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COMMUNITY CEREAL BANKING IN THE GAMBIA: DETERMINANTS AND IMPACTS ON FOOD AND NUTRITION SECURITY

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ABSTRACT

Community cereal banking is one possible strategy to help farming communities buffer production and prices shocks, as well as seasonal variations in their access to food. Based on a Randomised Control Trial (the Community Driven Development Project) in The Gambia, we use Propensity Score Matching (PSM) to analyse the determinants of the communities' choice of cereal banking as development project and assess the treatment effect on food and nutrition security outcomes. We find that cereal banking substantially reduces inter-seasonal food price variability at the community level, improves households' food and nutrition security, but has less impact on their wealth accumulation.

Keywords: cereal banks, grain banks, community, food security, propensity score matching

1. INTRODUCTION

Rainfall variability and food price volatility are some of the most important risk factors that affect lives and livelihoods of rural households in import-dependent developing countries (Vicarelli, 2010 p.2, Wright and Cafiero 2009, Warner et al 2013 p1). This is due in part to the climate-sensitive nature of small-scale farming and of primary sector-based economies, the low level of human development and adaptive capacity, the high share of household expenditures devoted to food purchases, and the national dependency on food imports. As a result, any change in food prices or production has a large impact on livelihoods (Kalkuhl et al 2013, Wheeler and von Braun 2013, FAO 2011). Research findings on the cause and impact of the food price hikes of 2008 and 2011 have revealed inherent market failures in ensuring food security for all, especially during crisis mainly induced by climate shocks (von Braun and Tadesse 2012). The aggravating impacts of these shocks on malnutrition, hunger and poverty of the rural poor in developing countries have been very high (Kalkuhl et al 2013, Tiwari and Zaman 2010, Ivanic et al 2012). Avoiding or minimising these impacts and their reoccurrence for vulnerable rural poor communities and households through responsive safety nets is likely to make a difference (ECOWAS Commission 2012, Compton, Wiggins and Keats 2010).

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Cereal banking is a community-based risk management strategy of holding physical food reserves to hedge the impact of inter-seasonal food price variation, enhance food availability and access and act as emergency buffer stocks (Beer 1990). It is the practice of storing food during times of plenty (at harvest) when prices are low, for use during times of scarcity when prices are high (Kent 1998, p. 2; IRIN 2008). Indeed, agricultural households tend to sell the bulk of their farm produce at low prices during harvest but during the lean period, they often buy food (often the same products) at high prices, due in part to several savings constraints. This inter-seasonal price variability tends to reduce farmers' income and to erode their purchasing power during the lean period (WFP 2011). As a result, food insecurity is more seasonal than a chronic problem in many rural areas of The Gambia.

Advocates of the scheme maintain that, when implemented well, cereal banking can improve food and nutrition security of participating households and communities. In the long term, it can also improve livelihood security (Basu and Wong 2012, Cortes and Carrasco 2012, Msaki et al., 2013, Action Aid 2011). Despite mixed experiences on success, the practice continued to be supported by communities and Aid Organisations (Bhattamishra 2012). For example, the ECOWAS Regional Food Security Reserves envisages to build or operationalize more than 5000 cereal banking schemes in 12 countries in West Africa (ECOWAS Commission 2012).

In spite of its widespread popularity as a community-based risk manangement strategy in most arid and semi-arid rural communities (Basu and Wong 2012, Bhattamishra 2012), the practice has seen little empirical scientific impact evaluations. In this paper, we attempt to estimate the impact of cereal banking on enhancing food, nutrition and livelihood security outcomes of rural communities in The Gambia. We test the hypothesis that communities and households that operate cereal banking schemes have better livelihood security outcomes and are more resilient to future market and climate risks.

2. STUDY AREA

Our study was conducted in three[i] of the six rural Local Government Areas (LGAs) of The Gambia. Beside their high poverty rates, communities in these LGAs are located further away from the main markets, and are home to more than 85% of cereal banking schemes in The Gambia. Underlying the high poverty rates is the low level of economic diversification, frequent weather-induced crop failures and low incomes (WFP 2011, ECOWAS Commission 2012).

The Gambia has features of Sahelian semi-arid climatic conditions. It is located in what is described as a climate change hotspot characterised by two seasons of about four months of rainy season (June – September) and eight months of dry season (Ericksen et al 2011). As a result of this short rainfall period, only a single cropping season is feasible for rainfed agriculture[ii]

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(Ceesay 2004), which prevails in the country. The occurrence of price and rainfall variability in the past three decades has contributed to increased poverty, food and livelihood insecurity (Kandji et al 2006, Ericksen et al 2011).

Weather events are key drivers of the food and nutrition security of farm households. Figure 1 indicates a 43% reduction in rainfall from 1400mm in 1860 to 800mm in 2011 whilst Figure 2 shows increasing rainfall variability beginning from the late 1960s. This not only exhibits a recurrent and protracted drought but a frequent succession of dry years and wet years, typical of the Sahelian climate (Kandji et al 2006, Ericksen et al 2011).

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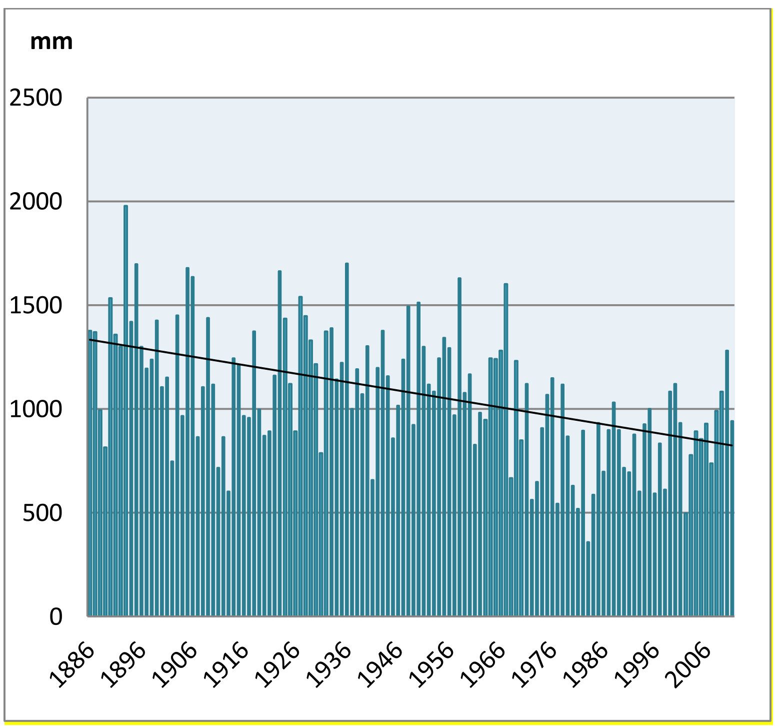

Source: Department of Water Resources, Banjul

Figure 1: Rainfall Trend in The Gambia (1886 – 2011)

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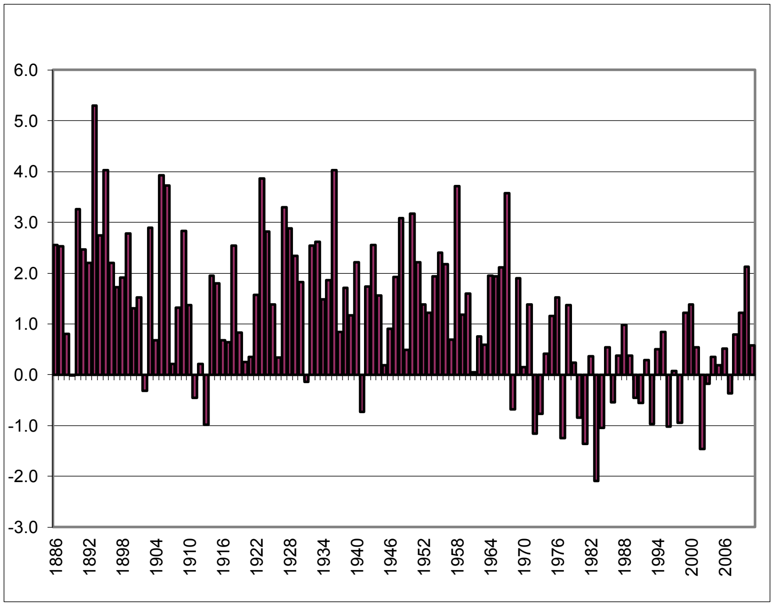

Source: Department of Water Resources, Banjul

Figure 2: Inter-annual Rainfall Variability in The Gambia (1886 – 2011)

There are also interesting spatial and temporal price dynamics of the grain flow across regions and seasons in the Gambia. Due in part to the concentration of large storage facilities in urban areas, grains flow from rural to urban areas in the immediate post-harvest period (WFP 2011, Barrett 1996). However, a flow reversal occurs during the farming season, otherwise called the hungry season, when private stocks in local communities are depleted (Barrett 1996). These dynamics are also accompanied by low producer prices for farm produce and high buyer prices of imports, adversely impacting on the food security (availability and access) and poverty levels of rural households. The transition from cereal net-seller to net-buyer in terms of its duration is influenced by rainfall variability, among other things (Khandker et al 2009), and food insecurity is experienced mainly as a seasonal issue: every year, poor households in rural areas face the "hungry season", depicted in Figure 3, a period of three to four months between July and September, when household food stocks are low or depleted and that transition to net-buyer is completed (FAO 2011).

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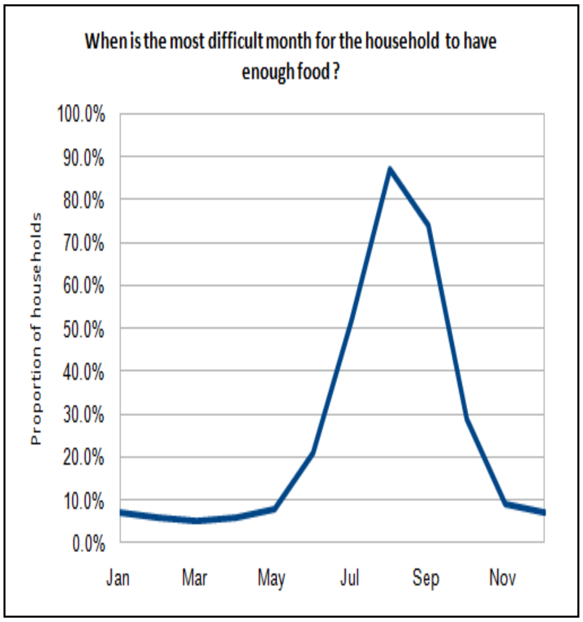

Source: WFP 2011

Figure 3: Seasonal Food Insecurity

3. THEORETICAL FRAMEWORK

The theories of consumption and savings; Permanent Income Hypothesis (PIH) and the Life Cycle Hypothesis (LCH) are conceptualised within an inter-temporal utility maximization and wealth accumulation objective for households (Deaton 1990). A slight but important departure in the application of the theories is considered in (Deaton 1990). She argues that savings is not only about wealth accumulation but also about consumption smoothening motivated by frequent inter-seasonal trends, not life cycle hump or intergenerational savings. This argument resonates with rural households in most developing countries (Aryeetey and Udry 2000). Smoothing consumption within a single agricultural cycle is as important as the life cycle consumption smoothing (Khandker, 2009, Basu and Wong 2012). The motivation for such short term saving behaviour is risk management.

In most arid and semi-arid countries like The Gambia, agricultural production is carried out once every year; during the rainy season. As such, households must allocate their produce, livelihood endowments and other incomes for consumption throughout the year (Basu and Wong 2012).

In communities with cereal banking schemes, households have the opportunity to save excess production (annual farm output) in a food store after catering for their consumption at harvest. This can then be withdrawn during the lean period to smooth consumption. The savings hedge

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the impact of inter-seasonal price variability or increasing import prices since the food stored can then be consumed instead of relying on the market (Gilbert 2012). Saving in a secured cereal bank (warehouse) also relaxes savings and credit constraints since households without saved cereals can also be given loans from the cereal banking scheme.

In addition to storage constraints and possible high storage loss at individual level, the difference between individual savings and community savings is that households who save on their own tend to sell all their stock even before the critical period of the hungry season (Beer 1990). For community cereal banking schemes, the rules often allow dissaving or giving out credit to members only during the critical period of the hungry season (Action Aid 2009). The timing for the disbursement of the credit has important ramifications not only for consumption and price stability but also on production. For example, when food supplies are issued during the lean period which also coincides with the farming season, this can allow poor households to concentrate on their own farm work. In the absence of such loans, poor and food insecure household may adopt inefficient and costly coping strategies. These coping strategies may increase the indebtedness of households and lead to low production and productivity (Action Aid 2009). In addition, cereal banking helps to instil a type of "forced savings and collective action" and thus encourages a high savings rate in a community (Bhattmaishra 2012).

4. METHODOLOGY

4.1 Sampling framework

Our data and methodology are based on a large scale Randomised Control Trial (RCT) implemented in The Gambia called The Community Driven Development Project (CDDP). It is a World Bank funded project that was implemented in The Gambia from 2008 to 2011, targeting rural communities across the country. Due to the large number of eligible villages relative to fund availability, a selection of final beneficiary villages went through the following process (Arcand et al 2010).

1. Stratification
   Using the National Population Census data of 2003 a Poverty Index was compiled for all the villages with a population of less than 10,000 inhabitants. The Poverty Index comprised the following variables
   i. Proportion of household heads who cannot read or write
   ii. Proportion of households without electricity
   iii. Proportion of households with clean drinking water
   iv. Proportion of households without own toilet facilities

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This stratification process was meant to set criteria for eligibility which eliminated some villages below the poverty threshold/index. 950 out of more than 1800 villages were deemed eligible.

2. Randomisation
   Out of the eligible villages, 495 villages were randomly selected (by simple lottery) to receive funding under the CDDP scheme.

According to the Baseline report (Arcand et al 2010), a comparison of the characteristics of the villages that were selected and those that were not produced fairly similar average characteristics. Thus, evaluating such a project can rely on experimental evaluation techniques. Of the 495 villages that received funding from CDDP less than 10% chose to implement cereal banking schemes from a wide range of possible subprojects based on communities' needs and aspirations[iii] (Arcand et al 2010, Jaimovich 2012).

We note that whilst the selection for CDDP intervention was randomised, the choice of subprojects such as cereal banking was not. It was likely influenced by endogenous village characteristics. Thus, any impact evaluation must control for these possible confounding factors in order to eliminate selection bias (Angrist et al 2009, Baker 2000, Rosenbaum and Robin 1983, Heckman et al 1998). Evaluating the impact of such subprojects requires the use of quasi-experiments (Abebaw and Haile 2013).

Unlike randomised experiments, quasi-experiments must deal with the problem of selection bias (Heckman et al 1997). Selection bias arises when comparing groups with significantly different characteristics and motivations for the choice of a programme (treatment). These initial differences may affect the outcomes of the treatment in these groups. Thus, the differences in outcomes after an intervention cannot be solely attributed to the treatment effect alone (Angrist et al 2009).

4.2 Matching treated and control villages

As widely discussed in the literature, to remedy the attribution issue in the identification of treatment effect mentioned above, one can estimate the average causal effect of the treatment by a) regressing the mean outcome variable on the treatment dummy and a vector of observed covariates, b) matching subjects with same covariates – similarly relying on the assumption that the only source of treatment selection bias is the vector of covariates, and c) regressing the outcome variable on the treatment dummy and an instrumental variable (IV) which is correlated with the treatment dummy but not the outcome variable.

Driven by data paucity in getting a credible instrument and methodological applicability, we opted for the matching approach, applying Propensity Scores Matching (PSM) to balance groups

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by matching similar treated and control units based on the conditional probability of receiving treatment given the covariates (Perraillon et al 2006, Austin P 2011, Caliendo and Kopeinig 2008). Doing these we by-pass the difficulty of matching subjects based on the values of each covariate, as PSM generates an index-like measure which captures all the characteristics affecting the predicted probability of being treated, called the propensity scores (Ravallion 2003). PSM ensures that at baseline and on average, groups are identical in their observable characteristics. Thus, if a treated subject and a potential control subject have the same propensity score, then the difference between the treated and control outcome after treatment is an unbiased estimator of the treatment effect (Abebaw and Haile 2013).

However, the crucial caveat to using PSM is that this assumption breaks down if there are important unobservables that affect treatment and outcomes (Caliendo and Kopeinig 2008). This important caveat can be dealt with is several ways, many of which we have applied in this study. First, it must be noted that the stratification and randomisation leading to the selection of villages was performed on at least 80% of villages below 10'000 inhabitants, thus being very representative of all village conditions/characteristics in the country. Second, we have matched 47 treated villages (i.e. they developed a cereal bank, regardless of whether that bank was still in operation or not) with control villages from a wide pool of non-treated villages to maximize the chances of having very good matches (495 villages received funding under the CDDP). Third we have tried to include many pre-treatment variables to perform the matching (at least 22, the full list is provided in Table A1, Appendices). Some of the potential bias can be removed by using fixed effects capturing time invariant unobservable heterogeneities (Olken 2012); in our case we applied fixed effects to control for district specific characteristics, as the villages are spread over several regions and districts. Finally, the regressions performed using additional control variables provide another level of control for biases in estimating treatment effects.

The question to ask then is: what are the determinants to the choice of cereal banking? We argue here that a community's natural and economic livelihood endowments, infrastructure, market connectivity and social networks determine its vulnerability to shocks such as rainfall and price volatility and thus its choice of risk management strategy (Brooks 2003), such as cereal banking. Any impact evaluation of the treatment using PSM must control for these possible confounding factors in order to eliminate selection bias (Angrist et al 2008, Baker 2000, Rosenbaum and Robin 1983).

Given these determinants, we can select control villages with similar characteristics to the treated villages (i.e. those who received funding and elected to invest in community cereal banking). By implication, the two groups are similar at the baseline (i.e. before the cereal bank is

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implemented). The assumption then is that given their similarities in these important observable characteristics, the impact of the programme on these two groups would be similar.

We estimate the propensity of a community participating in a cereal bank using a non-parametric logit model;

$$\mathbf{P(CB) = \beta Vc(i) + \varepsilon(i)} \dots\dots\dots\dots\dots\dots\dots (\mathbf{1})$$

Where P(CB) is the probability of participating in a cereal bank, Vc is a vector of pre-treatment village level social, economic, livelihood, natural and market characteristics and ε is the error term. On the basis of the CDDP scheme, we conduct the PSM using two subsamples:

1. Matching treatment villages with CDDP funded villages that opted for other subprojects rather than cereal banking (partial control group).
2. Matching treatment villages with villages that neither benefitted from CDDP funding, nor had cereal banking schemes (pure control group).

In addition to the 2003 National Census data, we use other sources of data, generating 22 pre-treatment village characteristics for a total of 826 villages (47 treated, 404 partial control and 375 pure control) from all six rural regions in The Gambia. Relative to our 47 treatment villages (of which 12 did not have an active community grain bank at the time of field work), the large sample size of possible control villages (779) ensures that the pre-treatment mean differences in village characteristics between the treated villages and their matched counterfactuals converge to zero (Ferret S 2010 Baker 2000, Heckman and Ichimura 1997).

We selected the One-to-One nearest neighbour matching algorithm without replacement. This enables the matching of every treated village to a unique village in the pure and partial control groups of villages. The choice of matching algorithm is dictated here by the fact that we choose for each treated village a unique corresponding control village on which cross sectional data will be collected for our impact estimation. Matching with replacement could have further reduced our sample size.

4.3 Results of the propensity score matching

The results of our PSM (Table 1) show the variables that determine the choice of cereal banking. In both matching (treated with partial control and treated with pure control), the results exhibit similar coefficients and significance levels. Overall, the R^2 suggests that our PSM model in equation 1 has a strong explanatory power for the probability of a village to choose cereal banking. Out of 22[iv] variables, 9 were significant at 5% significance level whilst 13 were significant at 10% significance level[v].

Table 1: Results of the Logit Model

	Partial Control PSM		Pure Control PSM	
Variable	**Coefficient**	**P>|z|**	**Coefficient**	**P>|z|**
Availability of Fruit Trees	-0.051	0.033	-0.043	0.102
Average household size	0.725	0.209	-0.283	0.501
Average rainfall	-0.012	0.613	-0.010	0.703
Average temperature	1.748	0.745	2.194	0.009
Coefficient of Variation (Price)	660.353	0.006	681.091	0.018
Coefficient of Variation (Rainfall)	13.871	0.286	16.076	0.246
Connected & lowland Villages	1.107	0.109	1.618	0.039
CV_Price * CV_Price	1128.559	0.004	-1157.499	0.016
Distance to market	0.527	0.038	-0.446	0.033
Dominant ethnicity gr. 2	7.445	0.004	3.842	0.113
Dominant ethnicity gr. 3	14.682	0.003	7.953	0.090
Households without daily market (%)	0.184	0.046	0.152	0.058
Households without electricity (%)	11.954	0.125	8.666	0.189
Households without improve transport (%)	0.537	0.009	0.476	0.038
Millet grown	0.001	0.004	0.001	0.009
Number of Households	-7.00E-05	0.964	-0.001	0.450
Poverty Index	7.249	0.035	2.695	0.408
Poverty * CV Price	35.039	0.292	28.577	0.326
Price Index	0.680	0.507	1.017	0.383
Proportion of Crop farmers	46.254	0.029	32.713	0.053
Proximity of the District	2.873	0.021	-3.023	0.016
Proximity of the LGA	33.202	0.024	33.592	0.020
Constant	-136.976	0.457	-102.470	0.638
Observations	451		422	
R2	0.455		0.395	

We briefly discuss some of the key results of Table 1. The coefficient of variation of food price is measured as the standard deviation divided by the mean for the prices of the main food crops in a village market or a market closest to the village[vi]. It estimates the dispersion in prices and thus the price risk. Our results show that communities that face a high price risk have a high propensity to choose cereal banking. These are similar results to Bhattamishre (2012) and Cortes and Carrasco (2012).

Average annual rainfall is 840mm and average temperature is 35°c. Rainfall variability measured by the Coefficient of Variation (COV) shows the extent of inter seasonal variation (0.24) is high relative to the global median of 0.21 (Erickson et al 2003). The COV shows that rainfall risk is

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not a significant determinant for the choice of cereal banking. This is likely because there is no significant difference in average rainfall received by regions in the Gambia.

Access to markets, measured by the distance from the village to the closest weekly market and availability of improved transport systems,[vii] indicate village connectivity or remoteness. The more isolated a community is, the higher the probability to choose cereal banking. This is also similar to results found in the literature (Cortes and Carrasco 2012, Bhattamishra 2012). The distance to market may oblige communities to store, since relying on the market may result in high transaction and market costs incurred by households in villages situated off the road/market route (Laborde et al 2013, Daviron and Douillet 2013, Gouel, 2013).

There are significant differences for the probability to choose cereal banking between food surplus communities and food deficit communities (Bhattamishra 2012, Cortes and Carrasco 2012). Lowland villages, defined by their distance to the fresh water sources of The River Gambia used for irrigation, often have more favourable ecologies for farming (Ceesay 2004, von Braun et al 1989). In most cases, they produce more food crops, especially rice, relative to other villages in upland ecologies. We observe that instead of buying rice, these communities often sell rice in order to purchase other livelihood needs (WFP 2011, von Braun et al 1989). A review of the choice of subprojects for the CDDP show that most of the communities that live in the lowland ecologies opted for production enhancement equipment; access to fields, gardening and not for cereal banking.

In summary, we can conclude that villages that are poor, remote, depending on rainfed agriculture[viii] and suffer from price volatility are more likely to choose and sustain cereal banking schemes. These results are echoed in the literature (e.g. Cortes and Carrasco 2012, Barrett and Bhattamishra 2008, Bhattamishra 2012). This supports the argument that a self-assessment of risk and vulnerability drives choices of adaptation or risk management strategy. In addition, the results also show the importance of targeting in programme delivery, since not all communities equally need and can sustain cereal banking schemes.

We test the robustness of our PSM using a t-test of the differences in sample means (Table 2), in order to set a solid foundation for the impact evaluation. The results of the t-tests indicate that before the matching, we observe some significant differences between treated and non-treated villages in terms of the mean values. However, after the matching, there is no significant difference between the values of the treated and control groups. Thus, we conclude that the matched treated and control villages have similar propensity scores and there is no significant difference between the treated and control villages before treatment.

Table 2: Results of PS Test

Variables	Sample	Treated	Partial Control	T-stat	Pure Control	T-stat
Average household size	Unmatched	11.419	11.120	0.620	11.245	0.350
	Matched	11.419	11.640	-0.330	11.710	-0.440
Coefficient of variation (price)	Unmatched	0.265	0.243	1.920	0.247	1.680
	Matched	0.264	0.263	0.190	0.266	-0.180
Distance to market	Unmatched	43.308	41.830	0.550	40.949	0.900
	Matched	43.300	45.168	-0.770	44.634	-0.530
Households with daily market (%)	Unmatched	81.476	62.650	4.240	66.731	3.460
	Matched	81.470	82.540	-0.270	80.683	0.200
Households with improved transport (%)	Unmatched	98.220	91.720	3.430	92.968	3.060
	Matched	98.229	97.668	0.540	97.415	0.720
Poverty Index	Unmatched	0.706	0.654	2.700	0.660	2.262
	Matched	0.706	0.732	-1.230	0.705	0.053
Proportion of crop farmers	Unmatched	0.966	0.921	4.140	0.927	3.760
	Matched	0.966	0.968	-0.410	0.970	-0.830
Remote & Upland Villages	Unmatched	0.511	0.411	1.310	0.421	1.880
	Matched	0.511	0.511	0.000	0.550	0.000

We can conclude that with the propensity-score nearest-neighbour matching it is possible to generate a control group which is similar enough to the treatment group to be used for the impact evaluation. In addition, unlike earlier researchers that used PSM, this method presents some superior attributes given that the PSM is built on both stratification and a randomisation (Arcand et al 2010, Abebaw and Haile 2013, Shiferaw et al 2014). This decreases the bias generated by unobservable confounding factors, albeit to an unknown extent. The extent depends crucially on the quality of the village characteristics as comprehensive drivers of the adoption of cereal banks.

5. ESTIMATING THE TREATMENT EFFECTS

Based on the PSM results and having considered an appropriate sample size and power (see Gertler et al 2003), we use a unique dataset of 134 villages:

- 35 are treated villages (i.e. 47 treated villages minus 12 villages whose grain banks were not operational),
- 51 are partial control villages,
- 48 are pure control villages.

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In each village, we randomly selected 10% of the households (460 households) and measured the Mid-Upper Arm Circumference (MUAC) of children below 5 years old in those households (366 children)[ix]. Further, we collected household level characteristics and outcomes for 163 treated households, 132 pure and 165 partial control households.[x]

Cereal banking is expected to generate diverse direct and indirect benefits to participating households. Once food is made availaible especially during the critical food gap or lean periods, it smooths consumption and reduces income spent on the food for participating households. It may enhance investment in own farming operations, generating higher yields, incomes, savings and thus food and nutrition security outcomes. The presence of food in food stocks also acts as a disincentive to speculative storage and thus reduces interseasonal price changes. Thus, we pay attention to indicators of food and nutrition security as well as livelihood security. Taking cue from recent state-of-the-art literature on the conceptualisation and measurement of Food and Nutrition Security (Hoddinot 2009, Pangaribowo et al 2013, Pieters et al 2012, Laborde et al 2013, Kalkuhl et al 2013, von Braun et al 2012, von Braun 2011), we have as far as possible gathered evidence on a number of outcome variables at the village and household level.

5.1 Difference in means as average treatment effects

In the first set of analysis, we provide a comparison of means to find out if there is any Difference in Means (DIM) between treated, pure and control villages that can reasonably be attributed to the treatment. Since villages were similar in the pre-treatment (baseline) characteristics, differences in the outcomes of interest post treatment can be attributed to the treatment (Ravallion 2003). In our cross-sectional data, the DIM indicates the average treatment effect (Olken 2012).

Like in the PSM, we find that most of the matched villages remained unchanged in their physical features such as availability/distance to roads, schools, hospitals, as well as ecological characteristics after 4 years of project implementation (2008 – 2012). This further proves the validity of our PSM. However, there are also some important mean differences among villages for several village-, household- and individual-level outcome variables, which indicate the Average Treatment Effect (ATE) of the programme (Becker and Ichino 2002). They are presented in Table 3.

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Table 3: Mean Differences between Treated and Control Villages

	Treated	Pure control	Test	Partial Control	Test
Village Outcomes					
Average Food gap in months	2.170	2.830	0.000**	2.490	0.047*
Price Cash crop – Harvest	726.470	625.000	0.003**	587.230	0.000**
Price Food crop - Lean in (GMD)	918.570	1057.970	0.002**	959.780	0.177
Variation in crop price – Lean (in GMD)	114.280	262.640	0.000**	238.630	0.000**
No. of Self-Help groups	1.9	1.6	0.665	1.7	0.872
WDC membership	2.645	1.927	0.894	1.979	0.895
Moneylenders/middlemen	1.4	1.72	0.025*	1.68	0.482
Household Outcomes					
Wealth Index	0.040	0.034	0.078	0.048	0.014*
Fertilizer Applied(in bags of 50kg)	3.000	1.700	0.047*	2.300	0.230
Feeding from own production (1-4 index)	1.817	1.586	0.007**	1.774	0.677
Pp. of Hh hiring out own labour	0.210	0.360	0.008**	0.320	0.034*
Changes in HH Food Availability	2.710	3.280	0.002**	3.580	0.000**
Children skipping meals	0.100	0.320	0.000**	0.209	0.013*
Average MUAC (cm)	15.010	13.770	0.000**	14.460	0.009**
Prop of severely malnourished chilldren (MUAC<11.5)	8.7	21.82	0.000**	11.20	0.002**
Production (in bags)	14.890	12.730	0.174	14.080	0.341
No. of coping strategies employed	1.560	2.270	0.000**	2.050	0.000**

*** p<0.01, ** p<0.05, * p<0.1

The next few paragraphs discuss some of the important results highlighted in Table 3, first for village level results and then for village averages of household-level results. The food gap, also called the lean period or hungry season[xi] (FAO 2012, WFP 2011) represents the number of months in a year households reported not having adequate food stocks or money to buy food. As seen in Table 3, on average, the number of months households suffer the food gap is more than 2.5 months. Whilst on average, households in treated villages suffer 2.1 months of the hungry season; households in pure control groups suffer close to 3 months with those in partial control group suffering 2.5 months of the hungry season. Thus, using the pure control group as a base, cereal banking reduces the food gap by 25%.

The results on producer prices of cash crops (Groundnut prices at harvest) as well as the buying price of food crops (prices of millet and maize during the lean period) also indicate a significant difference between treated and control villages. We observe that the price effect is more

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significant when comparing treated villages with partial treated villages suggesting that in the absence of a storage mechanism, households under the CDDP may produce more, the impact on income being ambiguous as they sell at lower prices. Figure 4 shows that at harvest time when most rural households are net sellers, the selling price of farm produce in control villages is 16% lower than seller prices in treated villages. In contrast, during the lean period when most rural households are net buyers, the buying price of cereals are significantly less expensive than in treated villages (about 15%). This implies selling at lower prices and buying at higher prices for households in control villages, contrary to conclusion in Kent (1998). Further, Figure 5 shows how these commodity prices in the four seasons vary from their annual mean prices. Clearly, the variability of prices for the three commodities (groundnuts, rice and millet), measured as mean deviations, is lower in the treated villages.

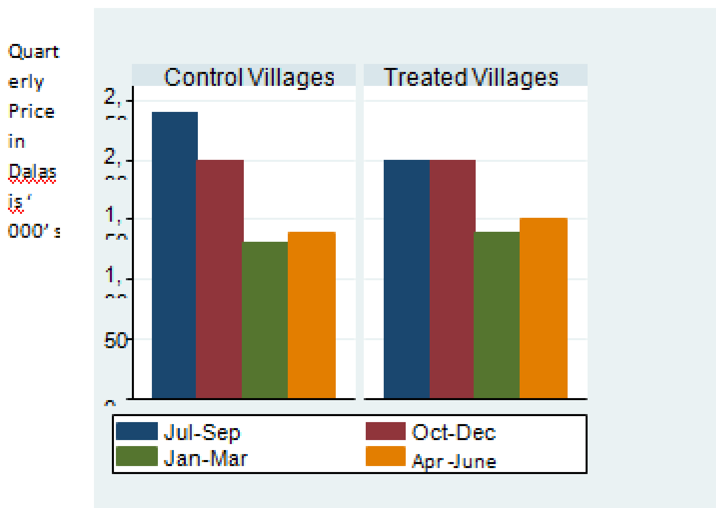

Figure 4: Quarterly Price of Food Commodities :Rice, Millet and Groundnut) in the Gambia (2012)

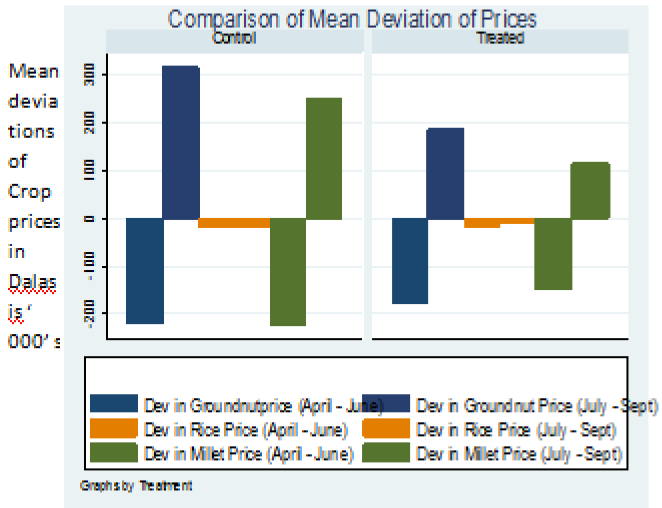

Figure 5: Mean deviations (Current price – Mean price for the year) of selected commodity prices in The Gambia over the hungry season in 2012

The difference in prices and price variability, almost all statistically significant, may be explained by the following combinations of factors:

1. A relatively higher proportion of households in treated communities reported to depend on their own produce for their food needs for more than six months of the year.
2. The results also show that treated communities engage in less selling of food crops at harvest and buying less during the lean period signifying that they become net buyers of food much later in the year than those in control villages.
3. The presence of cereal banking schemes becomes a disincentive to speculative arbitrage often carried out by middlemen, money and input lenders (Cortès and Carrasco, 2012, Kent 1998). In our model, "Middlemen" is a binary variable that captures the presence or otherwise of middlemen in a village. As can be seen from the DIM table above, middlemen are more active in pure control villages than in treated villages.
4. Similar to other research findings, the inter-seasonal price changes is much more significant for domestically produced food (millet and maize) as prices tend to change more than 50 - 300% between harvest to lean period in rural communities in developing countries. Compared to similar research (von Braun et al 1989, Barrett and Bhattamishra 2008), we found a slightly less, but significant inter-seasonal price change of 53% in treated villages and 84% in control villages.

Other village-level outcomes capture different dimensions linked to social capital formation. Ward Development Committee (WDC) membership is used here as a proxy for social capital (Jaimovich 2012), but the DIM is not conclusively different between treated and control villages, and neither is the DIM for the number of village-level self-help groups. This is against our expectation: research findings have shown that social safety nets enhance social capital and agency of vulnerable communities and groups (Banerji and Gentilini 2013). The argument is that safety nets such as cereal banking schemes provide platforms for debate on community actions, organising, management and interaction among participants. These, over time, enhance social networks internally and build the capacity to contribute to other community development initiatives[xii].

Beside the village difference, we also assess the average differences among households in treated and control villages for several variables. Literature has shown that increasing own-production is one of the most effective ways of reducing hunger in rural communities. For example, Ramirez concludes that a 1% increase in yields is associated with a 0.12% increase in the Human Development Index (Ramírez 2002 p7). From the data, we observe that households in treated villages are able to produce more food to feed their households for a longer period of the year than households in control villages[xiii].This may be explained by the following:

1. When food is made available during the hungry season, households can afford to invest more in inputs such as fertilizer. Similarly, several studies suggest that crop yields and profitability of farming activities respond positively to fertilizer application (Xu 2006, Akponikpe et al 2008). Our results show that whilst households that participate in cereal banking reported applying an average of 3 bags of inorganic fertilizer in the last cropping season, significantly different from households in the pure control villages who applied only 1.7 bags of fertilizer, a difference of 40%.
2. Ability to store food as in cereal banking reduces time spent in search for food during periods of scarcity at the expense of concentrating on own production (ActionAid 2009, Crola 2011). Indeed, the adoption of (often ineffective) coping strategies such as taking loans at high interest, hiring out own labour for payment is less pervasive in treated than in control villages.
3. These results and discussion are valid despite the impact on crop production being inconclusive, which we expected in the case of treated - partial control differences, but not in the comparison with the pure control group.

A typical strategy when food is short in supply is to decrease the number of meals. We observe in Table 3 that whilst only 10% of mothers reported their children skipping a meal (mainly the forth meal specifically left for children between Lunch and Dinner, known locally as "*Sitah*") in

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treated villages, 32% and 20% of pure and partial control households reported having their children skip a meal.

The implication of skipping meals, and more generally of food deficiency both in quantity and quality for children in children's first 1000 days can have long term effects on growth and cognitive abilities (Pangaribowo et al 2013, von Braun et al 1989). Unfortunately we do not have longitudinal data of our sample villages to capture long term growth and cognitive development. Thus we use the Mid Upper Arm Circumference (MUAC), one of the anthropometric measures of food and nutrition security. It is applied to children under five years as they are observed to respond more quickly to short term changes in food intake and quality (Pangaribowo et al 2013). The WHO guideline revised in 2013 suggest that in children who are aged 6 – 59 months, severe malnutrition be defined as Weight-for-height of ≤-3 Z score or MUAC of < 11.5cm. Whilst weight–to-height measure may be more appropriate for measuring age specific differences, MUAC is simpler and has a superior correlation to risk of death (WHO 2013, p25). It is also cheaper to use especially in measuring short term and emergency phenomena than other measures of malnutrition. According to Myatt et al 2006, MUAC is less prone to mistakes and interviewers influence. In WHO 2013 recommended cut off points Severe acute malnutrition below 11.5 cm MUAC, moderate acute malnutrition for 11.5 to 12.5 cm MUAC, risk of malnutrition for 12.5 to 13.5 MUAC and well-nourished for above 13.5 MUAC (WHO 2013, Biswas et al 2010). We use a dataset of 366 children aged between 1 – 5 years old from the sampled households. The average MUAC reading for the children in our sampled villages is 14.0cm. This implies that 21.8% of the children in our sample suffer from moderate to acute levels of malnutrition (MICS 2010, Mwangome Martha et al 2012). This is similar to the national average of 22% in 2006 (MICS 2006). The average MUAC readings and the proportion of children, who are severely malnourished, show significant differences between households in treated, pure and partial control villages respectively. The results show that only 8.7% of children in treated households are severely malnourished whilst 11.2% and 21.82% are severely malnourished in households from partial and pure control villages respectively. It is often observed that children respond quickly to even short term changes in food intake and as such these differences may be attributed to food availability, skipping of meals and intake differences during the critical lean period (Pangaribowo et al 2013) which may adversely affect energy and micronutrient deficiency.

Contrary to our expectations, our results in Table 3 show that cereal banking does not have much impact on wealth. Our Wealth Index, which sums up livestock, housing, farming implements and domestic assets, is higher in partial control villages than in both treated and pure control villages, and the difference between treatment and pure control villages is not significant. This suggests that cereal banking has little impact or that the impact of cereal banking on wealth may only be

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realised after implementing the scheme for a while. Alternatively, the increase in disposable income (due to the lower "consumer" prices in the hungry season and higher "producer" prices at harvest time) might not be invested but consumed in necessities. Our data does not allow investigating this further. The adoption of cereal bank nonetheless shows a positive association with higher fertilizer application, though only significantly different between treated and pure control villages. This may reflect the spill over effect of the CDDP scheme on further investment in agricultural production rather than the pure impact of the cereal banking scheme.

5.2 Estimating the Average Treatment Effect on the Treated

Given the stratification, randomization and successful matching, a cross-sectional econometric regression using Ordinary Least Square Estimation (Olken 2012) can then be implemented to estimate the actual impact of cereal banking on treated households, controlling for village and household level characteristics. This is similar to estimating the Average Treatment Effect on the Treated (ATET) or the Intention to Treat (ITT) (Arcand et al 2010, Duflo et al, 2002, 2007).

Our regression models at village level are estimated with;

$$\mathbf{Y(i) = \alpha(w) + \pi V(i) + \beta T(i) + \varepsilon(i) \dots\dots\dots\dots\dots\dots..(1)}$$

$$\mathbf{Y(i) = \alpha(w) + \pi V(i) + \beta T(i) + \Phi CDDP(i) + \varepsilon(i) \dots\dots\dots\dots\dots\dots..(2)}$$

So the village outcome variable **Y** for village i is regressed on a vector of village level characteristics (V), a Cereal Bank dummy (T = 1 if treated, 0 otherwise), and εi is the error term. In equation 2, we add a CDDP dummy also taking values 1 if the village received funding by CDDP and 0 if otherwise.

At household level our models are estimated with;

$$\mathbf{Y(hi) = \alpha(h) + \pi V(i) + \beta T(i) + \Upsilon H(hi) + \varepsilon(hi) \dots\dots\dots\dots\dots\dots..(3)}$$

$$\mathbf{Y(hi) = \alpha(h) + \pi V(i) + \beta T(i) + \Phi CDDP(i) + \Upsilon H(hi) + \varepsilon(hi) \dots\dots\dots\dots\dots\dots..(4)}$$

where Yi is a random variable measuring the outcome of interest for household (h) in village (i). V and H represent a vector of village and household characteristics respectively, Ti indicates the treatment status of village (i) (i.e. Ti = 1 if the village or household (i) participates in a cereal banking scheme and Ti = 0 if the household or the village does not. The CDDP in equation (4) captures the CDDP dummy as in equation (2), εi is a random unobserved "error" term which is assumed to be independently and identically distributed. The parameters α is the baseline outcome, π estimates the influence of village characteristics, β is our impact variable at village

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level accounting for the mean differences in outcome between treated and control groups. Y is the impact of cereal banking on households in communities with and without cereal banking.

The explained variables are selected to show dimensions of food and nutrition security that are important in rural food and livelihood security. The length of the hungry season and food price dispersions from harvest to lean period (where food unavailability and prices are at their minimum and maximum, respectively) are basic structural livelihood challenges that rural communities in The Gambia suffer due in part to characteristics of a community as well as households in a community (WFP 2011, von Braun et al 1989). The ability of a household to produce enough food to feed its members, or the stability of a household's access to food are key challenges measured at the household level. Finally, the intake of sufficient and nutritious food is best evaluated at the individual's level, even better for the most household's most vulnerable members – the children. The independent variables are drawn from the list of potential regressors presented in Table A2 in the Appendix.

In addition, we estimate our treatment effect using district fixed effects as a means to control for time invariant area specific characteristics that may affect the choice of cereal banking in a village (Olken 2012). For our case, fixed effects were important to capture among others effects such as leadership quality, elite capture, biophysical attributes, etc. Such exogenous attributes naturally partly determine the choice and impact of cereal banking. We expect that such estimation will enhance the precision of our estimates.

We now turn to the estimation of the treatment effect on the treated using regressions. This analysis focuses on five outcome variables linked to different dimensions of food security. As the treatment is applied at village level, but the FNS outcomes of interest often play out at household or individual level, we show results for the ATET on several outcomes. We start with two village level outcomes – namely the length of the food gap and inter-seasonal food price variability. The former is an indicator of village level food availability and accessibility, the latter is a key determinant of village level accessibility and a proxy for village level accessibility in the context of community grain reserves. We also present two ATET at household level outcomes, namely households' food self-sufficiency and the variation in the quantity of food used by households. They are linked to food availability and the stability of access to food at the household level, respectively. Finally, we report the ATET on nutrition at the individual level, captured here by the Mid Upper Arm Circumference (MUAC) of children under five.

5.2.1 ATET of the Food gap

The Food Gap indicates the number of months in the year households reported having significantly low food or means to buy food on average (see Maxwel and Smith 1992). Food deficit households and communities in the Gambia typically suffer a food gap during the hungry season when grains are no longer available in the household and are too expensive for them to purchase on the market (WFP 2011). This affects food and micronutrient intake as well as farm investments and yields. Such a structural or seasonal food and nutrition insecurity can have very long lasting impacts, on health, physical and cognitive development, even if each episode is of rather short duration. It inhibits the accumulation of all types of capital, including human capital, and thus undermines development at the national and regional scale. The Food Gap is a measure of household food availability and inaccessibility. As it is measured by the number of months of acute food scarcity, this is here reported as a village-level indicator since within village differences are less pronounced than across villages. In addition, in the presence of informal networks, households within the same village may support each other with loans which may help cushion the impact on individual households (Jaimovich 2012). Thus, we use the average of the household responses in each of the villages in our sample. We therefore regress the Food Gap on village level characteristics, as per equations 1 and 2 above. The results of different specifications are presented in Table 4.

Table 4: Impact of the treatment on the length of the food gap – OLS regressions

	(a)	(b)	(c)	(d)	(e)
VARIABLES	Food gap Treatment Dummy	Food gap CDDP Dummy	Food gap District FE	Food gap Pure Cont plus FE	Food gap Part. Cont plus FE
Treatment	-0.515** (0.194)	-0.473* (0.214)	-0.470* (0.216)	-0.509* (0.250)	-0.366 (0.322)
CDDP Dummy	No	-0.082 (0.175)	No	No	No
District Fixed Effects	No	No	Yes	Yes	Yes
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Observations	112	112	112	73	71
R-squared	0.40	0.40	0.50	0.54	0.54

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The results show that cereal banking leads to a reduction in the length of the food gap by about half a month. This impact is statistically significant for all specifications, except when looking at the treatment and partial control groups specifically (column (e)). The prices of food crops during the lean period (July – September) also significantly increase the food gap, with and without fixed effects. Thus, managing inter-seasonal prices is sure to reduce the hungry season in rural areas of The Gambia.

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The CDDP intervention though reducing the food gap does not significantly do so. This may be explained by the fact that the CDDP had a variety of community subprojects some of which may not have a direct and immediate impact on food production and consumption smoothing. The use of fixed effects is important in the sense that it increases the share explained variation in our dependent variable,l as shown both by a higher R^2. . It also addresses partly the endogeneity issue.

5.2.2 ATET of Price variability

Food accessibility at village level is proxied by inter-seasonal changes in prices of the three major crops in The Gambia[xiv]. In Amartya Sen's book "Poverty and Famines" in 1981, he argued that the problem of hunger or food insecurity is not only about food availability; there could be structural issues that deny access to food for some people even when food is available (Sen, 1981). Thus, some of the key indicators of food insecurity include household income, food prices and household expenditure.

High food prices during the lean period inhibit food-deficit poor households from buying and consuming adequate amounts of food (Gilbert 2012). At such high prices, rural poor households often adopt strategies such as reducing frequency of meals and quantity of food consumed, or forego other basic needs, taking loans or hiring out their own services for wages that can be used for the purchase of food. This can further exacerbate their indebtedness and poverty (Action Aid 2009). We rely on the inter-seasonal price variability between the lean and harvest periods to capture the impact of prices on food accessibility at the village level. This variation is relevant, as it is precisely on this price and consumption smoothing that we assume cereal banks have the most direct impact. To capture changes in inter-seasonal price variability, we estimate a price variability model defined as

$$\mathbf{Log(P_l - P_h) = \alpha(w) + \pi V(i) + \beta T(i) + \delta CDDP\,(i) + \varepsilon(i)}$$

where Pl and Ph are prices of food crops during lean period and harvest period respectively, V(i), T(i), and CDDP(i) are as defined above. The results of various specifications of the above equation are presented in Table 5.

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Table 5: Impact of the treatment on food Price Variability – OLS regressions

VARIABLES	(1) Log Price Var Treatment Dummy	(2) Log Price Var CDDP Dummy	(3) Log Price Var District Fixed Effects (FE)	(4) Log Price Var Pure Cont plus FE	(5) Log Price Var Part Cont plus FE
Treatment	-0.412***	-0.406***	-0.436***	-0.435**	-0.411**
	(0.121)	(0.132)	(0.121)	(0.179)	(0.172)
CDDP Dummy	No	-0.0116	No	No	No
		(0.0986)			
District Fixed Effects	No	No	Yes	Yes	Yes
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Observations	113	113	113	74	71
R-squared	0.593	0.594	0.669	0.717	0.701

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Our results in Table 5 show that cereal banking lead to a significant reduction in the inter-seasonal food price deviation from harvest to lean period (the treatment effect). The coefficient indicates that on average, there is a reduction of at least 41% in the inter-seasonal price changes due to cereal banking. Similar to other research findings, our results further show that the speculative behaviour of middlemen (proxied here by the number of middlemen present in the village) increases inter-seasonal food prices variability. The influence of middlemen in local level marketing, prices and food security is a debate, with most evidence showing that middlemen exploit farmers and erode profits. For example, (Cortes and Carrasco, 2012) argued that the intervention of middlemen raises buying prices for consumers and reduce selling prices for producers, lessening the profit margins farmers get from their farm produce. Often their engagement in temporary arbitrage (Kent 1998) may also have a positive influence on increasing prices during the lean period. This may have a negative effect on the food security of farmers who shift from being net seller at harvest to net buyers during the lean periods (Barrett and Bhattamishra 2008).

With regards, the district dummies used in the fixed effects model, our results show the importance of double cropping which is applicable for district 9, 4 and 5 out of 12 districts used in our sample. The results show a higher reduction of inter-seasonal price deviation as well as the food gap for for these districts based on district 1. Similarly, we also observe higher precision in the estimate, as shown by the R^2 increase indicating the presence of village specific fixed effects.

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Unlike most literature, we observe that distance of a village to the main road reduces price variability. This implies that villages on or close to the road suffer more price increases than villages off the road. This goes against earlier research findings that the remoteness of villages increases the cost of relying on the market, due in part to transaction cost of travelling or transportation (Daviron and Douillet 2013).

5.2.3 ATET of Food self-sufficiency

Food self-sufficiency, which is measured by the number of months households rely on their own produce for their food consumption needs, is an important driver to food security especially in rural communities in developing countries (Deb et al 2009). This is even more so in the face of recurrent global food crises, which worsen the issue of accessibility and make availability of grain at the household level all the more important. The regression results of Table 6 show the impact of the treatment on this household level indicator of food availability. a positive and significant treatment effect of cereal banking on household food self-sufficiency.

Table 6: Impact of the treatment on households' food self-sufficiency – OLS regressions

VARIABLES	(1) Self-Sufficiency Treatment Dummy	(2) Self-Sufficiency CDDP Dummy	(3) Self-Sufficiency District FE	(4) Self-Sufficiency Pure Cont plus FE	(5) Self-Sufficiency Part Cont plus FE
Treatment	0.182**	0.0883	0.160**	0.168*	0.141
	(0.0704)	(0.0786)	(0.0800)	(0.0961)	(0.0853)
CDDP Dummy	No	0.218***	0.0401	No	No
		(0.0838)	(0.0862)		
District Fixed Effects	No	No	Yes	Yes	Yes
Other Control Variables	No	No	Yes	Yes	Yes
Observations	459	459	459	294	327
R-squared	0.281	0.295	0.389	0.450	0.390

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The positive treatment effect implies that cereal banking enhances food self-sufficiency, across all specifications by at least 8.83%. When the CDDP dummy is introduced in model (b), the results show a positive and significant impact of CDDP on food self-sufficiency. We also observe negative influence of coping strategies, food and education expenditure on food self-

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sufficiency whilst revenue sources being from own production positively influences food self-sufficiency.

The key policy implication is that cereal banking enhances the capacity of smallholders to be food self-sufficient. We also estimate the ATET using district level fixed effects. Similar to Olken (2012), this was incorporated to reduce the potential bias from unobservable time invariant village characteristics confounding the results of our estimation. The estimation with fixed effects produces similar results to that without fixed effects. However, the results show a positive and significant impact of irrigation-enabled double cropping on food self-sufficiency. District 4 and 9 are rice growing areas that have access to Tidal Irrigation Infrastructure (Ceesay 2004, Carney et al 1992).

5.2.4 ATET of Food Stability

Using an Ordered Logit, we estimate the effect of cereal banking on the stability of the quantity of food used for household consumption at the time of the interview (during the lean period) relative to the harvest period. Change in food quantity consumed by the household is a self-reported categorical variable indicating the extent to which the quantity of food consumed by the household has changed during the hungry season captured in a scale 1 -5 as; increased very significantly, increased slightly, remain the same, reduced slightly, reduced significantly thus 1 indicates more stability whilst 5 indicates high instability Both the CDDP dummy and estimations using district fixed effects show a significant negative impact of the CDDP on reducing food instability. The results of this regression of a household level indicator of FNS stability are presented in Table 7.

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Table 7: Impact of the treatment on the variation of food quantity used by the households – ordered logit regressions

VARIABLES	(1)	(2)	(3)	(4)	(5)
Change in Food Quantity (Harvest – Lean period)	∇in Food Qty Treatment Dummy	∇ in Food Qty CDDP Dummy	∇ in Food Qty District Fixed Eff	∇ in Food Qty Part Cont plus FE	∇ in Food Qty Pure Cont plus FE
Treatment	-1.160***	-1.320***	-1.142***	-0.542*	-1.388***
	(0.201)	(0.220)	(0.215)	(0.279)	(0.255)
CDDP Dummy	No	-0.421*	No	No	No
		(0.224)			
District Fixed Effects	No	No	Yes	Yes	Yes
Other Control Variables	No	No	Yes	Yes	Yes
Observations	452	452	452	289	322
R2	0.0748	0.0773	0.1135	0.1352	0.1283
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1				

Our results show a negative treatment effect of cereal banking on food quantity instability. This implies that cereal banking significantly reduces household food instability. This is also true for access to double cropping and food self-sufficiency showing positive influence of irrigation for district 4 and 9. On the other hand, hiring out own labour and having large household sizes tend to increase food instability.

5.2.5 ATET of MUAC

The treatment effect on the level of nutrition measured by the Mid-Upper Arm Circumference (MUAC) score is positive (at least 0.488) and that this difference between the MUAC score of children in treated households is significantly different from children of households without. Whilst we do not observe a significant impact of the CDDP on nutritional level of children, the results show that in districts where there is tidal irrigation, children seem to be better nourished. The number and frequency by which households employ food related coping strategies such as skipping of meals has a negative impact on the level of nutrition whilst polygamy and illiteracy of household head negatively impacts on nutrition level.

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Table 8: Impact of the treatment on the nutrition of children under 5 years of age – OLS regressions

VARIABLES	(1) MUAC Score Treatment Dummy	(2) MUAC Score CDDP Dummy	(3) MUAC Score District FE	(4) MUAC Score Pure Cont plus FE	(5) MUAC Score Part Cont plus FE
Treatment	0.668** (0.215)	0.488* (0.237)	0.710** (0.219)	1.032** (0.315)	0.491* (0.217)
CDDP Dummy	No	0.451 (0.252)	No	No	No
District Fixed Effects	No	No	Yes	Yes	Yes
Other Control Variables	Yes	Yes	Yes	Yes	Yes
Observations	366	366	366	239	261
R-squared	0.47	0.48	0.55	0.59	0.60
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1				

This result confirms recent literature and empirical findings supporting the need to adjust the MUAC cut-off point to respond to age (WHO 2013, Onis et al 1997 WHO and UNICEF 2009). The level of malnutrition in children as measured by an unadjusted MUAC cut-off mark of 11.5cm indicates that malnutrition reduces with age of children. However, unlike our age-MUAC interaction, we do not observe any significant difference between male and female children in their MUAC scores although females tend to have a lesser MUAC scores than male children. Like other studies, we observe that the literacy of household head significantly improves the nutritional status children. However, we observe a slightly lower level of malnutrition in less than one year olds than 2-years old. Similar results in Mahgoub, Nnyepi and Bandeke 2006, were attributed to care giving (breastfeeding) being more in younger ages. We found this argument plausible for our case though we do not have data to prove this claim. In addition to the MUAC for age categorisation, we also undertake a MUAC for sex comparison. Unlike (Choudhury et al 2000) who found a significant MUAC gender gap in Bangladesh, our MUAC - gender interactions results were not dissimilar among male and female under-five year old children.

6. CONCLUSION

The extent to which markets can be relied upon to provide for the food security needs of the rural poor in developing countries have been questioned, given the recurrent food crisis and market failures. Having safety nets to protect vulnerable communities is thus crucial. We attempted to

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evaluate the impact of cereal banking as a community food reserves strategy by comparing FNS outcomes between treated and control villages and households.

Our results vividly support our hypothesis that cereal banking is important for enhancing the food and nutrition security of communities in the key dimensions of food availability, accessibility and stability. In the rural areas of The Gambia, as in many other rural areas of developing countries, food availability and prices are important FNS drivers.

Reducing both food price variability and the food gap by more than 31% and 25% respectively is important for enhancing food intake stability, reducing malnutrition and improve investment. This positively impacts on the capacity to feed from own production, building livelihood assets and enhancing the long term resilience of participating communities (Crola 2011, IPCC 2007).

Despite the benefits accrued from operating and sustaining cereal banking, there are also costs to communities, households and individuals from starting and sustaining cereal banking schemes. These costs include building of storage facilities, capital to start the scheme (seed money), storage and other operating costs, loss in grains value from storage and risk of embezzlement (ECOWAS Commission 2012). Our FGDs indicate that storage and operating cost can vary between 15 – 25% of the cost of cereals. This is still less than average inter-seasonal price changes of (53 – 84%). Inaddition, whilst community cereal banking schemes may be effective in addressing inter-seasonal price variations and idiosyncratic risks, they can be less effective in the face of covariate risks, especially climate risks. In addition to risk of embezzlement, there is a high failure rate in such circumstances. In such instances, some form of recapitalisation is required.

Cereal banking enhances the capacity of smallholders to be food self-sufficient. The treatment effect of cereal banking on food self-sufficiency is positive and significant implying that cereal banking enhances food self-sufficiency by an average of 11.6%.

The results show that whilst only 8.7% of children in treated households are severely malnourished, 11.2% and 21.82% are severely malnourished in households from partial and pure control villages respectively. Children respond quickly to even short term changes in food intake and as such these differences may be attributed to food availability, skipping of meals and intake differences across households in treated and control villages during the critical lean period (Pangaribowo et al 2013)

The Propensity score matching shows the importance of targeting in the choice and sustainability of cereal banking schemes. Cereal banking schemes are more viable in food deficit communities and, when accompanied for a while, they often lead to more credit making ventures, CBO formation and scaling up into a village saving scheme. Funding agencies and project developers must recognise these differences to prioritise and optimise investments.

Cereal banking enhances the ability of villages to forge networks and build their capacity to participate in other development interventions. Compared to food aid or humanitarian aid, cereal banking is more engaging and builds the capacity, agency and livelihoods of vulnerable people. It facilitates grassroots level, participation empowerment and ownership by affected households. Thus, it can be an effective and participatory channel for food aid delivery during drought. This is even more important since price and climate risks are recurrent occurrences (Cortès and Carrasco, 2012).

Cereal banking at community level present advantages over national and regional level stocks at reflecting local dimensions, priorities and preferences and in terms of food reserve purposes, management and responsiveness to shocks. Whilst food reserves at a more macro level may be challenging in terms of logistics, management and financial requirements to initiate, implement, manage and sustain, community cereal banks present some unique advantages and features. The logistical and decision-making requirements may be less cumbersome in community cereal banking schemes than at national level. Being closer to vulnerable communities implies less transportation and other administrative costs (Coulter, 2009).

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REFERENCES

Abebaw, D. and Haile, M. G., (2013). "The Impact of Cooperatives on Agricultural Technology Adoption: Empirical Evidence from Ethiopia". Food Policy, Vol. 38, 2013.

Action Aid (2011), "No More Food Crises: The Indispensable Role of Food Reserves" www.actionaid.org

Akponikpe P.B.I, Michels K., and Bielders C.L., 2008, "Integrated nutrient management of Pearl Millet in the Sahel combining Cattle manure, Crop residue and Fertilizer". Exp Agric 44:453-472Angrist J.D and Pischke J.S., 2009., "Mostly Harmless Econometrics: An Empiricist's Companion" Princeton University Press

Arcand, J.L., Cen, Y.P., He, Y., Diop, C. I. F., Wouabe, E. D., Garbouj, M., Jaimovich, D., and Zec, S. (2010), "The Gambia CDDP baseline: rural house-hold survey, qualitative survey, village network survey," Tech. rep., The Graduate Institute, Geneva, Switzerland

Aryeetey E., and Udry C., 2000. "Saving in Sub-Saharan Africa"Cambridge Center for International Development at Harvard Working Paper no. 38,

Baker, J. L., 2000. "Evaluating the Impact of Development Projects on Poverty: A Handbook for Practitioners", Washington D.C.: LCSPR/PRMPO, The World Bank

Barrett, C.B. 1996. "Urban bias in price risk: The geography of food price distributions in low income economies," The Journal of Development Studies, 32: 830-849

Barrett C.B., and Bhattamishra R., 2008, "Community-Based Risk Management Arrangements: A Review", World Development Vol. 38, No. 7, pp. 923–932, 2010

Basu K and Wong M., 2012, Evaluating Seasonal Food Security Programmes in East Indonesia

Bhattamishra, R. (2012). Grain Bank Survival and Longevity: Evidence from Orissa. The Journal of Applied Economic Research, 6(3), 311-336.

Brooks, N., 2003. Vulnerability, risk and adaptation: a conceptual framework. Working Paper 38, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich.

Banerji, A., & Gentilini, U. (2013). Social Safety Nets: Lessons from Global Evidence and Practice. In *Bank of Namibia's Annual Symposium on Social Safety Nets in Namibia, Windhoek, September* (Vol. 26).

Biswas S, Bose K, Mukhopadhyay A, Bhadra M. 2010. Mid-upper Arm Circumference Based Under nutrition among Bengalee Children of Chapra, West Bengal, India. Iran J Pediatr ; 20(1): 63 - 68.

ISSN: 2455-6939

Volume:03, Issue:02 "March-April 2017"

Beer F 1990, Cereal Banks in Niger , The Centre for Research on Economic Development, The University of Michigan pdf.usaid.gov /pdf_docs/PNABH198.pdf

Caliendo , M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of economic surveys*, *22*(1), 31-72.

Carney, J. A. (1992). Peasant women and economic transformation in The Gambia. Development and Change, 23(2), 67-90. *Chabe-Ferret, S. (2010), To Control or Not to Control? Bias of Simple Matching vs Difference-In-Difference Matching in a Dynamic Frame-work. mimeo*

Ceesay, M. M. (2004). Management of rice production systems to increase productivity in The Gambia, West Africa (Doctoral dissertation, Cornell University)

Compton, J., Wiggins, S., & Keats, S. (2010). Impact of the global food crisis on the poor: what is the evidence. London, ODI, 99.

Cortès, G. P., & Carrasco, I. G. First Line of Defence: Assessing the potential of local food reserves in the Sahel. Oxfam.http://www.oxfam.orgsites/www.oxfam.org/files/

Coulter, J. (2009) 'Review of Warehouse Receipt System and Inventory Credit Initiatives in Eastern & Southern Africa', UNCTAD, All ACP Agricultural Commodities Programme (AAACP).

Crola, J. D. (2011). Preparing for Thin Cows: Why the G20 should keep buffer stocks on the agenda. Oxfam Policy and Practice: Agriculture, Food and Land, 11(5), 57-75. http://www.oxfam.org/sites/www.oxfam.org/files/bn-preparing-thin-cows-food-reserves-210611-en.pdfwww

Daviron, B., & Douillet, M. 2013, Major players of the international food trade and the world food security. FOODSECURE working paper no. 12 (No. 12).

Deb, U., Hossain, M., & Jones, S. (2009). Rethinking food security strategy: self-sufficiency or self-reliance. UK Department for International Development, 2, 34. Deressa, T., Hassan, R. M., & Ringler, C. (2008). Measuring Ethiopian farmers' vulnerability to climate change across regional states. Intl Food Policy Res Inst.

Duflo, E., & Saez, E. (2002). The role of information and social interactions in retirement plan decisions: Evidence from a randomized experiment (No. w8885). National Bureau of Economic Research.

ISSN: 2455-6939

Volume:03, Issue:02 "March-April 2017"

Deaton, A. 1990. "Saving in Developing Countries: Theory and Review". World Bank Econ. Rev., Proceedings of the World Bank Annual Conference on Development Economics, 61-96.

Dercon, S. (2002), 'Income Risk, Coping Strategies and Safety Nets', World Bank Research Observer, vol. 17, 141-166.

Ericksen P, Thornton P, Notenbaert A, Cramer L, Jones P, Herrero M. 2011. Mapping hotspots of climate change and food insecurity in the global tropics. Report no. 5. CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.Ericksen .cgiar.org.

ECOWAS Commission 2012 Regional Food Security, http://documentation.ecowas.int/Reserve download/en/legal documents/regulations/

FAO 2011, The State of Food Insecurity in the World, How does international price volatility affect domestic economies and food security?

Gertler, P. J., S. Martinez, P. Permand, L. B. Rawlings, and C. M. J. Vermeersch 2011 Impact Evaluation in Practice. Washington DC: World Bank

Gilbert, C. L. (2012). International agreements to manage food price volatility. Global Food Security, 1(2), 134-142.

Gouel, C. (2013). Food price volatility and domestic stabilization policies in developing countries (No. w18934). National Bureau of Economic Research.

Government of The Gambia, 2003, Integrated Household Survey 2003/2004, www.gbos.gov.gm/Surveys

Government of The Gambia 2010, Integrated Household Survey www.gbos.gov.gm/Surveys

Heckman, J., Ichimura, H., Smith, J., & Todd, P. (1997). Characterizing selection bias using experimental data (No. w6699). National bureau of economic research. Heltberg, R., Siegel, P. B., & Jorgensen, S. L. (2008). Addressing human vulnerability to climate change: toward a 'no-regrets' approach. Global Environmental Change, 19(1), 89-99.

Huchet-Bourdon, M. (2011). Agricultural commodity price volatility (No. 52). OECD Food, Agriculture and Fisheries Working Papers.

Institute for Agriculture and Trade Policy (IATP) 2012, Grain Reserves and the Food Price Crisis: Selected Writings from 2008–2012,

Integrated Regional Information Networks (IRIN). 2008. Niger: Are Cereal Banks Best Option to Fight Hunger? Humanitarian News and Analysis: http://www.irinnews.org/report.aspx?reportid=80953 (accessed on 10 August, 2011)

ISSN: 2455-6939

Volume:03, Issue:02 "March-April 2017"

Ivanic, M., & Martin, W. (2008). Implications of higher global food prices for poverty in low-income countries1. Agricultural economics, 39(s1), 405-416. [IPCC] Intergovernmental Panel on Climate Change. (2007). Climate change 2007: impacts, adaptation and vulnerability. Jaimovich, D. (2011). Missing links, missing markets: Evidence of the transformation process in the economic networks of Gambian villages.

Kalkuhl, M., Kornher, L., Kozicka, M., Boulanger, P., & Torero, M. (2013). Conceptual framework on price volatility and its impact on food and nutrition security in the short term (No. 15). FoodSecure Working Paper.

Kandji, S. T., Verchot, L., & Mackensen, J. (2006). Climate change and variability in the Sahel region: Impacts and adaptation strategies in the agricultural sector. World Agroforestry Centre. Kent, L. (1998) Why cereal banks rarely work: A summary of findings. http://www.foodaid.org/pdfdocs/cmgmt/grainstoragesummary.pdf

Khandker, S. (2009). Poverty and Income Seasonality in Bangladesh. Policy Research Working Paper No: 4923, The World Bank, Washington, D.C.

Laborde,D. Tokgoz S., and Torero M., 2013, Long-Term Drivers of Food and Nutrition Security FOODSECURE working paper 06

Maxwel S., and Smith M., (1992): Household Food Security: Conceptual indicators and measurements: A technical review. UNICEF, New York and IFAD, Rome: 1-52.

Morris S., Carletto C, Hoddinott J, Christiaensen L., 1999, Validity of rapid estimates of Household Wealth and Income for Health surveys in Rural Africa FCND DISCUSSION PAPER NO. 72

Msaki M.M, Mwenda M.I, Regnard .I.J, 2013, Cereal Bank as a necessary rural livelihood institute in arid land, Makoja village, Dodoma-Tanzania, Asian Economic and Financial Review, 2013, 3(2):259-269

Mwangome, M. K., G. Fegan, T. Fulford, A. M.Prentice and J. A. Berkley (2012). "Mid-upper arm circumference at age of routine infant vaccination to identify infants at elevated risk of death: a retrospective cohort study in the Gambia." Bull World Health Organ 90 (12): 887-894

Olken B. 2012, Monitoring Corruption: Evidence from a Field Experiment in Indonesia, The Journal of Political Economy, Vol. 115, No. 2 , pp. 200-249

Onis de M, Blossner M.1997, WHO global database on child growth and malnutrition. Geneva, World Health Organization, WHO/NUT/97.4)

Pangaribowo, E.H., Gerber, N. and Torero, M. 2013 Food and Nutrition Security Indicators: A Review FOODSECURE working paper 05

Pieters H., Guariso A., Vandeplas A. 2012 Conceptual framework for the analysis of the determinants of food and nutrition security FOODSECURE Working paper no. 13

Ravallion M. 2003, Evaluating Anti-Poverty Programmes Development Research Group, World Bank

Rosenbaum, P. and Rubin, D.B.(1983) "The Central Role of the Propensity Score in Observational Studies for Causal Effects,"Biometrika, vol. 70, no. 1, 4155

Saaka M., and Osman M.S. 2013, "Does Household Food Insecurity Affect the Nutritional Status of Preschool Children Aged 6–36 Months?," International Journal of Population Research, vol. 2013, Article ID 304169, 12 pages, 2013. doi:10.1155/2013/304169

Sen, A., 1981. Poverty and famines: an essay on entitlement and deprivation. Oxford, Clarendon Press.

Shiferaw B., Kassie M., Jalet M., and Yirga C., 2014 Adoption of improved wheat varieties and impacts on household food security in Ethiopia, Food Policy 44 (2014) 272–284

Tadesse G, Algieri, Kalkuhl M., and von Braun J., 2013, Drivers and triggers of international food price spikes and volatility

Tiwari, S., Zaman, H., 2010. The impact of economic shocks on global undernourishment. World Bank Policy Research Working Paper Series, Vol.

Vicarelli M, 2010, Exogenous Income Shocks and Consumption Smoothing Strategies Among Rural Households in Mexico

von Braun J., 2011, Food price volatility and Food and Nutrition Security, Center for Development Research, University of Bonn

von Braun J, and Torero M., 2009, Implementing Physical and Virtual Food Reserves to Protect the Poor and Prevent Market Failure, International Food Policy Research Institute

von Braun J., and Tadesse G., 2012, Global Food Price Volatility and Spikes: An Overview of Costs, Causes, and Solutions, ZEF- Discussion Papers on Development Policy No. 161, Center for Development Research, Bonn, January 2012, pp. 42.ISSN: 1436-9931

von Braun, J., Puetz D., and Webb P.. 1989. Irrigation Technology and Commercialization of Rice in The Gambia: Effects on Income and Nutrition. No. 75. Washington, DC: International Food Policy Research Institute, August. http://www.ifpri.org/sites/default/files/publications/rr75.pdf

Warner, K., Afifi, T., Henry, K., Rawe, T., Smith, C., de Sherbinin, A. (2012). Where the Rain Falls: Climate Change, Food and Livelihood Security, and Migration. Global Policy Report of

ISSN: 2455-6939

Volume:03, Issue:02 "March-April 2017"

the Where the Rain Falls Project. Bonn: UNU and CARE. WHO 2013, Guideline: Updates on the management of severe acute malnutrition in infants and children Geneva: World Health Organization; 2013.

Wiggins S., and Keats S.,, 2009 Grain Stocks and Price Spikes, Overseas Development Institute

Wright B.,and Cafiero C., 2009, Grain Reserves and Food Security in MENA Countries, University of California, Berkeley

Wheeler T., and von Braun J., 2013 Climate change impacts on global food security. Science 134, 508 (2013) doi 10.1126/science.1239402

WFP 2011, Comprehensive Food Security and Vulnerability Analysis, www.wfp.org/.../comprehensive-food-security-and-vulnerability-analysis

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Appendix: Table A1. Variables used for the Propensity Score Matching

Variable	Description	Nature	Sources	Scale
Availability of fruit trees	Fruit trees available/population	Continuous	NASS 2007	Ward (Lumo)
Average household size	From census 2003	Continuous	Census 2003	Village (EA)
Average Rainfall	Averages from the MET stations in the districts taken for each villages	Continuous	DWR 1960-2012	District
Average Temperature	Mean of average temperature	Continuous	DWR 1960-2012	District
Coefficient of variation (Price)	Standard deviation/mean	Continuous	WFP 2005 - 2007	Ward (Lumo)
Coefficient of Variation (Rainfall)	Standard deviation/mean	Continuous	DWR 1960-2012	District
Connected & lowland villages	Distance of the village to Tarred roads & River Gambia	Categorical	NFA 2003, NEA GIS	Village
CV_Price * CV_Price	Interaction	Continuous	WFP 2005 - 2007	Village
Distance to market	Physical distance from village to closest lumo	Continuous	NASS 2007	Village (EA)
Dominant ethnicity (Fula)	Proportion of (Fula) households in a village	Ordinal	Census 2003	Village
Dominant ethnicity (Wollof)	Proportion of (Wollof) households in a village	Ordinal	Census 2003	Village
Ethnic Diversity	A measure of the proportion of different ethnicities in the village	Continuous	Census 2003	Village
Households without daily market (%)	Villages without established markets	Continuous	NASS 2007	Village (EA)
Households without electricity (%)	Including Solar energy sources	Continuous	Census 2003	Village
Households without Improve Transport (%)	As per source	Continuous	NASS 2007	Village (EA)
Millet Grown	As per source	Continuous	NASS 2007	Ward (Lumo)
Number of households	As per source	Continuous	Census 2003	District
Poverty * CV_Price	Interaction between poverty index and the price risks	Continuous	WFP 2005 - 2007	Village
Poverty Index	An index of the four variables compiled for CDDP eligibility	Continuous	Census 2003	Village
Price Index	A measure of the difference between national to local food price average	Continuous	WFP 2005 - 2007	Village
Proportion of crop farmers	Based on self-reported profession	Continuous	NASS 2007	Village (EA)
Proximity of the district capital	Measuring the distance of the village to the main city (Banjul)	Continuous	NEA (GIS)	District
Remote and upland villages	Distance of the village to Tarred roads and River Gambia	Categorical	NFA 2003, NEA GIS	Village

NB: EA is enumeration area, DWR is Department of Water Resources, NFA National Forest Assessment, NASS National Agricultural Sample Survey, NEA is National Environment Agency

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Appendix: Table A2. Explanatory Variables used for The Impact Evaluation

Food Security Dimension	Outcome	Description	Scale	Nature
Food availability	Food gap	Number of months of food gap	Village	Continuous
	Food Self Sufficiency	Number of months provided for by own farm produced	Household	Continuous
Stability	Changes of meals (quantity)	Relative assessment of changes in meal size	Household	Categorical
Accessibility	Price Variability	Log (Price at lean period – Price at harvest)	Village	Continuous
	Proportion of Food expenditure	Income spent on food	Household	Continuous
Nutrition	Anthropometric	MUAC reading as a measure of malnutrition in children.	Individual	Continuous

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Table A2: Variables used in Regressions							
	Control Variables	***Explained Varaibles***					
		Food Gap	*FoodPrice Variability*	*Food Self-sufficiency*	*Food Instability*	*MUAC*	***Description/Note***
Village Characteristics	*Distance of the village to main road*	√	√				*in Kms*
	Distance of the village to lower basic school		√				*in Kms (distance from tarred road)*
	Accessibility of village for vehicles		√				*No. of months village cannot be accessed by vehicles*
	Distance of the village to a health centre					√	*in Kms*
	Distance of the village to Weekly market	√	√				*in Kms*
	Distance of village to River Gambia	√	√				*in Kms ((used for fishing and irrigation)*
	Access to Lowland ecologies	√	√	√	√	√	*Distance to lowland ecologies*
	Abundance of land relative to village needs	√	√	√			*Pp. of HHs that borrowed land from others outside the village*
	Availability of forest resources	√	√		√		*Forest Area controlled in Ha*
	Main economic activity in the village(2nd)	√	√				*Crop Production, Livestock rearing, Fishing, Petty trading, Others)*
	Main crop cultivated	√	√	√			*Rice, Millet, Maize, Groundnut, others*
	Presence of middlemen	√	√				*As an alternative source of credit*
	Quarterly prices of crop	√					*Price of main crops average for the year*
	Number of Households in a village	√	√				*in Number*

	Main ethnic group in the village					√	*(Mandinka, Fula, Wollof and others)*
Household Characteristics	*Housing materials*					√	*Material used for the roof and floor*
	Index of household wealth(including livestock)				√	√	*Assets used for domestic purposes*
	% of land borrowed by Household			√	√	√	*in percentage*
	Access to double cropping			√	√		*Households having access to irrigation for double cropping*
	Remittances received				√		*In Dalasis*
	Pp of HH Expenditure on food, education, health & others		√	√		√	*Food, education, & health expenditure*
	Coping strategies used				√	√	*(Food and non food related)*
	Household engaged in hired labour			√	√	√	*Is any HH member engaged in hired labour*
	Children skipping meals			√	√	√	*Frquency at which chlidren skip meals*
	No. of HH members			√	√	√	*in Number*
	No. of male household members			√			*in Number*
	HH. Members in age categories			√	√		*(below 10 years, 10 - 20yrs, 20 - 30 yrs etc)*
	No. of HHs members who are farmers (with no other trade)			√			*in Number*
	Farming equipment own by Household			√			*Value of (sinehoe, seeders, ploughs etc)*
	Quantity of fertilizer applied last year			√	√	√	*Inorganic fertilizer in bags of 50kgs*
	Quantity of bags of main crop				√		*(No. of bags of rice, maize, millet, groundnut*

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	produced						*and others)*
Individual Characteristics	*Age of child*					√	*in months*
	Sex of child					√	*Male/Female*
	Education level of HH head			√		√	*Literate/not literate*
	Maraital statusof household head			√	√	√	*Polgamous, monogamous (with how many wives)*
	Age of household head			√	√	√	*in years*
	Gender of Household head			√	√	√	Male/Female

ENDNOTES

[i] Kuntaur (Central River Region-North) Janjabureh (Central River Region-South) and Basse (Upper River Region).

[ii] Irrigated area is less than 6% of arable land (FAOSTATS 2012)

[iii] Through Participatory Project Identification methods at village meetings, villagers choose which subproject to implement. Sub-projects including Farming Implements and Inputs, Vegetable Gardens, Ram Fattening, Draught Animals, Milling Machines, Water and Sanitation, Cereal Banking and others. Most categories were chosen by 5-10% of the villages, except for the first categories (Inputs, 40% of the villages).

[iv] The description of all the variables in given in Table A1 in the Annex.

[v] Our coefficients are expressed in odd ratios and not in marginal effects. The probability values indicate the level of significance for each of the variables used.

[vi] The price data is collected for 28 markets in the Gambia on a monthly basis, for the period 2005-2007.

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[vii] Improved transport systems captures households that use transport means (cars, carts, bikes) not walking on foot to market.

[viii] A review of the choice of subprojects for the CDDP show that most of the communities that live in the lowland, irrigated ecologies opted for production enhancement equipment; access to fields, gardening and not for cereal banking (CDDP Report, 2013).

[ix] Sample size was determined based on (Gertler et al 2003) .

[x] These figures report actual observations and exclude missing values.

[xi] The hungry period is characterised by low food availability, high food prices and coincides with the growing period. It often coincides with the months of July to September (IFAD 2011, FAO 2012).

[xii] Ward Development Committees were introduced in The Gambia as part of the Local Government Decentralisation Act of 2002, which attempted to devolve development planning and management to community level structures (GoG 2007).

[xiii] Feeding from own production is a categorical variable (1 being producing less than 5 months and 4 being producing food sufficient for more than 12 months of household food needs).

[xiv] Rice, millet and groundnut.

