Impacts of Villagization Program on Households' Food Security status and Local Coping Strategies in Benishangul-Gumuz Region, Western Ethiopia

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Abstract

Villagization program was amid to amalgamate the scattered settlement patterns of pastoral and semi-pastoral communities into a contiguous form of villages. The program was meant to enable the government to supply socio-economic infrastructure and improve agricultural technologies in a more convenient manner. Villagization is therefore meant to help the communities alleviate rural poverty and improve food security. The main goal of this study is to analyze the impact of the villagization program on households' food security situation in the Benishangul-Gumuz Regional State and assess their local coping strategies. The study employed a mixed research design that incorporated both quantitative and qualitative data sources. Both probability and non-probability sampling techniques were used to determine sample households. Accordingly, 109 and 112 respondents were randomly selected from villagized and non-villagized households, respectively. Descriptive statistics, a logistic model, and Propensity Score Matching (PSM) techniques were used to analyze the data. The results revealed that compared to households incorporated into villagization program, non-villagized households were found to be better in terms of food consumption and calorie intake. The propensity score matching results indicated that non-villagized households' food consumption scores were 3.56 times higher than villagized households. Besides, non-villagized households showed 573.9 times higher kcal/day as compared to the villagized households. Moreover, villagized households took more severe food coping responses compared with non-villagized households due to food shortages. To tackle the food insecurity issue of villagized households, the regional government and other concerned bodies should fulfill basic infrastructure and provide agricultural inputs. In addition, in the future, villagization program should be carried out through the active participation of beneficiaries.

***Keywords**: Villagization, propensity score matching (PSM), food security, local coping strategies*

1. Introduction

Villagization is one aspect of a resettlement program usually implemented to provide the rural population with a more applicable and manageable modern means of improving their current livelihoods (Buzuayew et al., 2016). It is also the term used to describe the process of transferring rural residents who live in dispersed settlements to large, government-designed villages, either voluntarily or forcibly (Gomersall, 2018; Stevenson & Buffavand, 2018). Villagization programs were regarded as popular strategies by national and local governments in developing countries for promoting local and national development (Gebresenbet, 2021; Rogers & Wilmsen, 2020). The majority of nations use villagization program to encourage: 1) infrastructure development, such as building roads or dams (Asiama et al., 2017; Tilt & Gerkey, 2016), 2) extensive natural resource extraction (Owen et al., 2018; Yang et al., 2017) and 3) preservation of the environment and ecological restoration (Karanth et al., 2018). Additionally, dangers brought on by climate change (i.e., droughts, floods, storms, famine) might lead to widespread villagization (Messay & Bekure, 2011).

Many African countries, including Tanzania, Mozambique, Rwanda, Zimbabwe, Cameroon, and more, have developed and put into practice villagization schemes. None of them, however, were able to modernize their respective populations as intended (Havugimana, 2009; Leeuwen, 2001). In Ethiopian history, villagization program was envisioned as a remedy almost a panacea for rural populations' poverty and suffering (Dessalegn, 2003; Ferede & Wolde-Tsadik, 2018). The program as a method of transforming the rural community started mainly in the 1980s, during the Derg regime, however, the anticipated outcome was not realized (Dessalegn, 2003; Yantiso, 2009). Similar to the previous regimes, the present government (Ethiopian People's Revolutionary Democratic Front) has also implemented a huge villagization program in several regions of the nation since 2003 primarily to address issues with food insecurity and poverty in rural areas (Daie, 2012; Messay & Bekure, 2011).

The federal government of Ethiopia has developed a villagization program specifically for pastoral and semi-pastoral

communities in order to gather 1.5 million people in preset areas. As a result, it was planned for some 500,000 people in the Somali, 500,000 in the Afar, 225,000 in the Benishangul-Gumuz, and 225,000 in the Gambella regions to be gathered in planned villages (New Coalition for Food Security in Ethiopia (NCFSE), 2003). The program's objectives were to provide fundamental socioeconomic infrastructure and guarantee food security (Buzuayew et al., 2016). The program was formally launched since 2010 in almost all districts of Benishangul-Gumuz region. Accordingly, the regional government has gathered 45,817 households (almost 229,085 people) into 239 nucleated villages between 2011 and 2018 (Benishangul-Gumuz Regional State (Benishangul-Gumuz Regional State (BGRS), 2018).

Despite the government's claims that the current villagization program will enhance socioeconomic growth, modernization, and food security, the empirical studies have demonstrated that the results are in doubt. For instance, Amare (2016) and Tesfaye (2020) revealed that the relocated communities to new villages as a result of villagization program have improved their food security situation. To the contrary, villagization schemes resulted in multifaceted impacts on the socioeconomic condition of the resettled communities as well as on environmental resources of the host population. These include violations of human rights; land grabbing (Human Rights Watch (HRW), 2012; Mittal, 2015); rampant food insecurity (Vanclay, 2017; Wilmsen et al., 2019); and rapid forest depletion (Abera et al., 2020; Gebre & Andualem, 2018; Getahun et al., 2017).

Whatever the situation may be, there hasn't been much study on how the villagization program has affected the level of food security in rural households in the Benishangul-Gumuz region. For instance, Daie and Labiso (2021) have made an effort to evaluate the effect of villagization program on rural household food security. However, this investigation did not employ enriched methodology, making it challenging to pinpoint the program's impact on food security. In order to close this gap and give strong empirical bases, propensity score matching (PSM) technique was used to analyze the impact of the program. Another limitation of previous research was its inability to explore the local coping mechanisms employed by households in the study area to mitigate food insecurity, a topic this study has addressed. This study also attempts to provide information for

policy and decision-makers in order to improve food security situations in the areas under study. Therefore, the goal of this study is to analyze the impact of villagization program on households' levels of food security and identify their local coping strategies in the selected districts of Benishangul-Gumuz region.

2. Materials and Methods

2.1. Study area

The study was conducted in the Benishangul-Gumuz National Regional State particularly in the Bambasi and Assosa districts. Bambasi district is located in the region's south, between 09º47 North latitude and 34º47 East longitude, while Assosa district is located between 10°04′ N and 34°31′ E. Administratively, Bambasi district is divided into 40 rural and 2 urban kebeles and it shares borders with the Oromia regional state and Mao-Komo special district in the south and southwest, and, Assosa district in the west and Oda-Buldigilu district in the northeast (Mulunesh & Menfese, 2021). Assosa district has 82 kebeles and is bordered by Kurmuk and Homesha in the north, Menge in the northeast, Oda-Buldigilu in the east, Bambasi in the southeast, Mao-Komo special district in the south, and Sudan in the west (Terekegn et al., 2020). Though no current population census has been conducted in the country, the population projection for 2018 was 91,455 (49% female) and 151,075 (49.14% female) in Bambasi and Assosa districts, respectively (Central Statistical Agency, 2013). A mixed farming system, involving both crop production and livestock rearing activities, is the dominant type of livelihood for the people in both districts (Benishangul-Gmumuz Regional State Bureau of Agriulture (BGRBoA), 2022). The practice of villagization program in Assosa and Bambasi districts is mostly focused on establishing basic infrastructure facilities, improving the livelihood and ensuring food security of rural households. Accordingly, 5569 households in Assosa and 6284 households in Bambasi district were relocated from their original settlement to new sites within their respective districts (Benishangul-Gumuz Disaster Risk Management Commission (BGDRMC), 2019).

2.2. Research design and sampling techniques

A mixed method research design was employed in this study. Both probability and non-probability sampling techniques were used to collect primary data from different

sources. Accordingly, the Assosa and Bambasi districts were purposely selected due to the existence of a relatively high number of villagized households as well as a large population and vast area coverage. This was followed by the selection of eight villages (four villagized and four non-villagized) using simple random sampling. Finally, a systematic random sampling technique was employed to obtain villagization program participant and non-participant households from the available lists of each sample kebele. To determine the number of sample respondents for this study, a formula developed by Kothari (2004) and practically tested and used by different scholars was used. Therefore, when the population is finite, its mathematical notation is given by:

$$n = \frac{Z^2 \times p \times q \times N}{e^2(N-1) + Z^2 \times p \times q} \qquad (1)$$

Where: n= sample size, Z=1.96 (confidence interval of 95%), N=population size, P=the population proportion (assumed to be 0.5),

$q = 1 - p = 0.5$, e= 5% error. Overall, there are 263 non-villagized and 256 villagized households, with a sample size of 112 and 109 households, respectively.

The sample size of non-villagized households ; $n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 263}{(0.05)^2(263-1)+(1.96)^2 \times 0.5 \times 0.5} =$ 112 and the sample size of villagized households ; $n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 256}{(0.05)^2(256-1)+(1.96)^2 \times 0.5 \times 0.5} =$ 109. Totally, 221 samples were drawn.

2.3. Data sources and collection methods

The necessary quantitative and qualitative data were gathered from a variety of sources. Quantitative data was collected using a survey questionnaire. The questionnaire was pre-tested and the necessary adjustments were made based on the feedback obtained from pre-test participants. A total of four enumerators who are familiar with the culture and the local language were trained and participated in collecting data from sample households. The qualitative data was generated through focus group discussions (FGDs) and an observation checklist. Eight FGDs with 7–12 participants in each group was held. The FGD participants were selected with great care to include men and women households who have good knowledge on issues related to villagization schemes, food security situations and coping mechanisms of the area. Besides, the secondary data was collected from relevant regional and local authority reports, books, and journals.

2.4. Methods of data analysis

The quantitative data were analyzed using descriptive statistics and econometric models (binary logistic regression and

Propensity Score Matching (PSM)). Descriptive statistics such as frequencies, percentages and mean were used to present the summary socio-demographic characteristics and food security indicators of respondents. In order to describe the variables that affected households' participation in the villagization program and to estimate propensity scores, the Logit model is utilized. Finally, the impact of the villagization program on the food security status of rural households in the study area is examined using the Propensity Score Matching (PSM) technique.

2.4.1. Food security measurements

Though it is difficult to find a single measure that is comparable across time and space while also capturing all food security dimensions(Sahu et al., 2017; Upton et al., 2016), most researchers and policymakers used nutrition-based food security measures (food consumption score, household dietary diversity score, coping strategies index, and household food balance model) (Broussard & Tandon, 2016). It is commonly acknowledged that a variety of indicators and techniques are required for the assessment of food security status in this study due to its multidimensional nature and the lack of a "gold standard" to quantify food security. Thus, outcome indicators like the food consumption score (FCS), which measures the utilization dimension, and the household food balance model (HFBM), which captures the availability dimension, were included to assess the food security status of both villagized and non-villagized households. The copying strategies index (CSI), despite being unable to evaluate households' food security directly, tends to capture the element of quantity or adequacy and aids in the investigation of how households react to food shortages (Maxwell & Caldwell, 2008).

Food Consumption Score (FCS): Is a composite score that takes into account dietary variety, food frequency, and the relative nutritional value of various food groups. It is calculated by looking at how frequently households consume various food categories over the course of the preceding seven days. In this study, the FCS of the sample respondents were calculated using the Technical Annex from(WFP, 2015) and grain and tuber, pulses, vegetables, fruit, meat and fish, milk, lipids, and sugar are among the food component categories. The frequency of consumption and weights attached to each food group is used for computing food consumption score(Carletto et al., 2013). For observed consumption pattern where oil and sugar are part of

frequently consumed food groups, the food consumption score yields categorical information regarding the level of food consumption achieved and provide three alternative set of cut-off points: In this regard, households with FCS of ≤ 28, between 28.5 to 42, and ≥ 42.5 are classified as poor, borderline, and acceptable consumption groups respectively.

$$\text{FCS} = (\text{grain \& tubers} * 2) + (\text{Pulses} * 3) + \text{vegetables} + \text{fruits} + (\text{meat} * 4) + (\text{milk} * 4) + (\text{fats} * 0.5) + (\text{sugar} * 0.5) \quad (2)$$

The Household Food Balance Sheet Model (HFBM): The model was initially formulated by (Degefa, 2006) adapted from FAO Regional Food Balance Model and then used by various researchers. A modified household food balance model employed in this analysis is therefore given by:

$$NGA = (GP + GB + FA + GG + MP + DP) - (HL + GR + GS) \quad (3)$$

Where; NGA=Net grain available, GP=Total grain produced, GB= Total grain bought, FA= Quantity of food aid obtained, GG= Total grain obtained (gift or remittance), MP =Meat, meat based products and poultry, DP= Dairy and dairy based products, HL= Post harvest losses due to grain pests, disasters, thievery, GR= Quantity of grain reserved for seed, GS= Grain sold.

Households who are found to fall above or equal to the national minimum daily calorie requirement level (≥ 2100 kcal/day/adult equivalent) were categorized as food secure and households who fall below the national daily calorie requirement are categorized as food insecure (Abi & Tolossa, 2015).

The coping strategies index (CSI): The CSI measures the experience of food insecurity as opposed to tools that base their assessments on consumption or caloric intake (REACH, 2021). It consists of coping strategies used by households when there is a food or financial deficit (Maxwell & Caldwell, 2008). Following Maxwell and Caldwell (2008), a set of questions were developed to capture households' basic consumption-related coping responses to inadequate access to food in a study area. The measurement of the coping strategies index of the respondents can be summarized by the following relationships:

$$CSI = \sum_{i=0}^{k} F_i S_i \quad (4)$$

Where; F_i = Frequency of the ith coping mechanism taken by a household in the past 7 days; S_i = is the severity weight attached to ith coping mechanism and k = maximum number of coping strategy.

2.4.2. Model specification

At the practical level, experiments are often costly and require close monitoring before and after program intervention. There may also be the possibility of being denied treatment, which can pose ethical issues that are politically sensitive. Thus, another alternative to the experimental approach is the use of quasi-experimental approaches that seek to create, using empirical methods, a comparable comparison group that can serve as a reasonable counterfactual (Winters et al., 2011).One of the quasi-experimental approaches mostly applied to a wide variety of subjects to identify the causal effects of policies, development programs, and projects in developing countries is Propensity Score Matching (PSM) technique. This study uses the Propensity Score Matching (PSM) procedure because it is a useful strategy to prevent bias and misleading issues (Bekele et al., 2021) and because it is a strong quasi-experimental technique that measures an intervention's impact in a straightforward manner (Caliendo & Kopeinig, 2008; Dillon, 2011). In order to estimate the PSM primarily the best matching estimator should be chosen among the available options, such as Nearest Neighbor (NN) matching, Caliper or Radius matching, Stratification or Interval matching, and Kernel and Local Linear matching (Khandker et al., 2010). Checking for overlap (common support) is another step for the implementation of PSM, which ensures that individuals/groups with the same values for characteristics X have a positive probability of being both participants and non-participants of a program, and it enables us to compare comparable units (Legesse et al., 2018).

A number of techniques are available for matching quality/effect analysis including; mean comparisons between treatment and comparison groups (before and after matching), standardized bias, and overall measures of covariate imbalance. In addition, comparison of pseudo-R^2 before and after matching is also an important method in testing the matching quality (Sianesi, 2004). It indicates how well the covariates X explain the probability of participating in the treatment. The Pseudo-R^2 has to be very low after matching to indicate success of the matching (Caliendo & Kopeinig, 2008).Before analyzing the impact of the program on the household food security status, the participation equation should be described using the Logit model, where the dependent variable, i.e., program participation, takes 1 when a household head participates in the villagization program and 0 otherwise.

Hence, the cumulative logistic probability function was specified as:

$$P_{i=}F(Z_i) = F[\alpha + \sum_{i=1}^{m} \beta_i X_i] = \left[\frac{1}{1+e^{-[\alpha+\sum \beta_i X_i]}}\right] \quad (5)$$

Where: P_i = the probability that an individual participates in villagization program X_i = represents the i^{th} explanatory variable α and β_i = are parameters to be estimated. e = represents the base of natural logarithms.The probability that a given household who did not participated in villagization program can be defined as:

$$[1 - P_i] = \left[\frac{1}{1 + e^{Z_i}}\right] \quad (6)$$

The ratio of the probability that a household who has participated in the program (eq.4) to the probability of that it who did not participated in the program (eq.5) (the odds ratio) is given by;

$$\left[\frac{P_i}{1 - P_i}\right] = \left[\frac{1 + e^{Z_i}}{1 + e^{-Z_i}}\right] = e^{Z_i} \quad (7)$$

The above natural logarithm including to disturbance term can be expressed as:

$$Z_i = \ln\left[\frac{P_i}{1 - P_i}\right] = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + U_i \quad (8)$$

Where; Z_i is natural logarithm of the odds ratio, α is an intercept β_1, β_2 and β_m are partial slopes of the equation. $X_1, X_2 \ldots X_m$ are vectors of explanatory variables. U_i is the error term.

Finally, the Average Treatment Effect on the Treated (ATT) can be estimated using the following steps:

$$Ti = Yi(1) - Yi(0) \quad (9)$$

Where;Yi1 and Yi0 is the outcome with and without treatment respectively for household i. Consider $D = \{0,1\}$ to be a binary indicator where 1 equals being assigned into treatment and 0 means not being assigned treatment. The Average Treatment Effects (ATE) can be estimated through:

$$ATE = E[Yi/Di = 1] - E[Yi/Di = 0] \quad (10)$$

ATE is hence the average difference between the treated households (villagized households) and the non-villagized households. However, such comparison might not capture the true impact of the treatment if we have selection into treatment and there are other factors that are correlated with both treatment and some omitted variable that is affecting the outcome variable. A fundamental problem is that we can observe the outcome variable under either treatment or control for each household, but never both at the same time. In this case, a preferred parameter to use instead of ATE is the Average Treatment Effect on the Treated (ATT), defined by:

$$ATT = E\left[\frac{Y^1}{D} = 1\right] - \left[\frac{Y^0}{D} = 1\right] \quad (11)$$

Where; $E(^{Y^1}/_{D} = 1)$ is never observed, replacing it by the expected value of$(^{Y^0}/_{D} = 0)$, which is observable in ATE, will not give an accurate estimate as long as

Y^0 for the treated and comparison group systematically differs. The true parameter is only identified if:

$$E[Y^0|D = 1] - E[Y^0|D = 0] = 0 \quad (12)$$

But, this is not very likely to hold in non-experimental studies. Instead we rely on a matching approach in order to derive a counterfactual that enables us to match treated households with non-treated households with as similar characteristics as possible in order to reduce the bias from self-selection. The matching is made based on an index, the propensity score, summarizing the pre-treatment characteristics of each household. The propensity score is the probability of assignment into treatment, $P(x)$, conditional on a set of pre-treatment characteristics, X, so that

$$P(x) = Pr[D = 1|X] = E[D|X] \quad (13) \quad .$$

3. Results and discussions

3.1. Socio-demographic characteristics of respondents

Table 1 show that 71.5% and 28.5% of the respondents were from male- and female-headed households, respectively. About 39.7% of female-headed households were from villagized sites and 60.3% were from non-villagized sites, whereas 53.2% and 46.8% of male-headed households were from villagized and non-villagized sites, respectively. The majority (72%) of the respondents were between the ages of 19-35 years of age. Table 3 also illustrates that the majority (75.1%) of the respondents were married, while the remaining; 13.6%, 6.8%, and 4.5% of the respondents were single, divorced, and widowed, respectively. Furthermore, 55.2% of the respondents' family sizes fell between 3 and 5. 56.1% of the respondents were illiterate (cannot read and write), while the remaining 43.9% were literate. Of the illiterate household heads, 42.7% were from villagized sites, whereas 57.3% were from non-villagized sites. It seems clear that the illiteracy rate is higher in villagized sites.

Table 1: Socio-demographic characteristics of respondents

		Villagized(N=109)		**Non-villagized (N=112)**		**Total**	
Variables	**Category**	Frequency	(%)	Frequency	(%)	Frequency	(%)
Sex	Female	25	22.9	38	33.9	63	28.5
	Male	84	77.1	74	66.1	158	71.5
Age	19-39	76	69.7	83	74.1	159	72
	40-60	30	27.5	24	21.4	54	24.4
	Above 60	3	2.8	5	4.5	8	3.6
Marital status	Single	6	5.5	24	21.4	30	13.6
	Married	93	85.3	73	65.2	166	75.1
	Divorced	8	7.3	7	6.3	15	6.8
	Widowed	2	1.8	8	7.1	10	4.5
	< 3	8	7.3	34	30.3	42	19

Family size	3-5	52	47.7	70	62.5	122	55.2
	≥ 6	49	44.9	8	7.1	57	25.8
Education level	Illiterate	53	48.6	71	63.4	124	56.1
	Literate	56	51.4	41	36.6	97	43.9

Source: Own computation (2022)

3.2. Descriptive results of food security indicators

Table 2 illustrates the proportion of households falling under the two food groups developed based on the chosen thresholds. Accordingly, 56.3% and 37.6% of non-villagized and villagized respondents had acceptable food consumption practices, respectively. Likewise, 51.4% of villagized respondents had a borderline FCS as compared to 30.3% of non-villagized respondents at the same FCS level. About 11% and 13.4% of the surveyed villagized and non-villagized respondents fall within the poor food consumption category, respectively. Moreover, the household food balance model (HFBM) result confirms that 58.7% and 47.3% of villagized and non-villagized respondents were food insecure (<2100 kcal) respectively. In general, when calorie intake per day is taken into account, 52.9% of respondents were food insecure. The results of all food security assessment methods show that respondents who were villagized were found to be more food insecure than respondents who were not villagized.

Table 2: Descriptive results of outcome variables

Outcome variable	Consumption category	Villagized HHs		Non-villagized		Total	
		Frequency	percent	Frequenc	percent	Frequency	percent
FCS	Poor	12	11	15	13.4	27	12.2
	Borderline	56	51.4	34	30.3	90	40.7
	Acceptable	41	37.6	63	56.3	104	47.1
	Total	109	100	112	100	221	100
HFB	Food secure (≥ 2100 kcal)	45	41.3	59	52.7	104	47.1
	Food insecure (<2100 kcal)	64	58.7	53	47.3	117	52.9
	Total	109	100	112	100	221	100

Source: Own computation (2022)

3.3. Factors influencing participation in villagization program

The conditional probability of households' participation in villagization program is estimated using a Logistic Regression Model. The model considered all observable covariates that affect participation for which observational data is available. In this respect, family size and access to credit had positively influenced participation in villagization program at 1% level of significance

In addition, participation in off-farm activities and irrigation farm size had positively influenced participation in villagization program at 5% and 10% level of significance respectively. Whereas, cultivated farm size and distance to market had negatively influenced participation in villagization at 1% level of significance respectively. Similarly, access to grazing land and annual income had also negatively related with participation in the program at 5% level of significance. Besides, marital status and livestock holding had negatively influenced participation in villagization at 10% level of significance (see Table 6). Meanwhile, the main purpose of this stage is to compute the propensity scores, which are used in the matching process in the next stages, we were not discussed the details of the magnitude and why each of the covariates affected households' participation in the intervention.

Table 6: Propensity score estimation of the determinants of participation in the program

Variables	Coefficients	Std. Err.	z
Gender	0.4266486	0.5394458	0.79
Age	-0.0283711	0.0238305	-1.19
Marital status	-0.9657683	0.5387274	-1.79 *
Family size	0.9563993	0.1981747	4.83***
Sex ratio	0.2033603	0.6370044	0.32
Dependency ratio	-0.1207543	0.4869163	-0.25
Educational status	0.5661036	0.4920301	1.15
Perception	0.7491893	0.5489252	1.36
Cultivated farm size	-0.5654441	0.1718466	-3.29***
Irrigation farm size	3.439745	1.810753	1.9*
Livestock holding (TLU)	-0.1300703	0.0734143	-1.77*
Access to grazing land	-1.490615	0.5868865	-2.54**
Off-farm activities	1.056201	0.5139112	2.06**
Access to credit	1.342465	0.4982312	2.69***
Distance to market	-44.14706	12.2555	-3.6***
Annual income	-0.0000916	0.0000447	-2.05**

Constants	2.809247	1.85527	1.51
		Obs.	221
		LR chi2(16)	181.39
		Prob > chi2	0.0000
Log likelihood	-62.46918	Pseudo R2	0.5921

*,** & *** denote statistical significance at 10%, 5% and 1% level respectively.
Source: Own computation (2022)

3.4. Estimation of propensity score

In this investigation, the radius caliper (D = 0.25) was found to be the best and most appropriate matching algorithm for the data, which yields lower Pseudo-R^2 and a large matched sample size. The common support ensures that treatment observations have comparison observations "nearby" in the propensity score distribution. As shown in Figure 1, the distribution of propensity scores of the treatment groups is found in the upper hand (the red color) of the distribution, whereas that of the control groups is found on the lower hand (blue color) of the distribution. This ensures that any combination of characteristics observed in the treatment group can also be observed in the control group (Granger et al., 2020). As a result of this restriction, some observations from the control were discarded (Figure 1).

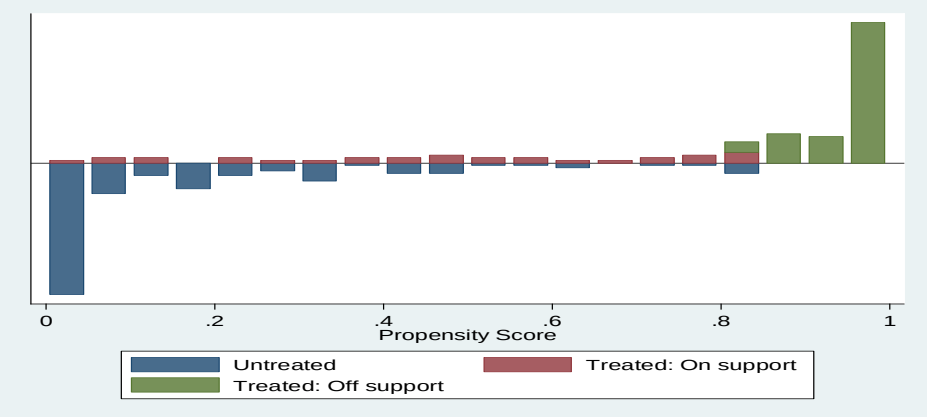


Figure 1: Distribution of Propensity Score across Treatment and Comparison Groups

Besides, the matching quality analyses indicated that before matching, 10 out of the chosen variables exhibited statistically significant differences, but after matching, all covariates had statistically insignificant differences. This implies that the matching process was effective in balancing the distributions of the covariates in the matched sample. In addition, the standardized percentage before matching among the covariates was between 6.5% and 109.9%, but, after matching, the standardized bias

percentage for almost all covariates lay between 1.3% and 23.5%. Moreover, the result also indicated that before matching, pseudo R^2 was 0.593 but after matching it had reduced to 0.027, implying that both the treated and control groups have an identical distribution in the covariates after matching and the impact of the program could be easily evaluated since the participants and the non-participants are similar in their pre-intervention observable characteristics.

3.4.1. The impacts of villagization program on food security

The propensity score matching results presented in Table 3 indicate that villagization program has negatively and significantly affected the food security situations of households in the study areas at a 10% significance level. Specifically, the estimates of the average treatment effect showed that non-villagized households had on average 3.56 higher food consumption scores than those who had engaged in the program. Similarly, the finding also indicated that non-villagized households obtained an average of 573.49 kcal higher compared to those households that participated in the villagization program. The overall results indicated that households that have participated in government-sponsored villagization programs had lower food consumption scores and lower calorie intake per day as compared to households that have not participated in the program.

This result is in conformity with the findings of (Daie & Labiso, 2021; Stevenson & Buffavand, 2018; Zikargie & Cochrane, 2022). For instance, Daie and Labiso (2021) revealed that the introduction of villagization schemes in the Benishangul-Gumuz region did not improve the food security status of the rural communities, as evidenced by the fact that 67% of the assessed households have experienced food insecurity. The FGD discussants also confirmed that the food security situation in new villages is dire. Because the areas where they have been moved are often dry with poor-quality soil, some of the farmers have become landless because of the absence of a feasibility study of the new sites. Besides, the promises of the regional government to provide infrastructure (schools, health facilities, water,…) and agricultural extension services or input have not been maintained. The new villages seem to provide even fewer resources than the existing ones, and some farmers are returning to their old villages. The results of (Amare, 2016; Labiso, 2020), in contrast to the findings of this study, showed that the start of the villagization program had

significantly improved the lives of the rural communities by bringing about positive changes that had not previously existed in some districts of Gambella and the Benishangul-Gumuz region.

Table 3: Results of the ATT of food security indicators

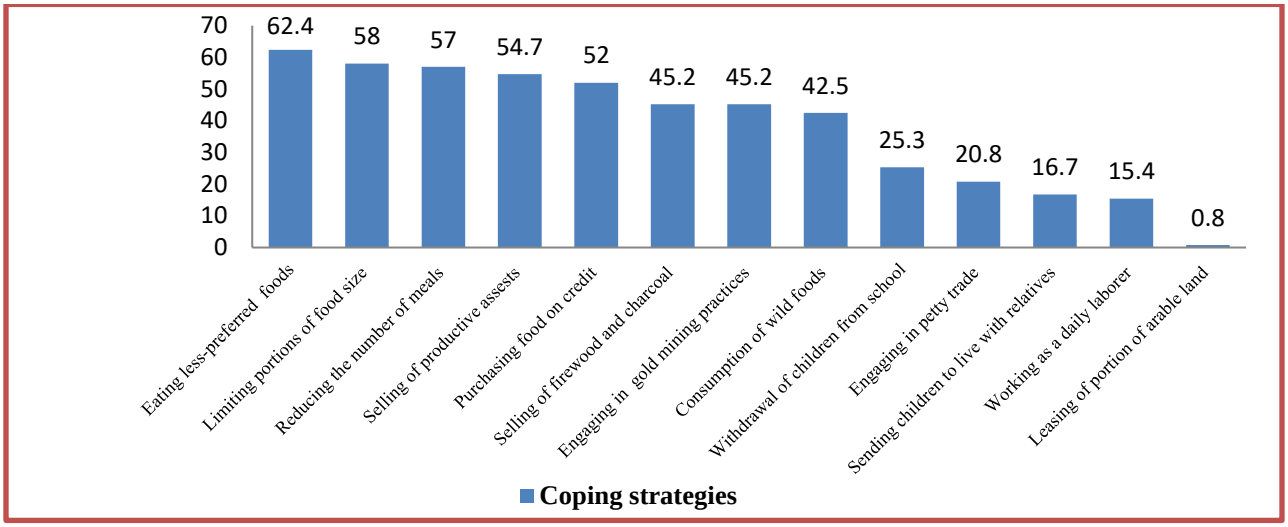
Outcome variables	Sample	Villagized	Not-villagized	Difference	t-statistics
FCS	Unmatched	36.82	44.29	-7.48	
	ATT	38.29	41.85	-3.56	-1.97*
HFBM	Unmatched	2296.06	3039.27	-743.20	
	ATT	2164.39	2737.88	-573.49	-1.93*

* denote statistical significance at 10% level. ATT =Average Treatment Effect on the Treated.
Source: Own computation (2022)

3.5. Households coping strategies to food insecurity

The information gathered from FGDs and previous studies indicated that households in the study areas adopted multiple forms of coping strategies at times of food shortage and/or food insecurity. Accordingly, the coping strategies index developed by Maxwell and Caldwell (2008) was modified and adapted to the local situation, and 13 commonly used coping strategies were established. This study confirmed that the main coping mechanisms households adopted during food shortages were: eating less-preferred and less expensive foods (62.4%); limiting portions of food size at mealtime (58%); reducing the number of meals per day (57%); selling productive assets (livestock and small animals) (54.7%); purchasing food on credit (52.2%); selling of firewood and charcoal (45.2%); engaging in traditional gold mining practices (45.2%); consumption of wild foods (42.5%); withdrawing children from school (25.3%); engaging in petty trade (20.8%), sending children to live with relatives (16.7%); working as a daily laborer (15.4%) and leasing of a portion of arable land (0.8%) (Figure 2). Information obtained from FGDs indicated that most rural households consume low-quality foods that are affordable to them. Besides, they reduce the amount of food prepared and consume less of it to cope with the risks of food shortages. In the study area, sometimes household heads consume only coffee during breakfast time and decrease their meal times from three to two a day to feed

their family. They also depend on the consumption of wild foods such as mushrooms, roots, vegetables, fruits, and bamboo shoots during the rainy season.



Note: a single respondent has listed all of the coping strategies he/she used in times of food insecurity.

Figure 2: Coping strategies against food insecurity.

Source: Own computation (2022)

Furthermore, the mean values of the coping strategies index of food villagized and non-villagized households were also compared using the independent-samples T-test. As presented in table 8, the mean values of the coping strategies index of villagized and non-villagized households were found to be 15.84 and 26.29 respectively. The mean difference (-10.443) of coping strategies index of the two groups is significantly different from zero at 1% significant level. This implies that coping mechanisms of villagized households were significantly different from non-villagized households and on average, food villagized households took many and/ or more severe coping mechanisms than non-villagized households so as to cope-up food shortage. As indicated in the CSI field methods manual, the higher the value of coping strategies indexes the more food insecure the households are (Maxwel & Caldwell, 2008).

Table 8: Summary Statistics of Mean values of Coping Strategy Index

	Respondents	N	Mean (SD)	Mean Difference	t-value
Coping Strategies Index	Villagized	109	27.28 (21.84)	11.76	4.778***
	Non-villagized	112	15.51 (14.03)		

***Significant at 1% significance level

Source: Own computation (2022)

4. Conclusion and recommendations

4.1. Conclusions

This study has analyzed the impact of villagization programs on households' food security status and assessed their coping mechanisms in the selected districts of the Benishangul-Gumuz region. The outcomes of descriptive and propensity scoring matching analysis of the sample data indicates that, compared to villagized households, non-villagized households are better off in terms of the mean total food consumption score and calorie intake per day. Besides, non-villagized households used less severe coping mechanisms than villagized households to cope with food shortages. In conclusion, households that took part in the villagization program did not considerably enhance their food security situation as anticipated at the start of its operation. As a result, the implementation of the villagization program in the study districts did not succeed in achieving its goals, which included lowering poverty and enhancing food security.

4.2. Recommendations

Relocating scattered dwellings and settling in predetermined geographic areas through villagization alone would not provide a sustainable and lasting solution to the chronic food insecurity problems in the study areas. As a result, the required and promised infrastructure facilities and necessary technology for farm products such as improved farm tools, improved seed varieties, organic fertilizers, and extension services should be provided in the study areas. Furthermore, future villagization efforts in the region should prioritize feasibility studies in new locations and include communities in all aspects of program planning and implementation.

Acknowledgements

We thank the local authorities for allowing access to the study area and setting up all required support during data collection. We would also like to express our gratitude to

the rural farmers, community elders, women representatives, steering and technical committees for the villagization program, kebele managers, and development agents for contributing important information during the household survey and focus group discussions, without which this study would not have been possible. We also acknowledge the enumerators' contribution to the timely completion of the data collection.

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