you think is the reason (Please indicate)?

If number or productivity increased	tick	If number or productivity decreased	***tick***
New variety, improved forage and training from government		Lack of new variety, poor forage and training	
New variety, improved forage and training from Investor		Disease, insects and pests	
New variety, improved forage and training from NGOs		Climate problem because of displacement	
Favorable environment, improved vaccination and disease protection and good compensation		Loss of resource (grazing land, water) and poor compensation by mechanized agriculture	
Increasing communal grazing land, water and surrounding vegetation		Decreasing grazing land because of expansion of traditional agriculture	
Others (specify)		Others (specify)	

Part six: Agrochemicals application

10. Are there impacts of Agrochemical application on different aspects (Please indicate)?

Impacts on biological	Yes	No	Rank	Impacts on physical	Yes	No	Rank
Human damage				Water pollution			
Livestock/wildlife damage				Land/soil pollution			
Plants damage				Air pollution			

Rank by indicating; 1=low, 2 = medium and 3 = high.

Part seven: Lost resource, compensation and satisfaction

11. Are there any resources you lost and compensated for it (select)? A. Lost and compensated B. Lost, but not compensated C. Not lost any resources. IF your answer is A/B, indicate the type of resources you lost and compensated.

No	Type of resources lost	Type of compensation	No	Type of resources lost	Type of compensation
1	Forest land		5	Livestock	
2	Crop and bare land		6	Fruits and vegetables	
3	Grazing land		7	House	
4	Communal land		8	Others (specify)	

Indicate for compensation type as A= in cash B= in kind (1= forest land, 2 = crop land and bare land, 3 = grazing land, 4 = communal land, 5 = livestock, 6 = house 7 = other).

12. How you explain your satisfaction level on the following categories?

Satisfaction categories	Satisfaction level
Lost resources	
Salary	
Services (medical, insurance etc.)	

Indicate as 1= very low, 2 = low, 3 = medium, 4 = high, 5 = very high.

Part eight: Perception/view on investment

13. Generally, how you explain your perception/view concerning investment (indicate and explain the reason for your view)?

Perception	Tick	Explain why
Neutral		
Positive		
Negative		
Both (+ and -)		

Part nine: Natural resource status

14. Can you indicate the resources change and the reason for the change from the list?

No	Resources type	D	I	NC	Reason	No	Resources type	D	I	NC	Reason
1	Woody plant species					7	Utensil				
2	Fuel wood					8	Construction material				
3	Forage					9	Charcoal				
4	Wild fruit					10	Land size				
5	Wild animals					11	Forest area				
6	Medicinal plant					12	Water				

Hint: D=decreased, I= increased and NC= no change. For reason indication, use IN (for investment), TA (for traditional agriculture), O (for others; can be fire, high demand, climate change etc.).

15. Are there any wild animal species disappeared from the surrounding since investment

Established? A. Yes B. No. If yes; can you list it? ....

16. Are there any water related problems because of LSAI? A. Yes B. No. If yes, explain in detail.

17. What are the sources of fuel wood for you (indicate)?

source	Previous	Current	Source	Previous	Current
Wood			Kerosene		
Cow dung			Charcoal		
Crop residues			Other (specify)		

18. Do you have problem to get enough fuel wood due to LSAI? A. Yes B. No

19. If yes for QN-18, how serious is the shortage? A. Great B. Medium C. Low

20. If there are changes in natural resources, how long/much you go to obtain it (km/hr)?

Type of resource	Before	After		Before	After
Wild fruit			Forage		
Traditional medicine			Water		
Construction material for house, fence, hive etc.			Fuel wood		

21. In QN-20, what is the reason for change of distance (Please circle and Rank it)?

A. Investment (1, 2, 3) B. Traditional Agriculture (1, 2, 3) C. Others (1, 2, 3)

Appendix 2: Checklist of questions for key informant interview

Expert/person interviewed: ____________________ Interview completed by______________ Date: ____________________

My name is Negatu Ararso, MSc fellow at Jimma University. The purpose in meeting with you today is to learn about your thoughts, feelings, and experiences with regard to ‘‘**Socio-economic and Ecological Impacts of Large Scale Agriculture Investment: The Case of Sibu Sire District, Western Ethiopia''**. Your contribution has a vital role in the success of the study. Your participation in this interview is totally voluntary. I would like to assure you that the information that you are giving used only for this study and honestly there is no any risk to you. Are you willing to answer the questions?

1. How do you see the impacts of large scale agricultural investment (LSAI) on vegetation and local livelihood in your district?
2. How do you see the lost resources and compensation given for it to farmers during LSAI establishment and how do you explain the satisfaction level of compensated household?
3. If there was no compensation in #2, what was the reason behind?
4. If LSAI in the area is serious problem to local people, what government did to solve it?

   4.1. Do you think that this LSAI negatively affect environment/ecology (depleted the forest cover of the area and diversity, affect water and wild life etc.?

5. Do you believe that the LSAI should be promoted as a solution to improve local livelihood to your district and country?
6. What are the social services and technology provided to the local people in your district and how they are effective in improving local livelihood if provided?
7. What interpretations do you give when you see the investment policy on paper and the practical work on ground (Are they fit)?
8. What are consequences of chemical application by LSAI on biophysical Environment?
9. Do you think that LSAI can be a reason for conflict occurrence between investor and local people in the area? If so what solutions done by the concerned bodies?

10. In general, when you compare the negative and positive impacts of LSAI on local socio-economic and Environment, which one is greater as you think?
    I. Explain your reasons in detail. II. What recommendations would you make on this?

Appendix 3: Checklist of questions for focus group discussion

Group interviewed: ____________________ Interview completed by: ______________

Date: _____________________

My name is Negatu Ararso, MSc fellow at Jimma University. The purpose in meeting with you today is to learn about your thoughts, feelings, and experiences with regard to ‘‘**Socio-economic and Ecological Impacts of Large Scale Agriculture Investment: The Case of Sibu Sire District, western Ethiopia''**. Your contribution has a vital role in the success of the study. Your participation in this interview is totally voluntary. I would like to assure you that the information that you are giving used only for this study and honestly there is no any risk to you. Are you willing to answer the questions?

1. What are benefits you provided by LSAI in your area? Discuss.
2. Do you believe that LSAI in the area is serious problem to local people livelihood and Environment (forest cover, crop and woody species diversity, wild life, land etc.) in your area?
3. If there is a series a problem in # 2, how you resist and? What do you think is the way to solve these problems? Discuss.
4. Can you explain perspective/perception you have on investment? Discuss.
5. What are promised issues by the investor or by government because of investment established in the area, but not did for your area? Discuss.
6. What are the advantages you were obtaining from the land before it transfer to investor and are there any advantage you lost and any conflict as a result? What solutions done for this?
7. Do you support the expansion of LSAI? Discuss.
8. Can you explain if there is any private resource lost because of investment establishment and do you think that the compensation is fair and satisfactory?
9. Generally, when you compare the living conditions of the three groups (insider, outsider and control), are there any difference? If yes, elaborate in detail whether the group benefited or affected more?

Do you have any other comments and suggestion about LSAI impact on socio-economic and ecology?

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Thank you for your time!

Appendix 4: Indentified woody species

Site	Scientific name of species	Local name of species	Family	Habit	Origin	Altitude range(m)
Both	*Acacia abyssinica*	Laaftoo	Fabaceae	T	I	1500-2800
Subsistence	*Acacia albida*	Garbii	Fabaceae	T	I	Up to 2600
Both	*Acacia etabaica*	Doddota	Fabaceae	T/S	I	Up to 1800
Subsistence	*Bersama abyssinica*	Araarsaa/Lolchiisaa	Melianthaceae	T	I	1700-2700
Subsistence	*Calpurnia aurea*	Ceekaa	Fabaceae	S	I	
Both	*Caparis tomentosa*	Harangamaa	Capparidaceae	S/C	I	500-2300
Both	*Carissa spinarum*	Hagamsa	Apocynaceae	S/T	I	500-2600
Subsistence	*Celtis africana*	Cayii/meteqamma	Ulmaceae	T	I	1300-2300
Subsistence	*Clausena anisata*	Ulumaayii	Rutaceae	S	I	---
Subsistence	*Combretum molle*	Dhandhansa	Combretaceae	T	I	500-2200
Both	*Cordia africana*	Waddeessa	Boraginaceae	T	I	900-2500
Both	*Croton macrostachyus*	Bakkanniisa	Euphorbiaceae	T	I	1100-2500
Commercial	*Diospyros abyssinica*	Lookoo	Ebenaceae	T	I	500-2400
Both	*Ehretia cymosa*	Ulaagaa	Boraginaceae	S/T	I	1400-2300
Subsistence	*Ekebergia capensis*	Somboo	Meliaceae	T	I	1600-3000
Subsistence	*Erythrina abyssinica*	Waleensuu	Fabaceae	T	I	1300-2400
Both	*Eucalyptus camaldulensis*	Baargamoo diimaa	Myrtaceae	T	E	1200-2800
Subsistence	*Euclea racemosa*	Mi'eessaa	Ebenaceae	S/T	I	1000-2400
Both	*Ficus sycomorus*	Odaa	Moraceae	T	I	500-2000
Subsistence	*Ficus thonningii*	Dambii	Moraceae	T	I	1000-2500
Both	*Ficus vasta*	Qilxuu	Moraceae	T	I	---
Both	*Flacourtia indica*	Akuukkuu	Flacourtiaceae	S	I	400-2100
Subsistence	*Galiniera saxifrage*	Mixoo	Rubiaceae	S/T	I	1500-3000
Both	*Gardenia volkensii*	Gambeela	Rubiaceae	T	I	500-1300
Subsistence	*Grevillea robusta*	Graviilaa	Proteaceae	T	E	1500-2700
Subsistence	*Grewia bicolour*	Harooressa	Tiliaceae	S/T	I	500-1800
Subsistence	*Grewia ferruginea*	Dhoqonuu	Tiliaceae	S/T	I	1300-2700
Subsistence	*Lepidotrichilia volkensis*	Gursadee	Meliaceae	T/S	I	1050-2800
Commercial	*Mangifera indica*	Maangoo	Anacardiaceae	T	E	500-1800
Subsistence	*Maytenus arbutifolia*	Hacaaccii	Celasteraceae	S/T	I	1200-3000
Subsistence	*Maytenus senegalensis*	Konbolcha	Celasteraceae	S/T	I	400-2400
Both	*Myrsine africana*	Qacamaa	Myrsinaceae	S	---	---
Commercial	*Olinia rochetiana*	Daalachoo	Oliniaceae	T	I	1200-3500
Subsistence	*Phoenix reclinata*	Meexxii	Arecaceae	P/T	I	700-2600
Both	*Piliostigma thonningii*	Liilluu/Kora	Fabaceae	T	I	500-2000
Both	*Premna schimperi*	Urgeessaa	Verbenaceae	S/T	I	1300-2300
Commercial	*Rhus vulgaris*	Xaaxessaa	Anacardiaceae	S/T	I	1500-2800
Subsistence	*Schefflera abyssinica*	Gatamaa/Marfattuu	Araliaceae	T	I	1400-2800
Both	*Sesbania sesban*	Sasbaaniya	Fabaceae	S/T	I	300-2000
Both	*Steganotaenia araliacea*	Jirma-jalee	Apiaceae	S/T	I	400-1900
Both	*Stereospermum kunthianum*	Botoroo	Bignoniaceae	T	I	1000-2400
Subsistence	*Sysygium guineense*	Baddeessaa	Myrtaceae	T	I	1200-2600
Both	*Vernonia amygdalina*	Eebicha	Asteraceae	S/T	I	600-2700
Both	*Vernonia auriculifera*	Reejjii	Asteraceae	S	I	---

Appendix 5: Secondary data from concerned bodies

1. Employment opportunities

Year	Monthly average payment		Number of employees	
	Permanently employed	Temporarily employed	Permanently employed	Temporarily employed

2. Type of Agrochemical applied and crop production

Crop		Agrochemical	
Year	Crop type	Chemicals type	Liter/yr. in average.