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Land scarcity, resettlement and food security: Assessing the effect of voluntary resettlement on diet quality in Malawi

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Abstract

Food insecurity persists globally, with lack of access to farmland among the main factors contributing to chronic undernourishment. Population resettlement to areas of low density presents a possible but controversial solution to land scarcity. This paper examines the case of Malawi's Community Based Rural Land Development Project, a World Bank funded internal resettlement scheme for 15,000 participating households. Based on four months of fieldwork, including a survey of 200 households, 5 focus group discussions and 20 expert interviews, we assess how voluntary, internal, 'rural to rural' resettlement affects food security and nutrition through diet quality. Overall, we found that lack of wage labour opportunities and poor access to markets lowered food access (HDDS) among beneficiaries compared to non-beneficiaries (who did not participate in the resettlement scheme from the outset but were eligible), former beneficiaries (who had participated in scheme but had abandoned it by the time of the study), and national averages. Diet quality (IDDS) varied significantly according to resettlement location, as well as between beneficiaries and former-and non-beneficiaries, where overall, beneficiaries who were still living in their resettlement location at the time of the study had the lowest IDDS and therefore poorest diet quality. The regression results and the focus group discussions suggest that beyond access to infrastructure and markets, secure entitlements to training and farming inputs need to be sustained and improved in relocation areas to bring about positive food security outcomes for resettled populations.

Keywords Food security · Nutrition · Diet quality · Land reform · Resettlement · Community-driven development

Highlights
• Resettlement participants have lower HDDS, or access to food, than former and non-participants, which could reflect the remoteness of resettlement sites and lack of market access.
• Resettlement participants have lower IDDS, or diet quality, than former and non-participants, which could result from lower access to diverse food sources and limited ability to produce a wide range of foods for self-consumption.
• Access infrastructure, markets and farming inputs affect food security in voluntary resettlement schemes
• Voluntary resettlement schemes should account for changes in household income generation options and market access for both selling and buying food.

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1 Introduction

Approximately 815 million individuals worldwide suffered from hunger in 2016, nearly 30% of whom were living in sub-Saharan Africa (FAO et al. 2017). Food insecurity - a lack of access to safe, adequate and nutritious (including diverse) foods to sustain a life that is both healthy and active (World Food Summit 1996) - is a major cause of mal-and-undernutrition. Rather than a result of lack of calories, food insecurity often reflects poor quality diets (Ruel 2002): a poor *quality diet* is a major problem for individuals in developing nations relying on starchy staples with little access to animal products or produce (Ruel 2003; Swindale and Bilinsky 2006). It is common amongst rural sub-Saharan African households, notably because even with agro-diversity, subsistence farming in land scarce areas leaves many families with insufficient produce to meet their consumption needs (Conelly and Chaiken 2000).

To address food insecurity, some governments have turned to voluntary resettlement, where they provide households with plots larger than those in their current possession, with the aim of increasing food production. In Malawi, domestic authorities and international donors supported an initiative to reallocate land from large-scale commercial export crop operations, such as idle farms cultivating tobacco, to individual households farming small plots for subsistence and local markets. The research presented below examines the effects of one such voluntary resettlement programme on the food security and diet quality of its 'beneficiaries.' The Community-Based Rural Land Development Project (CBRLDP) moved 15,000 low-income farming households internally within southern Malawi between 2004 and 2011. Although controversial, resettlements programmes may receive further support in the future, especially if the resettlement follows a voluntary process and takes into account the many factors that can influence the success of such initiatives (see Sharp et al. 2019). Here, we compare the relative food security of different groups, as measured in terms of food access, diet quality, and relation with a resettlement scheme. We also identify and discuss factors associated with food security and dietary quality outcomes. This study is among the few to examine the impacts of resettlement on diet quality (see also Shack et al. 1990; Kinsey 1999; Santos et al. 2014), a critical component to human health and development, and ending the poverty cycle.[1]

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[1] Shack et al. (1990) find that resettlement in Papua New Guinea increased the diversity of nutrient intake through food purchases. Kinsey (1999) notes that there is a decrease in nutritional status amongst land reform children in Zimbabwe as they become more vulnerable to drought-related shocks. Santos et al. (2014) also suggest that the distribution of micro-plots to women in West Bengal is likely to be positive, if slow, due to improved land tenure, investments in agriculture and greater women's involvement in farming.

2 Food security, diet quality and land reforms in Malawi

Malawi's population is among the least urbanized in the world, with 84% of its 18 million inhabitants living in rural areas (The World Bank 2015a). The agricultural sector employs about 80% of the population, mostly in subsistence farming that lacks irrigation (only 5% of farmland is irrigated) (Reynolds 2000). The country also faces severe population pressure: density averaged nearly 175 inhabitants per square kilometre in 2014, making it the ninth most densely populated country in Africa (The World Bank 2015b). An estimated 70% of small scale households cultivate less than 1 ha (IFAD 2011; Chirwa and Matita 2012), with land holdings in the most populous Southern region as low as 0.1 ha per capita (Tchale 2009). This situation has left rural populations susceptible to food insecurity.

2.1 Food security policies in Malawi

The Government of Malawi's (GoM) efforts to address food security have largely focused on increasing agricultural productivity through the Farm Input Subsidy Program (FISP), which provides rural households with subsidized fertilizer and maize seeds through a coupon system distributed by traditional authorities. Launched in 2005, FISP accounted for 74% of the Ministry of Agriculture and Food Security budget and 16% of the national budget by 2008/9 (Dorward and Chirwa 2011). The programme was initially criticized for its focus on increasing maize production - which already accounted for 90% of cereals produced and 50% of overall caloric intake in the country (Leete et al. 2013; GIEWS/FAO 2015) - rather than extension services or access to credit that could help to diversify diets (Graeub et al. 2015).

The government has since acknowledged the importance of diet quality, and, in 2008, added fifteen objectives to the Ministry of Agricultures' Agriculture Development Program, the majority of which were related to crop diversification and improving diet quality. Yet, it remains unclear whether these policy changes have had a positive effect in practice (Meerman 2009; The World Bank 2015c). Despite efforts by both the government and international partners, the majority of Malawian households still suffer from food insecurity, and crops are insufficiently diverse (FAO et al. 2014), which has led to a high prevalence of stunting and malnutrition amongst children in the country (Bezner Kerr et al. 2010; Sassi 2012).

2.2 Land reforms and food security

To date, studies on land reform have focused on various indicators of food security (e.g. access or availability) or proximate causes of malnutrition correlated with land reform

participation. Studies examining initiatives within southern Africa have associated land reform with poor nutritional outcomes for beneficiaries. Children from resettled households in Zimbabwe were found to have a higher rate of severe chronic malnutrition than those who remained in the site of origin, while severe chronic malnourishment was much higher amongst resettled populations than the national averages (Kinsey 1999). In South Africa, propensity scores matching amongst land grant recipients and non-participants indicated that beneficiaries are significantly more food insecure than non-participants, possibly the result of the high cost of moving and loss of income from places of origin (Valente 2009).[2]

The effect of Malawi's CBRLDP on food security has been 'mixed,' including a negative effect on consumption assets (Datar et al. 2009), increased production but no increase in yields (Chirwa 2008; Chinsinga 2011; Simtowe et al. 2011; Mueller et al. 2014), modest gains in agricultural income levels (Mendola and Simtowe 2015), and increased and reduced production of maize and cash crops respectively, compared to control groups (The World Bank IEG 2013; Mueller et al. 2014). Mueller et al. (2014) hypothesize that producing cash crops might be riskier for resettled households when locations of markets are far or unknown, and that remoteness may have influenced beneficiaries to diversify staple crop production instead in order to meet consumption needs. Overall, Mueller et al. (2014) conclude that the project had positive long term effects on household food security for beneficiaries; however, they only examined caloric intake (meals per day), and not diversity of nutrients, which is now commonly viewed as a more accurate indicator of nutrition. Though previous productivity findings are critical in understanding food security within voluntary resettlement, quality of diet has been overlooked. This study addresses the relationship between resettlement and diet quality, measured through consumption patterns of beneficiary households.

3 Case study background

In part because of high population pressure, particularly in the south, many Malawian farmers face declining soil fertility (Sauer and Tchale 2009), cultivate on hilly slopes, and expand into woodlands or on land that is unsuitable for farming (Place and Otsuka 2001). Small landholdings, particularly where soil quality is poor, contribute to the country's high levels of extreme poverty, with 52% of the general population and 60% in the southern region living under the poverty line in 2005 (Government of Malawi 2010). In this context of limited land, poverty and food insecurity, the government of Malawi launched the CBRLDP.

Implemented across southern Malawi between 2004 and 2011, the CBRLDP resettled 15,000 landless or land poor households to underutilized cultivable areas through rural to rural in-country voluntary resettlement. World Bank funding provided cash grants of US$1050 to individual beneficiary households. Paid in three tranches, each household was to spend 30% on land, 10% on transport and shelter construction, and 60% on farm development (The World Bank IEG 2013). Despite the individual character of the grant, beneficiaries were required to form a 'trust' of 20-30 households while still in their place of origin. Trust members then had to elect representatives to form an 'executive committee,' who would negotiate the purchase of the land on behalf of the beneficiary households in the trust. The trust was to gain collective ownership of the land in the form of a group title deed, issued in the name of the trust rather than the individual. With sufficient income, a single household could later apply for an individual title, although this did not appear to be a likely outcome, and is discussed below. The elected representatives allocated two-hectares of land to each beneficiary household. All households within the trust resettled together, but they were discouraged from moving with extended family members (i.e., only one household of a certain family per trust) due to concerns of nepotism (Programme Official, personal communication, 27 May 2014). Project staff were expected to provide training on negotiation skills for land purchase and on farm management practices. The majority of resettlement took place within four districts located in Southern Malawi: Machinga, Mangochi, Mulanje, Thyolo (see Fig. 1), with a small percentage of households later resettled from Ntcheu and Balaka.

4 Methods

This study is primarily based on five months of fieldwork carried out in southern Malawi between May and September 2014. A survey of 203 individuals from beneficiary households was conducted in Machinga, Mangochi, Mulanje and Thyolo (referred to as beneficiaries, as they were living on their resettlement land at the time of research); sample sites were selected to represent a diversity in proximity to infrastructure.[34] Five focus group discussions were conducted in

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[2] The study used the South African Labour Force Survey from 2001 to 2004, and resettlements were ongoing beginning post-apartheid.

[3] The resettlement sites surveyed for this research were chosen to represent a diverse set of Traditional Authorities, wherein some were remote and others were close to a main road in order to address the reported differences in infrastructure access. Beneficiary groups were randomly selected within classifications of remote and central areas, providing they fit a district of origin criteria that ensured diversity. Within chosen beneficiary groups, researchers skipped every two homes in order to randomly sample one third of the homes in the group.

[4] All beneficiaries from Machinga and Mangochi included in this study were resettled internally (see Figure 1), and most were already living on or beside their 'new' land. In Machinga, 56 households were resettled within their Traditional Authority (TA) of origin, 10 moved to a new TA, and 1 response was illegible. In Mangochi, all but one household were resettled within their TA of origin. This reflects overall trends within the programme.

Fig. 1 Map of southern Malawi
with location of sampling sites
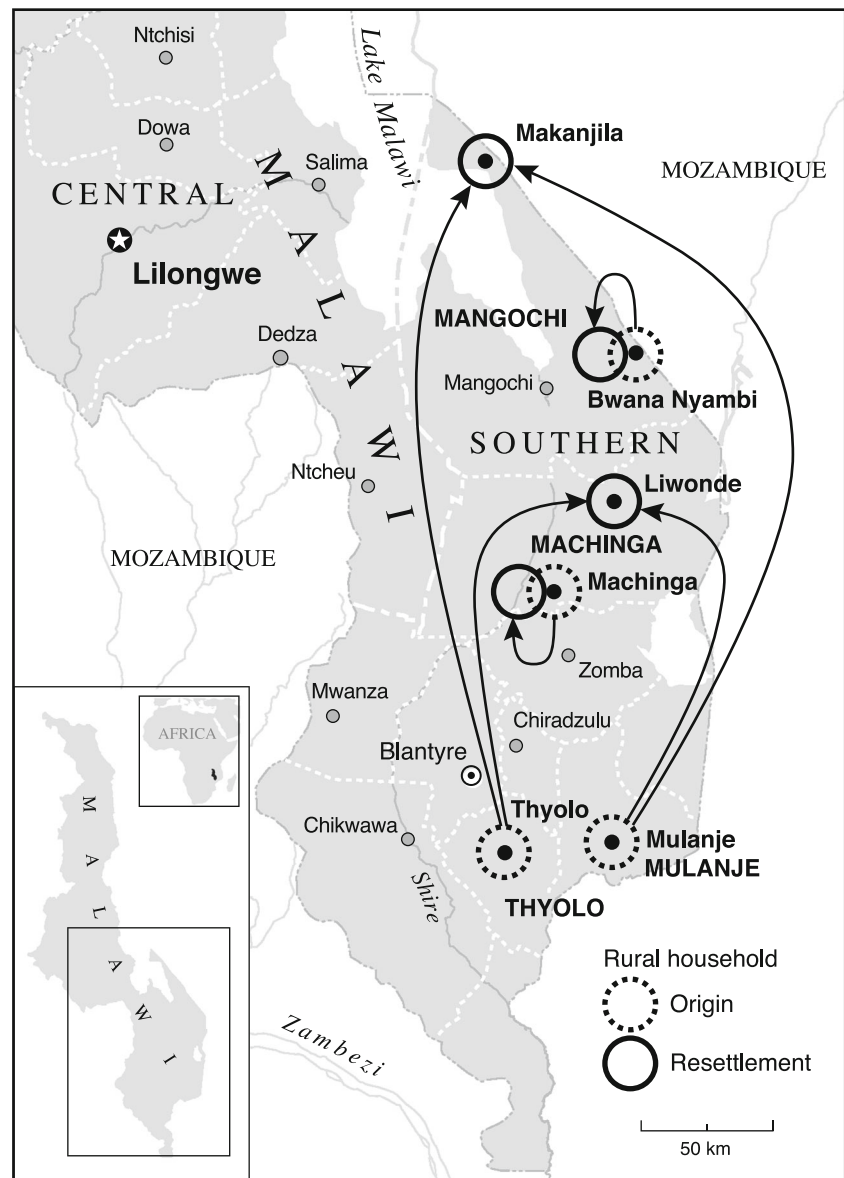
Mulanje and Thyolo: two with households who were eligible
but decided not to participate in the CBRLDP (referred to here
as 'non-beneficiaries', and who, at the time of research, were
living on the same land as they were when the CBRLDP took
place), and three with former CBRLDP beneficiary households
who withdrew after resettlement and returned to their district of
origin (referred to as 'former beneficiaries' and who were living
on their land of origin at the time of research). Nineteen in-
depth interviews were conducted with various project and gov-
ernment officials, academics and select beneficiaries, and were
semi-structured for project implementers and academics, and
open-ended with beneficiaries and group leaders.

Following the questionnaire and focus group discussions,
participants were asked to take the Household Dietary
Diversity Score (HDDS) - a validated 24-h recall survey ad-
ministered at the household or individual level. The HDDS
survey is an instrument used to calculate two indicators, the

HDDS, a proxy for economic ability to obtain sufficient food,
and the Individual Dietary Diversity Score (IDDS), a measure
of nutrient adequacy and the quality of an individual's food
intake.[5] More specifically, it indicates the quality of a diet,
rather than quantity of calories consumed. The dependent

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[5] We conducted the HDDS at the household level and used the values to
calculate scores at both the household and individual level. Respondents were
asked what they ate in the last 24 h, and the food categorized within sixteen
food groups and marked with a 1 (consumed) or 0 (not consumed). In order to
analyze the HDDS, the scores were regrouped in order to form a score out of
twelve food groups rather than sixteen food items. Food groups, rather than
individual foods, are used in the calculation they serve as a better indicator of
the quality of diet in terms of macro and micronutrients (foods of the same
category provide similar nutrients) (Swindale & Bilinsky, 2005). Individual
scores (IDDS) were regrouped to form a score out of 9, where categories such
as beverages and sweets were not included. There were no cut-off scores for
the HDDS or IDDS; rather they are used comparatively to see which groups
are better off than others, either over all or by specific category (see Kennedy
et al., 2011).

variable (IDDS) can take multiple values ordered from 0 to 9. We used ordered logit regressions to determine the correlation between IDDS and various beneficiary characteristics and programme outcomes (independent variables).

The ordered logit is the estimate of a linear function of all the independent variables and the cutpoints related to the dependent variable. The probability of outcome *i* corresponds to the probability that the estimated linear function is within the range of cutpoints estimated for the dependent variable (Freese and Long 2006). This is outlined in the model below:

$$P = P\big(k_{i-1} < \beta_1 x_{1j} + \beta_2 x_{2j} + \ldots + \beta_k x_{kj} + u_j \leq k_i\big)$$

where P is the probability that a respondent has an increase in IDDS, k is the number of possible outcomes, $x_1, \ldots, x_{k-1}$ are the cutpoints, and β represents each independent variable. The binary logit model is:

$$P = 1/(1 + e^{-y})$$

such that P is the probability that a respondent has an increase of one unit of IDDS, e is a constant and Y is the log odds of dependent variables.

5 Results and discussion

The beneficiaries interviewed ranged in age from 18 to 83 years old; 43% were male, and 57% female. In terms of ethnicity, 51% were Lomwe and 30% were Yao, both of which follow matrilineal inheritance, other ethnicities represented included Chewa, Nyanja, Ngoni, Sena and other (each less than 7%). Former and non-beneficiaries were between 24 and 88 years old, 59% were male and 41% female, and the majority were Lomwe, while five or fewer respondents were Chewa, Amanganja, Sena and Yao.

5.1 Resettlement and household food security factors

In order for a voluntary resettlement programme, such as the CBRLDP, to increase food security, it would need to improve food access, availability, stability or utilization (FAO Food Security Programme 2008). In addition to simply increasing the amount of land farmed, participating in the CBRLDP could have potentially influenced the four food security dimensions listed above by either providing additional support to increase farm productivity or by placing farmers in areas with more favorable conditions. The programme potentially affected farm productivity by providing additional training and farm inputs (such as fertilizer). It changed farm conditions by relocating farmers to areas with different soil quality and with different opportunities for market access. Below we explain how these for factors - training, inputs, soil quality, market access including ability to sell crops – are specifically

related to changes in food security in order to justify their inclusion in the analysis. We then provide an overall analysis of HDDS as a proxy for food security as it measures socioeconomic status, and the purchasing power for food.

5.1.1 Training

Training improves food security by increasing production, thereby improving food access and availability. The CBRLDP provisioned for beneficiary training in the form of farm and production management, and productivity improvements (The World Bank IEG 2013, p. 17); yet, no studies have critically assessed CBRLDP training, and few have examined its effects on beneficiary food security. Only one study found that an increase in the diversity of crops grown by beneficiaries was likely the result of increased knowledge of soil quality and intercropping in the resettlement site, but it was not specified if this knowledge was obtained during programme training (Mueller et al. 2014).

We found that CBRLDP training, which we define as the conveyance of knowledge on a topic by a hired trainer, to be limited in both coverage and scope: only 28% of survey respondents said they received it, half of whom were on the executive committee. When those who received training were asked to describe it in their own words, 47% mentioned activities related to better crop management and some specified maize and cassava crops, 11% noted crop use suited to the resettlement, 9% highlighted beneficiary cooperation, and another 9% described crop diversification strategies. The remaining 24% did not to specify. Training was inconsistent, *but those who were trained particularly in soil quality or crop growth should be more food secure than those who were not trained due to increased productivity.*

5.1.2 Inputs

The CBRLDP did not operate in isolation of other government programmes. A key interaction between the resettlement and other farm supports is through fertilizer access. Fertilizers can improve food security by increasing productivity, resulting again in improved access and availability if it is for personal-consumption. At the same time, revenues gained from selling excess crops are often offset by the cost of the inputs (Bezner Kerr 2012). Malawian farmers have several options to reduce these costs, including FISP, Farmers Clubs (externally funded clubs that provide training and subsidized inputs for members), and the government funded Malawi Rural Development Fund (MARDEF) that provides loans to farmers. This study confirmed that, unlike training, the vast majority of beneficiaries received fertilizer as part of their input packages. Thus, in this study we include both the fertilizer provided under the CBRLDP, as well as, fertilizer under these different programs, particularly as their access may have

been influenced by their participation in the resettlement program.

We asked beneficiaries if they were eligible for, or received fertilizer from any of the aforementioned programmes since resettling; Table 1 summarizes these findings. Of particular interest is FISP, as it was the Government's most widespread agriculture initiative. A previous study found that 65% of all farming households in Malawi received FISP coupons in 2008/09 (Dorward and Chirwa 2011), and this finding is mirrored in our research. However, given that traditional authorities are responsible for distributing the coupons and that beneficiaries were 'outsiders' in their new communities, many beneficiaries reported that coupons were withheld from them.[6]

CBRLDP participants were to receive six bags of fertilizer in their starter pack (The World Bank IEG 2013), which would partially explain the initial higher production levels and related improved food security described in Mueller et al. (2014). However, beneficiaries facing discrimination in FISP coupon distribution may have had to spend their income on inputs rather than food, or could have foregone fertilizer, resulting in lower outputs. Furthermore, upon termination of the programme, the beneficiaries would no longer receive these inputs through the programme and would again rely on FISP. *Except in the cases where FISP was withheld, beneficiaries should initially be more food secure due to increased access to fertilizer, assuming the fertilizer is appropriate and used correctly.*

5.1.3 Soil quality

Soil quality can impact crop productivity and the need for fertilizer, where for example, sandy soil requires more fertilizer than nutrient rich earth. All else equal, higher quality soil should result in higher productivity for less cost and increases in food access and availability. 88% of beneficiaries stated that their soil quality was better in the current plot compared to their plot of origin, 6% said it was the same, and another 6% said it was worse. However, these findings do not represent the views of all beneficiaries in all sites. Perceptions of soil quality were different between former and current beneficiaries, providing evidence that the quality of land varied. Given high population densities in villages of origin, beneficiaries could have previously been farming on hillsides or areas that never fallowed; it is not thus surprising that many beneficiaries reported that the soil quality was better in the resettlement site. However, reports of flooding and sandy soil at the resettlement sites were common amongst former beneficiaries, and in one focus group in particular. It seems possible that those

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[6] The Project Implementation Manual did highlight the possible conflicts that could occur when 'outsiders' move in to a new community and noted that inter-district migration should occur as infrequently as possible in order to reduce incidences of such conflict (Government of Malawi, 2005).

Table 1 - Beneficiary receipt of and eligibility for fertilizer subsidies

Fertilizer programme	Since resettling, percentage of beneficiaries who received fertilizer from:	Since resettling, percentage of beneficiaries who perceived they were eligible to participate in:
Farm Input Subsidy Programme (FISP)	68.5%	95.6%
Farmers Club	14.8%	53.2%
CBRLDP	95.1%	93.1%
MARDEF (loans)	18.7%	53.7%
		N = 203

who received land with better soil were more likely to stay in the resettlement site, while those who did not were more likely to leave. *Beneficiaries reporting better quality soil in resettlement areas should be more food secure.*

5.1.4 Market access and ability to sell crops

Access to markets can improve food security through income opportunities and diet diversification. This can mean increased access to food as well as improved stability due to decreased dependence solely on self-production. Market access is problematic for CBRLDP participants, as many resettled to remote sites located far from roads and trading centers. Remoteness can result in fewer nearby customers and longer distances to travel to reach customers, and fewer or more expensive purchased foods. Half of the survey respondents were moved to remote resettlement sites, and half to relatively central locations.

Beneficiaries were asked how they viewed their market access, in terms of proximity, compared to their village of origin. Table 2 lists perceptions of market access by receiving district, and by migration pattern (internal or external). Respondents in Mangochi offered particularly revealing results, where the majority (63%) of those who migrated internally found their access was the same, reflecting the number of participants from Mangochi who remained on their original land or resettled close by. Also of interest is the 91% of externally resettled individuals to Mangochi who found their access to markets worse than before. Explicit mention of market access was not included in the CBRLDP Project Implementation Manual and was not included as an objective of the project, suggesting that it was overlooked within project design (Government of Malawi 2005). Other studies also found beneficiary access to markets was worse off after moving (PricewaterhouseCoopers 2005, pp. 8). This illustrates the remoteness of resettlement sites, and the lack of infrastructure that many participants faced.

We asked beneficiaries how they sold crops, for which market proximity is an influencing factor. The majority sold

Table 2 - Beneficiary perception of market access

Access to markets	Machinga as receiving district (N = 100)		Mangochi as receiving district (N = 102)	
	Internal migration (N = 67)	External migration (N = 33)	Internal migration (N = 27)	External migration (N = 75)
Better off now	64%	58%	30%	8%
Worse off now	15%	42%	7%	91%
Same	21%	0%	63%	1%
Total	100%	100%	100%	100%

to middlemen (58%) or to vendors coming directly to their home (4%). A sizable minority took their products to the market directly (28%), which is indicative of the distance to markets and remoteness of the resettlement site. Several participants qualified that more vendors visited their homes in the resettlement site than had before.

Beneficiaries were asked in which location they were able to sell more crops and why (see Table 3). The majority that found it easier to sell in the district of origin claimed this was due to better market access, whereas the majority who sold more in the resettlement site indicated it was because they produced more crops there. Similar conclusions were made during the focus groups. These findings are logical as districts of origin (Mulanje and Thyolo namely) have more access to infrastructure than the resettlement districts (Machinga and Mangochi) (see also Mueller et al. 2014), and, as mentioned above, Mueller et al. (2014) concluded that beneficiaries produced more in their resettlement site than they did prior to moving.

If remoteness was in part remedied by home visits from vendors and middlemen, the purchase price would be lower than at the market, and beneficiaries would miss the opportunity to buy diverse market foods. Despite this, *beneficiaries produce more crops in the resettlement site, and thus could sell surplus produce*, though for a reduced price per unit and with more limited access to nutritious food due to restricted market access.

5.1.5 Consumption and HDDS as proxies for food security and access

We asked beneficiaries their perception of their own consumption in order to understand their food security, and specifically changes to it following resettlement. 94% of respondents stated that they consumed more food in the resettlement site compared to their village of origin, of whom 71% attributed this to the increase in land size, and 29% to better soil quality, affirming the findings in Mueller et al. (2014).

We contrast perceptions of consumption through a comparison of HDDS among beneficiaries, former and non-beneficiaries. We note, however, that there could be a positive bias in this sampling, as households that elected not to move may have already been more food secure than their neighbours who did join CBRLDP.

The HDDS indicates food access and consumption of a household, and because food access is assumed to go up with income, it is a measure of the socio-economic status (Swindale and Bilinsky 2006). Beneficiary HDDS was compared with a group of former beneficiaries (27 former beneficiaries who moved back to their district of origin) and non-beneficiaries (19 individuals who had the opportunity to join the CBRLDP but elected not to). The average HDDS score was 4.55 (N = 196), with a range of 1-9 for beneficiaries, and 5.13 (N = 46) on average for

Table 3 - Summary statistics of why beneficiaries sell more crops in specified locations

Why more crops are sold there:	Where more crops are sold:		
	District of origin	*Resettlement site*	*No change*
Access to markets is better	56 (28%)	44 (22%)	4 (2%)
Produce more crops	11 (5.4%)	71 (35%)	0
More help	1 (0.5%)	1 (0.5%)	0
Less people to feed	1 (0.5%)	2 (1%)	0
More vendors	0	1 (0.5%)	0
Part of a club	0	1 (0.5%)	0
			N = 193

former/non-beneficiaries with a range from 3 to 8. A Mann-Whitney Rank Sum test indicated that the difference between beneficiary and former/non-beneficiary HDDS values was statistically significant ($p = 0.014$). Though the HDDS is a value out of 12, there is no 'ideal' score (Swindale and Bilinsky 2006), and they therefore must be used comparatively. Scores of 4 and 5 can both be categorized as 'medium' access to food (Kennedy et al. 2011), but the slight difference in value does indicate that non-beneficiary households are relatively better off. Though the HDDS averages were not vastly different, *non-beneficiary households were found to have a higher food access than beneficiary households, and should therefore be more food secure due to socio-economic status*. There is the possibility of self-selection bias such that beneficiaries began at a lower socio-economic level than non-beneficiaries. Future work should account for this factor.

Additionally, beneficiaries had a much lower score than participants in a 2010/2011 International Food Policy Research Institute (IFPRI) national study of food security in Malawi ($N = 11,280$). They found that the average HDDS for participants in their study was 8.2, and 6.1 was the average for the poorest rural quintile and the poorest quintile in the Southern region (Verduzco-Gallo et al. 2014). This puts those respondents in a 'high' level of food access (greater than 6), compared to the medium score found with beneficiaries interviewed here. Therefore, *beneficiaries also had a lower socio-economic status based on HDDS values than national averages, and may therefore be less food secure.*

To sum-up, beneficiaries perceived that they consumed more food in the resettlement site, and findings in previous studies indicate that they also produced more food there (Mueller et al. 2014; Mendola and Simtowe 2015), yet this only represents one dimension of food security (availability). Beneficiaries who remained in their resettlement site observed a higher quality soil there than in their district of origin. This would positively impact their agricultural productivity and availability of food, however not all sites had relatively better quality soil, nor was soil quality homogenous within sites. Further, many beneficiaries claimed to have better access to fertilizers than in their district of origin, but unfortunately some beneficiaries were unable to access FISP particularly due to discrimination.

Roughly half of the beneficiaries perceived their market access decreased as compared to before resettling (dependent on the resettlement district and district of origin), however, they sold more on average largely due to an increase in production. Interestingly, it was common for beneficiaries to sell to a middleman, which saves on transportation time and cost, but reduces

opportunities to purchase goods and sell crops for higher earnings at markets. Mueller et al. (2014) found that beneficiaries grew more pigeon peas than the control group, and hypothesized that this was due to an increased knowledge of soil quality and intercropping in the resettlement site, alluding to programme training outcomes. Yet, we found that only 28% beneficiaries within the sample received training (which could have included training on the benefits of intercropping in specific environments, and nutritional education, among others), and of those who received training half said it was related to soil management. The HDDS, which provides a holistic view of household food access, indicated that beneficiaries had statistically significant lower socio-economic status' on average than non-beneficiaries, indicating they were less food secure. Further, comparing beneficiary HDDS results to national averages, beneficiaries also had lower scores. This suggests that though beneficiary households were able to produce more food than before due to a larger plot of land (and/or better soil) than those who remained in or returned to their village origin, they were not more food secure.

5.2 The effects of resettlement on individual diet quality

Three models outlined below assess effects on the dependent variable, IDDS. Models 1 and 2 use the full sample of beneficiaries and former/non-beneficiaries (where former/non-beneficiaries include individuals who were eligible to participate and elected not to, and former beneficiaries who returned to their district of origin). The first model compares beneficiaries to former/non-beneficiaries while accounting for household socio-demographic factors. The second model is similar, but divides the beneficiary and former/non-beneficiary groups by their current location, indicated by a dummy variable 'districts.' Model 3 includes only beneficiaries, with an expanded set of beneficiary characteristics and other programmatic variables. All of the variables are defined further below.

- *Model 1*

$$Y = \beta_0 + \beta_1 beneficiarystatus + \beta_2 age + \beta_3 gender + \beta_4 religion$$

- *Model 2*

$$Y = \beta_0 + \beta_1 curdist2 + \beta_2 curdist3 + \beta_3 curdist4 + \beta_4 age + \beta_5 gender + \beta_6 religion$$

- *Model 3*[7]

$$Y = \beta_0 + \beta_1 totalamtcropssold + \beta_2 nonfarmer$$
$$+ \beta_3 districts2 + \beta_4 districts3 + \beta_5 districts4$$
$$+ \beta_6 districts5 + \beta_7 districts6 + \beta_8 fertilizers$$
$$+ \beta_9 farmtraining + \beta_{10} memberonEC + \beta_{11} gender$$
$$+ \beta_{12} education + \beta_{13} religion + \beta_{14} age$$
$$+ \beta_{15} typeownership1 + \beta_{16} typeownership2$$
$$+ \beta_{17} typeownership3 + \beta_{18} typeownership4$$
$$+ \beta_{19} typeownership5 + \beta_{20} havetitledeed$$

The dependent variable, IDDS Total is a calculation from a 16-category diet quality assessment, where to calculate the IDDS certain categories from the original questionnaire are omitted or combined in order to create a score out of nine (see section 3.4).[8] This score represents individual diet quality rather than household level.

Table 4 below summarizes the variables in Models 1 and 2, and Table 5 below is a summary of the statistics for Model 3.

Outlined below is the justification for variable inclusion criteria. Amount of crops sold and non-farmer status were included in the model, as income has a direct effect on what foods individuals are able to purchase (Thorne-Lyman et al. 2009). The number of fertilizer programmes used was included because qualitative studies of Malawi have found a link between poor soil quality and low nutrition levels (Bezner Kerr and Chirwa 2004; Bezner Kerr et al. 2007); though these studies did not make this conclusion, this relationship could be exacerbated by increasing climatic irregularity undermining the effects of fertilizer inputs. The executive committee played a significant role in determining the location of resettlement site and how plots were distributed, and therefore those individuals could have chosen superior land; as such we included presence of a household member on the executive committee as an independent variable. The HDDS questionnaire is typically given to the household member who prepares the food, which is often a woman; due to logistical constraints this study was unable to ensure that all respondents prepared the meal, and therefore inclusion of respondent gender accounts for that difference (Swindale and Bilinsky 2006). Past studies have found that religion contributes to diet quality, and therefore it was included here (Savy et al. 2005). Education level and age have both been found to have an effect on diet quality and

were thus included (Thorne-Lyman et al. 2009; Torheim et al. 2004). Training was included because it relates to farming knowledge, and Mueller et al. (2014 pp 231) alluded to an increased knowledge of intercropping. Much has been said in the literature speculating that official, Western style ownership status will increase the ability of farmers to invest in their land (de Soto 2000), and therefore the title deed and perception of ownership type were included. Given the significance of household size in affecting HDDS (Torheim et al. 2004), it was also included in original regressions but was omitted due to collinearity with education.

Table 6 presents the findings from Model 1 ordered logit regression, with IDDS as the dependent variable. This model compared the beneficiary status, where beneficiary is a dummy variable coded as 0, and all former/non-beneficiary respondents were coded with a 1. Beneficiary status was statistically significant ($p = 0.035$), and that for a one-unit increase in status (i.e., going from beneficiary to non-beneficiary), the odds of a higher IDDS score are 2.03 greater, with a 95% confidence interval (1.04, 3.94). Religion was also statistically significant ($p = 0.051$), where for every unit increase in religion (i.e., increasing from 0, Christian, to 1, Muslim), the odds of a higher IDDS rank was 0.59 times higher, with a 95% confidence interval (0.35, 1.00). That is to say, Muslim respondents were more likely to have a less diverse diet than Christian respondents.[9] There is some possibility that the sign of the effect of religion is actually positive given that the CI crosses 1, but given that the majority of the confidence is less than 1, the effect is likely to be negative.

Table 7 presents the findings from the ordered logit regression of Model 2, which compares the effects of the current districts for the entire sample, including both beneficiaries and former/non-beneficiaries, on the dependent variable that is IDDS from 0 to 9. The results of Model 2 indicate that for every one-unit increase in the dummy variable curdist4 (i.e., not living in Thyolo district, 0, to living in Thyolo district, 1), results in 2.7 times greater likelihood to have a higher IDDS, than compared to individuals in curdist1, Machinga District, with a 95% confidence interval (1.06-7.05). The findings were not significant for individuals living in Mangochi or Mulanje districts. Religion has statistical significance at $p < 0.1$, where for one-unit increase (i.e., moving from 0 to 1, or Christian to Muslim), results in a .60 times greater chance in having a higher IDDS, with a 95% confidence interval (0.35-1.01). The confidence interval crosses 1 and therefore the directionality of the effect is not certain, however, given that the $p = 0.055$, and the majority of the CI is below zero, it can be said that Muslim respondents generally have lower IDDS than Christians. Age and gender were not significant factors in determining the IDDS.

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[7] Size of household is omitted from this model due to collinearity.
[8] Three ordinal logit regressions were performed on a categorical IDDS, where 0-3 was low diversity, 4-5 was medium, and 6-9 was high. However, there was insufficient variety in IDD scores for these to provide results with high enough probabilities to make conclusions.

[9] Reasons for this are outside the scope of our study and would require further analysis.

Table 4 - Summary statistics for regression Models 1 & 2 variables

Variable	Description	Mean	Std. Dev.	Min	Max
Dependent					
iddsbg9total	IDDS (calculated), 0-9	3.71	1.09	1	7
Independent					
curdist1 (omitted variable)	Respondent current district: Machinga, 0 = no, 1 = yes	0.419	0.496	0	1
curdist2	Respondent current district: Mangochi, 0 = no, 1 = yes	0.428	0.496	0	1
curdist3	Respondent current district: Mulanje, 0 = no, 1 = yes	.0742	.263	0	1
curdist4	Respondent current district: Thyolo, 0 = no, 1 = yes	.0786	.270	0	1
beneficiarystatus	Beneficiary status: 0 = beneficiary; 1 = former/non beneficiary	0.153	0.361	0	1
age	Age of respondent (years)	43.34	15.5	18	88
gender	Gender of respondent, 0 = male, 1 = female	0.555	0.498	0	1
religion	Religion of respondent, 0 = Christian, 1 = Muslim	0.328	0.470	0	1

N = 229

The results of regression Model 3 (Table 8) show that the odds for the dummy variable for type of ownership 2 (beneficiary perception of having customary ownership in the resettlement site 1, or not customary, 0) are 21.3 times

Table 5 - Summary statistics for regression Model 3 variables

Variable	Description	Mean	Std. Dev.	Min	Max
Dependent					
iddsbg9total	IDDS (calculated), 0-9	3.63	1.10	1	7
Independent					
amtcropssold	Total amount of crops sold (in Kwacha) annually	61,018	222,382	0	3,000,000
nonfarmer	Respondent livelihood that is not farming, 0 = no, 1 = yes	0.649	0.478	0	1
districts1 (omitted variable)	District movement: from Machinga to Machinga, 0 = no, 1 = yes	0.335	0.473	0	1
districts2	District movement: from Mangochi to Mangochi, 0 = no, 1 = yes	0.144	0.352	0	1
districts3	District movement: from Mulanje to Machinga, 0 = no, 1 = yes	0.124	0.330	0	1
districts4	District movement: from Mulanje to Mangochi, 0 = no, 1 = yes	0.119	0.324	0	1
districts5	District movement: from Thyolo to Machinga, 0 = no, 1 = yes	0.0361	0.187	0	1
districts6	District movement: from Thyolo to Mangochi, 0 = no, 1 = yes	0.242	0.430	0	1
fertilizers	Received fertilizer from each of four common fertilizer programmes (sum of 4 binary scores)	1.95	0.813	0	4
training	Respondent given training by CBRLDP, 0 = no, 1 = yes	0.284	0.480	0	1
memberhhonec	Member of household on executive committee, 0 = no, 1 = yes	0.356	0.480	0	1
gender	Gender of respondent, 0 = male, 1 = female	0.567	0.497	0	1
education	Education of respondent (years)	4.08	3.35	0	12
religion	Religion of respondent, 0 = Christian, 1 = Muslim	0.371	0.484	0	1
age	Age of respondent (years)	43.4	15.6	18	83
typeownership1	Perceived type of ownership: Don't know, 0 = no, 1 = yes	0.201	0.402	0	1
typeownership2	Perceived type of ownership: customary, 0 = no, 1 = yes	0.010	0.101	0	1
typeownership3	Perceived type of ownership: individual freehold, 0 = no, 1 = yes	0.711	0.454	0	1
typeownership4	Perceived type of ownership: individual leasehold, 0 = no, 1 = yes	0.0103	0.101	0	1
typeownership5	Perceived type of ownership: group freehold, 0 = no, 1 = yes	0.0464	0.211	0	1
havetitledeed	Respondent household has the title deed, 0 = no, 1 = yes	0.454	0.499	0	1

N = 194

Table 6   - Model 1

Variable	Coefficient	Odds Ratio	95% Confidence interval
Beneficiary status	0.711**	2.04**	1.04-3.94
Age	−0.0097	0.990	0.97-1.00
Gender	−0.345	0.708	0.43-1.15
Religion	−0.518*	0.596*	0.35-1.00
			$N = 229$
			$Prob > chi2 = 0.0064$
			$Pseudo\ R2 = 0.0209$

10% significance denoted with *; 5% significance denoted with **

greater, compared to the perception of the actual type of ownership of group leasehold. These results are statistically significant ($p = 0.043$), at 95% confidence interval (CI) (1.09, 417.76). However, given that the confidence interval is incredibly large, there is low confidence that the results are precise, and therefore this finding should be critically examined. The other perceptions of ownership, particularly those who perceived they had individual freehold (ownership type 3), which was the vast majority of the beneficiaries (72%), did not have a statistically significant effect on IDDS. Gender and religion, both are statistically significant at $p < 0.1$ ($p = 0.059$, $p = 0.094$ respectively). For the gender dummy variable, for every unit increase in gender (i.e., an increase from 0, male, to 1, female) the odds were 0.55 times less likely to be a higher IDDS value (95% CI [0.29-1.02]). Similarly, for the religion dummy variable, one-unit increase in religion (i.e., from Christian [0] to Muslim [1]) decreased the odds of having a higher IDDS value 0.52 times (95% CI [0.4-1.11]) – thus the odds were lower. One district level movement pattern was significant at $p < 0.1$, and that was for beneficiaries who moved from Thyolo to Mangochi (Districts5; $p = 0.099$). Those beneficiaries were 0.30 times more likely to have a higher IDDS than individuals who moved internally within Machinga (Districts1) (95% CI [0.07-1.25]. None of the other beneficiary movements were significant. Gender, religion, and district

Table 7   - Model 2

Variable	Coefficient	Odds Ratio	95% Confidence Interval
Curdist2	−0.0911	0.913	0.54-1.54
Curdist3	0.349	1.42	0.57-3.50
Curdist4	1.00**	2.74**	1.06-7.05
Age	−0.0100	0.990	0.97-1.00
Gender	−0.317	0.728	0.44-1.19
Religion	−0.511*	0.600*	0.35-1.01
			N = 229
			$Prob > chi2 = 0.0158$
			$Pseudo\ R2 = 0.0228$

10% significance denoted with *; 5% significance denoted with **

movement from Thyolo to Machinga all had 95% confidence intervals that crossed 1, and therefore there is a possibility that the sign related to each may be the opposite.

The majority of the coefficient's signs are as expected, with the exception of non-farmer status and member of the household on the executive committee, neither of which are significant (both have negative signs, but logically should be positive.) Firstly, non-farming status is a binary dummy variable where respondents who reported to have at least one non-farming livelihood are represented with a 1, and those who only farm are represented with a 0. These beneficiaries should have more access to finances and should be more resilient to crop failure, however this result can be explained by the remote location of their resettlement sites, and though they may have additional income they may not have access to diverse foods to purchase, or food is likely to be comparatively more 'expensive' than for farmers. Respondents with a member of the household on the executive committee could be expected to have a higher IDDS because those families could have received better land or more training, however this does not seem to have been the case, at least in terms of how these translate into higher IDDS. Both variables have 95% confidence intervals that cross 1, and therefore there is a probability that the signs are the opposite. Although the majority of the signs of the coefficients are as expected and some coefficients do show statistical significance, the model overall fails to reject the null hypothesis that all the predictors are simultaneously equal to zero and the results should be treated with caution.

Table 9 summarizes the findings from all three models, highlighting the significant independent variables.

So far, very few studies have examined the effect of land reform, or resettlement more specifically, on diet quality. Only one comparable study concluded that Zimbabwe's resettled children had higher rates of severe chronic malnutrition than non-resettlement children (Kinsey 1999). More studies have researched agricultural productivity, and in the case of the CBRLDP many concluded that productivity did increase (Mueller et al. 2014; Mendola and Simtowe 2015), which would suggest that there could be a similar increase in food security and potentially also diet quality. Here, we aimed to establish the effect resettlement pattern, current district, and beneficiary status had on the IDDS of respondents, which is a critical question that requires further exploration.

To sum-up, the findings related to IDDS can be examined at two levels. First are the factors related to household socio-demographics. Here, a key outcome is that Christian respondents generally had a higher dietary score than Muslim respondents (in all three models). This is similar to findings in the literature, where a study of nutritional status of women in Burkina Faso determined that Christian respondents had the highest IDDS, and Muslim respondents had the lowest (Savy et al. 2005). Further investigation is necessary to determine whether this is a reflection of dietary restrictions (i.e. against

Table 8 - Model 3

Variable	Coefficient	Odds Ratio	95% Confidence Intervals
Total amount crops sold	8.26e-07	1.00	0.99-1.00
Non farmer status	−0.259	0.771	0.38-1.55
Districts2	−0.0876	0.916	0.36-2.29
Districts3	−0.168	0.846	0.32-2.20
Districts4	−0.384	0.681	0.24-1.90
Districts5	−1.19*	0.305*	0.07-1.25
Districts6	0.143	1.15	0.51-2.58
# Fertilizers	0.0649	1.07	0.75-1.50
Training	0.423	1.53	0.80-2.89
Member of HH on EC	−0.241	0.786	0.44-1.40
Gender	−0.593*	0.553*	0.29-1.02
Education	0.0137	1.01	0.92-1.11
Religion	−0.643*	0.526*	0.24-1.11
Age	−0.0054	0.995	0.97-1.01
Type of ownership1	0.227	1.25	0.16-9.59
Type of ownership2	3.06**	21.4**	1.09-417.76
Type of ownership3	1.07	2.91	0.42-19.86
Type of ownership4	−1.11	0.329	0.01-6.19
Type of ownership5	0.738	2.09	0.23-18.95
Have the title deed	−0.397	0.673	0.38-1.16
			N = 194
			Prob > chi2 = 0.210
			Pseudo R2 = 0.0425

10% significance denoted with *; 5% significance denoted with **

pork consumption) or whether religion is a proxy for other social factors that influence access to resources that are not captured by our variables.

Age and education, factors that are sometimes correlated with nutritional outcomes, were not found to have an impact on

Table 9 - Summary of findings from 3 regression models

Model #	Dependent variable	Comparison	Summary of findings
Model 1	IDDS /9	Beneficiary vs. non-beneficiary, and respondent characteristics	Beneficiary status significant, religion less so
Model 2	IDDS /9	Current district for all beneficiaries and non-beneficiaries, and respondent characteristics	Living in Thyolo is significant; religion less so
Model 3	IDDS /9	Beneficiary movement locations, other factors related to resettlement, respondent characteristics and socio-economic status	Customary ownership is significant; Religion, Gender, Moving from Thyolo to Machinga less so

respondent IDDS (all models for age, and Model 3 for education). Interestingly, though one could assume that training would increase crop diversity, and nutrition education has been shown to improve dietary diversity in other studies (Murendo et al. 2018), training does not appear to translate into a more diverse diet according to the IDDS scores of our respondents (Model 3). This is further supported by the fact that training opportunities were not widely available or utilized and only a limited number of respondents received training. Finally, there does not appear to be a strong relationship between nutritional outcomes and the farmer's perceptions regarding their type of land ownership. Thus, land ownership perception does not seem to influence crop decisions in a way that impacts diet quality.

Second are the factors related to origin of participants (and non-participants) and the patterns of resettlement. While internal migration within a district might be expected to result in better farming outcomes than migration between districts due to institutional memory and social networks, this is not supported by the regression results of Model 2. Given similarities in farming conditions between resettlement sites, one possibility is that external settlers at least partially made up for any disadvantages of moving to a new location by taking advantage of the increase in land available to them.

A key result, however, is that former-and non-beneficiaries had statistically significantly higher diet quality than those who remained at the resettlement sites in Model 1, supported by the findings in Model 2 for at least one district. This is in line with the related findings by Kinsey (1999) in Zimbabwe, and other studies that have found that market access improves diet quality where households can purchase foods they do not or cannot produce (Koppmair et al. 2016). One possible explanation for these results is the remoteness of resettlement sites as mentioned above; we surveyed non-beneficiaries in Mulanje and Thyolo, two well situated districts in southern Malawi that draw tourists and are known for tea estates, which offer alternative livelihoods, but also are in close proximity to both urban centers (Zomba and Blantyre), and infrastructure (including markets and roads). Individuals living in these areas are more likely to have higher income, as well as better access to markets wherein they could purchase and sell crops – with these two factors contributing to higher diet quality. Another potential contributing factor is soil quality, where many former-beneficiaries in qualitative interviews complained of dry soil prone to flooding in the resettlement site; however, many beneficiaries cited the problems associated with hilly landscapes in Mulanje and Thyolo. The relationship between diet quality and beneficiary status, as well as the effect of living in Thyolo indicate that having a larger plot of land does not necessarily result in better quality diet, particularly when there are fewer alternate livelihoods, poor access to markets and roads, and potentially poor soil quality. Based on these findings, it is critical that the impact of resettlement location on diet quality, and particularly opportunities to buy and sell food, be considered with more attention in future resettlement projects.[10]

6 Conclusion

This study examined factors influencing food security, at both the input and post-production levels, for various groups of small-scale farmers in relation to a land resettlement scheme in Malawi. Beneficiaries of resettlement were generally better off according to a small number of factors that should positively influence food security (including larger plot size and initial access to fertilizer). Yet quantitative results including HDDS demonstrate that beneficiaries access to food was lower than that of former-and non-beneficiaries and of the national average,[11] and regression models of IDDS indicate that though crop production increased, nutrition in terms of diet quality was poorer amongst beneficiaries than former-and non-beneficiaries. Qualitative information from some focus group discussions qualify this general finding, with most notably former-and non-beneficiaries

pointing at low access to infrastructure, poor soil quality, and concerns over continued access to fertilizers in resettlement areas. The utility of voluntary resettlement must therefore be questioned as an effective policy tool to address food insecurity based on the results presented here unless factors such as remoteness, infrastructure and market access, and entitlements to farming inputs can be sustained and improved in relocation areas.

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[10] Training should also receive some attention.

[11] This outcome, however, cannot be attributed with certitude to the effects of resettlements given that there is no pre-settlement baseline data on the food security status of all households.

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