Sunflower and Livelihood Outcomes among Households of Smallholder Farmers in Iramba District, Tanzania

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Abstract[1]

Sunflower production is an important economic activity which is potential for improving livelihood outcomes among smallholder farmers' households. However, despite such potentials, studies still debate on whether livelihood outcomes among smallholder farmers can be attained through sunflower cultivation or otherwise. This paper presents analysis of the livelihood outcome levels among smallholder farmers before and after engaging in sunflower cultivation. Also, it compared the livelihood outcome levels between sunflower and non-sunflower smallholder farmers. The study adopted a cross-sectional research design whereby household survey, focus group discussion and key informants interviews were used to collect data from 368 respondents. Qualitative data were transcribed, categorised, coded, and grouped into themes and analysed using constant comparison technique. Quantitative data were analysed by using descriptive statistics while difference in difference estimation was run to compare livelihood outcomes. Findings show that households of sunflower smallholder farmers' had higher levels of livelihood outcomes and they were significantly different unlike before sunflower cultivation. The livelihood outcomes between sunflower and non-sunflower smallholder farmers' households were significantly different (t = 12.51; p =0.000). The significant differences were evidenced by the number of household assets and access to financial services. Thus, sunflower cultivation stands a better chance for improving livelihood outcomes among smallholder farmers unlike other economic activities in the study area. Since findings show that some of the households had low level of livelihood outcomes it is recommended to smallholder farmers that they should consider building their livelihood capabilities through collective efforts as they are constrained by land size for cultivation. This can be done through forming farmers groups whereby they can join efforts to access microfinance loans and acquire small scale processing machines. This would enable them to increase household incomes by selling sunflower oil as well as seed cakes compared to selling few quantities of raw sunflower seeds individually.

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1.0 Introduction

United Republic of Tanzania is basically an agricultural-based economy, where by agriculture accounts for more than a quarter of Gross Domestic Product (GDP) and remains to be an important contributor to economic growth whereby in 2015, it contributed to 29.0% of the GDP, while in 2016, contributed 29.1% of the GDP (Deloitte, 2017). More than 75% of the population is in rural areas and about two-thirds of the employed population works in the agricultural sector; showing that most of the poor derive their livelihood from agricultural sector (Salami *et al.,* 2010). Smallholder agriculture in Tanzania remains to be major engine of rural growth and livelihood improvement as well as pathway that can lift large members of the rural poor out of poverty (World Bank, 2007). The pathway can be in terms of exchange or market based livelihood whereby rural households which produce surplus food crops or non-food agricultural products or by-products earn their livelihoods by selling. Also, it can be in terms of labour-based livelihood whereby most of the households derive livelihoods by selling their labour into different agricultural activities (Acharya, 2006).

In Iramba, agriculture is the back born of the district economy and about 90 percent of its residents depend on it as their main source of livelihood. Agriculture contributes over 94 percent of the District's GDP and it is carried out in all wards of the district (Iramba District Profile, 2016). Among the cash crops produced in the District, sunflower is the dominant one with an average annual production of 59,684.1 tons, equivalent to 76.4 percent of all cash crops produced in the District occupying cumulative annual average area of 41,232.8 hectares equivalent to 73.9 percent of the district's total land area under cash crops cultivation. The crop has increasingly become important for the majority of the smallholder farmers' households in the central corridor regions (Singida, Dodoma, Tabora) who depends on farming as one among the major household livelihoods strategies (Salisali, 2012). It has resulted into improved livelihoods either directly in the form of income for smallholder farmers (Gabagambi and George, 2010) and increased resilience to livelihood

shocks, or indirectly by providing livelihoods to individuals partially involved into sunflower value chain activities.

Livelihood depicts households or groups efforts aiming at making a living or attempting to meet their various needs while coping with uncertainties and responding to new opportunities (De Haan and Zoomers, 2005). The efforts determine the living gained by the individual or household, thus influencing livelihood outcomes of the respective household (Ellis and Freeman, 2004). Potential livelihood outcomes include increased income, increased well being, reduced vulnerability, improved food security and more sustainable use of the natural resource base (Serrat, 2010). Nonetheless, livelihood outcomes as the achievements or outputs of livelihood strategies (DFID, 2001) are important to be established in terms of levels achieved (Machimu, 2016). In the context of this study, livelihood outcomes were qualified to include ownership of household in-house assets, possession of a modern house and increased land ownership.

Literature on sunflower [TEOSA, (2012); Mameho *et al*., (2014); Henningsen *et al*., (2015)] provides empirical evidences on the income potentials of sunflower to smallholder farmers. Household income has been anticipated to be driving individuals or households to engage in sunflower cultivation due to its potentials (Lubungu *et al.,* 2014; Ugulumu and Inanga, 2008). To the contrary, Gabagambi and George (2010) observed that some smallholder farmers are still having poor livelihoods despite their participation in sunflower cultivation. Hence, most studies [Henningsen *et al*., (2015); Beerlandt *et al.*, (2013); TEOSA, (2012); Gabagambi and George, (2010)] though with contrasting empirical orientations, documented the potentials of sunflower to smallholder farmers' wellbeing singlehandedly basing on household income and unevenly cognisant of the livelihood outcomes among smallholder farmers broadly.

Literally, the above review makes the determination of livelihood outcomes among sunflower smallholder farmers patchy and inconclusive. Thus, basically there is a missing link on the empirical evidence regarding sunflower and livelihood outcomes among

households of smallholder farmers. A thorough understanding on the livelihood outcomes among households comprehensively is paramount as it provides the empirical ground for determining the contribution of livelihood initiatives to the specific society (Moyo, 2016; Mapila, 2011; Ponte, 2002). Therefore, specifically the study objective was to determine livelihood outcome levels among sunflower smallholder farmers before and after engaged into sunflower cultivation. In view of the preceding objectives, it was hypothesised that: (i) livelihood outcomes of smallholder farmers before and after engaged into sunflower cultivation do not differ, and (ii) livelihood outcomes between sunflower and non-sunflower smallholder farmers do not differ.

2.0 Theoretical Review

The study was guided by the Sustainable Livelihood Approach (SLA) (DFID, 2001). The SLA enhances understanding of the livelihoods of poor households since it is a multidimensional, integrated and a rational approach to poverty eradication (Kamarrudin and Samsudin, 2014). The approach provides the key component for analysis livelihoods of individuals and their communities in terms of capital assets, vulnerability context, the transforming structures and processes, livelihood strategies and livelihood outcomes as the key elements. The SLA contextualises the livelihood to be people centred and focuses on improving their livelihoods in terms of satisfying cultural, social, economic and environmental needs and aspirations of present generations without undermining the ability of future generations (Chambers and Conway, 1991). Thus, towards understanding households' livelihood outcomes it was important to understand how smallholder farmers utilise the livelihood capabilities and assets to achieve the desired livelihood outcomes in terms of sustainable use of resources, increased household income, reduced vulnerability, empowerment, better household assets and improved household wellbeing as qualified by DFID (2001).

3.0 Methodology

The study was conducted in Iramba District located in Singida Region. The Region has been purposely selected because it is the leading Region in the Country in sunflower production. Within the Region, Iramba is the leading District in sunflower production with 59 684.1 tons followed by Singida Rural with 55 576 tons (Iramba District Profile, 2016). The study adopted cross-sectional research design since it allows data collection for multiple variables from a representative sample with varied characteristics (Labaree, 2009; Rindfleisch *et al.*, 2008; Olsen *et al.*, 2004) to be examined at a single point in time in order to detect variables patterns of association (Bryman, 2008). Data were collected from sunflower (participants) as well as non-sunflower smallholder holder farmers (non participants) for comparison purposes so as to establish the differences in livelihood outcomes and qualify the influence of sunflower on livelihood outcomes. The sample size including participants and non-participants into sunflower cultivation was 368 respondents estimated by using Daniel, (2009) formula for infinite population.

Systematic sampling technique was used to obtain respondents whereby the lists for selection was obtained from the farmers' registers kept by the Village Agricultural Extension Officers (VAEO) as well as from the village households register obtained from the Village Executive Officer (VEO). The sampling interval (k^{th} element) was determined using the Kth formula and thereafter a first observation (*L*) was randomly chosen by writing the serial numbers on separate paper pieces and then folded before the random picking. Quantitative data were collected by using a household survey approach with a structured questionnaire at household level. A total of 368 copies of the questionnaire were administered to households' representatives in the 5 villages.

Qualitative data were collected using Focus Group Discussion (FGD) and Key Informant Interview (KII). A total of 7 KIIs were conducted with key informants (technical and administrative personnel) selected basing on their knowledge on sunflower cultivation, community livelihood and development. At the Village level some of the VEO, VAEO or

Ward Agricultural Extension Officer (WAEO) were involved in the interviews whereas at the District level, some members of the District Community Development Office as well as District Agricultural and Livestock Development Office were interviewed. A total of 5 FGDs were conducted with smallholder farmers (1 FGD in each of village). On average, the number of participants ranged from 6 to 8 members. These FGDs provided information about sunflower cultivation experience, challenges encountered in sunflower cultivation, livelihood status before and after sunflower cultivation, chances of livelihood sustainability, livelihood of their neighbours not involved with sunflower cultivation among others. Qualitative data recorded in the field notes and recorded audio conversations were transcribed, categorised, coded and thereafter grouped into themes with reference to the study objectives. Then data were analysed by using constant comparison technique in terms of comparing incidents applicable to each category and delimiting data to the theory as proposed by Kolb, (2012).

Livelihood outcomes among respondents were measured by developing a Livelihood Outcome Index (LOI). The LOI indicators were customised from the Sustainable Livelihoods Framework basing on the livelihood asset pentagon that includes natural, social, human, physical and financial capitals (assets). The indicators before and after engaged into sunflower production included ownership of household in-house assets, modern house ownership and land ownership. The classification of the scores on the index basing on the computed median ranged from high livelihood outcomes (8.1 to 13), moderate livelihood outcomes (8.0) and low livelihood outcomes (0.0 to 7.9.) Thereafter, Difference in Difference (DID) analysis was conducted compare livelihood outcomes between sunflower (participant) and non-sunflower (non-participant) in sunflower cultivation in order to capture the significance of the differences in livelihood outcomes.

However, in order to control bias in the comparisons the preliminary analysis for balance of characteristics and selection of common support region the algorithm to estimate the propensity scores was run. As a preliminary test it was useful to check the covariates

balance between the two groups as they need to be very similar to allow comparability of the outcome. The balance of characteristics was established stepwise. Step 1 involved identification of the optimal number of blocks. A total of 5 blocks were identified for ensuring that the mean propensity score is not different per blocks.

```
**************************************************
Step 1: Identification of the optimal number of blocks
Use option detail if you want more detailed output
**************************************************

The final number of blocks is 5

This number of blocks ensures that the mean propensity score
is not different for treated and controls in each blocks


**************************************************
Step 2: Test of balancing property of the propensity score
Use option detail if you want more detailed output
**************************************************

The balancing property is satisfied

This table shows the inferior bound, the number of treated
and the number of controls for each block
```

Inferior of block of pscore	0	1	Total
.155777	73	12	85
.2	1	3	4
.6	81	184	265
.8	0	14	14
Total	155	213	368

```
Note: the common support option has been selected

*********************************************
End of the algorithm to estimate the pscore
*********************************************
```

Plate 1: Assumption of estimation of comparison blocks for treatment and control

Step 2 involved a test of balancing property of the propensity score. The balancing property was satisfied and common support option was selected. Restricting the analysis to the region of common support rules out the perfect predictability of treatment status based upon the covariates.

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********************************************************
Step 1: Identification of the optimal number of blocks
Use option detail if you want more detailed output
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The final number of blocks is 5

This number of blocks ensures that the mean propensity score
is not different for treated and controls in each blocks



*********************************************************
Step 2: Test of balancing property of the propensity score
Use option detail if you want more detailed output
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Note: the common support option has been selected


*******************************************
End of the algorithm to estimate the pscore
*******************************************
```

Plate 2: Balance of properties and selection of common support area for comparison

Difference in differences treatment effects have been widely used when the evaluation of a given intervention entails the collection of cross section data. DID integrates the advances of the fixed effects estimators with the causal inference analysis when unobserved events or characteristics confound the interpretations (Angrist and Pischke, 2008). DID estimations offer an alternative reaching the unconfoundedness by controlling for unobserved characteristics and combining it with observed or complementary information (Villa, 2012). Unlike t-test, the difference in difference estimation attributes any differences in trends between the treatment and control groups which occurred at the intervention and to that intervention. The difference in difference estimation and analysis was done basing on the following formula as given by Angrist and Pischke, (2008) and Villa, (2012).

$$DD = [(\bar{Y}_1|D=1)-(\bar{Y}_0|D=1)] - [(\bar{Y}_1|D=0)-(\bar{Y}_0|D=0)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (1)$$

where:

DD   =   difference in difference estimation

Y   =   outcome variable

D   =   differences in outcomes in a given time (0 = Non-participant: 1=Participant)

$$Y = \beta_0 + \beta_1 period_i + \beta_2 treated_i + \beta_3 period_i x\ treated_i + \beta_4 X_{k,i} + e_i \ \dots\dots\dots\dots\dots\dots \ (2)$$

where:

Y   =   observed outcome in groups in a given time

$\beta_0 \dots \beta_k$ =   beta coefficients

e   =   error term

Thereafter, effect size statistics (Eta squared and Cohen's D) were applied to provide an indication of the magnitude of the differences between the compared groups (participant and non-participant). Eta squared ranges from 0 to 1 and represents the proportion of variance (Pallant, 2011). The interpretations of eta squared value were made using the guidelines proposed by Cohen (1988) that 0.01 = small; 0.06 = moderate; 0.14 = large magnitude.

$$\text{Eta Squared} = \frac{t^2}{t^2 + (n1 + n2 - 2)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .... \ (3)$$

4.0 Findings and Discussion

4.1 Socio-economic Characteristics

Respondents were profiled in terms of their socio-economic characteristics in order to qualify the livelihood outcomes and concretise the comparatives. Among the respondents the minimum age was 20 years for sunflower and 21 years for non-sunflower smallholder farmers. The maximum age was 72 years for sunflower and 58 years for non-sunflower smallholder farmers while the average age was 40 and 37 for sunflower and non sunflower smallholder farmers respectively. With an average age of 40 and 37 years among the respondents findings imply that most of household heads were still active to participate into cultivation activities. According to URT, (2007) the youth age ranges from 15-35 years who are the most productive labour power. Thus, household heads in the study area were among the most active labour power in cultivation activities which were very important for generating household income and sustenance of livelihood outcomes.

With regard to household size findings in Table 1 indicate that the average household size for participants' households was 3 persons, minimum of 1 with the maximum of 7 persons while 2 persons (average), 1 person (minimum) and the maximum of 5 persons for non participants' households. Though the average household sizes are below the average household size portrayed in the national census (URT, 2014) with "5.3" for Singida Region while "5.4" for Iramba District, theoretically the sustainable livelihood approach holds that large household size matters when it comes to sources of labour for livelihood activities (human asset/capital). Similarly, Machimu, (2016) and Kayunze, (2000) argued that household size has implication on family labour supply and levels of livelihood outcomes since they work together in most of the household economic activities aiming at generating household income.

Table 1: Household size and Household head age statistics (n=368)

Variable	Respondent	Minimum	Average	Maximum
Head of household Age	Sunflower	20	40	72
	Non-sunflower	21	37	58
Household Size	Sunflower	1	3	7
	Non-sunflower	1	2	5

The study profiled the households in terms of access to financial services particularly savings and access to credit which have an influence on livelihood outcomes as put forward by the assumptions of the sustainable livelihood approach. The approach assumes that access to financial capital (as one among the attributed of livelihood assets pentagon) greatly influences livelihood outcomes. Findings in Table 2 show that respondents' households accessed credit from different sources with an average of TZS 130 967.74 and TZS 96 525.82 for sunflower and non sunflower smallholders respectively. Also, households were able to make cash savings at an average of TZS 336 244.13 for sunflower smallholder farmers and TZS 155 535.48 for non sunflower smallholder farmers. However, households of sunflower smallholder farmers had higher propensity to save (almost twice) compared to their counterparts. This is similar to observations of Torimiro *et al.,* (2013), Gabagambi and George, (2010) that through sunflower cultivation smallholder farmers were able to increase household incomes and access to financial services in terms of savings and access to credit (Girabi and Mwakaje, 2013).

Table 2: Household asset index, total credit and cash savings statistics (n=368)

Variable	Respondent	Minimum	Average	Maximum
Total cash Savings (TZS)	Sunflower	0	336244.13	8900000
	Non-sunflower	0	155535.48	800000
Total credit borrowed (TZS)	Sunflower	0	96525.82	2000000
	Non-sunflower	0	130967.74	1500000
Household Asset Index	Sunflower	2	5.90	10
	Non-sunflower	2	4.05	7

Households of sunflower smallholder farmers scored higher index in household assets unlike their counterparts. Findings in Table 2 indicate that households of sunflower smallholders had a minimum score of 2, average of 5.90 and a maximum of 10 compared to their counterparts' households with achievement scores of 4.05 and 7 for average and maximum respectively. Findings imply that households of sunflower smallholder farmers were better off, but most importantly it provided an indication that they had better livelihood outcomes compared to their counterparts largely as a result of sunflower cultivation.

The impact can also be witnessed on the aspect land ownership as a composite of household assets index whereby participation in sunflower has enabled smallholder farmers to increase land size. Through focus group discussion it was remarked that participating into sunflower cultivation, smallholder farmers were able to acquire more in-house assets (television, bicycle and motorcycle) and land for cultivation in order to enhance their chances of more yield and probably more incomes if the prices are fair during the marketing season... (Kibigiri-March, 2017). Increasing land size was an essential determinant of yields and farm income as observed by Kawamala, (2012) who found out that sunflower cultivation enabled smallholder farmers to acquire more land in order to increase production, productivity and household incomes.

4.2 Livelihood Outcomes among Households of Sunflower Smallholder Farmers

Livelihood outcomes were computed into scores before and after participation into sunflower cultivation in order determine the livelihood output for each household. The livelihood outcome scores before engaged into sunflower cultivation were computed as a baseline. Before participating into sunflower cultivation, findings show that smallholder farmers had low livelihood outcomes. Results in Table 3 indicate that 62.9% of smallholder farmers before participation into sunflower cultivation had lower livelihood outcomes. This implies that lower livelihood outcomes among households were a result of not being able to generate abilities from their productive activities. It was observed during

FGDs and KIIs that mostly the smallholders highly depended on maize cultivation and/or livestock keeping which were not significantly potential for improving livelihood outcomes at that time.

Similarly, the World Bank, (2007) found out that smallholder farmers who remained in poverty are those who stuck more on one crop traditional farming systems while the most successful were the ones who diversified their farming activities by growing food crops for their own consumption and non-traditional cash crops as well as raising livestock. The District Extension Officer during an interview pointed out that "mostly the smallholder farmers over the years depended on growing maize as a main food crop as well as cash crop...they were not able to produce substantially and could not get enough yield as well as incomes for improving their livelihood outcomes due to unfavourable weather conditions since most of the District area is a covered with semi-arid climate...." (Iramba DC Offices-March, 2017).

Thus, the remarks show that overdependence on maize production as food crop and cash crop without diversification of income sources affected the smallholders' household incomes and livelihood. However, to some extent some of the households managed to cope with the vulnerabilities and achieve higher livelihood outcomes as evidenced by the 19.2% in Table 3. A few who achieved higher livelihood outcomes were the smallholder farmers who were engaged into maize production as well as livestock keeping as alternative income source. Thus, they were able to hedge and improved their household livelihoods as a result of improving their household income.

Table 3: Livelihood outcome levels among Smallholder Farmers (n=213)

Livelihood Outcome Levels	Before Sunflower Cultivation		After Sunflower Cultivation	
	Frequency	Percent	Frequency	Percent
Low	134	62.9	63	29.6
Moderate	38	17.8	35	16.4
High	41	19.2	115	54

After participating in sunflower cultivation the livelihood outcomes among the households of smallholder farmers improved significantly. Findings in Table 3 show that the levels of livelihood outcomes among smallholder farmers improved whereby 29.6% had low level while 16.4% and 54% had moderate and high levels of livelihood outcomes respectively. The levels show that households were endowed differently depending on how they were bestowed with access and utilisation of the livelihood assets as put forward by the Sustainable Livelihood Approach (DFID, 2001).

Hence, generally the smallholder farmers after participation into sunflower cultivation as a main cash crop their households' livelihood outcomes improved as accounted by 54% with higher livelihood outcome level compared to 19.2% who had higher livelihood outcome level before sunflower cultivation. This was also highlighted by smallholder farmers during focus group discussion whereby it was noted that: *"households' livelihood outcomes among sunflower smallholder farmers have changed drastically compared to 5 years ago which is evidenced by the presence of well built and roofed houses, increase in household assets as well as small business ventures across the village"* (Nselembwe-March, 2017).

However, despite the fact that majority of the respondents have higher livelihood outcomes, there were few respondents with low livelihood outcomes accounted by 29.6% (Table 3). During focus group discussion it was revealed that these households were constrained by land size and shortage of funds to purchase pesticides for treating the sunflower plants. Hence, they were not able to produce enough sunflower quantities that would have yielded adequate household income for improved livelihoods. Thus, with sunflower cultivation as their major economic activity they were not able to achieve higher livelihood outcome status.

A comparison of livelihood outcomes before and after sunflower cultivation shows that there is a significant difference in the scores before and after sunflower cultivation. This

implies that, through participating into sunflower related activities smallholder farmers were able to gain more abilities in terms of possessing more household assets as well as increased their household incomes unlike before. Thus, the null hypothesis was rejected since the livelihood outcomes before and after sunflower cultivation differs significantly. This was also observed by Mameho *et al.*, (2014) who found out that participation into sunflower cultivation improves the livelihoods of smallholder farmers in terms of increased household income and assets. The differences were also highlighted by one of the VEOs during KII that:

> *"participation into sunflower cultivation has enabled me to get enough household income to meet household requirements such as paying medical bills, paying tuition fees conveniently unlike before when it was a bit complicated. Also, I was able to acquire more land and purchase two ox ploughs. Thus, it has enabled my household to have steadfast livelihood"* (Ulemo-March, 2017).

4.3 Livelihood Outcomes between Sunflower and Non-Sunflower Smallholders' Households

Livelihood outcomes were computed and categorised into levels of high, moderate and low between households of sunflower (participant) and non-sunflower smallholder farmers (non-participant) in order to determine whether there is a significant difference as it was hypothesised. Findings indicate that most of sunflower smallholders' households had higher level of livelihood outcome compared to non-sunflower smallholders' households. Results in Table 4 indicate that households of sunflower smallholder farmers (54%) had high livelihood outcomes compared to their counterparts' households whereby the majority (67%) had lower livelihood outcomes.

Findings imply that households of non-participants into sunflower cultivation had lower livelihood outcomes probably as a result of generating lower abilities from socio-economic activities which were not as productive as sunflower cultivation. It was observed during FGD that mostly these households highly depended on maize cultivation and/or livestock

keeping which were not significantly potential for improving households' income due to the drought (semi arid) conditions covering major part of the district. However, the observed disparities in households' levels of livelihood outcomes is evident that households were endowed differently depending on how they were bestowed with access and utilisation of the livelihood assets as put forward by the sustainable livelihood approach (DFID, 2001).

Table 4: Livelihood outcomes levels between smallholders (n=368)

Livelihood Outcome Levels	Non-Sunflower SHF (n=155)		Sunflower SHF (n=213)	
	Frequency	Percent	Frequency	Percent
Low	104	67	63	29.6
Moderate	23	14.8	35	16.4
High	28	18.1	115	54

Therefore, the households of smallholder farmers involved with sunflower cultivation as a main cash crop their livelihood outcomes improved. This was observed during FGD that:
"livelihood outcomes among sunflower smallholders' households have changed drastically compared to 5 years ago which is evidenced by the presence well built and roofed houses as well as small business ventures across the Mwanza Road" (Nselembwe-March, 2017). Same was observed by Faty *et al.*, (2013) who noted that there has been a significant change in household livelihoods in the district as a result of sunflower cultivation such as the presence of modern houses built with burnt bricks and roofed with corrugated iron sheets unlike 5 years before many farmers used to live in poorly constructed and roofed houses.

The study went further to test the hypothesis that "livelihood outcomes among participants and non-participants smallholder farmers in sunflower cultivation do not differ". Difference in difference estimation was conducted to establish whether the livelihood outcomes were significantly different. Results in Plate 3 show that there was a significant difference between the livelihood outcome scores between participant and non-participant.

Statistics show that the differences in livelihood outcomes are significant (p = 0.000) with a positive coefficient (0.087). As a result, the null hypothesis was rejected.

Talking on the differences in livelihood outcomes between households, a key informant (VEO) from Nguvumali village said

> *"sunflower smallholder farmers have better livelihoods compared to their counterparts, unlike others they have built modern houses in the village, bought improved farming equipments which increases their productivity but also they have invested into bodaboda (motorcycles) business which enables them to have alternative sources of income"* (Nguvumali-March, 2017).

Thus, this signifies that sunflower cultivation has an influence on livelihood outcomes on households of participant smallholder farmers.

```
. regress r TotalScores

      Source |       SS           df       MS            Number of obs =     368
-------------+----------------------------            F(  1,    366) =  156.56
       Model | 26.8783437        1  26.8783437         Prob > F      =  0.0000
    Residual | 62.8363302      366  .171683962         R-squared     =  0.2996
-------------+----------------------------            Adj R-squared =  0.2977
       Total | 89.7146739      367  .244454152         Root MSE      =  .41435


           r |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 TotalScores |   .0871881   .0069682    12.51   0.000     .0734854    .1008909
       _cons |  -.4079851     .08177    -4.99   0.000    -.568783   -.2471871
```

Plate 3: Difference in difference estimation on livelihood outcome scores

Basing on the t statistic (12.51), eta squared analysis yielded a statistic of 0.299 which indicated a large effect size (magnitude) which implies that there is a considerable difference in the livelihood outcomes status between households of sunflower smallholder

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farmers (participant) and their counterparts (non-participants). Thus, participation into sunflower cultivation had a considerable influence on livelihood outcomes among households since it is the most paying cash crop as noted by Zilihona *et al.*, (2013) as well as Iramba District Profile, (2016). The crop is dominant and accounts for 72.8 % of total revenue in the District. Thus, its influence on smallholder farmers' livelihood outcomes is impressive.

5.0 Conclusion and Recommendations

There are significant changes in livelihood outcomes in terms of household in-house assets ownership, construction of better houses, increased land ownership and use of improved agricultural tool/equipments before and after sunflower cultivation. Also, there were significant differences between participants and non-participants smallholder farmers into sunflower cultivation. Therefore, sunflower cultivation has an influence on the changes in livelihood outcomes among households of smallholder farmers.

Since findings show that some of the smallholder farmers had low level of livelihood outcome it is recommended to smallholder farmers that they should consider building their livelihood capabilities through collective efforts as they are constrained by land size for cultivation. Thus, they should think about upgrading the production activities through processing sunflower at local level instead of selling few quantities raw sunflower seeds individually. This can be done through forming farmers groups whereby they can join efforts to access microfinance loans and acquire small scale processing/ milling machines. This would enable them to increase household incomes by selling sunflower oil as well as seed cakes.

Given that sunflower cultivation stands better chances for livelihood improvement due to being the most paying cash crop, it is recommended to the non-participant that they should consider adopting sunflower as an alternative crop instead of sticking to their traditional

one crop (maize). This would enable them to diversify means of household income and generate more household income to cater for their subsistence needs eloquently.

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