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Impact of Sunflower Production on Livelihood Outcomes among Smallholder Farmers Households in Iramba District

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ABSTRACT

Sunflower is among the cash crops with potentials for improving smallholder farmers' livelihood. However, its impact on livelihood outcomes among smallholder farmers is hardly ascertained. The study specifically aimed to examine the contribution of sunflower cultivation on livelihood outcomes of smallholder farmers' households basing on propensity scores matching. Cross-sectional research design was adopted whereby household survey, focus group discussion and key informant interviews were used to collect data. The study had a sample size of 368 respondents including sunflower and non-sunflower smallholder farmers. Qualitative data were transcribed, categorised, coded, thereafter grouped into themes and analysed using constant comparison technique. Quantitative data were analysed by using propensity score matching. Through propensity score matching, average treatment of the treated, difference in difference analysis, nearest neighbour matching and radius calliper matching techniques were used to establish the contribution. Findings indicate that participation into sunflower cultivation had an impact on livelihood outcomes as observed by the significant differences in livelihood outcomes (MD = 2.31; t = 5.94 from nearest neighbour matching and MD = 2.52; t = 9.69 from radius calliper matching). Therefore, the study concluded that sunflower cultivation had a significant impact on the livelihood outcomes among households of sunflower smallholder farmers. Thus, the null hypothesis was subsequently rejected. The study recommends to smallholder farmers that they should up-scale their production systems and techniques. This can be done through creating awareness and sensitisation on improved cultivation techniques that would guarantee more yields and household incomes for sustenance of the achieved livelihood outcomes.

Keywords: livelihood outcomes, sunflower, smallholder farmers, participation

INTRODUCTION

Agriculture is the backbone of the Tanzania's economy which accounts for 15% of national exports, and it has contributed 27.8% of Gross Domestic Product (GDP) 29.0% in 2015 and 29.1% in 2016 (Deloitte, 2017). The sector provides livelihood to more than three quarters of the population mostly smallholder farmers (TFCG, 2014). World Development Report (2008) observed that GDP growth originating in agriculture is about four times more effective in reducing poverty than GDP growth of other sectors (World Bank, 2008). The pathway in agriculture towards poverty reduction can be in terms of exchange (market) based livelihood or in terms of labour-based livelihood (Acharya, 2006). Bresciani and Valdes (2007) framed the pathway in terms of three key channels of labour market; farm income; and food prices.

Throughout Tanzania, agriculture sector is mostly dominated by smallholder farmers who occupy the majority of land and produce most of the crop and livestock products (Lyatuu *et al.,* 2015). Smallholder agriculture continues to play a key role in most of East African economies whereby it accounts for about 75% of agricultural production and over 75% of employment (Salami *et al.,* 2010). However, despite the number of sound agricultural policies (URT 1983; URT, 1997; URT, 2008), the key long-standing challenge of the smallholder farmers is low productivity (Cervantes-Godoy and Dewbre, 2010) stemming from the lack of access to markets and technology. Hence, the sector's growth remains insufficient to adequately address poverty, attain food security, and lead to sustained GDP growth (Dessy *et al.,* 2006; World Bank, 2008).

In Tanzania sunflower is cultivated by around 250 000 households of smallholder farmers owning an average of 0.4 to 2 hectares (1-5 acres) using hand-hoe with a few medium and large scale farmers cultivating over 405 hectares (TEOSA, 2012). It is estimated that more than 80% of these smallholder farmers are located in Eastern and Central Corridor (Manyara, Singida, Dodoma and Morogoro) and Southern Highland Regions (Iringa and Mbeya). The crop has high priority because of the growing demand for edible oil and oilseeds as well as its income potential to the livelihoods of poor smallholder farmers (Beerlandt *et al.,* 2013).

Sunflower economic values portend its great potential for enhancing agricultural productivity and poverty alleviation among smallholder farmers (Torimiro *et al.,* 2014). However, imperfections along the value chain continue to widen the disparity of benefits leaving smallholder farmers with least value (IFPRI, 2008). Thus, despite the promising potentials of sunflower which foretells great prospective for poverty alleviation, optimum benefits of sunflower towards improving smallholder farmers livelihoods have not been adequately harnessed (Torimiro *et al.,* 2014). The existing studies on sunflower production (Beerlandt *et al.,* 2013; TEOSA, 2012; Gabagambi and George, 2010; IFPRI, 2008) are exhaustive of sunflower initiatives in terms gross margins, crop utilisation, value chain analysis, food security though without concretising the impact of sunflower on the livelihood outcomes. Thus, literature points to limited information on the concretised empirical evidence on the impact of sunflower production on the livelihood outcomes among smallholder farmers.

Conceptually, livelihood refers to individuals, 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). Livelihood comprises of assets (natural, physical, human, financial and social), activities and access to assets mediated by institutions and social relations (Ellis and Freeman, 2004) which together determine the living gained by the individual or household, thus influencing livelihood outcomes of the respective household. Livelihood outcomes include increased income, improved well-being, reduced vulnerability to economic shocks, improved food security and more sustainable use of natural resources (Mensah, 2012). In the context of this study, livelihood outcomes were qualified to include household assets ownership (house, agricultural equipments/tools, land) and total cash savings. Thus, this study analysed the impact of sunflower cultivation on livelihood outcomes of smallholder farmers in Iramba District, Tanzania. The study hypothesised that participation into sunflower cultivation is not related to household livelihood outcomes.

THEORETICAL UNDERPINNINGS

The study was guided by Theory of Participative Behaviour (McClusky, 1963; McClusky, 1970) and Sustainable Livelihood Approach (SLA) (DFID, 2001). The theories were used jointly as they supplement each other in the study towards addressing the key aspects of participation and livelihood outcomes. The theory of participative behaviour (theory of margin) was

developed by McClusky (1963) basically for understanding adults' behavior towards participating into different socio-economic activities especially when various households' demands or pressures increase. The theory is built on the assumption that being an adult means facing continuous growth and change in which constant effort must be made to participate into different socio-economic activities for meeting normal living responsibilities (McClusky, 1963). Therefore, participatory behaviour is a function of the power a person can command over and above that required for maintaining a minimum level of living. A necessary condition for participation then is access to and/or the activation of a margin of energy that may be available for the process of participation (McClusky, 1970). In this study the theory provided the theoretical reflections towards understanding the underlying participatory behaviour among the smallholder farmers' households into sunflower related production activities aiming at improving their livelihoods.

The SLA enhances understanding of the livelihoods of poor households and unlike other approaches; it is a multidimensional, integrated and rational approach to poverty eradication (Kamarrudin and Samsudin, 2014). The approach provides the key component for analysing 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 of present generations as well as future generations (Chambers and Conway, 1991). Therefore, 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 and ownership of household assets as qualified by DFID (2001). Thus, the study focused on understanding how participation into sunflower production has influenced the livelihood outcomes of smallholder farmers' households.

METHODOLOGY

The study adopted cross-sectional research design. Cross sectional design is commended since it allows use of different methodological approaches of data collection and analysis which bring together methods from different paradigms (Kabelele, 2014). Thus, the approach provided a better opportunity to address the key important variables in the study in such a way that findings were reliable and inferences were made from them as recommended by Bryman (2008) and Tashakkori and Teddlie (2003). The study was conducted in Iramba District whereby 5 villages namely Ulemo, Kitukutu, Nguvumali, Kibigiri and Nselembwe were randomly selected. 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 production on livelihood outcomes.

The sample size including participants and non-participants into sunflower production was 368 respondents. Systematic sampling technique was used to obtain respondents whereby the lists for selection was obtained from the village households register obtained from the Village Executive Officer (VEO). The sampling interval was determined and thereafter randomness was applied to find the first observation unit whereby serial numbers were written 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 whereby a total of 368 copies of the questionnaire were administered to households' heads.

Also, Focus Group Discussion (FGD) and Key Informant Interview (KII) were used for collecting qualitative data. KIIs were conducted with 7 key informants selected basing on their knowledge on sunflower production and households livelihood. The key informants included purposely selected technical and administrative staff at village, Wards and District levels. One focus group discussion was conducted with smallholder farmers in each of village. On average, the number of participants ranged from 6 to 8 members including youth and elders (men and women). These FGDs provided information about sunflower production experience, livelihood status before and after sunflower production and livelihood status of their neighbours not involved with sunflower production.

The analysis of qualitative data was done stage wise whereby data were recorded, transcribed, categorised, coded and grouped into themes relating to livelihood outcomes and the contribution of sunflower production. Constant comparison technique in terms of comparing incidents applicable to each category and delimiting data themes of interest was applied for analysis.

Livelihood outcomes among households were measured by developing a Livelihood Outcome Index (LOI). The livelihood outcomes were captured by using indicators such as total cash savings made and household assets index (house ownership, in-house assets and land ownership). The indicators reflect the asset pentagon in the sustainable livelihood framework (natural, social, human, physical and financial) and livelihood outcome indicators in the SLA (DFID, 2001).

Propensity Score Matching (PSM) technique was used to establish the contribution of sunflower production on livelihood outcomes among smallholder farmers' households. PSM makes use of the available sensitivity tests to examine the presence of hidden bias (Nichols 2007) and it has been argued that matching may allow for better causal inference than regression models, as comparisons are only made between households with similar observed characteristics (Gerring 2007). Hence, the matched households were also more likely to resemble each other on unobserved variables. The underlying concepts of PSM are that two groups are identified namely treated group (participant) and control group (non-participant) (Ravallion, 2003). For the purpose of this analysis households of sunflower smallholder farmers were coded as treated (participant) while their counterparts were coded as control (non-participant).

PSM reduces dimensionality problem (dimensions of covariates) to a scalar (propensity score) and can balance the observables between compared groups (Becker and Ichino, 2002). Thus, it scales the contribution of the selected covariate against other covariates when establishing the impact on a pre-determined outcome basing on the propensity scores. Then based on propensity scores, the Average Treatment on the Treated (ATT) was established to capture the average effect of treatment on the treated basing on Difference in Difference analysis. In order to concretise the impact, Nearest Neighbour Matching (NNM) and Radius (calliper) Matching (RM) techniques were performed.

FINDINGS AND DISCUSSION

Areas of common support and balance of characteristics between treated and control groups households

In order to have quality matching of propensity scores it is important that $0< p(X) < 1$ so as to ensure common support whereby there are treated and control for each characteristic in the outcome variable X on which the comparison is made (Mpeta *et al.,* 2018). This restriction ensures comparisons are made only to observations whose propensity scores belongs to the

intersection of support of the propensity score for treated and control (Becker and Ichino, 2002). Thus, if *p(X) = 1* such household was dropped and the ATT was estimated only for households where *p(X) < 1.*

Therefore, the algorithm to estimate the propensity scores was run as a preliminary test for checking the covariates balance between the two groups as they need to be very similar to allow comparability of the outcome so that *P(D = 0|X) = 1- P(D = 1|X)*. The estimated propensity scores in region of common support are shown in Table 1 and a total of 5 blocks as optimal number of blocks were identified for ensuring that the mean propensity scores are not different per blocks for treated and control groups. The analysis produced the propensity scores and findings (Table 1) show that the average probability in the treatment for households was 62.9% depicting the probability that a particular household would be affected with the initiative (sunflower production) with respect to the outcome variable (household livelihood outcomes).

Table 1: Assumption on estimation of propensity scores on Livelihood Outcomes

Estimated Propensity Score				
	Percentile	**Smallest**		
1%	0.061	0.045		
5%	0.061	0.045	Observations	368
10%	0.202	0.060	Sum of weights	368
25%	0.426	0.061	Mean	0.629
50%	0.746		Standard deviation	0.306
		Largest		
75%	0.921	0.998	Variance	0.936
90%	0.993	0.998	Skewness	-0.343
95%	0.994	0.998	Kurtosis	1.774
99%	0.998	0.999		

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. Results in Table 2 show the number of households in the areas of common support selected basing on the balancing on characteristics *P(D = 0|X) = 1-P(D = 1|X)*. Thus, there was a considerable overlap of propensity scores between the treated and control households, which implies that the match was good and balanced. A larger proportion of overlap implies a good match of treated and control cases (Dehejia and Wahba, 2002). Thus, in each class of the propensity score there was a certain number of treated and untreated households.

Table 2: Test of balancing property and common support option

Inferior of block of propensity score	**Households per Common Support Block**		**Total**
	Control (n=155)	**Treated (n=213)**	
0.155	73	12	85
0.2	1	3	4
0.6	81	184	265
0.8	0	14	14

The minimum, mean and maximum propensities have been depicted in Table 3. The pooled statistics shows that the maximum propensity was 9.690 while the minimum and mean score

were 0.597 and 5.033 respectively. However, the individual group propensities shows that the control group had minimum, mean and maximum propensities of 0.597, 3.827 and 7.265 accordingly while the treated group had 1.203, 5.910 and 9.690 for minimum, mean and maximum category. Thus, the treated group had higher propensities on the outcome variable (livelihood outcomes) compared to their counterpart with a mean difference of 2.083.

Table 3: Descriptive statistics on the estimated propensity scores

Category (p_score)	Pooled (n=368)	Control (n=155)	Treated (n=213)
Mean	5.033	3.827	5.910
Std. Deviation	1.881	1.725	1.459
Minimum	0.597	0.597	1.203
Maximum	9.690	7.265	9.690

Impact of sunflower production on smallholder farmers households' livelihood outcomes

The difference in difference analysis was performed basing on the Average Treatment on the Treated (ATT) computations. Findings show that there is a significant contribution of sunflower cultivation on the livelihood outcomes of smallholder farmers. Results presented in Table 4 indicate that there are considerable differences between the treated and control depicted by the average effect of treatment on the treated depicted by the mean differences (MD = 1.525; t = 10.03) for household assets index and MD = 220845.07; t = 2.59 for total cash savings. Findings imply that that treated (sunflower smallholder farmers) were better off in terms of livelihood outcomes (particularly the household assets owned due to a higher t-test score) compared to their counterpart. The differences in ATT scores mean that through participation into sunflower cultivation the smallholder farmers were able to improve their livelihood outcomes unlike before. This is similar to observations of Girabi (2013) and Torimiro *et al.* (2013) that through sunflower cultivation smallholder farmers were able to increase household assets, increase household incomes and access to financial services. Generally, the findings support the assumptions of the SLA (DFID, 2001) that effective utilisation of the livelihood assets would gradually result into improved livelihood outcomes among household in terms of household assets, reduced shocks and improved use of natural resources.

Table 4: ATT on the impact of sunflower on livelihood outcomes

Indicator	Sample	Treated	Controls	Difference	S.E.	T stat.
Total Savings	Unmatched	336244.131	155535.484	180708.648	71678.177	02.52
	ATT	336244.131	115399.061	220845.07	85228.162	02.59
Household Asset Index	Unmatched	5.906	4.058	1.848	0.135	13.60
	ATT	5.906	4.380	1.525	0.152	10.03

Thereafter, the Nearest Neighbour Matching (NNM) was performed whereby each treated unit was matched to control unit with the nearest propensity score. Once each treated unit is matched with control unit, the differences were obtained to qualify the contribution by averaging the differences. Preliminary analysis using a probit model indicated that the model was statistically significant at p = 0.00 and produced a Chi-square of 209.26. Also, the model

had a Pseudo R^2 of 0.417 meaning that the variables entered in the model explained only 41.7% of the variance. Thus, the remaining percentage was accounted by other covariates not accounted for in the study.

The NNM has shown that there is a significant impact of sunflower cultivation on the livelihood outcomes among households of smallholder farmers. Results in Table 5 show that there is a significant difference (MD = 2.31; t = 5.94) in the overall propensity scores of the livelihood outcomes between treated (M = 12.61) and control (M = 10.30). The contribution has been captured on the indicators of total cash savings as well as household assets using an index. On the aspect of total cash savings findings imply that through sunflower cultivation smallholder farmers were able to increase the amount of household cash savings. This was supported by a comment of the DALDO who said that: *"...sunflower famers on average get more incomes unlike their counterparts because the crop is the most paying and has high demand due to increased requirements for edible oil in the country...as a result smallholder farmers accumulate more household incomes which increases their propensity to make savings in VICOBA and a few in SACCOS to cover for future household transactions..."* (Iramba District Council Offices, Kiomboi-March, 2017).

Also, a review of the District Profile (URT, 2016) shows that sunflower crop is the most dominant paying cash crop in the District, hence, households that were involved with sunflower production stood better chances of accumulating more household income and cater considerably for their subsistence household needs.

Table 5: PSM results on impact of sunflower production on livelihood outcomes

Matching Method	Sample	Treated	Controls	Difference	S.E	T-stat
Nearest Neighbour Matching	Unmatched	12.76	9.32	3.43	0.27	12.51
	ATT	12.61	10.30	2.31	0.38	5.94
Calliper Matching (radius 0.005)	Unmatched	12.76	9.32	3.43	0.27	12.51
	ATT	12.64	10.11	2.52	0.26	9.69

psmatch2 common support (n=368): off support (untreated 0; treated 18), on support (untreated 155; treated 195)

Since the NNM might have assumed high difference in propensity scores for a participant and its closest nonparticipant neighbour, calliper matching was run as a supplementary matching method to analyse the impact. A maximum propensity score radius (a 'caliper') was established, and all non participants within the given radius were matched to participants. A caliper matching algorithm with a caliper distance of 0.005 was assumed with Logit Model specification. Also, no replacement option was specified so that controls were only used once in the matching. The common support option was specified so that it left out cases that lie outside the range of propensity scores of the controls.

Through calliper matching findings also indicated that there was a significant impact of sunflower cultivation on household livelihood outcomes signified by a significant mean difference propensity score (MD = 2.52; t = 9.69). Findings in Table 2 show that the participants (treated) had mean propensity of 12.64 while 10.11 for non participants (control). Thus, within the same proximity the participants achieved higher livelihood outcomes as a result of sunflower production unlike their counterparts. Basing on the indicators of livelihood outcomes the participants were better off in terms of ownership of household in-house assets

(agricultural equipments, bicycle, motorcycle, sofa set), improved housing condition and land for cultivation. This kind of contribution was also observed by Faty *et al.*, (2013) who noted that there has been a significant change in housing conditions over the past 5 years as a result of sunflower. As such, a VEO as a key informant reported that: *"...sunflower smallholder farmers have built modern houses in the village with burnt bricks and roofed with corrugated iron sheets compared to 6 years ago where most of the houses had mud walls and roofed with grass..."* (Ulemo Village - March, 2017).

The contribution was also witnessed on the aspect land ownership as a composite of household asset index whereby participation in sunflower cultivation has enabled smallholder farmers to increase land size. This was evident in a FGD where the members supported the comment made one member that sunflower cultivation has enabled smallholder farmers to acquire more land for cultivation in order to enhance their chances of more yield and probably more incomes if the prices are fair during the selling season (Kibigiri Village-March, 2017). Thus, increasing land size is an essential determinant of yields and farm income as observed by Kawamala (2012) who found out that sunflower cultivation enabled smallholder farmers to earn more household incomes and acquire more cultivation land in order to increase production.

CONCLUSION AND RECOMMENDATIONS

Participation into sunflower production has a significant contribution on the livelihood outcomes among smallholder farmers in terms of household assets and increase in total cash savings. Thus, the null hypothesis that; participation into sunflower production activities is not related to smallholder farmers' livelihood outcomes was rejected as the achieved livelihood outcomes were attributed to participation in sunflower production. As highlighted by the sustainable livelihood framework, it is evident that participation into livelihood activities through utilising the livelihood assets gradually result into better livelihood outcomes among households in terms of household assets, household income and reduced shocks. Therefore, the study concluded that sunflower production has a significant impact on the livelihood outcomes among smallholder farmers. Since sunflower production stands a better chance of improving smallholder farmers' livelihoods the study recommends to smallholder farmers that they should up-scale their production systems and techniques. This can be done through creating awareness and sensitisation on improved cultivation techniques that would guarantee more yields and household incomes for sustenance of the achieved livelihood outcomes.

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