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Full Length Research Paper

Incidence, severity of food insecurity and inequalities in resource distribution in Malawi's prisons

***Hastings Moloko[1], Davies Ng'ong'ola[2], Joseph Dzanja[2] and Thabbie Chilongo[2]**

[1]University of Malawi, Malawi.
[2]Lilongwe University of Agriculture and Natural Resources.

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While Malawi's per capita cereal production may be higher than her per capita cereal consumption, Malawi is a net cereal importer and thus food insecure. The food situation is much worse in Malawi's prisons because inmates generally eat one meal per day. The general objective of this study was to determine the extent of food insecurity in Malawi's prisons. Specifically, the study intended to determine the incidence and severity of food insecurity, and inequalities in the distribution of food and subvention in Malawi's prisons. Using structured questionnaires in face to face interviews, the study collected data from 1000 prisoners and 30 officers-in-charge from all prisons in the country. The data was analysed using Stata 12 and employed the Foster-Greer-Thorbecke (FGT) modeland Gini Coefficients as an analytical tools. Results from the analysis showed that practically all prisoners in Malawi's prisons were food insecure. There existed a per capita aggregate food insecurity gap of 1,738.6 kilocalories per day or an aggregate food insecurity gap of 21,902,883 kilocalories per day or Malawi Kwacha (MK)18,932,100.00 worth of food deficit per day for the 12,598 prisoners or MK1,502.79 or USD 2.07 per prisoner per day in 2015. Prisoners in the prisons operated on 71 percentage points below the food security threshold. There were inequalities in the distribution of food and subvention in Malawi's prisoners. Both the Watts Index and Sen Index confirmed the high levels of food insecurity in Malawi's prisons.

Keywords: Malawi's prisons, incidence of food insecurity, severity of food insecurity, inequalities in food and subvention.

INTRODUCTION

Politically, Malawi is divided into four regions, these being the Northern, the Central, the Eastern and the Southern regions. There are six prisons with a prisoner population of 1,717 in the Northern region. In the Central region, there are eight prisons with a prisoner population of 3,784. The Eastern region has eight prisons with 4,072 prisoners, while the Southern region has 3,025 prisoners in eight prisons. There were 12,598 prisoners in Malawi's 30 prisons in 2016 when this study was conducted.

STATEMENT OF THE PROBLEM

Although Malawi is generally food insecure, it is common in Malawi that most people consume three meals per day. What differs is mainly the quality, quantity and variety of the food that they eat. Inmates in Malawi's prisons, however, generally eat one meal per day (African Commission on Human and Peoples' Rights, 2002; Penal Reform International, 2005). These

Corresponding author's E-mail: hmoloko@poly.ac.mw

reports mention food issues as observations made in relation to health and human rights. None of these studies specifically studied the incidence and severity of food insecurity or inequalities in the distribution of food and subvention in Malawi's prisons.

Justification of the Study

The overall objective of the Food and Nutrition Security Policy is to significantly improve the food and nutrition security of the Malawi population (Malawi Government, 2005). The specific objective of the Food Security Policy is to guarantee that all men, women and youth in Malawi have, at all times, physical and economic access to sufficient nutritious food required to lead a healthy and active life (Malawi Government, 2006). Since prisons accommodate about 0.08 percent of the Malawi population, it is important that prisons are food secure and that every prisoner has access to not less than the minimum meal requirement. Given the Malawi Government's commitment to ensuring food security, it was important that this study be carried out so that the incidence and severity of food insecurity, and inequalities in food and subvention in Malawi's prisons could be ascertained. It was important to study and understand these economic parameters in order to lay the foundation upon which efforts to improve and re-engineer the food situation in Malawi's prisons could be based. This would enable policy makers and prison management to take appropriate policy and budgetary measures regarding prison subvention, strategic resource allocation, food production or procurement, and food demand and consumption levels to accurately address the problem and ensure prison food preparedness and improve prison food security. Also, since no study had been conducted in this area, it was important to conduct this study so that the existing knowledge gap could be filled.

Objectives of the Study

The general objective of this study was to determine the extent of food insecurity in Malawi's prisons. The specific objectives of the study were:

i. To determine the incidence and severity of food insecurity in Malawi's prisons, and;
ii. To determine the level of inequalities in food and subvention distribution in Malawi's prisons.

Limitations of the Study

There were two major limitations to the study. The first was that all interviewees were male. This was because, for security reasons, the research team was only allowed to access prisoners that committed less serious offenses. Such prisoners were allowed to go out for farming activities because they were considered a lower security risk. The research team was advised to interview the sampled ones as they carried out their farming chores. The second limitation was that no female prisoners were in this category, not necessarily because they committed serious crimes, but because female prisoners were not allowed to go out for farming duties and the research team was not allowed to enter into the female side of the prison. As a result of these two limitations only 1000 male prisoners, instead of the required 1418 prisoners were interviewed.

The food situation in Malawi

The Millennium Development Goals (MDGs) through the medium term development strategy, the Malawi Growth and Development Strategy (MGDS), identified nine key priority development goals (Malawi Government, 2010). The first of these development goals was to eradicate extreme poverty and hunger. To achieve this, the Government's target was to halve, between 1990 and 2015, the proportion of people who suffered from hunger. One of the indicators for monitoring hunger was the proportion of the population living below the minimum level of dietary energy consumption of 2,100 kilocalories per person per day (Ecker & Qaim, 2008; Malawi Government, 1999).
Malawi is an aggregate net exporter of food. The bulk of the food exports, however, are non-cereals such as tea and sugar and so although the country is a net food exporter, it remains a net importer of cereals and thus food insecure. Maize is the staple food in Malawi (De Graaff, 1985; Kidane, et al., 2006; World Bank, 2008; FAO, 2010;IFPRI, 2012;FAO, 2015).

The food situation in Malawi's prisons

It is a requirement of the United Nations that every prisoner should be provided, by the administration at the usual hours, with food of nutritional value adequate for health and strength, of wholesome quality and well prepared and served (Medecins Sans Frontieres, 2009). The Malawi Prison Act Cap. 9:02, (1983) provides a dietary schedule for prisoners belonging to various categories of prisons. Despite these legally binding dietary guidelines, the practice on the ground is different. The African Commission on Human and Peoples' Rights (2002) observed that Malawian prisoners received only one meal per day and that meals were not balanced as prisoners ate the same food every day. The report also observed that the meals comprised of maize (*nsima*) and boiled beans and sometimes pigeon peas or vegetables. Neither meat nor fish was provided but salt was available in all prisons. This is a typical case of food insecurity.

MATERIALS AND METHODS

Data Collection Techniques

Both primary and secondary data were collected using questionnaires, one administered to prisoners, and the other to prison officers-in-charge. A total of 1,000 male prisoners from all the 30 prisons were randomly selected and interviewed using questionnaires administered in face to face interviews. Secondary data were collected from official records obtained from the Malawi Prison Service Headquarters and the various prisons that were visited.

Data Analysis

Data were entered in Excel and analysed using Stata 12. The output from the analysis was reported using descriptive statistics such as means, proportions and percentages.

Sampling Methods

All prisons in Malawi formed the field of study and every inmate, except those that had been in prison for less than four weeks, was an eligible interviewee. The four week requirement is a normal procedure followed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) project which developed a questionnaire (Maxwel & Frankenberger, 1992; Swindale & Bilinsky, 2006) upon which the questionnaires used in this study were based. In order to select respondents from the population of inmates, the stratified random sampling and simple random sampling methods were used. The stratified random sampling method was applied to select *n* units out of *N* sub-populations called strata. In this case, each prison was a strata and from each strata *n* number of inmates were selected using simple random sampling in order to give each prisoner an equal chance of being selected (Bryars, 1983; Agresti, 1996; Zikmund, 1997; McGill et al., 2000). In order to select participating inmates, tables of random numbers (Magnani, 1997) were used. In selecting prison officers for the interview, the purposive sampling method was used.

Sample Size

For more precision on sample size calculation, when population size and population proportions are known, the formula given below is used (Kothari, 2004).

$$n = \frac{z^2}{e^2}\frac{p.q.N}{(N-1)+z^2.p.q} \quad \textbf{(1)}$$

where *n* = sample size, *z* = 1.96 = z-value yielding 95% confidence level, *p* = proportion of the population of interest, *q* = 1 – *p*, *N* = 12,598 = the population of interest, *e* = 5% = absolute error in estimating *p*.

The population proportion for each prison was calculated as in Equation **(2).**

$$\text{Prison proportion, } p = \frac{\text{Number of prisoners at a given prison}}{\text{Total prisoner population in Malawi}} \quad \textbf{(2)}$$

In 2016, the total number of, both convicted and un-convicted, inmates in Malawi's prisons was 12,598 (Malawi Government, 2016), while the population of Malawi as given by the UNDP in its 2011 Human Development Report was 15,380,900 (UNDP, 2011). Following the reasoning articulated above and applying Equation **(1)**, the value of *n,* the sample size, was found to be 1418. However, only 1,000 inmates were interviewed because of the study limitations.

Data were collected by three trained interviewers using a questionnaire that had been reviewed by a group of key informants, refined by eight prisoners that were representative of the survey population but who were not part of the survey sample, and pretested on fifteen prisoners through a preliminary survey. Data collected were subjected to regression and correlation analysis and results summarized.

Model Specification

The Foster-Greer-Thorbecke (FGT) model and Gini Coefficients were used to analyse the data.

The FGT model. This is expressed as given in equation **(3)**(Gujarati, 2004):

$$F(\alpha) = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{(m-y_i)}{m}\right]^{\alpha} \quad \textbf{(3)}$$

where n is the number of sample prisoners; y_i is the food caloric intake per adult equivalent of the i^{th} prisoner; m is the cut-off between food security and insecurity (expressed in caloric requirements); q is the number of food-insecure prisoners; and α is the weight attached to the severity of food insecurity. It must be noted, however, that m - y_i = 0 if y_i >m. As for the weightα, giving no weight to the severity of food insecurity is equivalent to assuming that α = 0. If that is done, the formula collapses to F(0) = $\frac{q}{n}$, which is called the food insecurity head count ratio.

The head count ratio or the incidence of food insecurity would be the share of the prison population whose food intake was below the food security threshold of 2,100 kilocalories. It was also possible for one using several food insecurity thresholds, say one for food insecure and another for extreme food insecure, to estimate the incidence of both food insecurity and extreme food insecurity. A weakness of the headcount ratio, however, is that it ignores the depth of food insecurity in that should the hungry become hungrier, the head count ratio would not change (United Nations, 2015). In order

to use the FGT model, the quantities (in kilograms) of the foods that prisoners ate were converted into energy intake in kilocalories using Tanzania Food Composition Tables (Lukmanji, *et al*., 2008).

Giving equal weight to the severity of food insecurity among all food insecure prisoners was equivalent to assuming that α = 1. If the sum of the numerator were taken, one would get the food insecurity gap, which when divided by m would give the food insecurity gap index (Gujarati, 2004). The food insecurity gap index would provide a better indication of the depth of food insecurity. It would also allow food insecurity comparisons and would provide an overall assessment of Malawi prisons' progress in curbing food insecurity. The food insecurity gap index would also help in the evaluation of Malawi's prison policies related to food and other initiatives. By multiplying the prisons' food insecurity gap index by both the food security threshold and the total number of prisoners in the country one would get the total amount of food energy needed to bring the food insecure prisoners out of food insecurity and up to the food security threshold(Gujarati, 2004;Coudouel *et al*, 2002; Sen, 1976). This is known as the Total Caloric Requirement (TCR). This means that the food insecurity gap index is an important measure beyond the head count ratio. If there were two prisons having similar headcount ratios, but different food insecurity gap indices, it would mean that the prison with a higher food insecurity gap index had more severe food insecurity. The food insecurity gap index is additive, meaning that the index can be used as an aggregate food insecurity measure, as well as be decomposed for various sub-groups of the prisoners (Sen, 1976). The index F(1), therefore, provided the possibility to estimate resources required to eliminate food insecurity. The Total Caloric Requirement (TCR) needed to bring the food insecure prisoners to the required daily caloric level was given by equation **(4)**:

$\mathrm{TCR} = \prod \mathrm{mnF}(1)$ **(4)**

where m is the cut-off between food security and insecurity (expressed in caloric requirements),n is the number of sample prisoners and F(1) the food insecurity gap.

Allowing α = 2, gave equation **(5)**:

$$\mathrm{F}(2) = \frac{1}{\mathrm{n}}\sum_{\mathrm{i}=1}^{\mathrm{q}}\left[\frac{(\mathrm{m}-\mathrm{y_i})}{\mathrm{m}}\right]^2 \textbf{(5)}$$

This yields the severity of food insecurity. The severity of food insecurity took into account not only the distance separating the food insecure from the food security threshold but also the inequality among the food insecure. That is, a higher weight was placed on those who were further away from the food security threshold (Foster, Greer, & Thorbecke, 1984). So, F(0) was the percentage of food insecure prisoners, F(1) the food insecurity gap and F(2) the severity of food insecurity.

The Sen and Watt indices. These are other indices for measuring poverty (Coudouel *et al*, 2002; Ravallion & Shaohua, 2001). The Sen index combines the effects of the number of the food poor, the depth of their food poverty, and the distribution of the food poverty within the group. The index is given by equation **(6):**

$P_s = P_0[1-(1-G^p)\frac{\mu^p}{Z}$ **(6)**

where P_0 is the headcount index, μ^p is the mean income (subvention) of the food poor, and G^p is the Gini coefficient of inequality among the food poor.

The Sen Index can also be written as the average of the headcount and food poverty gap measures, weighted by the Gini coefficient of the food poor, giving equation **(7):**

$P_s = P_0 G^p + P_1(1-G^p)$ **(7)**

The Sen Index may also be written as equation **(8):**

$P_s = P_0 P_1^p (1+G^{pp})$ **(8)**

where G^{pp} is the Gini coefficient of the food poverty gap ratios of only the food poor and P_1^p is the food poverty gap index calculated over poor individuals only.

The Watt index is a distribution-sensitive poverty measure which takes the form of equation **(9):**

$W = \frac{1}{N}\sum_{i=1}^{q}[l_n(z) - l_n(y_i)]$ **(9)**

where *N* is individuals in the population (prisoners) indexed in ascending order of income (subvention). The sum is taken over the *q* individuals (prisoners) whose income (subvention) y_i falls below the food poverty line *z*.

The Gini coefficient. The Gini coefficient (or Gini ratio), G, is a summary statistic of the Lorenz curve and a measure of inequality in a population. The Gini coefficient was used to determine the inequalities in food and subvention in Malawi's prisons. The Gini coefficient is most easily calculated from unordered data as the "relative mean difference", as given in equation **(10)**, i.e., the mean of the difference between every possible pair of individuals, divided by the mean size, μ.

$$G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i - x_j|}{2n^2\mu} \textbf{(10)}$$

If the *x* values were first placed in ascending order, such that each *x*had rank*i*, then some of the comparisons above could be avoided and the computation could become as shown in equations **(11)** and **(12):**

$G = \frac{2}{n^2\bar{x}}\sum_{i=1}^{n} i(x_i - \bar{x})$ **(11)**

$G = \frac{\sum_{i=1}^{n}(2i-n-1)x_i}{n\sum_{i=1}^{n}x_i}$ **(12)**

where *x* is an observed allocation of food or subvention to a prison, *n* is the number of prisons in the country and*i*is the rank of prison in ascending order of food or subvention allocation. Only positive non-zero values were used.

The Gini coefficient ranges from a minimum value of zero, or correspond to a Lorenz curve identical to the 45^{o} line, when there is absolute equality in food or subvention allocation to the prisons, to a theoretical maximum of one in an infinite number of prisons in which every individual prison except one has zero food quantity or zero subvention (Dixon *et al.* 1987). So, the further the Lorenz curve is below the diagonal, the more unequal is the food or subvention distribution. The area between the diagonal and the Lorenz curve, as a fraction of the entire area below the diagonal gives the Gini Coefficient, and the closer it is to one the more inequality there is (Snowdon & Vane, 2006). A Gini coefficient between 0.47 and 0.49 would show that the gap in food or subvention distribution is relatively large, and the 0.4 mark would be viewed by analysts as the point at which social dissatisfaction would erupt (Damgaard & Weiner, 2000).

RESULTS AND DISCUSSION

Food Insecurity Head Count Ratio, Food Insecurity Gap Index, Severity of Food Insecurity, and Watts and Sen Indexes

Results from the analysis using the FGT model showed the percentage of food insecure prisoners (also known as the food insecurity head count ratio),the food insecurity gap index, and the severity of food insecurity using the weight, α.

Food insecurity head count ratio or the incidence of food insecurity

The incidence of food insecurity or the food insecurity head count ratio, given as the percentage of prisoners below the food security threshold, was used to measure food insecurity. Table 1 shows that the incidence of food insecurity of 100 percent, or a food insecurity headcount ratio of 1,was found. This meant that practically all prisoners in Malawi's prisons were food insecure. An extreme food insecurity head count ratio of 97.1 percent showing in Table 1 meant that about 97 percent of the prisoners in Malawi's prisons were extremely food insecure.

Food insecurity gap index

A food insecurity gap index of 0.8279 in Malawi's prisons meant that there was, on average, an almost83 percent shortfall in food received by prisoners from the food security threshold of 2,100 kilocalories per day per person (Malawi Government, 1999; Ecker & Qaim, 2008). In other words, prisoners received about 17 percent (or 357 kilocalories) of the recommended daily provision. This scenario gave rise to a per capita aggregate food insecurity gap of 1,738.6 kilocalories per day or an aggregate food insecurity gap of 21,902,883 kilocalories per day for the 12,598 prisoners that were in prison in 2016. These kilocalories were the Total Caloric Requirement (TCR) levels from the various food stuffs that Malawi's prisons needed to source in order to make prisons food sufficient. When these energy levels were proportionately converted to kilograms of maize, beans, vegetables and meat(Lukmanji, et al., 2008), and the price of each food item applied, it was found that Malawi's prisons needed to buy MK18,932,100.00 or USD 26,124.41(1 USD = MK 724.69 as at 26/12/2016) worth of these food items per day for the 12,598 prisoners. This was equivalent to spending an extra MK1,502.79 or USD2.07 on food per prisoner per day, in addition to the amount already being spent on prisoners' food. This would then make the prisons food secure.

Severity of food insecurity

The severity of food insecurity at0.7050 was very high, meaning that there were serious inequalities even among the food insecure prisoners. These inequalities may have resulted from how far away from prison the prisoner's home was, the prisoner's socioeconomic status, and the prisoner's position or title in prison. During interviews it was learned that Head prisoners, commonly known as *nyapala* were given special treatment by fellow prisoners and this included being given bigger food portions by cooks. Cooks, who were appointed from among the prisoners, also gave themselves bigger food portions than what they gave the other prisoners. Furthermore, cooks gave bigger portions to their friends or those who could bribe them with money or other commodities. Inequalities in food distribution may also have arisen from the fact that some prisons had farm land where they grew crops and raised animals while others did not have farm land. Also, some prisons were heavily congested while others were less congested, resulting in smaller food rations in heavily congested prisons and larger food rations in less congested prisons. Inequalities in food distribution may possibly have also arisen from the fact that prisons were subverted differently, depending on the security class of the prison and its location in the country.

Watts and the Sen Indexes

Both the Watts Index and the Sen Index can be used as

Table 1. Food insecurity measures.

Mean	Estimate	Std. Err.	p-value	[95% Conf.	Interval]
Head Count	1	0		1	1
Food Insecurity Gap	0.8279	0.0044	0.0000	0.8192	0.8366
Severity of Food Insecurity	0.7050	0.0042	0.0000	0.6967	0.7133
Headcount ratio %	100				
Extreme Food Insecurity Headcount ratio %	97.1				
Aggregate food insecurity gap	1738626				
Per capita aggregate food insecurity gap	1,738.6				
Watts index	187.5				
Sen index *100	86.77				

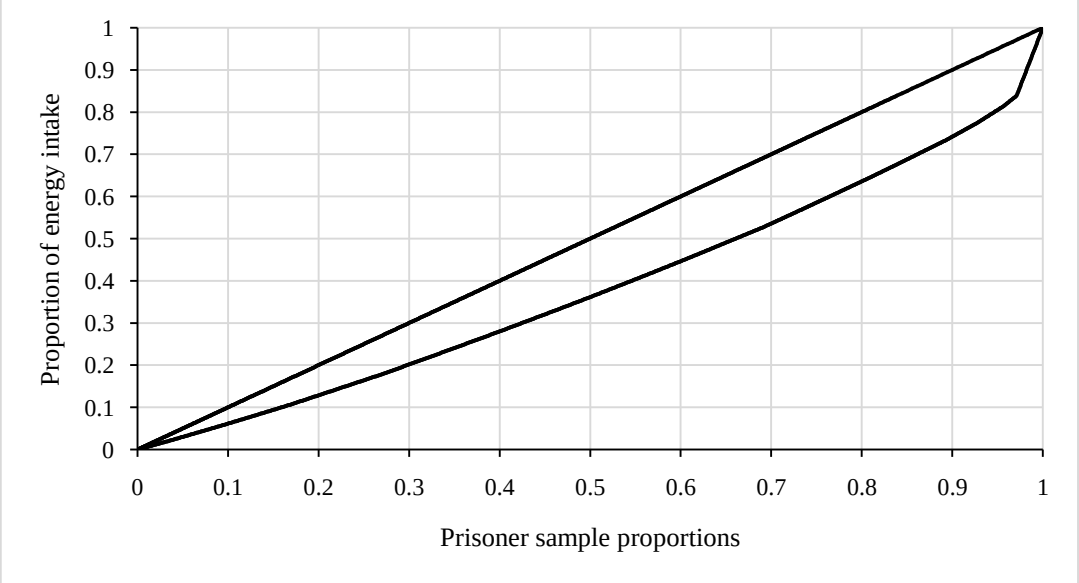

Figure 1. Lorenz curve of prisoner food energy intake.

alternative measures of food poverty. Generally, populations with lower mean levels of per capita expenditure (or income) have higher headcount food poverty rates, higher food poverty gaps, food poverty severity, and Watts indexes. The Sen Index sought to combine the effects of the number of the food poor, the depth of their food poverty, and the distribution of food poverty within the group. The high Watts Index of 187.5 and Sen Index of 86.77 were manifestations of severe food poverty among prisoners.

Distribution of Food Energy and Subvention

The Gini coefficient was used to measure the distribution of food energy and subvention in Malawi's prisons. The Lorenz curve was used to visually indicate how much inequality there was in resource distribution. When resources are more equally distributed, meaning that there is equality, the Lorenz curve shifts towards the diagonal line. In a case of perfect equality, the Lorenz curve lies on the diagonal. When there is perfect equality, the Gini coefficient becomes zero. When resources are less equally distributed, the Lorenz curve moves outwards. In perfect inequality, the Lorenz curve lies over the two right-angled sides of the triangle (in figure 1, the triangle is below the diagonal, formed by the diagonal, the x-axis and the y-axis). In that case, the Gini coefficient becomes one.

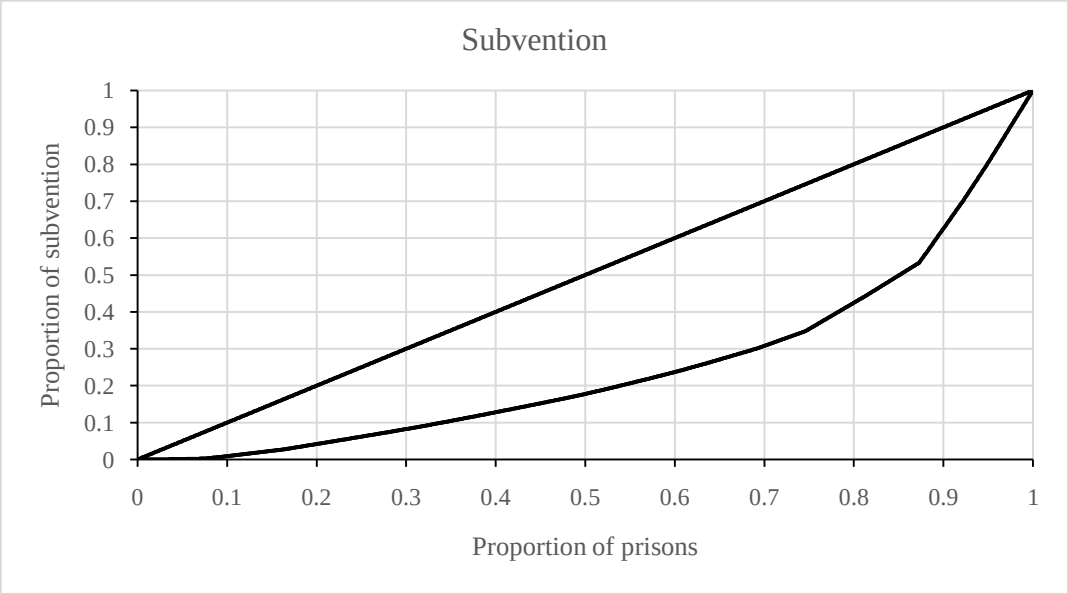

Figure 2. Lorenz curve of subvention.

Distribution of food energy

The Lorenz curve below shows that there was inequality in food distribution in Malawi's prisons. The Gini coefficient in this case was 0.2314, confirming that there was inequality, although not huge. Figure 1 shows the Lorenz curve of prisoner food energy intake.

Distribution of subvention

A Lorenz curve of subvention also showed that there was inequality in the subvention given to prisons. The inequality in subvention may have influenced the inequality in food energy distribution. The Gini coefficient in subvention was 0.5005, which was very high. This showed that there was higher and more serious inequality in the way subvention was distributed than in the way food was distributed. Figure 2 shows a Lorenz curve of subvention.

CONCLUSION

Practically all prisoners in Malawi's prisons were food insecure, with 97 percent of them being extremely food insecure. There existed a per capita aggregate food insecurity gap of 1,738.6 kilocalories per day or an aggregate food insecurity gap of 21,902,883 kilocalories per day. This was the equivalent of MK18,932,100.00 worth of food deficit per day for the 12,598 prisoners or MK1,502.79(USD 2.07) per prisoner per day in 2016. Prisoners in the prisons operated on 71 percentage points below the food security threshold and that there were serious food inequalities even among the food insecure prisoners. Both the Watts Index and Sen Index confirmed the high levels of food insecurity in Malawi's prisons.

A Gini coefficient of 0.2314 in food energy distribution, and one of 0.5005 in the distribution of subvention confirmed that there were inequalities in resource distribution in Malawi prisons. There were more serious inequalities in the way subvention was distributed than in the way food was distributed.

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