ALOE SOAP VALUE CHAIN INTIATIVE AND ITS EFFECT ON LIVELIHOOD DIVERSIFICATION STRATEGY: THE CASE OF PASTORALISTS AND AGRO-PASTORALISTS OF BORANA, SOUTHERN ETHIOPIA

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Abstract

This study aimed at assessing the effect of ' Aloe soap value chain initiative' on pastoralists and agro-pastoralists in supplementing their livelihood diversification strategy to overcome impacts of recurrent shocks in the Didayabello, Fulduwa and Dambala Badana Pastoral Associations (PA) in Yabello, Arero and Dire districts, respectively, of Borana Zone. Wild Aloe plant is one of the abundant plant species found in the area and most neglected/underutilized as means of livelihoods except for few traditional medicines and ritual purposes. The research employed qualitative and quantitative research methods using both primary and secondary data. Purposive sampling method was used by which three sample PA administrations with potential aloe soap processing sub-centers were selected for data collection. A total of 120 sample households (60 participants and 60 nonparticipants) were selected by using probability proportional to size for the survey.

Data analysis was made by descriptive statistics and econometrics using propensity score matching method. The study, therefore, had evaluated the effect of aloe soap value chain initiatives interventions in the target PAs. It has used cross-sectional survey data of 2012-2013 to see the effect of the intervention in supplementing the participants livelihood diversification strategy. The intervention has resulted in an increased amount of income to participants earning an average total income of Birr 2688.70 per month *from the aloe soap production. . Besides being a productive plant species with best economic value, the Aloe plant species are found to be environmental friendly, drought tolerant and best for soil and water conservation, in addition to its magnificent medicinal uses. Based on the results obtained, such innovative product of market development interventions has a paramount importance for the enhancement of alternative livelihood diversification strategies of the pastoralists and agro-pastoralists.*

Key words*: pastoralist, recurrent drought, wild, Aloe soap, livelihood, propensity score matching*

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Introduction

Background

In Greater Horn of Africa (GHA), pastoralism is one of the most important economic activities from which millions of people derive their livelihoods. Pastoralists in this region keep a significant part of their wealth in the form of livestock. Out of the total population, pastoral and agro-pastoral population is about 60% in Somalia; 33% in Eritrea; 25% in Djibouti; 20% in Sudan and 12% in Ethiopia (Coppock, 1994, quoted in Ahmed et al., 2001). Ethiopia is home for more than 12-15 million pastoralists and agro-pastoralists who reside in 61% of the nation's landmass. The pastoral areas are estimated to comprise 42% of the national total livestock population. Livestock and livestock products provide about 12-17% of Ethiopia's foreign exchange earnings, out of which hides and skins contribute about 90%. It contributes about 33% to the agricultural GDP and 16% to the national GDP (Adugna, 2012). Livelihood diversification is complex, and strategies can include enterprise development (Adugna and Wegayehu, 2012). Diversification of income sources, assets, and occupations is the norm for individuals or households in different economies, but for different reasons (Adugna, 2005). Ouma et al. (2012) have described, a rapidly diminishing rangelands resource base and the continued fall in animal productivity, pastoral households suddenly found themselves in a situation where they have to seek alternative forms of livelihood to sustain their families. This situation has forced pastoralists to seek temporary income and subsistence bases; thus, livelihood diversification has become a common phenomenon among pastoral households.

Stark et al. (2011) has stated that in Borana alternative economic activities, such as trading, crafts, salt mining, incense and gum collection, and the harvesting of Aloe for soap and related production are generally better thought

of as supplements to unstable pastoralist livelihoods which depend mostly on livestock. Teshale (2011) also described that a number of NGOs in Borana have been working to reverse the livelihood crises initiated by recurrent droughts. Currently, they have diversified their intervention approach from direct aid to strategies that bring long term livelihood impacts. He further explained that some NGOs like AFD, GTZ, and SOS Sahel Ethiopia are working on improving the productivity of the gum and resin trees, trading access, and value addition.

Promoting alternative livelihood diversification strategies on non-timber forest products, such as gum and resin production and trade in Borana, have an invaluable importance to supplement the fragile livestock based livelihood. SOS Sahel Ethiopia has explored through its different projects the livelihood diversification potential of wild Aloe plant products, such as aloe soap among others, through value addition process. Accordingly, products of soaps from Aloe are already tested (Teshale, 2011) and it has continued implementing this livelihood activity since 2007, which is termed as 'Aloe soap value chain initiative'. Among many project intervention districts of SOS Sahel Ethiopia, there were three Aloe soap producing pastoralist and agro-pastoralist groups/cooperatives in Yabello, Dire and Arero Districts. Hence, the research work focuses on the effect of this 'Aloe soap value chain initiative' in supplementing the livelihood diversification strategy of these households of the selected study area.

Pastoralist and agro-pastoralist areas of Borana with their high degree of climatic variability and unpredictability have required flexibility, mobility and adaptation to different opportunities and challenges. The causes of these are traced by most of the literatures as settlement, population pressure, conflicts and the recurrent droughts (Little et al. 2004). In Borana, pastoralism is the

principal livelihood strategy with recent attempts to diversify into agriculture, forest products marketing, and petty trade (Tache and Oba, 2010). Simultaneous outbreaks of livestock diseases are common in pastoral areas and spread along the drought fronts, aggravating the number of animal mortalities. Therefore, pastoralists in general and the livestock in particular are vulnerable to unpredictable macro-climatic variability (Amaha, 2006). Degradations in biological and physical rangeland resources have become serious challenges, bearing negative impacts on the pastoral ecosystems, livestock production and livelihoods thereof (Vetter, 2005).

Eyasu and Feyera (2010) stated that similar to other Sub-Saharan countries, the Ethiopian pastoralists have been subjected to political marginalization. The land alienation is behind many of the problems detected in the pastoral areas today. These problems include environmental degradation, food insecurity, drought vulnerability and ultimately destitution. The same authors has revealed that the root causes of these problems lies on the fact that the national policy tends to be biased against pastoralism in favor of alternative economic activities such as commercial agriculture, wildlife conservation parks and modern ranches.

The resilience of the pastoralist community has declined due to increased frequency of drought. People have lost the capacity to recover from this crisis. The fact that drought affects many households simultaneously means that "many of the informal mechanisms for mitigating and coping with risk become ineffective" (Skoufias, 2003). However, among these adaptive strategies, the importance and economic contribution of the abundant and easily growing aloe plant species were either not considered or was negligible. The economic potential of underutilized wild Aloe plants species to improve alternative livelihoods of pastoralists and agro-pastoralists of Borana has not been yet

realized. The abundant vegetation of Aloe plants had no recognized economic use to the community except for few traditional uses as medicine and rituals. Moreover, prior to launching 'Aloe soap value chain initiative', Aloe plants were rather considered as invasive plant species like bushes in the Borana rangeland.

This study, therefore, was envisaged to evaluate the impact of the innovative Aloe soap making technology interventions on the livelihood diversification strategies of pastoral and agro-pastoral communities in selected sites, namely, Dida Yabello, Fulduwa and Dambala Bandana PAs of Yabello, Arero and Dire Districts, respectively, in Borana Zone.

Definition and Basic Concepts

Pastoralists: are smallholder households where more than 50% of household income/consumption is derived from livestock or livestock related activities, either as a result of sales of livestock products or of direct consumption, and **agro-pastoralists** as deriving 25-50% income/consumption from livestock produce (Swift, 1988, as cited in Adugna, 2012). According to Odi (2010), there are four dominant livelihood systems in pastoral areas across the Horn of Africa in general and Borana in particular: 1) *Pure pastoral livelihoods*-livestock – based livelihoods; 2) A*gro-pastoral livelihoods* – these combine extensive livestock rearing and rain-fed cereal production; 3) S*edentary farmers* – practice mixed farming, cultivating food crops with modest sheep and goat herds; 4) E*x-pastoralists* – these are households who have lost their livestock and now depend largely on human labor.

Pastoral livelihood diversification: is defined as the pursuit of any non-pastoral income-earning activity in both urban and rural environments (ILRI, 2000). This include various forms of wholesale and retail trade (e.g. selling

livestock, milk, hides and skins, honey, and artisan goods, etc.), rental property ownership and sales, waged employment (local and non-local, including working as a hired herder, farm worker and migrant laborer), farming (subsistence and commercial), and the gathering and selling of wild products (e.g. gum Arabic, firewood, or medicinal plants like Aloe) (Little, 2001).

Aloe soap value chain initiative: is an innovative idea of making soap locally from wild aloe sap initiated by SOS Sahel Ethiopia project implemented in Borana rangelands since 2006 to enhance pastoral and agro- pastoral livelihood diversification strategy. The aloe soap is made manually by the local community using simple and locally available materials with few industrial ingredients. The Aloe soap is made from formulated combination ratio of edible oil, caustic soda, water, perfumes, colors/dyes and drops of Aloe sap/exudates collected from cut leaves of Aloe plant species. Based on the interest of the target customer, different colors and perfumes are used for further attraction (SOS Sahel project reports). There are steps and given combination ratios of the ingredients within few minutes to produce a batch of bars of Aloe soap.

Pastoral Livelihood Diversification Strategy in Borana

According to Hurst et al., (2012), the livelihood diversification strategies for most Borana pastoralists are beekeeping for honey, Aloe products (soaps and lotions), scent wood (similar to perfume or “locally named qayya”), incense and gum, poultry farming (for sale of birds in the market, not for direct consumption), charcoal, employment (local and distant e.g. a family member relocates to Nairobi to seek employment), milk (for sale in local market only), gold mining, salt mining (sodda), cut firewood. These authors have also described that households cope with changing climate and social structures,

many of them are choosing to increase the diversity of their livelihood strategies. Moreover, Jibat et al., (2013) have also described that among livelihood options and food sources for the Borana people, livestock-related livelihood options accounted for about 32% of the total means of food, whereas, farming, food aid and petty trade contributed 21%, 15% and 14%, respectively. In addition, mining, charcoal production and employment are also mentioned as means of living.

General Description of Aloe Plant Features, Products and Marketing

Different literatures showed that, the genus Aloe is represented in several biodiversity hotspots, including the Horn of Africa, Madagascar and Indian Ocean Islands, Maputaland-Pondoland-Albany, Cape Floristic Region (Mittermeier et al., 2004; Myers et al., 2000). It also includes many taxa that are naturally rare and geographically restricted (Oldfield, 2004). The majority of *Aloe* species occur in southern and eastern side of the African continent (Newton, 2004). The term *Aloe* is derived from Arabic “alloeh” which means a bitter substance (Joseph and Raj, 2010). The leaf-succulent genus Aloe plants are perennial plants that comprise herbs, shrubs and small trees. Most Aloes are characterized by their thick and fleshy leaves with spiny margin. They have tubular flowers that are brightly yellow, orange or rarely white in color (Smith and Steyn, 2004 as cited in Fikre, 2012). Aloe comprises over 500 species, ranging from diminutive shrubs to large tree-like forms, with new taxa still being described regularly (Frodin, 2004). Fully comprehensive studies of the taxonomy and biology of Aloe plants are difficult and research to date has largely focused on geographical or taxonomic subsets. Most Aloes require rainfall of between 300mm to 850mm annually. Aloes have shallow roots and do well in fertile, rocky/gravel soil. Aloes grow well in soils with high nitrogen content (0.4 - 0.5 %), with pH range between 4.5 and 7.0 (Mukonyi,

2003). The species grow poorly in sandy soils and in areas prone to water logging (Appendix 1).

Wabuyele and Keyalo (2008) described that most of the Aloes are exploited from the wild; it is only *Aloe barbendensis (Aloe vera)* which is under cultivation. *Aloe vera* is the primary species selected for commercial production across the world for its active ingredients, high leaf gel content and strong growth history. *Aloe ferox* is a species successfully exploited in the industry primarily in South Africa, Africa's largest producer of Aloe-based products that are consumed in Africa. Aloe species propagation varies according to variety, however most of them propagate through suckers and a smaller proportion also through seeds. The ethnobotany of Aloe is described in a considerable body of literature, analysis of which suggests most species are valued in some way and used on a local scale (Grace et al., 2008, 2009). Surprisingly few species of Aloe have been known in formal trade. It has been described by the same author that the market profiles of species, such as *Aloe ferox Mill* and *Aloe vera* appear to be expanding, yet the trade in Aloe-derived products remains poorly understood and relevant information unavailable.

In the flora of Ethiopia and Eretria, 46 species of Aloe have been described, out of which 41 (89%) are endemic or near endemic indicating that they have high degree of endemism in the flora area. Only five species: *Aloe laterita, Aloe macrocarpa, Aloe rivae, Aloe secundiflora* and *Aloe vituensis* have wider distribution extending to east or West Africa. However, most other species have restricted distribution in area and known from few localities and populations. The altitudinal distribution of Aloes in the flora area is wide ranging from 500m.a.s.l (e.g. *Aloe megalacantha* in desert and semi-deserts of Somalia region) to above 3000m.a.s.l (e.g. *Aloe steudneri* and *Aloe ankoberensis*), both of which reach the sub-afro-alpine vegetation (Sebsebe et

al 2001; 2003; 2011). The degree of endemism in the genus *Aloe* in the flora is therefore nearly three times higher than the average figure for all vascular plants (Friis *et al.*, 2001; Sebsebe Demissew *et al*., 2001). Only five species are wide spread extending to East Africa or West Africa: *Aloe lateritia, Aloe macrocarpa, Aloe rivae, Aloe secundiflora* and *Aloe vituensis* (Reynolds, 1966, Sebsebe Demissew & Gilbert, 1997, Sebsebe Demissew *et al.*, 2001).

Fikre (2012) described that though not yet fully investigated and exploited for their use as in other parts of Africa, Aloes in the flora of Ethiopia and Eretria may have potential economic and ecological values. The leaf gels from *Aloe debrana* and *Aloe trichosantha* are used in the manufacturing of sacks for coffee export. It has also been reported that *Aloe gilbertii* individuals are being used by the local community in rehabilitating degraded land (Fikre, 2006). *Aloe calidophilla*, a shrubby species with relatively wider range of distribution in the southern lowlands of Ethiopia including Borana pastoral areas and in the northern part of Kenya, is identified to be one of the commercially important species and listed among species that need conservation in Kenya (Wabuyele and Keyalo, 2008).

Plate 1: Typical Wild Aloe calidophilla Plant in Borana Rangelands (Dida Yabello PA), Source: Field survey 2014

Aloe Commercial Extracts and Their Uses: As described by Kavaka and Nellie (2008), different products can be extracted from various parts of Aloe plant which includes flowers, leaves, stems and roots. There are different products from various parts of Aloe plant, such as from flowers – herbal tea; from leaves – sap/exudate, processed gum and gel; from stems and roots – fermentation catalyst, that is, the dried stem and roots are ready for use in fermentation process. About 15 roots of *Aloe secundflora* are used to brew 20 Liters of alcohol.

Kavaka and Nellie (2008) have described that Aloe sap tapping occurs where the leaf is harvested. Harvesting sap is done when Aloes are 3 to 4 years old. The sap is harvested immediately after the rainy season. Harvesting is usually avoided during the rains or drought period. Tapping is done between late morning and early afternoon on a hot still (not windy) dry day. According to Joseph and Raj (2010), the bitterness of Aloe plant results from the presence of aloin and aloe- emodin. *Aloe vera* secretes two types of fluid containing proteins and cellular elements. One is a reddish-yellow thick bitter fluid secreted from the pericyclic cells of the plant and the other, a transparent mucilage gel produced by tubular cells in the central parenchyma zone of the leaf (Joseph and Raj, 2011). These fluids are mainly used for laxative (reddish-yellow) and several medical (gel) purposes.

In Ethiopia, Ermias Dagne (1996) has investigated the variation in the distribution of typical Aloe compounds in leaf exudates/sap i.e. Aloenin, Barbaloin, Nataloin, Aloinoside, Homonataloin, 7-Hydroxyaloin, Aloesin and Microdontin were reported among and between eleven species found in the country: *Aloe debrana, Aloe calidophila, Aloe camperi, Aloe elegans, Aloe sinana, Aloe megalacantha, Aloe pubescens, Aloe pulcherrima, Aloe rivae, Aloe secundiflora,* and one unidentified Aloe species. Similarly, *Aloe*

calidophila yielded Homonatalion as its major constituent. Others, however, share one to three compounds between and among themselves, indicating some degree of relationships in their chemical composition.

In Borana, the community collects sap/exudate from the most popular *Aloe calidophila* and *Aloe Scandiflora* and *Aloe Scabrifolia* to process their soap. These aloe plants have different capacity to generate sap/exudate (Table1). Hence, currently the Aloe soap producers use five milliliters of Aloe sap to produce 5000 grams of dry aloe soap or 10 bars (500 grams/bar) at production time. They use vegetable oil, caustic soda, water as a main ingredient, and dye (food color) or perfume will be added into it based on consumer preference.

Table 1: Sap Yield for Various Aloes in Different Localities in Kenya

Aloe Species	Site	Number of leaves harvested	Sap yield (mls)	Milliliters (mls) obtained per leaf
Aloe secandflora	Laikipia,	25	60	2.40
Aloe scabrifolia	Samburu,	22	60	2.73
Aloe calidophila	Moyale	20	120	6.00
Aloe rivae	Marsabit	19	35	1.84

Source: Adapted from Kavaka and Nellie (2008)

Plate 23: *Aloe Soap Products, Source: Dida Yabello PA, 2014*

Aloe calidophila is the most popular species found in Borana range lands. As shown in table 1, it has high sap yield per leaf which is of paramount importance in Aloe soap processing. Among the parts of Aloe leaf (Plate 4) only its sap is currently used for the soap making. But as many literatures show none of Aloe plant parts (flower, stem, leaf and root) are wasted, i.e., all have their own economic value to the people growing it.

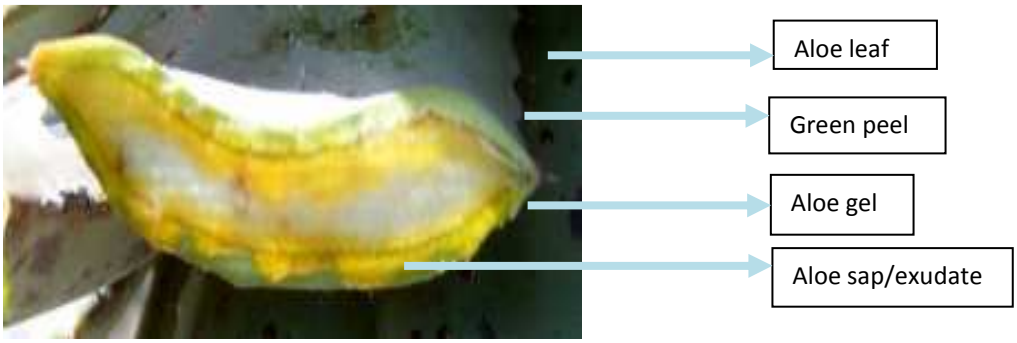

Plate 34: Exposed Inner Parts of Aloe Leaf Cut, Source: Photo from Field survey 2014

The selected community members were provided with technical trainings. The information obtained from the Aloe producers groups/cooperatives and Milki Forest Products Marketing Union shows that if all necessary ingredients and conditions are fulfilled or normal, a person can produce an average of 593 bars of soaps with 500gm. They are mostly challenged by the supply of vegetable oil and caustic soda which are not locally available.

Research Methodology

Description of the Study Area: The study was conducted in Borana Zone which is located in the Southern part of Oromiya National Regional State. The Zone has 13 districts, eight of which have pastoral and agro-pastoral ecosystem. Specifically, Yabello, Dire and Arero districts of Borana Zone,

which are pastoral and agro-pastoral area, were deliberately selected because of their proximity. Geographically, Borana Zone is located $3^0 26'$ to $6^0 32'$N latitude and $36^0 43'$ to $40^0 46'$E longitudes extending for about 3^0 or 331.6Kms North to South and for about 4^0 or 442.06Kms East to West and vice versa. Borana zone shares common boundaries with Guji Zone in the East, Somali Regional State in South-East, Southern Nations Nationalities and Peoples Region of Southern Ethiopia in the North and West, and one international boundary with Kenya in the South-West at 521Kms long and the zone has an area of 63,028Km^2 (BZFED, 2009) (Figure 1). The vegetation is tropical savanna with varying proportions of open grassland, and perennial herbaceous and woody vegetation (Pratt and Gwynne, 1977). The Borana rangeland also has stretches of Acacia-Commiphora small-leaved deciduous woodlands, with a mixture of the genera Acacia, Boswellia and Commiphora. Other important genera include Boscia, Maerua, Lannea, Balanites and Aloe plants (Coppock, 1993; Gemedo et al., 2005; Adefris, 2006).

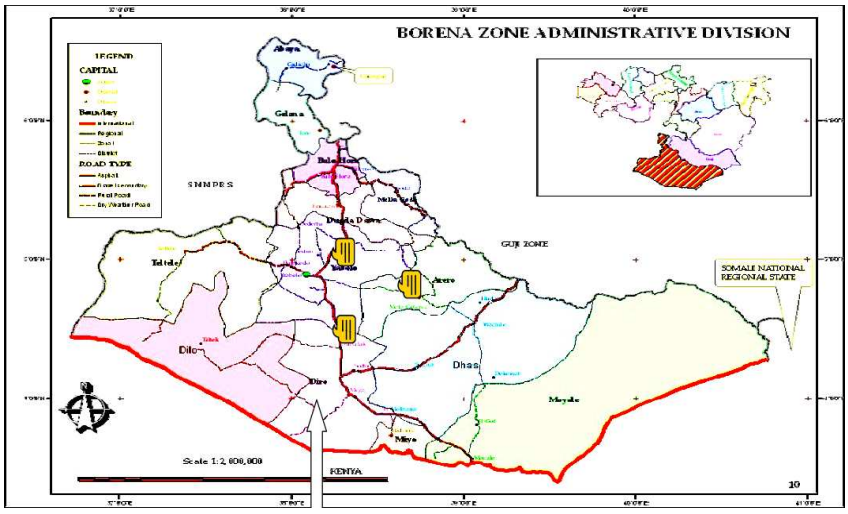

Figure 1: Location of the study area

Source: Borana Zone Finance and Economic Development (BZFED) Office, 2009

Type and Source of Data: In this study, both quantitative and qualitative data was collected from primary and secondary sources. Enumerators who have at least college diploma, with previous experience in data collection and knowledge of the local language were recruited and trained. Before commencing data collection, the structured questionnaire was pre-tested to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions. Hence, appropriate modifications and corrections were made on the questionnaire. Data was collected under continuous supervision of the researcher.

Sampling procedure and Size: A multistage stratified sampling procedure was used. In the first stage, Yabello, Arero and Dire Districts where Aloe soap processing is being implemented in Borana Zone were selected purposively. In the second stage, three PAs (Dida Yabello, Fulduwa and Dambala Badana) were purposely selected from the three target districts, respectively, based upon the Aloe soap production practices and the relatively abundant Aloe plant vegetation cover. Finally, a total number of 120 households were selected randomly from both participant and nonparticipant households in Aloe soap value chain initiative project from the target PAs based on probability proportional to size (PPS) (Table 2).

Table 2: Distribution of Sample Households

Districts	PAs	Total HH	Participants		Non-participants		Total HHs
			Total	Sample	Total	Sample	
Yabello	Dida Yabello	816	73	28	743	18	46
Arero	Fulduwa	859	52	20	807	20	40
Dire	Dambala Badana	903	30	12	873	22	34
Total		2,578	155	60	2,423	60	120

Source: Field survey 2014

Methods of Data Collection

Primary data were collected from sampled respondents through pre-tested structured questionnaire from March to April 2014. The data focuses on the effects of the 'Aloe soap value chain initiative' induced and attitudinal characteristics of pastoralists/agro-pastoralists and the factors directly influencing their livelihood diversification strategies. Checklists were used to collect preliminary information about the study area. Five focus group discussion (FGD) was held with women, men, youth (boys and girls), elderly groups and one general discussion. Each group was composed of 8 to 12 persons in each Dida Yabello, Fulduwa and Dambala Badana Pastoral Associations. There were different key informant interview (KII) conducted with two project staff, two Zonal pastoral development officers, and one staff from each district, Yabello, Arero and Dire Pastoral Development Offices (PDO), one Gada leader and one elderly person were contacted for the survey.

Secondary data were collected from written documents obtained from Regional, Zonal, District level relevant sector offices and other non-governmental organizations' reports. Recent published articles and research findings at national and international level about the pastoral/agro-pastoral livelihood diversification, and Aloe plant and Aloe product business reports were also used.

The data were analyzed using descriptive, qualitative and econometric analysis. The effect of Aloe soap value chain initiative on pastoralist and agro-pastoralist households livelihood diversification strategy, the economic and social issue of the households, environmental and institution issues were analyzed from the survey data collected from individual household. The descriptive analysis uses tools such as minimum, maximum, mean, percentage, standard deviation,

frequency distribution and T-test and chi- square statistics to compare participants and non-participant households in Aloe soap making processes.

Necessary information on changes in environmental, organizational and institutional aspect of Aloe soap value chain initiatives on pastoral and agro-pastoral households' livelihood were collected from the community using focus group discussion, interviewing experts in different organizations in the district and community members; and reference was made to secondary sources which were described and explained qualitatively as well as physical observation of the researcher. This information was used to augment the quantitative analysis results.

Foster, (2003) stated that distilling the effect of intervention per se from those factors that affect individuals in examining outcome response of an intervention involved is the central methodological challenge in non-experimental evaluation method. There are different econometric approaches that have been used to avoid or reduce this problem, out of which, Propensity Score Matching (PSM) is one among others. The PSM method, as devised by Rosenbaum and Rubin (1983), can justifiably claim to be the solution to this problem, and thus to be the observational analog of a randomized experiment. The method balances the observed covariates between the treatment group and a control group (sometimes called comparison group for non-random evaluations) based on similarity of their predicted probabilities of receiving the treatment (called their propensity scores). The difference between PSM and a pure experiment is that the latter also assures that the treatment and comparison groups are identical in terms of the distribution of all observed or unobserved characteristics. Hence, there are always concerns about remaining selection bias in PSM estimates.

Estimating propensity score is the first step in estimating the Aloe soap value chain initiative effect on livelihood diversification strategies of the target households. To get this propensity scores, any standard probability model such as logit, probit or multi-nominal logit can be used (Rajeev et al., 2007). Since the propensity to participate is unknown, the first task in matching is to estimate this propensity. Any resulting estimates of program effect rest on the quality of the participation estimate. This can be routinely carried out using a choice model. The appropriate choice model depends on the nature of the program being evaluated. If the program offers a single treatment, the propensity score can be estimated in a standard way using a probit or logit model, where the dependent variable is 'participation' and the independent variables are the factors thought to influence participation. The logit model was used to assess the effect of participating in 'Aloe soap value chain initiatives' on households' livelihood diversification strategy. Because, a logit regression of treatment status (1 if a household is participated in aloe soap processing, 0 if household non-participant) was run for the sampled households, on observables that include age, education, family size, experience in aloe soap making, access to market center, extension visits, livestock holding and access to rural credit services. The major concern of this regression was to predict the probability of a household to participate in Aloe soap making used for supplementing pastoral and agro-pastoral households livelihood diversification strategies, i.e., to predict propensity scores, based on which, the treatment and control groups of households were matched using the matching algorithms.

As cited by different authors, Pindyck and Rubinfeld (1981) have specified the cumulative logistic probability function as:

$$P_i = f(Z_i) = f[\beta_0 + \sum_{i=1}^{n} \beta_i X_i] = \left[\frac{1}{1+e^{-[\beta_0+\sum \beta_i X_i]}}\right] \qquad (1)$$

Where: ***e*** = represents the base of natural logarithms (2.718…); $\boldsymbol{X_i}$ = represents the ith explanatory variable; P_i = the probability that an individual participants in the Aloe soap value chain initiative intervention project; β_0 and β_i are parameters to be estimated.

Interpretation of coefficients will be easier if the logistic model can be written in terms of the odds and log of odds (Gujarati, 2004). The odds ratio implies the ratio of the probability that an individual will be a participant (P_i) to the probability that he/she will not be a participant ($1 - P_i$). The probability that he/she will not be a participant is defined by:

$$[1 - P_i] = \left[\frac{1}{1+e^{Z_i}}\right] \qquad (2)$$

Using equations (1) and (2), the odds ratio becomes:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \qquad (3)$$

Alternatively, $\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{[\beta_0 + \sum \beta_i X_i]}$ (4)

Accordingly, taking the natural logarithms of equation (4) will give the logit model as indicated below.

$$Z_i = ln\left[\frac{P_i}{1-P_i}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - - - + \beta_n X_n \qquad (5)$$

Where, P_i is probability of participating in making Aloe soap that ranges from 0 to 1 and Z_i is a function of ***n*** explanatory variables X_i, β_0 is an intercept, β_1, β_2, …, β_n are the slope parameters in the model.

If we consider a disturbance term U_i, the logit model becomes:

$$Z_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + U_i \qquad (6)$$

So, the binary logit will become: $Pr(P_{pt}) = f(X)$ (7)

Where, P_{pt} is project participation $f(X)$ is the dependent variable project participation and *X* is a vector of observable covariates of the households:

PALVCI = f(X) = f[FSIZHH, SEXHH, AGEHH, EDUHH, ACRD, ACEXT, AMKT, TLU, PASP, KAEC, FMPASM, CMPASM, ASLDV, ALMKTY, ASCOMPT, PEASVCI, RDGT]

Where: PALVICI = Participation in Aloe soap making value chain initiatives; FSIZHH = family size of the household; SEXHH = sex of the household head; AGEHH = age of household head; EDUHH = education level of household head; ACEXT = access to extension service (DAs) of HH residence; ACRD = access to credit; AMKT = household Access to Market; TLU = size of livestock holding; PASP = perception of aloes soap; KAECU = knowledge about aloe plant economic uses; FMPASM = family members participating on aloe soap making; CMPASM = community income groups participating on aloe soap; ASLDV = aloe soap supplementing livelihood diversification; ALMKTY = aloe soap marketability in the local market; ASCOMPT = Aloe soap competency or preferability, PEASVCI = positive effects/rank of aloe soap value chain initiative in the area and RDGT = Recurrent drought.

The propensity score estimation by itself is not enough to estimate the ATT of interest. This is due to the fact that propensity score is a continuous variable and the probability of observing two units with exactly the same propensity score is, in principle, zero. Various matching algorithms have been proposed in the literature to overcome this problem. The methods differ from each other with respect to the way they select the control units that are matched to the treated, and with respect to the weights they attribute to the selected controls

when estimating the counterfactual outcome of the treated. However, they all provide consistent estimates of the ATT under the CIA and the overlap condition **(**Caliendo and Kopeinig, 2008).

According to Becker and Ichino (2002), it is a matching method whereby all treated units are matched with a weighted average of all controls with weights which are inversely proportional to the distance between the propensity scores of treated and controls. Kernel weights the contribution of each comparison group member, so that more importance is attached to those comparators providing a better match. The difference from caliper matching, however, is that those who are included are weighted according to their proximity with respect to the propensity score. The most common approach is to use the normal distribution (with a mean of zero) as a kernel, where the weight attached to a particular comparator is proportional to the frequency of the distribution for the difference in scores observed (Bryson *et al*., 2002).

According to Caliendo and Kopeinig (2008), the drawback of this method is that possibly bad matches are used as the estimator includes comparator observations for all treatment observation. Hence, the proper imposition of the common support condition is of major importance for kernel matching method. A practical objection to its use is that it will often not be obvious how to set the tolerance. However, according to Mendola (2007), kernel matching, with 0.25bandwidth, was most commonly used.

The question remains on how and which method to select. Clearly, there is no single answer to this question. The choice of a given matching estimator depends on the nature of the available data set (Bryson *et al*., 2002). After obtaining the predicted probability values conditional on the observable covariates (the propensity scores) from the binary estimation, matching will be

done using a matching algorithm that is selected based on the data at hand. Then the effect of household's participation in the Aloe soap value chain initiative supported by SOS Sahel Ethiopia's intervention on a given outcome (outcome in this study is the additional income obtained due to Aloe soap value chain initiative) (Y) is specified as:

$$\tau_i = Y_i(D_i = 1) - Y_i(D_i = 0) \qquad (8)$$

Where τ_i is treatment effect (effect due to participation in the Aloe soap making process), Y_i is the outcome on household ***i***, D_i is whether household ***i*** has got the treatment or not (i.e., whether a household participated in the Aloe soap making innovative approach or not).

However, one should note that $Y_i(D_i = 1)$ and $Y_i(D_i = 0)$ cannot be observed for the same household at the same time. Depending on the position of the household in the treatment (Aloe soap value chain initiatives), either $Y_i(D_i = 1)$ or $Y_i(D_i = 0)$ is unobserved outcome (called counterfactual outcome). Due to this fact, estimating individual treatment effect τ_i is not possible and one has to shift to estimating the average treatment effects of the population than the individual one. Most commonly used average treatment effect estimation is the 'average treatment effect on the treated (τ_{ATT}), and specified as:

$$\tau_{ATT} = E(\tau / D = 1) = E\left[\frac{Y_{(1)}}{D=1}\right] - E[\frac{Y_{(0)}}{D=1}] \qquad (9)$$

As the counterfactual mean for those being treated, $E\left[\frac{Y_{(0)}}{D=1}\right]$ is not observed, one has to choose a proper substitute for it in order to estimate the average treatment effect (ATT). One may think to use the mean outcome of the untreated individuals, $E\left[\frac{Y_{(0)}}{D=0}\right]$ as a substitute to the counterfactual mean for those being treated $E[\frac{Y_{(0)}}{D=1}]$. However, this is not a good idea especially in non-experimental studies. Because, it is most likely that components which

determine the treatment decision also determine the outcome variable of interest.

In this particular case, variables that determine household's decision to participate in the Aloe soap making process developed by the project interventions could also affect household's input use intensity, level of productivity, household income, etc. Therefore, the outcomes of individuals from treatment and comparison group would differ even in the absence of treatment leading to a self-selection bias. By rearranging, and subtracting $E\left[\frac{Y_{(0)}}{D=0}\right]$ from both sides, one can get the following specification for ATT.

$$E\left[\frac{Y_{(1)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] = \tau_{ATT} + E\left[\frac{Y_{(0)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] \qquad (10)$$

Both terms in the left hand side are observables and ATT can be identified, if and only if $E\left[\frac{Y_{(0)}}{D=1}\right] - E\left[\frac{Y_{(0)}}{D=0}\right] = 0$; i.e., when there is no self-selection bias. This condition can be ensured only in social experiments where treatments are assigned to units randomly (i.e., when there is no self-selection bias).

In non-experimental studies one has to introduce some identifying assumptions to solve the selection problem. The following are two strong assumptions to solve the selection problem.

A) Conditional Independence Assumption (CIA): It is given as:

$$Y_0\, Y_1 \perp \frac{\mathrm{D}}{\mathrm{X}}, \forall\, \mathrm{X}, \qquad (11)$$

Where, $\perp$ indicates independence, X -is a set of observable characteristics, Y_0 - Non-participants and Y_1-Participants.

Therefore, given a set of observable covariates (X) which are not affected by treatment (in our case, Aloe soap making participant), potential outcomes

(level of productivity, income, etc) are independent of treatment assignment (independent of how the Aloe soap making participation decision is made by the household). This assumption implies that the selection is solely based on observable characteristics and variables that influence treatment assignment (Aloe soap making participation decision is made by the household) and potential outcomes (productivity level, income, etc) are simultaneously observed (Bryson *et al*., 2002; Caliendo and Kopeinig, 2008).

After adjusting for observable differences, the mean of the potential outcome is the same for $\mathrm{D} = 0$ and $\mathrm{D} = 1$, and $\mathrm{E}(\mathrm{Y}_0/\mathrm{D} = 1, \mathrm{X}) = E(\mathrm{Y}_0/\mathrm{D} = 0, \mathrm{X})$. Instead of conditioning on X, Rosenbaum and Rubin (1983), suggest conditioning on a propensity score (propensity score matching). The propensity score is defined as the probability of participation for household i given a set X which is household's characteristics (X) = (D = 1/X). Propensity scores are derived from discrete choice models, and are then used to construct the comparison groups. Matching the probability of participation, given covariates solves the problem of selection bias using PSM (Liebenehm *et al.,* 2009). The distribution of observables X is the same for both participants and nonparticipants given that the propensity score is balancing score (Liebenehm *et al.,* 2009). If outcomes without the intervention are independent of participation given X, then they are also independent of participation given (X). This reduces a multidimensional matching problem to a single dimensional problem. Due to this, differences between the two groups are reduced to only the attribute of treatment assignment, and unbiased impact estimate can be produced (Rosenb aum and Rubin, 1983).

B) Common support Assumption: It rules out perfect predictability of D given X. That is, $0 < P\left[\frac{D=1}{X}\right] < 1$. This assumption ensures that persons with the same

X values have a positive probability of being both participants and non-participants. Given the above two assumptions, the PSM estimator of ATT can be written as:

$$\tau_{ATT}^{PSM} = E_{\frac{P(x)}{D=1}}\{E\left[\frac{Y(1)}{D=1}, P(X)\right] - E[\frac{Y(0)}{D=0},\ P(X)]\} \qquad (12)$$

Where ***P(X)*** is the propensity score computed on the covariates ***X***. Equation (12) is explained as the ***PSM*** estimator is the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of participants.

Before proceeding to estimate the data using logit model, checking the existence of multicollinearity between explanatory variables tests were undertaken. The variance inflation factor (VIF) technique was employed to detect the problem of multicollinearity for the continuous variables VIF can be defined as;

$$\mathrm{VIF}(\mathrm{X_i}) = [1 - \mathrm{R_i}^2]^{-1} \qquad (13)$$

Where, $\mathrm{R_i}$ is the squared multiple correlation coefficient between and other explanatory $\mathrm{X_i}$ variables. The larger the value of VIF, the more troublesome it is. As a rule of thumb, if a VIF of a variable exceeds 10, the variable is said to be highly collinear.

Similarly, for dummy variables contingency coefficients (CC) test were employed using the following formula:

$$C = \sqrt{\frac{X^2}{n+X^2}} \qquad (14)$$

Where C is contingency coefficient, X^2 is chi-square value and n = total sample size.

For dummy variables if the value of contingency coefficients is > 0.75 the variable is said to be collinear. Heteroscedasticity exists when the variances of all observations are not the same, leading to consistent but inefficient parameter estimates. More importantly, the biases in estimated standard error may lead to invalid inferences (White, 1980). Heteroscedasticity was detected by using Breusch - Pagen test (hettest) in STATA 12.

Finally, the Aloe soap value chain initiative effect on pastoral and agro-pastral households livelihood diversification strategy were estimated through STATA 12 software using psmatch2 developed by Leuven and Sianesi (2003). In addition SPSS version 16.0 software was deployed to analyze the descriptive statistics.

Results and Discussion

- **Social, Organizational and Institutional Aspects of Aloe based Livelihoods Social**: Based on the result obtained from FGD, the project interventions on the NRM and NR based income generation activities are economically affordable. Traditional pastoral adaptation strategies in coping with climatic effects and other shocks usually involve a rational use of existing resources and through sharing scanty resources with other neighboring communities. . The introduction of Aloe soap value chain initiative was not easily accepted by the community, because, the plant was not used to produce any economic benefit to the local community for longer period of time. It took time to convince the community to use Aloe plant as source of livelihood in order to mitigate the risk of drought and other shocks (KII).
- **Organizational**: The pastoralists or agro-pastoralists groups were organized into cooperatives and union. That helped them to share

capital investments, gain bargaining power, and to enforce their contracts. In organizing themselves vertically, they benefited not only by collecting but also by providing basic processing services in order to sell higher value Aloe plant products on the market. At the same time, Aloe soap production is restricted externally by the presence of input supply, fixed costs, lack of credit markets and the lack of infrastructures (KII).

- **Institutional**: Under the umbrella and guidance of customary institutions, pastoralists and agro-pastoralists of Borana have adapted in many ways to the uncertainty of their environment. As all respondents agreed, the pastoral livelihood assets such as natural, financial, human and social assets on which Borana community depend are significantly affected by recurrent drought, other human and climate related shocks. The pastoral and agro-pastoral communities have never tried to use Aloe plant for supplementing their usual means of livelihood. They have been using Aloe plant only for traditional medicines for both human and animals, and for ritual purposes (FGD and KII).

The pastoral community were convinced that Aloe species are the most reliable and drought tolerant plant which grows throughout the year. Aloe plant species has now got recognition from the local government and community members as the potential income generating plant in supplementing the pastoral and agro-pastoral livelihood diversification strategies. Currently, this Aloe soap value chain initiative was able to attract the attention of local government, donors, likeminded NGOs and observed being scaled up to adjacent districts and Guji Zone. During this survey period, there were around 12 aloe soap producing groups initiated and Aloe plant domestication is being exercised (KII).

Description of Sample Households' Characteristics

To describe the profile of sample households included in this study both continuous and discrete variables were used. Statistical analysis was run to observe the distribution of the independent variables (Table 4).

Table 34: Summary Statistics of Variables

Variable	Mean	Std. Dev	Min	Max
FSIZHH	6.64	2.99	2	16
PALVCI	0.5	0.5	0	1
SEXHH	0.43	0.5	0	1
AGEHH	38.24	13.73	18	87
EDUHH	1.46	0.94	1	4
PASP	1.13	0.42	1	3
KAECU	0.58	0.5	0	1
FMPASM	5.13	15.67	1	
CMPASM	2.4	1.19	1	4
ASLDV	0.93	0.25	0	1
ALMKTY	0.43	0.5	0	1
ASCOMPT	0.77	0.42	0	1
MCOOP	0.5	0.5	0	1
CRDAC	0.7	0.46	0	1
DMKT	12.09	3.29	5	15
ACEXT	0.7	0.46	0	1
RFINSC	205.11	435.79	1	
RDGT	0.83	0.37	0	1
PEASVCI	2.6	0.76	1	4
TLU	9.43	11.72	0	75

Source: Own survey

The socio-economic and institutional characteristics of the sampled households such as age, sex, family size, market distance, extension visit, accesses to credit, livestock holding, were identified to affect participation in the program. Of the total 120 sample respondents interviewed 60 were participants and the rest were non-participants of Aloe soap making technologies (Table 4).

Respondents Total Income (TOINC) Estimate per Month: Under favorable conditions, that is, if the ingredients such as caustic soda, vegetable oil, water and Aloe sap are available and other things remain constant, those household members who participate in Aloe soap making business had better income than the non-participants. Participant households undertake the Aloe soap making business parallel to their usual livelihood activities, i.e. livestock and livestock products sales (Table5).

Table 45: Respondents Total Income per Month (TOTINC) in Birr

PALVCI	Mean	Std. Dev.	min	max
Non-participant	1647.00	846.11	540.00	3510.00
Participant	4731.31	1019.63	2801.54	6866.16

Source: Own survey

The mean monthly income of non-participants was Birr1647.00, whereas that of participant's monthly mean income was Birr 4731.31. The participant's monthly mean income was higher due to the income they additionally obtained from Aloe soap processing business.

With regard to respondents view and perception of the Aloe Soap Making Business, there was no negative effect reflected directly or indirectly. The survey question was forwarded to check whether there exists any cultural or traditional situation which hinders the community from using Aloe plant for

generating income. As shown in Table 6, Only 7% of the total women respondents and none of the men have indicated that Aloe soap business has poor effect on their livelihood diversification strategy. The majority of the respondents had positive attitude towards Aloe soap marketing value chain initiative (Table 6).

Table 56: Rank of Positive Effects of Aloe Soap Making Business

Sex	Poor		Good		Very good		Excellent		Total	
	N	%	N	%	N	%	N	%	N	%
Female	5	7	29	42	27	39	8	12	69	57.5
Male	0	0	24	47	20	39	7	14	51	42.5
Total	5	4	53	44	47	39	15	13	120	100

Source: Own survey

Respondents were requested to express their perception on the aloe soap making business. Among the total respondents, 93% of women and 88% of men expressed a favorable attitude toward aloe soap making business (Table 7).

Table 67: Respondents' Perception of Aloe Soap Making Business

Sex	Favor/good		Moderate/neutral		Disfavor/not good		Total	
	N	%	N	%	N	%	N	%
Female	64	93	3	4	2	3	69	57.5
Male	45	88	4	8	2	4	51	42.5

Source: Own survey

Prospects and Determinant Factors of Aloe based Livelihood Diversification

Pastoralists have developed elaborate and complex mechanisms and institutions that enable flexibility and opportunity mainly herd mobility and diversification. These institutions govern mobility, resource use and redistribution, and have enabled pastoral societies to withstand extreme pressures of both their environment and their competitors. The study has revealed that wild Aloe vegetation was thought to be abundant but has negligible economic contribution to the livelihoods of the sample pastoral community. It was confirmed through KIIs that Aloe soap value chain initiative was introduced to Borana by SOS Sahel before seven years during 2008/2009 on a trial basis through community participation. Prior to this initiative, Aloe plant was considered as invading plant covering their grazing areas. Hence, the community had submitted a request to the zonal government offices to clear-out the Aloe plant species from the rangelands (FGD and KII).

To ensure institutional sustainability, different capacity building activities at community and government level were provided and attempt to link the Aloe based cooperatives/groups to the respective government institutions through legal registration mechanism. Due to the intervention of Aloe soap value chain initiatives in the study area, there were magnificent changes observed regarding the economic use of Aloe plant. Prior to the intervention, the Aloe plant species were considered as invading bush encroachment except its traditional medicinal and ritual services. After the intervention, the Aloe soap product was promoted at all events both at local and national level. There were many networks created by the local traders in the region reaching the capital city, Addis Ababa. This innovative approach of making soap from underutilized Aloe plant species has alerted the livelihood of the local

community, as such the local government and NGOs had promoted the initiative as one of the livelihood diversification options in the Borana rangelands.

Hence, based on discussion with FGD and KII and the researcher's personal observation, Aloe soap value chain initiative had got a wider acceptance from all corners of the region. Households were organized into cooperatives and the government had given them a legal certification or work permit in Aloe soap production and even encouraged them to be organized into 'Aloe Soap Producers and Forest Resources Products Marketing Cooperatives Union' at Zonal level. The Borana Zone Administration had allotted /land for building bio-enterprise center where all rangeland products like Aloe soap, gum and incense, honey and scent wood can be sold. Some NGOs operating in Borana were encouraging those interested pastoral and agro-pastoral communities to domesticate Aloe plants and fetch their income in a more advanced way than before.

The aloe soap value chain system includes the individual households, affiliated institutions, CBOs, input suppliers, the government line departments like cooperative offices, Children and Women Affaires, primary cooperatives, the cooperatives union, financial institutions like Banks, NGOs, private traders, wholesalers, retailers and consumers. However, there is no, as such, matured Aloe soap value chain systems developed in the area except input supply, product development, promotion and marketing. Hence, the prospects of Aloe soap value chain initiative is promising and could be more productive and relatively best option in supplementing the livelihoods of the respective rural poor and gradually support the local economic transaction which may lead to advanced and diversified products of Aloe plant species found in the country.

Econometric Results of Propensity Score Matching

To measure the average treatment effect on the treated (ATT) for outcome variables, a logit model was used to estimate the propensity scores. The odds ratio and marginal effect was run to identify the variables on the level of household participation. Next a matching estimator that best fit to the data was selected. Then, based on those scores, estimated and selected matching estimator and matching between participants and non-participants was performed to find the impact of the project on the mean values of the outcome variables. Therefore, this section illustrates all the required algorithms to calculate the average treatment effect on the treated, which helps us to identify the impact of the project.

Odds Ratio and Households Participation in Aloe Soap Processing

The odds ratio depicted in Table 8 below shows that the coefficients of variables which are influencing the probability of households to participate or not in the Aloes soap making business. Interpretation of coefficients will be easier if the logistic model can be written in terms of the odds and log of odds (Gujarati, 2004). The odds ratio implies the ratio of the probability that an individual will be a participant (P_i) to the probability that he/she will not be a participant ($1 - P_i$). The odds ratio is one of a range of statistics used to assess the risk of a particular outcome if a certain factor (or exposure) is present. The odds ratio is a relative measure of risk, telling us how much more likely it is that someone who is exposed to the factor under study will develop the outcome as compared to someone who is not exposed. Odds are a way of presenting probabilities, but unless you know much about betting you will probably need an explanation of how odds are calculated. The odds of an event

happening is the probability that the event will happen divided by the probability that the event will not happen.

Westergren et al., (2001) has stated that if the odds ratios are greater than one, then the event (in our case, 'participation into aloe soap value chain initiative') is more likely to happen than not. If the odds ratio are less than one, then the event is less likely to happen than not.

Hence, as seen in the Table 8 below, age, second cycle of education (i.e., grade 5-8), knowledge about Aloe economic use (KAEU), family members participating on aloe soap making process (FMPASM), aloe soap supporting livelihood diversification (ASLDV), Aloe soap marketability (ALMKT), Aloe soap competency in the market (ASCOMPT), distance from the market (DMKT), access to extension services (ACEXT) and livestock holding (TLU) has more likely to participate and contribute to the households' income through aloe business.

Table 7~~8~~: Logistic Regression of Odds Ratio of Participants

Variable	Odds Ratio	Standard Errors	Z-Value
FSIZHH	1.086*	0.109	0.82
SEXHH	0.381	0.204	-1.80
AGEHH	1.001	0.022	0.70
EDUHH			
2	0.482	0.403	-0.87
3	0.573	0.708	-0.45
4	0.422	0.624	-0.58
KAECU	3.540*	2.658	1.68
FMPASM	1.028	0.012	2.42
CMPASM	0.796	0.206	-0.88
ASLDV	12.996*	15.046	2.22
ALMKTY	3.964*	2.214	2.47
ASCOMPT	8.358*	7.542	2.35
CRDAC	1.025	0.629	0.04
DMKT	1.104*	0.101	1.07
ACEXT	0.863	0.456	-0.28
RDGT	0.615	0.545	-0.55
PEASVCI	0.574	0.215	-1.48
TLU	1.065*	0.028	2.41
_cons	0.007	0.018	-1.96

* Shows the variables that have a higher contribution to participate in aloe soap making business

NB: In EDUHH (Education of the HH)1 represents the illiterate sample (EDUHH) and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

Propensity Scores

Prior to running the logistic regression model to estimate propensity scores, the explanatory variables were checked for existence of severe multicollinearity problem. A technique of Variance Inflation Factor (VIF) was calculated to detect the problem of multicollinearity among continuous explanatory variables. Accordingly, the VIF (X) result shows that the data had no serious problem of multicollinearity (Appendix 2). This is because, for all continuous

explanatory variables, the values of VIF were by far less than 10. Therefore, all the explanatory variables were included in the model (Appendix 3).

Moreover, heteroskedasticity test was done using Breusch-Pagan/Cook-Weisberg test for heteroskedasticity and the P-value was 0.2954 which is insignificant implying the absence of the problem of heteroskedasticity (Appendix 4).

A logistic regression model was used to estimate the propensity scores of respondents which help to put into practice the matching algorithm between the treated and control groups. The matching process attempts to make use of the variables that capture the situation before the start of the intervention. The logit result revealed a fairly low pseudo R^2 of 0.361 (table below). The pseudo-R^2 indicates how well the regressors *X* explain the participation probability (Caliendo and Kopeinig, 2005). A low R value means participant households do not have much distinct characteristics overall and as such finding a good match between participant and non-participant households becomes easier (Yibeltal, 2008).

The maximum likelihood estimate of the logistic regression model result shows that participation was influenced by 5 variables (Table 9). These are family size, education level, distance from nearest market, access to extension service and recurrent drought. In addition, households having higher number of livestock are more likely to be a participant in the market development interventions of the Aloe soap value chain initiatives project and this is on the contrary to the finding of Zikhali (2008) in Zimbabwe.

Table 8~~9~~: Logit Results Household Program Participation

Variable	Coefficient	Standard Errors	Z-Value
FSIZHH	0.083*	0.105	0.79
SEXHH	-0.965***	0.541	-1.78
AGEHH	0.001**	0.023	0.06
EDUHH			
2	-0.730***	0.894	-0.82
3	-0.556***	1.235	-0.45
4	-0.863***	1.082	-0.80
KAECU	1.264**	0.646	1.96
FMPASM	0.027**	0.022	1.26
CMPASM	-0.228***	0.226	-0.89
ASLDV	2.565**	1.286	1.99
ALMKTY	1.377	0.553	2.49
ASCOMPT	2.123	0.746	2.84
CRDAC	0.024*	0.580	0.04
DMKT	0.099*	0.089	1.11
ACEXT	-0.148***	0.561	-0.26
RDGT	-0.486***	0.790	-0.61
PEASVCI	-0.555***	0.366	-1.52
TLU	0.063**	0.027	2.30
_cons	-4.921	2.781	-1.77
Number of Obs	120		
Wald chi2(18)	60.090		
Prob > chi2	0.000		
Log pseudo likelihood	-53.132		
Pseudo R2	0.361		

***, ** and * means significant at the 1%, 5% and 10% probability levels, respectively.

NB: In EDUHH (Education of the HH) 1 represents the illiterate sample and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

Matching Participants and Comparison of Households

As already noted, choice of matching estimator is decided based on the balancing qualities of the estimators. According to Dehejia and Wahba (2002),

the final choice of a matching estimator was guided by different criteria such as equal means test referred to as the balancing test, pseudo-R^2 and matched sample size. Balancing test is a test conducted to know whether there is statistically significant difference in mean value of treatment characteristics of the two groups of the respondents. Accordingly, matching estimators were evaluated via matching the participant and non-participant households in common support region.

The estimated model appears to execute well for the intended matching exercise. The pseudo- R^2 value is 0.35 (Table 10). The pseudo- R^2 indicates how well the covariates explain the participation probability. Therefore, a matching estimator having balanced (insignificant mean differences in all explanatory variables) mean bears a low pseudo R^2 value that results in large matched sample size which is preferred. In line with the above indicators of matching quality, kernel of Epanechnikov type (default to kernel matching) with no band width is resulted in relatively low pseudo R^2 with best balancing test (all explanatory variables insignificant) and large matched sample size as compared to other alternative matching estimators indicated in Table 10. Then it was selected as a best fit matching estimator for dataset.

Table ~~9~~10 : Logistic Regression for Choices of Matching Algorithm

Variable	Coefficient	Standard Errors	Z-Value
FSIZHH	0.083*	0.105	0.79
SEXHH	-0.965***	0.541	-1.78
AGEHH	0.001**	0.023	0.06
EDUHH			
2	-0.730***	0.894	-0.82
3	-0.556***	1.235	-0.45
4	-0.863***	1.082	-0.80
KAECU	1.264*	0.646	1.96
FMPASM	0.027**	0.022	1.96
CMPASM	-0.228***	0.256	-0.89
ASLDV	2.565	1.286	1.99
ALMKTY	1.377*	0.553	2.49
ASCOMPT	2.123	0.746	2.84
CRDAC	0.024**	0.580	0.04
DMKT	0.099**	0.089	1.11
ACEXT	-0.148***	0.561	-0.26
RDGT	-0.486***	0.790	-0.61
PEASVCI	-0.555***	0.366	-1.52
TLU	0.063**	0.027	2.30
_cons	-4.921	2.781	-1.77
Number of Obs	120		
Wald chi2(18)	34.65		
Prob > chi2	0.011		
Log pseudo likelihood	-53.132		
Pseudo R2	0.361		

***, ** and * means significant at the 1%, 5% and 10% probability levels, respectively.

NB: In EDUHH (Education of the HH) 1 represents the illiterate sample and serve as the reference point; 2 represents samples with grade 1-4; 3 represents grade 5-8; and 4 represents grades 9-12.

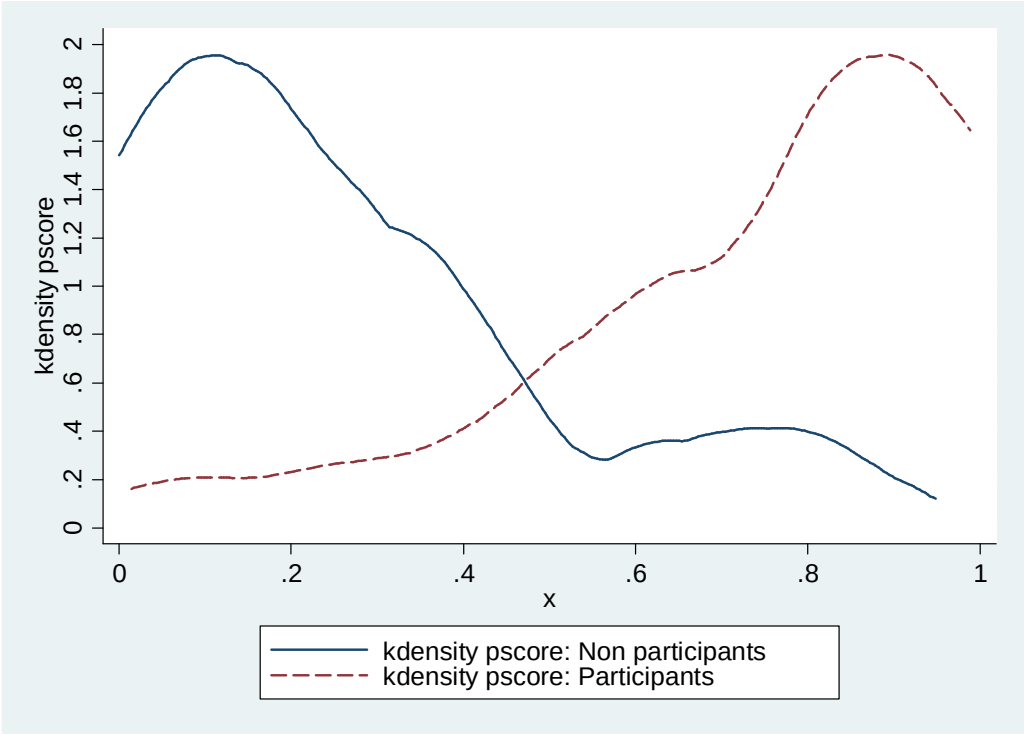

Figure 13: Graph of Kernel density of propensity score distribution

Source: Field Survey 2014

On the basis of this participation model, we then computed the distribution of the propensity score for each household included in the treated and control groups to identify the existence of a common support. Figure 3 portrays the distribution of the household with respect to the estimated propensity scores. Most of the treatment households are found in the right side and partly in the middle. On the other hand, most of control households are found in the left side of the distribution. In general, the graph shows that there is wide area in which the propensity score of participants is similar to those of nonparticipants.

Estimates of Average Treatment Effect on the Treated (ATT) Income

Given that those who follow through in participating may very well be systematically different from those who are assigned to treatment but do not

participate, it may not be appropriate to simply compare those randomized to treatment with those in the randomized-out control group. The voluntary nature of participation in many interventions introduces the potential for **selection bias**, where we only observe outcomes for a nonrandom subsample of all units assigned to treatment. This is an example where propensity-score matching (PSM) could be used to match participants with members of the control group who are similar in the same selective ways as those who receive services. As shown in Table 11, the ATT reveals that participants would have lost a physical amount of birr near to 2688.70 if they didn't participate in aloe soap making business. The difference that the participants can make in fetching their additional income is that totals to about Birr2688.70 per month.

Table 1011: Estimate of ATT of income per month

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
TOTINC	Unmatched	4731.31	1647.00	3084.31	171.05	18.03
	ATT	4683.21	1994.51	2688.70	343.72	7.82
Note: S.E. does not take into account that the propensity score is estimated						

The cross-sectional data (2012-2013) collected from both participant and non-participant sample households were analyzed using propensity score matching method. Accordingly, the average treatment effect on the treated (ATT), that is, the difference between the mean values of the outcome variable of treated and control of the intervention has shown the total income earned per month. The participants have received a better income per month from the aloe soap production over the counterparts. This difference was found to be significant at 5% level.

Conclusions

This study confirmed that in addition to the traditional pastoral livelihood diversification strategy which is based on livestock and livestock products, the sample households were hunting alternative livelihood strategies including Aloe soap making. Households differed on the actual livelihood strategies adopted depending on the sex, age and family member participating in the Aloe soap making business. The sample households faced challenges due to recurrent drought, unusual settlements, expansion of farmlands, clan conflict, human capital (illiteracy & lack of appropriate skills). At the same time, Aloe soap production is restricted externally by the presence of input supply, fixed costs, lack of credit markets and the lack of infrastructures. As the Aloe soap value chain initiative was implemented to supplement the pastoral and agro-pastoral livelihood diversification strategies, the sample households had diversified their livelihood strategies to ensure survival and meet desired livelihood outcomes. The pursuit of Aloe based alternative livelihood strategies was a struggle against challenges, which needed collective solutions from community, elders, customary institutions, the government, research centers and NGOs to guarantee success.

There was a significant association observed between increased vulnerability of a livestock-only livelihood strategy and adoption of alternative livelihood diversification strategies. Similarly, there was a significant association between household characteristics and pursuit of alternative livelihood strategies.

The finding of this study applies to these particular sample households who have access to Aloe based livelihoods. They cannot be regarded as representative for all pastoralists and agro-pastoralists in Borana. However, these insights provide an impression of how the livelihoods diversification

strategies can be supplemented by Aloe based products in Borana and similar agro-ecologies and vegetation covers in the country. The constraints are likely to exist elsewhere and set the frame of Aloe based production potential as well as engagement in additional activities, perhaps even within most rural, small-scale pastoral and agro-pastoral households in Borana.

The fact that different livelihood strategies were identified indicates a tendency that calls for different targeted interventions. The Aloe soap processing activities are, however, currently not equally accessible to all households. As the non-livestock activities are to be conducted as either additional activities or alternative activities, it is possible that even the poorest household can benefit. Therefore, prioritizing a focus on Aloe based alternative livelihood diversification activities hence appears to be the most reasonable strategy, as the strategy is to address the destitute households as well.

The finding of this study reveals a positive and statistically significant effect of the project on participants, an effort of such kind plays a vital role in making pastoralists and agro-pastoralists market oriented and makes them better off by making their aloe soap making a business enterprise. The increased level of input use (ingredients, machineries/equipment, and market information and access) by the side of participants made them beneficiaries of the increased productivity and earners of higher net income and profits. The development of input market of such kind which is participatory - supplied by the private sector, integrated (multifaceted), and sustainable with the provision of market information and new ways of doing can increase the welfare of the communities in the long run and income in the short run.

In addition, it was observed that the interventions that were delivered by the project were not the kind that develop dependency syndrome among the

beneficiaries. It was a kind of making beneficiaries self-reliant and resilient as to from where Aloe plant is found, as to how to plan domestication and conservation of the wild Aloe plant, to whom to sell and more interestingly as to how to make informed decision regarding aloe soap producing and marketing. Therefore, there has to be such an institution which serve as a bridge among the stakeholders, stimulate the use of NTFPs like the abundant and underutilized Aloe plants in the region informing the pastoral development offices and the CBOs (co-operatives) and 'innovative knowledge adviser' in the nation at large. Moreover, scaling up of the Aloe soap value chain initiative practice of the project to other places has paramount importance for the development endeavor of the pastoral areas in line with enhancing food security of the rural poor and mitigation of the rigorous climate change affecting them.

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Appendix 1: Aloe Vera Plant and the Bioactive Chemical Constituents

Source: Adapted from (http://mumbai.olx.in/*Aloe-vera*-products-id-4852352)