Household food insecurity in sub-Saharan Africa: lessons from Kenya

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Despite the widely acknowledged prognosis that the danger of unrelenting hunger and famine looms large in sub-Saharan Africa and that there is a constant need for donors to provide much required food relief, there is a paucity of literature based on comprehensive empirical work at the household or individual level. Based on data collected across two years and two locations in rural Kenya, attempts to develop further the literature on household food security. Food balances are computed and various approaches to food poverty analysis are employed by setting a very low poverty line to determine the proportion of households whose members would require external food support. Results show that per capita food production is low and varies with rainfall and food poverty and inequality in distribution are high. A great deal could be done, therefore, in the sphere of livelihood opportunities to enhance household purchasing power and hence effective demand and food distribution.

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Introduction

Food security is one of the most challenging issues in sub-Saharan Africa which has continued to generate debate. Literature abounds showing that Africa is the only region in the world where per capita food production has declined during the last two decades. Food self-sufficiency ratios dropped from 98 per cent in the 1960s to about 86 per cent by the mid-1980s, implying that, on average, each African had 12 per cent less home grown food in the 1980s than 20 years earlier (Kates *et al.*, 1993). Subsequent evidence on food production in this region continues to paint a gloomy picture. Indeed, it has been reported that while hundreds of millions in the industrialized countries often suffer from diet-related diseases owing to excessive intake of food, a large number in the developing countries are, ironically, faced with hunger owing to lack of food. Of the 800 million people globally suffering from inadequate food intake, over 700 million are in the Third World among whom over 100 million can be found in the African continent. Most of these are said to be residing in the rural areas (Pinstrup-Andersen, 1994; Sansoucy *et al.*, 1995).

Some studies stress that food production in sub-Saharan Africa is in crisis while others doubt this (see, for example, Wiggins, 1995). Indeed, some project that without a sharp increase in domestic food output, this region's capacity to produce its food requirements will continue to worsen because of shortfalls in domestic production over consumption. These studies assert that the production of food has slowed down and, coupled with high rates of population growth, sub-Saharan Africa has shifted from a state of near self-sufficiency to a situation of widespread hunger and famine (Omosa, 1992). It is projected that in the sub-Saharan region between now and the year 2000, population will grow at a rate of more than 3 per cent per annum while food production will grow at 2 per cent per annum or less. By the year 2000, the production shortfall is estimated to increase from about 14 million tonnes of grain as it is at present to about 50 million tonnes. If current trends continue, it is estimated that by the year 2020 sub-Saharan Africa will have a food shortage of 250 million tonnes, which will be 20 times greater than the current food gap (Pinstrup-Andersen, 1994). From food production and population trends, sub-Saharan Africa will then be able to feed no more than half of its population, and poverty, malnutrition and hunger will have increased significantly.

In spite of these projections, however, there is a paucity of literature based on comprehensive empirical work at the household or individual level. The gloomy global or continental picture is thus not easy to discern at this level in specific locations or countries. Further, it has been documented that while food may seem to be sufficient at the national level, households can be confronted with a grave scarcity of food, depending on their geographical and social characteristics, which influence livelihood opportunities (Sen, 1981a). Thus questions arise as to how exactly the national statistics bear on the household or individual. In other words, it cannot be assumed that figures that portray the national situation necessarily provide an accurate reflection of the plight of individual households in a remote district within the wider region. This article attempts to bring into focus the food insecurity position at this level.

Household food security: conceptual framework

Introduction

Perceptions of food security have changed over time and definitions have changed with them (see, for example, Maxwell, 1996). In recent years, more attention has been focused on household access to available food rather than food production. Emphasis on food access, or food "entitlement", as coined by Amartya Sen (1981a), is due to the recognition that increased national food production in the past has not necessarily translated into improved food security at the local level. It is now, therefore, generally agreed that food security is a term which encompasses food supply and food demand issues (Shuttleworth *et al.*, 1988; Webb and von Braun, 1994). The World Bank (1991) defines food security as

"access by all people at all times to adequate food for an active life". Although food is the defining concept, it is implied that food is not all that matters; it also addresses issues related to abilities or inabilities to secure food. The definition of food security thus comprises two major elements: First, the availability of food, through production, storage or imports; and second, access of people to food through their purchasing power to obtain it from a market, or financial outlays and other resources to grow it (Kennedy and Haddad, 1992; Webb and Reardon, 1992; Weber *et al.*, 1988). Thus, since there is a time dimension to food security, the lack of food (i.e. food insecurity) can be either short-term (transitory) or long-term (chronic) (Oluoch-Kosura and Kilungo, 1992; Weber *et al.*, 1988).

At the individual level, a person is considered food-secure if he/she can afford and has access at all times to a diet that is adequate to sustain an active and healthy working life. This is the micro-level or household (or local level) food security (Phillips and Taylor, 1990). It can, therefore, be argued that the primary cause of food insecurity is poverty or lack of a secure source of income. Thus, the concept of micro-level food security addresses the risk of individuals and households not being able to secure sufficient food (Oluoch-Kosura and Kilungo, 1992; Webb and Reardon, 1992).

A similar definition of food security holds true at the macro- or national level. At this level, however, the subject is a nation (or region) and not an individual or a household. A mere increase in food production or supply at the national level may not necessarily result in an improvement in food security at the local level unless individual consumers can be assured of access to it (Kennedy and Haddad, 1992). Hence macro-level food security implies that a country is able to store or import enough food, which may have nothing to do with ensuring that citizens have access to it.

Hypotheses and the framework

The present work entails the analysis of household data collected from a semi-arid district – Makueni – in Kenya. This district was chosen as a representative case of a low to medium potential area; it is areas of this type which collectively form 80 per cent of the country's landmass and in which households are involved in small-scale farming. It is in semi-arid districts where households are most prone to food insecurity.

For the purpose of conceptualizing the study, the following hypotheses were postulated:

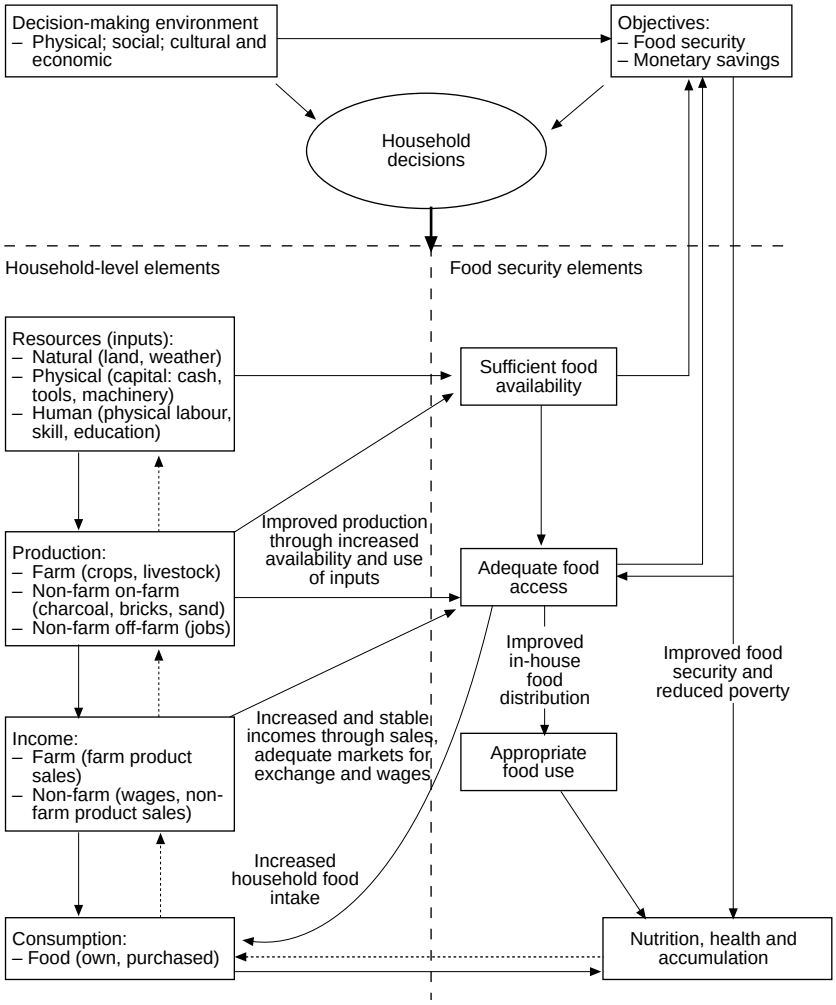
- Sources of livelihood other than farming are playing a more important role in determining household food access, thereby reducing food insecurity, than own-food production in the low to medium potential rural areas of Kenya. Stemming from this are two corollaries:
  - household strategies to acquire sufficient food are primarily a struggle for access to a portfolio of livelihood opportunities, in addition to farming;
  - households in rural areas consume more food than they produce.
- Household food poverty levels in rural areas of Kenya are high relative to a predetermined poverty line.

Figure 1 presents a framework which shows the key elements that determine household food security. The framework is useful as a guide to identify differences in the food security status of individual households.

Accurate information on household food security status of a population is essential for policy intervention by governments and/or donors to improve food security and reduce the incidence of hunger and malnutrition. The lack of such information is a major constraint in planning and policy-making activities among many governments (Babu and Mthindi, 1994; Kumar, 1993). As already implied in the foregoing discussion, one of the major factors that determines the ability of a household to acquire adequate food throughout the year is its ability to produce or purchase food. Implicit in this is the ability of the household to use available natural, physical and human resources efficiently. The availability of resources such as land and labour plays a prominent role in food production in a developing country like Kenya. When land is limiting, the labour resources of a household determine the income to be earned from employment to access food.

A household that relies on its own food production is influenced by the technology available for crop production, the conditions of production and the productivity of resources. The adoption of a particular technology will be influenced by the specific costs and benefits it offers, the needs and aspirations of the adopters, and the nature of the economic, political and social system into which the technology is introduced (Jaeger and Humphreys, 1988; Spencer, 1995). These include availability and ability to use improved crop varieties, availability and ability to use associated inputs like fertilizers and pesticides, and availability of irrigation water (especially in semi-arid areas) (Babu and Mthindi, 1994; Islam, 1988). The availability of cash from credit and remittances will also determine the level of use of improved seed, fertilizer and pesticide.

Figure 1
Conceptual framework: elements of household food security



If a household depends on the food markets to access food, it must raise additional cash from elsewhere. This may be through sale of its produce after harvest. Its members may also generate extra cash by engaging in farm or non-farm employment and/or on-farm non-farm activities. If a household grows cashcrops, it has to spend the cash generated to access food. The types, qualities and quantities of food accessed in markets will depend on the characteristics of these markets. The structure of the markets will in turn be influenced by the nature of the prevailing infrastructure. To understand the effects of food markets, therefore, it would be important to study differences in the food security status of households located in areas with different levels of infrastructural development (Islam, 1988). Differentiation in crop and livestock production and income generating activities, which will be in turn be also influenced by infrastructure, in relation to food consumption and expenditure on food and non-food items, will also contribute to household food security.

Food security at the household level may not in itself be sufficient to determine the nutritional (and health) status of its members. Food must be used appropriately. In addition, intra-household food distribution must be equitable. Even when food is distributed equitably, the nutritional status of some members of a household may be affected by other factors, especially those that affect their health (Alderman and Garcia, 1994). This is particularly so for vulnerable groups, such as women and children (Kennedy, 1989; Kennedy and Haddad, 1994).

From the foregoing, therefore, it can be argued that underlying conditions relevant to food insecurity include proneness to production fluctuations, lack of employment opportunities, household resource limitations, isolation from markets, constraints to improvement of human capital, and low levels of farm technology. Thus, policies aimed

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at reducing food insecurity that concentrate only on a limited number of activities at the farm level are unlikely to succeed since they will not address the resource constraints and alternative options open to households that could increase their food production or availability and access. Household food security, therefore, should be viewed not in isolation but as a function of a gamut of variables (Figure 1); thus the need to collect information and data on a wide range of these variables for a successful analysis.

Area of study and data

The study area was in Makueni District which lies east of the Great Rift Valley in the South-east of Kenya. Most of its population of 800,000 live in the rural areas with only about 8 per cent urban dwellers, living mainly in Machakos and Athi River Townships (ROK, 1994; Tiffen *et al*., 1994). The district is classified into several agro-ecological zones (AEZ) or agro-climatic zones (ACZ) (Jaetzold and Schmidt, 1983; Sombroek and Braun, 1980). Makueni District has six agro-climatic zones (I-VI), the most dominant of which are ACZs IV and V. Except for small areas under large-scale livestock production (ranching), most of the land is under small-scale mixed farming. In the high altitude and hilly areas around Kilome Hills, coffee, vegetables, and fruits are grown and dairy cattle are kept. In the lower areas, livestock keeping – cattle, sheep, goats, rabbits (and poultry) – is the major occupation, but crop production is also important. The main foodcrops include "Katumani" maize, pigeon peas, cow peas, beans and sorghum.

Samples of 50 households were drawn separately from villages in Kibwezi and Kilome – zone IV/V and zone III/IV respectively. The northern part is better served with roads and is in a wetter ecological zone than the central part. In addition, the central part was more recently settled, the earliest settlements having been in the early 1970s. Drawing samples this way offers an opportunity to investigate whether there are differences between households owing to differing agro-ecology and infrastructure.

In Kibwezi Division, the 50 households interviewed in an earlier survey conducted by the Germany and Israel Agricultural Research Agreement (GIARA) project were re-interviewed. In this area, cluster or area sampling was carried out by considering each administrative location (under a Chief) as a cluster. This is normal practice in a country like Kenya because of poor infrastructure and difficult terrain (Casley and Lury, 1987). The clusters were randomly selected after which a sampling frame was prepared and systematic sampling applied to the frame. In Kilome Division, a semi-arid sub-location was purposively selected, since some areas in the division are of high potential, after which the names of all households in the area were collected. A sampling frame was formed and 50 households were systematically selected and interviewed.

Households were visited three times in both divisions to obtain cross-section data for three different seasons – the rain season ending December 1994 (second season), the harvest season in July/August 1995 (first season) and the harvest season of February/March 1995/96 (second season). The visits at different times of the year were particularly helpful in tracking consumption and food expenditure patterns. They also provided time-series based on season. Data on consumption and household food expenditures were based on the meals prepared in the 24 hours and the week preceding the visits and represented an estimate of food expenditure during that season. The farmers were questioned as to whether the 24 hour period or week preceding the visit was "normal" in terms of the foods prepared. The advantages and disadvantages of these methods of estimating consumption have been discussed in detail by Bouis *et al*. (1992) and Webb and von Braun (1994).

Household food availability and access: methodological issues

Potential food access (food security) measures

Household grain consumption in each season is estimated from foods prepared by the household. The difference between availability and consumption gives an indication of household self-sufficiency. The difference (positive for net "sales" and negative for net "purchases") shows whether a household has a real surplus or needs to purchase extra grain, or obtain it from other sources, to meet consumption shortfalls. Note that household grain consumption during harvesting time, when availability is not constrained, is a good estimate of requirement. However, consumption figures for food estimated this way compared with annual or seasonal consumption figures reported by respondents were found to concur, albeit with slight differences.

Since household food access is a function of own-production and income from farm and off- or non-farm sources, it should be described precisely as potential food access; food that can be obtained through purchases depends on availability in markets and

whether it is actually purchased. The implied (or potential) amount of food accessed by a household is therefore given by available food from production plus income equivalent of food net of non-food expenditures. Non-food expenditures are estimated from reported purchases of non-foods per week during the survey visits. The equivalent of foodgrain is obtained by dividing income set aside for food by the average price of grain realized by the households at the local markets during the year or season in question. Total per capita food access is then calculated as total household food access divided by the number of adult equivalents in each household (children taken as 0.5 of adults). Implied per capita access to foodgrain equivalents per day is herein referred to as the food security measure. This measure is not a complete definition of food security since it says nothing about food distribution within a household and intake by individual household members. It is reasonable, however, to expect that low access to calories is likely to lead to poor distribution and low intake.

Estimating levels of food insecurity (food poverty)

Insufficient access to food, food poverty or more generally food insecurity is the reverse of food security. Attempts to improve food security are unlikely to succeed without also making direct efforts to alleviate or eradicate predisposing factors to food poverty among a population. Since food security could be improved by raising incomes and as a result lowering poverty, discussions of food security cannot be divorced from those of poverty.

Food poverty just like general poverty is a relative concept. In other words, it may not be of the same nature and extent for all people, at all times and in all regions; it may be time, location, group or even culture-specific. There is need, therefore, to understand the magnitude and causes of poverty at the local level with its specific socio-economic, cultural and geographical characteristics. An attempt is made, therefore, to show differences in the incidence, depth, and severity of food poverty with respect to time and location in one group of people (the Akamba) with a similar culture, for which there are data.

As is the case for many other studies, there are many and differing views on methods of poverty analysis concerning how welfare should be measured, how and what poverty lines should be used, and what kind of measure is suitable. Methodological choices in poverty measurements naturally depend on the purposes of measurement and data availability. The choice of definition of poverty should therefore be guided by the use to which it is to be put and the environment in which it is to be applied (Orshansky, 1978). Like the adage that "beauty is in the eye of the beholder", this continues to emphasize the relativity of poverty assessment. In the area of study where what may be viewed as an average lifestyle in the developed world would, in the eyes of many, reflect lavish living, it is necessary that poverty be defined at its basic level. In the case of food, a household is defined as poor if it is unable to provide its members with "sufficient quantities". A sufficient quantity is basically that amount necessary to maintain physical wellbeing. This is the concept of absolute poverty (Greer and Thorbecke, 1986a; Ravallion and Sen, 1996).

The analysis of poverty involves answering several questions after setting an "appropriate" poverty line. For example, who is poor; how poor; and how much poverty exists? Anyone with a food expenditure less than the poverty line is regarded as poor and he/she is poor by the amount by which food expenditure falls below the food poverty line. Determining the amount of total poverty requires summary statistics measuring the extent or severity of poverty within a population.

Most studies related to food poverty have used two main methods to set the poverty line. These are the "food-energy-intake" (FEI) (see, for example, Bouis and Haddad, 1981) and the "cost-of-basic-needs" (CBN) method (see, for example, Ravallion and Sen, 1996). In the former method, the poverty line in each sector and period is obtained by finding the expenditure or income level at which the expected value of caloric intake, conditional on expenditure, equals predetermined food-energy requirements. The latter method, which has been adopted in this study, involves setting the poverty line as the cost of a "normative basic needs" bundle of goods. That bundle is normally chosen to be sufficient to reach a predetermined caloric requirement, with a composition that is consistent with the consumption behaviour of the poor.

Each of the methods has advantages and disadvantages. The main arguments for the FEI method are that it:

(1) results in consistent estimates (i.e. on average people on the poverty line will have the same food-energy intakes relative to requirements);
(2) reflects differences in preferences between subgroups as these preferences do affect the poverty line derived; and
(3) has a practical advantage in that it does not require data on prices.

This last advantage is, however, not fully realized because to estimate the FEI data on

the quantities of food consumed are required and expenditures are collected to compute unit or average "prices". The main disadvantage of this approach is an empirical one; the "implicit" bundle of goods varies so much as to be inconsistent even with the same standard of living.

The CBN method has its problems too. The most serious one is that the poverty lines generated ignore utility-compensated substitution effects. It is, nevertheless, thought to be a more favourable method (see Ravallion and Sen, 1996) especially for making poverty comparisons, in that it explicitly aims at controlling for differences in purchasing power over basic consumption needs.

Alternative poverty measures

Aggregate poverty measures entail a normative construction of what is considered to be an acceptable poverty line. The distance of each household from the line is then measured. This is not without controversy in particular regarding the method of aggregation and what is regarded as "acceptable". This has led to the use of various poverty indexes. These indexes have proved useful in explaining certain aspects of poverty distribution.

The most basic way of assessing poverty is by using the head-count ratio. This index is interpreted as a measure of the incidence of poverty. It shows the percentage of the population, in terms of per capita adult-equivalents, living in households which have consumption less than the poverty line[1]. It does not, however, show the extent (or depth) or severity of poverty (Sen, 1976, 1981b). To show poverty depth, the mean of poverty gaps index is used. This index is defined by the mean distance below the poverty line as a proportion of that line, where the mean is formed over the entire population, assigning zero values for those who fall on or above the poverty line[2]. The disadvantage of this measure is that it is not affected by changes in inequality among the poor (Ravallion and Sen, 1996).

Another commonly used measure is the mean sum of squares of poverty gaps index. This index is similar to the mean of poverty gaps except that it is weighted by the income gaps themselves. Therefore, greater weights are given to wider gaps resulting in an index that reflects the severity of poverty, which is sensitive to changes in inequality among the proportion of the poor within the population. The necessary data are the distribution of income over the population and the poverty line[2]. This index has the major advantage that it is additively decomposable so that total poverty can be disaggregated over population subgroups in a way that reflects each subgroup's contribution to total poverty. These correlations are important for identifying causal factors and formulating poverty alleviation policies (Greer and Thorbecke, 1986b).

In studies of poverty, the Gini coefficient (also referred to as the Lorenz coefficient) has been widely adopted as a standard measure of income inequality in the population (Mellor, 1990; Sen, 1981b). The index, like all the other poverty measures mentioned, ranges in value between 0 and 1. As the income distribution approaches equality, the index approaches zero, while as income inequality rises, it approaches one. The coefficient is a weighted average of individual people's income levels. The weights are determined by the rank order position of individual incomes[3]. Gini coefficients therefore imply the welfare status of the population.

Sen's measure of poverty (Sen, 1976) is another common index. It emphasizes the distribution of income associated with the poor. The measure is closely related to the head-count ratio and Gini coefficient as it includes them in the computation[4]. For policy purposes, Sen's measure is regarded as a more suitable or realistic measure compared to the head count or the poverty gap index since it takes into account both the distribution of income among the poor as well as the extent of aggregate shortfall of income from the poverty line (Nautiyal and Nautiyal, 1995). Unlike Sen's measure, the head count ratio violates the monotonic axiom that "given other things, a reduction in income of a person below the poverty line must increase the poverty measure"; while the poverty gaps index violates the transfer axiom that "given other things, a pure transfer of income from a person below the poverty line to anyone above the line must increase the poverty measure".

Results and discussion

Net producers and consumers

Table I shows the number of households that experienced deficit production in Kibwezi. It also reports the percentage of actual sales or the fraction of households involved in the marketing of their produce (market participation). It is shown in the Table that in 1991, a majority of households (66 per cent) were net buyers of the main staple, maize. However, a large fraction of households were either able to produce a surplus or balance their production with consumption in the case of pulses. The number of those experiencing deficit production increased in the first season of 1995 to a high of 85 per cent, mainly because

of low rains. For the year, on average, over 60 per cent of households experienced scarcity of maize grain from their fields. The volume of grain or pulses marketed was generally low, especially during the dry season. Except for the first season of 1995, maize sales were below 50 per cent of production.

Numbers of net producers and consumers in Kilome are given in Table II. The Table also indicates the proportion of households that sold part of their crop and the actual sales that took place. As in Kibwezi, a majority of households (60 per cent) were net purchasers of maize grain during the drought season, although this was a slightly smaller proportion compared to that of Kibwezi in the same season. Even in the relatively wet season of 1994, a large proportion of households (40 per cent) were net consumers of grain. This implies, as in Kibwezi, that this proportion of households had to either substitute grain with some other foods or fill the deficit from outside their own fields. There is not a significant difference in the proportion of produce marketed in Kilome compared to Kibwezi.

Explaining differences in household potential food access

This section investigates differences in the food security status of households between the two years in Kibwezi and the three seasons in both Kibwezi and Kilome using a number of variables for which data are available. Households were stratified a posteriori by calculating total (net) income from all sources and deriving per capita (adult equivalent) income. The households were then subdivided into three groups – lower tercile (implying poorer), middle tercile and upper tercile (richer). The values of the various variables are computed and compared.

A variety of variables is used as indicators of differences in the level and causes of food scarcity. Household size per land area available indicates the potential availability of labour (relative to land). The inverse indicates the relative availability of land with respect to potential labour available. Land area under crop shows the relative extensification of cropping between groups while crop harvest per hectare shows intensification of cropping. The relative importance of cropping as an income earner is shown by comparing income from crops as a percentage of the total income from all sources. The relative intensity of livestock production is given by the number of units kept by each tercile while the relative importance of livestock income from direct sales is the percentage of livestock income per household over total income. The relative contribution of other sources of income to total income is given by non-farm income as a percentage of total income. Some of the questions to be answered by comparing these variables include the following:

- Are there differences in income from crops between the richer and poorer households? If yes, which group shows higher income? If the richer have higher crop income then there is a greater scope to try to raise farm productivity and efficiency to improve food security.
- How does livestock contribute to income and hence food security? Do the more food secure possess more or less livestock, or derive more or less income from direct sales? If they keep more animals then it may be concluded that livestock contributes significantly to food security.
- Is there any indication of extensification (land area cultivated in relation to numbers of people) among the more food secure?
- Are there indications of intensification of both crops (crop harvests per hectare) and livestock (livestock units per household) in the richer group?
- What is the role of non-farm income? If the more food secure have an income that has a higher proportion from non-farm sources then it may be said that non-farm sources of food security may be playing a more important role than farm sources. What non-farm

Table I
Net producers and consumers in Kibwezi

Year/season	Crop	Net sellers[a] Number	Net sellers[a] Per cent	Per cent production marketed[b]	Net consumers Number	Net consumers Per cent
1991	Maize	17	34.0	18.0	33	66.0
	Beans	13	26.0	34.0	18	36.0
	Pigeon peas	12	24.0	26.0	10	20.0
	Cow peas	12	24.0	26.0	11	22.0
2nd season 1994	Maize	25	50.0	31.0	25	50.0
	Beans	32	63.6	39.2	4	16.2
	Pigeon peas	36	71.4	59.6	14	28.6
	Cow peas	29	58.0	51.0	21	42.0
1st season 1995	Maize	7	14.6	55.3	41	85.4
	Beans	3	7.8	14.4	37	90.2
	Pigeon peas	28	68.7	10.6	12	29.3
	Cow peas	22	43.7	15.6	19	46.3
2nd season 1995	Maize	26	53.1	35.0	23	46.9
	Beans	22	47.8	25.7	24	52.2
	Pigeon peas	32	76.2	23.9	10	23.8
	Cow peas	26	54.2	17.9	22	45.8

Notes:
[a] If difference between total production and consumption is positive (i.e. potential sellers); percentage of those cropping
[b] Actual sales as a per cent of total production by the households realizing a crop

sources are available? Does their number matter?

Differences in household potential food access in Kibwezi

Table III indicates differences between the lower and upper terciles in Kibwezi in 1991. The table shows that the less food secure (lower tercile) had more people per land area. It indicates that although larger households imply more labour availability, their labour does not sufficiently compensate for the greater number of people that they have to feed. This is to say that households with fewer members are more likely to be food secure.

Both land area under crop and crop harvests per hectare were less in the lower tercile than the upper tercile. This shows that in this year cropping had a significant influence on household food security in Kibwezi. This is also supported by the higher income realized from cropping by the upper tercile.

While more livestock (units) were kept by households that were more food secure, less direct income was realized by this group. It may be suggested that, at least in this period, farmers in Kibwezi kept livestock more as capital that enhanced crop production than as a means of direct income generation through sales of live animals and their products – milk, hides, skins, manure, and eggs. The richer tend to keep more cattle (which contribute to higher livestock units) and hence more livestock capital than the poorer. The poorer tend to keep small stock (sheep and goats) and therefore tend to have more income from direct sales. The richer do sell their large stock during drought and may occasionally realize a higher income from this source. Overall, however, livestock sales did not seem to contribute significantly to total income in Kibwezi (Tables III and IV).

Table IV indicates that the richer had consistently smaller household sizes per land area than the poorer, supporting the argument that labour availability, that should influence crop extensification and/or intensification, does not seem to compensate sufficiently for the extra food requirement. Since there was also consistently more extensive cultivation by the richer, this may suggest that factors other than labour availability may be influencing the size of land cultivated. These may include livestock availability (which was higher in this group in terms of units in 1991 and in all the seasons of 1994/95/96), cash availability to hire an ox-plough or tractor, and access to irrigation water (six out of seven in the upper tercile in both 1991 and 1995 had access to some irrigation).

Non-farm income also seems to have a fixed pattern of influence on food security in Kibwezi. It generally contributes substantially to overall income, especially among poor households. In 1991 it contributed about 20 per cent to total income in both groups, but slightly less for the richer (Table III). In 1995 (Table IV), it contributed significantly during the drought season. The drought season had a particularly devastating effect on the crop income of poorer households, which experienced a net loss of over 20 per cent of total income. This is because there was crop failure, mainly of maize and beans. The bulk of this income (about 94 per cent) was then obtained from the non-farm sources. However, the number of non-farm income sources appears not to follow a clear pattern. In 1991, those households that occupied the upper tercile had access to more sources of income,

Table II
Net producers and consumers of major foodcrops by season in Kilome 1994/95/96

Year/season	Crop	Net sellers Number	Net sellers Per cent	Per cent production marketed	Net consumers Number	Net consumers Per cent
2nd season 1994	Maize	30	60.0	30.0	20	40.0
	Beans	5	27.8	33.7	13	72.2
	Pigeon peas	13	72.2	12.3	5	27.8
1st season 1995	Maize	20	40.0	34.6	30	60.0
	Beans	18	28.3	15.6	28	59.6
	Pigeon peas	23	49.0	9.4	26	51.0
2nd season 1995	Maize	38	76.0	48.4	12	24.0
	Beans	10	20.0	53.2	40	80.0
	Pigeon peas	20	40.0	45.8	30	60.0

Table III
Differences in household characteristics by food security groups in Kibwezi 1991

Characteristic	Lower tercile	Upper tercile
Food security measure[a]	1.2	6.7
Household size (adult equivalents/ha)	1.0	0.3
Land area under crop (ha)	2.1	3.8
Crop harvests (kg maize equivalents/ha)[b]	940.8	1,821.8
Crop income (% of total income)	66.7	74.3
Livestock units/household	3.1	8.3
Livestock income/household (% of total income)[c]	9.1	7.3
Non-farm income (% of total income)	24.2	18.4
Number of non-farm income sources[d]	1.1	1.3

Notes:

[a] Per capita per day grain equivalent (kg) of total income "set aside" for food

[b] Values of maize equivalents/ha appear rather high because of double counting of crop yields owing to intercropping

[c] Income from direct sales of live animals and by-products

[d] Number of members per household in salaried jobs, e.g. as labourers in other farms, in government, private sector, NGOs, etc.

while a mixed scenario was observed for the 1994/95/96 data set (Tables III and IV).

Differences in household potential food access in Kilome

Table V reports differences between terciles in the three seasons in Kilome. Similar to Kibwezi, the less food secure (lower tercile) had more people per land area, supporting the contention that labour availability has not compensated enough for the larger number of people in each household. Therefore, likewise, households with fewer members are more food secure. Land area under crops and crop harvests per hectare also show a similar pattern to Kibwezi; both were less in the lower tercile than the upper tercile. Further, higher income was realized from cropping by the upper tercile. These observations support the hypothesis that cropping has a significant influence on household food security in Makueni in general.

While the contribution of livestock to total income and hence food security appears to be the same in Kilome as in Kibwezi, the opposite is the case in terms of livestock units kept. Although differences were minimal in two out of the three seasons, a consistently higher number of units of livestock were observed in the households that were less food secure. This means that the more livestock a household possessed, the less food secure it was. Also, there was always more direct income from livestock in proportion to total income in the poorer group, implying that the richer did not keep livestock as a source of direct income. It may be deduced that farmers in Kilome may be experiencing some form of competition between crops and livestock as far as household food security is concerned.

As in Kibwezi, the more food secure in Kilome had higher crop extensification as well as intensification, as shown in Table V. Crop income for the richer was higher in all seasons, and the gap was more pronounced in the drought season of 1995. Income from non-farm sources was higher in the upper tercile in the "normal" seasons – second season of 1994 and second season of 1995. In the drought season, contributions to total income by non-crop sources (livestock and non-farm incomes) were significantly higher in the lower tercile than the upper tercile, probably because the low rainy season had a more adverse effect on crops in the lower tercile.

The pattern of number of non-farm income sources was more systematic in Kilome than in Kibwezi; the more food insecure had less access to non-farm sources of income, which tends to support the hypothesis that if these sources were increased, food security in Kilome would also increase. When the seasonal values for the two areas are scrutinized, however, in general more household members were involved in non-own-farm jobs in the lower tercile in Kibwezi compared to Kilome. This does not, however, imply that the availability of non-farm employment is not important in Kibwezi. What the seasonal values for Kibwezi tend to indicate is that the higher number of income sources may be a

Table IV
Differences in household characteristics by food security groups in Kibwezi 1994/95/96

Characteristic	2nd season, Kibwezi 1994		1st season, Kibwezi 1995		2nd season, Kibwezi 1995	
	Lower tercile	Upper tercile	Lower tercile	Upper tercile	Lower tercile	Upper tercile
Food security measure	0.7	4.7	0.3	2.1	1.1	4.9
Household size (adult equivalents/ha	1.7	1.0	2.6	1.2	1.7	1.1
Land area under crop (ha)	3.0	4.0	2.4	3.9	3.1	4.3
Crop harvests (kg maize equivalents/ha)	1,738.0	1,576.8	176.5	338.1	648.0	1,787.0
Crop income/household (% of total income)	38.8	26.6	(22.6)	26.6	40.6	69.6
Livestock units/household	3.3	4.9	1.1	3.8	3.2	4.7
Livestock income/household (% of total income)	7.1	23.6	28.7	10.2	21.9	4.8
Non-farm income/household (% of total income)	54.1	49.8	93.9	62.0	37.5	25.6
Number of non-farm income sources/household	1.4	1.5	1.8	1.6	1.2	1.3

Table V
Differences in household characteristics by food security groups in Kilome 1994/95/96

Characteristic	2nd season, Kilome 1994		1st season, Kilome 1995		2nd season, Kilome 1995	
	Lower tercile	Upper tercile	Lower tercile	Upper tercile	Lower tercile	Upper tercile
Food security measure	1.1	4.3	0.8	4.4	1.5	7.4
Household size (adult equivalents/ha)	2.2	1.5	2.8	1.4	2.7	1.7
Land area under crop (ha)	1.7	1.9	1.6	1.8	1.5	1.7
Crop harvests (kg maize equivalents/ha)	1,667.6	2,120.7	847.7	1,402.0	1,203.9	3,142.2
Crop income/household (% of total income)	45.6	55.6	19.0	52.0	33.0	39.0
Livestock units/household	5.6	5.2	6.0	3.8	4.4	4.2
Livestock income/household (% of total income)	19.1	7.6	23.0	5.0	14.0	4.2
Non-farm income/household (% of total income)	35.3	36.8	58.0	43.0	53.0	57.0
Number of non-farm income sources/household	0.8	1.3	1.3	1.6	1.3	1.7

manifestation of food insecurity rather than a contribution to food security. It may also be argued that the lower tercile required household members to do a greater number of less lucrative (odd) jobs to be able to secure some food, while there was less need for the richer to be involved in such jobs. This is because of the large difference between the value in the wetter season than that in the drier season.

Locational and annual food security differences

Table VI reports the analysis of the terciles on an annual and locational basis for ease of comparison. First, households were potentially more food secure in Kibwezi in 1991 than in 1995. Second, households in Kilome were potentially more food secure than households in Kibwezi in 1995. Third, on average, there was slightly greater availability of off-farm jobs in Kilome than in Kibwezi.

Even though annual averages may obscure the causes of food insecurity, contrary to the rather mixed seasonal observations, the number of income sources tends to explain more clearly annual differences in food security. In general, the higher the number of income sources, the higher the food security status of the households. Although the influence on food security of non-farm income was not always clear in the two locations, owing to the nature of the sources of this income, it is clear that the more food secure households in Kilome had a higher proportion of their income derived from non-farm income sources, implying that these sources have a role to play in ensuring household food security in Makueni.

Table VI
Differences in household characteristics by food security groups (annual measures)

	Kibwezi 1991		Kibwezi 1995		Kilome 1995	
Characteristic	Lower tercile	Upper tercile	Lower tercile	Upper tercile	Lower tercile	Upper tercile
Food security measure	1.2	4.7	0.9	3.3	1.2	5.3
Household size (adult equivalents/ha)	1.0	0.3	1.0	0.9	1.9	0.9
Land area under crop (ha)	2.1	3.8	2.9	4.3	1.7	1.7
Crop harvests (kg maize equivalents/ha)	940.8	1,821.8	244.0	398.0	710.0	1,413.4
Crop income/household (% of total income)	66.7	74.3	49.4	59.3	35.8	36.3
Livestock units/household	3.1	8.3	2.5	5.1	4.6	3.7
Livestock income/household (% of total income)	9.1	7.3	13.3	6.0	16.9	4.4
Non-farm income/household (% of total income)	24.2	18.4	37.4	34.9	47.3	60.0
Number of non-farm income sources/household	1.1	1.3	1.2	1.3	1.5	1.6

Food distribution and poverty measures

For purposes of computing annual poverty indexes, a common poverty line for both Kibwezi and Kilome is constructed from the list of foods consumed as reported in the survey. The proportion of each food consumed is also estimated from this list. Total income for each household is then calculated and the non-food expenditures are subtracted. Rather than set a fixed proportion, non-food expenditures are used as reported in the survey. Per capita incomes are then computed and adjusted for inflation using the rural food price indexes so as to obtain "real" per capita (adult equivalent) income per day. The incomes so derived are compared with the poverty line to estimate the poverty indexes (Table VII). In addition to comparing food poverty levels between the two geographical areas (Kibwezi and Kilome), the indexes for the Kibwezi sample of 1991/92 are compared with the indexes derived for the 1995/96 sample, to determine what changes have occurred between the two periods.

Table VIII reports the alternative food poverty measures and distribution indexes for Kibwezi and Kilome based on the CBN approach. The objective here is not to test different methodological approaches, but to adopt fairly well understood and acceptable methods of poverty analysis to show the situation in the study areas. The main inputs to the poverty measures are the caloric requirements, the food bundle to achieve that requirement, and an allowance for non-food items, which entails a normative judgement. The results are nevertheless consistent with those obtained in a similar study by Greer and Thorbecke (1986).

As shown in the Table, every poverty measure, except Sen's and Gini, increased in Kibwezi between 1991 and 1995. Given that these two years had similar rainfall, this indicates that rural poverty increased over this period. The almost doubling of the mean sum of squares of poverty gaps index suggests that the poorest of the poor as well as those close to the poverty line, as indicated by the less dramatic change in the head-count ratio, were experiencing falling food access or living standards. The head-count ratio rose by 12 per cent between the two years.

Sen's measure seems to contradict the other measures. It indicates that poverty reduced, albeit only a little. However, recall that the measure incorporates distribution in addition to total head-count in its computation. What this means is that while the number of

Table VII
Per capita per day food balance sheet for the study areas

Food item	Nutrient content per 100 gm (edible portion) Calorie (gm)	Protein	Per capita normative daily threshold Food (gm)	Calories	Protein	Rural values of food (Ksh/kg) 1991/92	1995/96 Current	"Real"
Whole maize	345	9.4	259.9	734.0	19.3	3.75	10.00	4.38
Pulses (peas and beans)	347	23.0	80.8	274.0	17.8	6.80	22.50	9.86
Sorghum/millet	327	9.7	17.5	54.0	1.5	11.27	18.69	8.19
Cassava	138	1.2	25.6	28.0	0.2	4.00	10.00	4.38
Sweet potatoes	109	1.6	37.0	37.0	0.6	3.97	14.00	6.14
English potatoes	75	1.7	20.3	15.0	0.3	3.97	14.00	6.14
Wheat	333	10.0	24.9	68.0	2.0	5.30	30.00	13.15
Banana	85	1.5	15.1	9.0	0.3	3.00	10.00	4.38
Other fruit	–	–	12.3	7.0	–	9.88	20.00	8.76
Vegetables (green)	22	1.3	44.8	10.0	0.6	8.85	31.00	13.59
Whole milk	79	3.8	90.0	57.0	2.9	5.10	20.00	8.76
Meat (beef, mutton)	171	15.0	20.7	35.5	3.1	25.50	100.00	43.82
Chicken	73	20.1	16.4	11.9	3.3	35.30	130.00	56.97
Eggs	140	12.0	2.9	8.0	0.3	14.12	60.00	26.29
Fats/oils	700	0.0	12.3	96.0	–	20.60	122.10	53.51
Beverages	51	0.6	31.1	16.0	0.2	41.78	121.10	53.07
Sugar/honey	375	0.0	50.4	194.0	–	5.76	40.00	17.53
Nuts/oil seeds	572	23.0	9.9	20.0	0.5	20.00	50.00	21.91
Total (gm, calories, proteins)			772.0	1,674.0	53.0			
Poverty line expenditure on food (Ksh per capita/day)						6.40		9.77
Rural CPI for food[a]						100.00		228.19
Rural CPI for non-food[a]						100.00		296.86

Note:
[a] Derived from estimates by the CBS (1995/96) for Eastern Province (ROK, 1996)
Source: Adapted from World Bank Sector Reports (1991)

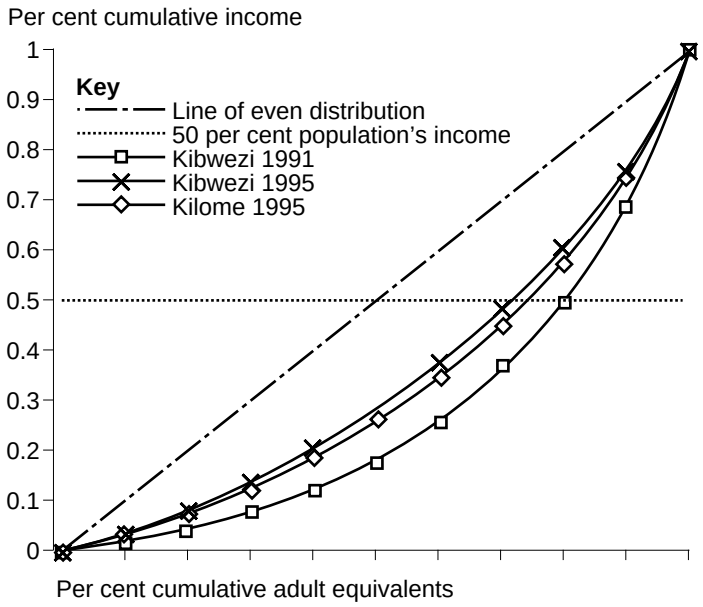
Table VIII
Food poverty measures

Measures (%)	Kibwezi 1991	Kibwezi 1995	Kilome 1995
Head count ratio (*h*) (%)	34.0	46.0	36.0
Mean of poverty gaps (*g*) (%)	12.2	17.5	12.1
Mean sum of squares of poverty gaps (*P*) (%)	5.0	9.1	5.4
Gini coefficient	0.43	0.32	0.34
Sen's measure (%)	31.8	27.7	19.2

poor and overall poverty increased between the two years, the situation of those below the poverty line actually improved. This is to say that while more people became poor, the condition of the poor relative to the rich got better. Although Sen's measure and the rest of the poverty measures do not agree on direction, the former moves in the same direction as the Gini coefficient. Note that Sen's measure does not violate the two important axioms in poverty analysis – the monotonic and transfer axioms (Sen, 1981b). On the other hand, the head count ratio violates the monotonic axiom that "given other things, a reduction in income of a person below the poverty line must increase the poverty measure", while the poverty gaps index violates the transfer axiom that "given other things, a pure transfer of income from a person below the poverty line to anyone above the line must increase the poverty measure". Since the number of poor increased, it may be inferred that the gap between the poorest of the poor and the richest of the poor became wider.

Poverty measures for 1995 indicate higher poverty in Kibwezi than in Kilome. Therefore, with respect to command over food consumption needs, Kilome farmers were more secure – Kilome households suffered less incidence, depth and severity of food poverty. The Kilome households in 1995 appear to have faced a food poverty situation similar to that of the Kibwezi households in 1991, considering the closeness of most of the indices. This picture is clearly shown in Figure 2. The figure illustrates the distribution of food poverty in the two years and the two locations using the Lorenz curves. For Kibwezi, the section of the Lorenz curve below 50 per cent of total income for 1991 moved closer to the line of equal division of the income-equivalent of food, supporting the direction of Sen's

Figure 2
Lorenz curves: income-equivalent of food distribution over household population



measure. This depicts an improvement in the welfare of the poor between 1991 and 1995 in terms of food poverty. Overall distribution also got better, as implied by the lower Gini coefficient. However, as shown by the rest of the poverty measures, overall poverty levels worsened. In 1991, about 80 per cent had less than 50 per cent of total income, while in 1995 this proportion reduced to about 70 per cent.

Conclusions and possible remedies for food insecurity

This article has discussed variations in the numbers of net producers and consumers by season and year in the two areas of study. It has also demonstrated how various characteristics of households influence their food security status across seasons, years and locations. Between 1991/92 and 1995/96, prices of food in rural areas increased two-fold (200 per cent) while those of basic non-food items increased threefold (Table VII). However, since most farmers in the semi-arid areas are faced with food shortfalls, they have to purchase food to make good the deficit between production and their food requirements. This requires generation of income from non-food crops or from outside their farms. Since prices have increased, to ensure an improvement in their food security status incomes must increase at a faster rate to increase effective demand. This has not been the case, as can be inferred from the deteriorating poverty situation in Kibwezi between the two periods in question. Also, prices of inputs, including fertilizers and improved seed, have increased while producer prices have not improved at the same rate. In addition, due to liberalization of grain imports, cheap grain has been finding its way into the country, pushing these prices further down. It is likely then that the observed deterioration in grain production and worsening food poverty have been triggered, among other possible causes, by the inability of farmers to net out profits from their produce.

This analysis may be used to draw conclusions with respect to seasonal variations in food availability and access and food poverty, as well as the seasonal effects of food price policies in a recently liberalized economy such as Kenya. The results cast doubt on the much touted "beneficial" trade – and price-liberal policies introduced in Kenya. Policies which aim to increase food prices may be skewed in favour of a minority of producers who are net sellers of staples. The large numbers who are net purchasers are harmed by such policies. However, this is not to suggest that higher prices for food in the short run might not be necessary as part of a long-run food security policy aimed at increased production, but that high food prices are a problem in the rural areas of relatively low potential zones. It also indicates that food policy needs to place greater emphasis on non-price factors to increase farm production and non-farm income, especially among food-deficit households.

Notes

1 Head-count ratio:

$$h = \frac{q}{n}$$

where h is the poverty index, q is the number of households falling below the poverty line and n is the total number of households in the sample.

2 Mean sum of squares of poverty gaps index:

$$p = \frac{1}{nz^2}\sum_{i=1}^{q} g_i^2$$

where P is the weighted (normalized) sum of the income gaps, z is the poverty line and n is the total number of households, q of which are poor.

3 Gini coefficient:

$$G = 1 + \left(\frac{1}{q}\right) - \left(\frac{2}{q^2 z}\right)\sum_{i=1}^{q}(q + 1 - i)y_i$$

where G is the Gini coefficient of income distribution (i.e. income distribution among households), q is the number of poor households (i.e. those falling below the poverty line), z is the mean income of the poor households and y_i is the income of household i.

4 Sen's poverty measure:

$$S = h\left[1 - \frac{z}{p}\left(1 - G\right)\right]$$

where S is Sen's measure, h is the head-count ratio, z is the mean income of the poor households, p is the value of the poverty line and G is the Gini coefficient of income distribution.

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