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Analysis of the Impact of Population Change on Food Availability in Tanzania: A case Study of Ukerewe Islands

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Abstract

With a population density of about 409 persons per km², Ukerewe Islands is faced with limited resources, particularly land for farming. This land shortage has necessitated out-migration of some of the inhabitants as a livelihood strategy to support their families, thus creating labor shortage in some of the households that depend on agriculture for their livelihood. This study looks into this aspect, especially as relates to the effects of population change on food availability. The Principal Component Analysis (PCA) was used in the construction of households' possession indices, which were then used as the proxy determinant of food availability. The 2-level random intercept model with 3-ordered categorical response variables was used in the estimation of coefficient of effects of the independent variables The paper shows that household seasonal migrants, education attainment by household members, and farm land resources do reduce the odds ratio of a household being extremely poor or poor. The young-age-headed households (18-35 years old) were found to be 3 and 5 times less likely of being extremely poor as compared to middle-age- and old-age-headed households respectively.

Introduction

The term population dynamics refers to the change in population size and structure brought about by fertility, mortality, and migration. It involves the study of marginal and long-term changes in the number and composition of individuals in one or more several populations. Food availability refers to the amount of food that can be obtained by a person from his/her own production and/or purchase, or community support.

According to Robinson (1981), the tremendous increase in the size of the world population poses two fundamental questions: (i) Will there be enough living space to accommodate the increased number of population in the future? (ii) Will it be possible to feed adequately all the additional mouths when there is already a serious hunger problem?

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From these fundamental problems, it is observed that, with time, population growth is regarded as the major factor influencing high demand for natural resources such as land, water, and others. Land as the major input for food production has been deteriorating due to population pressure (Todaro, 1992). As Table 1 shows, the growth of the world population is historical. Since AD 14 there has been a rapid and accelerating expansion of world population from 731 million in 1750 to 6.14 billion in 2001. This is contrary to Ehrlich's (1970) prediction of maximum global population of 3.7 billion people. According to him, hundred of million people were expected to starve to death during the 1970s. Robinson (1981) reported that 3.7 human beings were being born every second, the rate of growth being 1.9 percent annually. This would result into doubling the population in less than 34 years, thus posing a challenge in food availability.

Table 1: Estimated population growth through history.

Year	World population (in million)	Africa (in million)
AD 14	256	23
1000	280	50
1500	427	85
1750	731	100
1950	2519	221
1960	3021	277
1970	3692	357
1980	4435	470
1990	5264	622
2000	6071	796
2001	6148	814

Source: Demographic Year Book 2001

On the other hand, every year 11 million children under the age of five die of hunger or related diseases (Lean et al., 1990). It is predicted that global food availability will exceed population growth by the year 2030, but at the same time millions of people in developing countries will face hunger (FAO and UN Food, 2002).

Approximately 90% of the increase in world population is taking place in less developed countries (Kiessling & Landbeg, 1994). The population growth rate in SSA countries is over 2.5% per annum, and almost half of its population are children. This makes it difficult for the agricultural sector to cope with the rising demand for food (Kamuzora, 1994). Starvation and famine are reported to be persistent in these countries.

Food availability is worst for SSA countries, whereby food output per head has been declining continuously (Table 2). Although the importation of food is the option to many developing countries to supplement domestic food shortage, many countries in Africa and Asia will starve due to their too poor and debt-ridden economies that are unable to import food (Sen, 1984).

Table 2: Estimated Indices of food production per head by region

Region	1974-6	1979-81	1985-7	1990-2
World	97.4	100.0	103.8	104.1
Europe	94.7	100.0	106.4	103.5
North America	90.1	100.0	99.1	99.2
:USA	89.8	100.0	97.9	97.2
Other developed countries	107.5	100.0	98.3	91.6
Africa	104.9	100.0	95.8	94.2
: Tanzania	92.3	100.0	94.0	83.2
Kenya	115.4	100.0	105.6	98.8
Uganda	109.5	100.0	98.0	105.4
Latin America	94.0	100.0	100.5	103.1
Asia	94.7	100.0	111.9	120.8
: India	96.5	100.0	109.2	122.4
China	90.1	100.0	122.7	136.4

Source: L.Kiessling et al (1994).

Population growth in Tanzania

Tanzania's population is characterized by high fertility rate and relatively high mortality rate. Although population is growing fast, total fertility rate has been declining from 7.0 in 1978 to 6.1 children per household in 1994 (GoT, 1993; 1995). Previous population censuses show continuous growth of the Tanzania's population from 7.9 million in 1948 to 34 million in 2002 (see Table 3) (NBS census reports, 1948-2002,

Table 1.3 Tanzania's population growth.

Year	Population size (in million)	Growth rate per year
1948	7.9	1.8
1957	9.6	2.2
1967	12.3	2.7
1978	17.5	3.0
1988	23.1	2.8
2002	34	2.9

Source: National Censuses

In contrast to the growth of population, food production has been unpredictable, leading to food shortage. For instance, indices of food production per head in Tanzania declined from 100 in 1979-81 to 83.2 in 1990-92 (Kiessling & Landbeg, 1994). This decline has sometimes created acute shortage of food to the extent that FAO (1999) identified Tanzania as one of the 38 countries in the World requiring emergency assistance of food. Food availability in Tanzania has, in general, been deteriorating year after year, partly due to the growth of population. This situation raises a special concern towards the understanding of food availability at household level in relation to socio-demographic variables for planning purposes.

Statement of the Problem

Food availability at the household level is determined by the ability in agricultural production process and purchasing power of a household. In Tanzania, a high proportion of people rely on agricultural production in earning their income. A drop in agricultural production is, therefore, accompanied by the collapse of the power of an individual to purchase food.

Due to low level of technology in the African peasant economy, increase in agricultural production to match with population increase has resulted into expansion of farms under-cultivation rather than intensification. Expansion of area under cultivation is limited by the fixed land supply owned by the household. Increase in population size may result into plot of land per person in the household becoming too small to the extent of alienating some of the household members from land resources, which may then lead into cultivation of marginal land or out-migration. It may also result into stiff competition over limited resources in the household so that provision of human basic needs such as food, shelter, and education are jeopardized.

The size of the population in a household (age group15-60 years) determines the amount of labor force available in the production process. The quality and labor input in any household may be affected due to out-migration as a response to pressure on resources created by population growth. Shortage of labor may cause lower agricultural production thus leading to deterioration of household's economic status. On the other hand, the amount of remittance from out-migrants to rural households producing them may improve the household economic status although food availability as a result of remittances is not guaranteed.

Literature Review

The impact of population change on Food Availability

The main aspects in population change are the size, growth rate, and its composition. Increased number of people causes increased demand for food and other essential materials from the resource pool (Repetto & Holmes, 1983). Keyfitz (1991) viewed that too many people may slow down and even prevent development in some areas. This is in line with the argument by Sauvy (1956) that once the welfare of people came to be the main consideration rather than the power and wealth of kings, Malthus' perspective of population control became inevitable. But according to Ogendo (1993), the population effect on resources depends on the level of development, resources available, level of technology, and the size of population in a particular society.

The impact exerted by growth of population in developing countries is a bit complex, and is viewed in three different perspectives. One group of scholars associates it with the factors that intensify the problem of the shortage of arable land, and hence threatening food availability (Sadik, 1989; Igun, 1972). In contrast to this, scholars such as Boserup (1965), Clacke (1977), Simon (1981), Hurschman (1958), and Todaro (1992) view agricultural production—particularly food production—crises as arising largely because of growing production pressure on land resources relative to low level of technology. Thus, the net result is a continuous deterioration of land productivity over time. These scholars are convinced that population pressure create innovative ideas to stimulate land use changes. On the other hand, scholar such as Dyson (1994) identified institutional ineffectiveness rather than population growth as one serious cause of the problem in agricultural production in SSA. Thus, a link between population growth and poor agricultural production in developing countries is not yet clear.

In the absence of technological development in Africa's agricultural sector, population is the primary resource. Population problem in Africa is rather rapid population growth in relation to the generation and utilization of the available natural resources (Ogendo, 1993). The dominance of subsistence agriculture in rural areas of Tanzania, as in many other developing countries, encourages high reproduction to meet the ever-growing labour demand. Large family as an important factor for increased production of food surplus (Malcom, 1953) is the focus of this study.

Boserup's (1965) theory of population growth and technological change has successfully been used to explain agricultural change in different societies. The theory, based on historical Europe, is applied to understand patterns

of development in contemporary developing countries. According to her, SSA is a sparsely populated continent relative to other world regions, and as a result, subsistence agriculture, low technology, and long fallow systems are predominant in the region. Boserup proposes that a growing population can use land more frequently and increase output by substituting technological input such as fertilizer or irrigation for fallow to retain soil fertility. She developed six different food systems resulting from increase in technological levels and their associated population density.

Newman and Matzke (1984) summarized the possible outcomes of population growth by a disaster development scenario that incorporated both Malthus' and Boserups' ideas. They argued that population increase can either disrupt the man-land support system, or intensify it. If the system gets disrupted, the consequence is environmental deterioration that leads to subsistence deterioration and demographic depression. If the system is intensified, there is resources enhancement, leading to increased productivity and demographic moderation. In either case, the direction is towards the attainment of a balance between population and available resources. It is generally accepted that pressure on land resources increase over time with the growth of population (Blaike & Brookfield, 1987; WCED, 1987; UNFPA, 1991). Sadik (1989) has remarked on rapid population growth as a cause to inappropriate farming practices that lead to impoverished and eroded soil, reduced vegetation, over-used and improper use of agrochemicals, and frustrated water resources management. The result of such practices is severe land degradation. This motivates the assessment of the magnitude of land shortage problems in relation to food availability in the household

The Impact of Population Change on Food Availability in the Tanzania Context

Tanzania, like other developing countries, has been experiencing a rapid population growth since 1950's. However, it shows that the growth of population has caused considerable pressure on land resources, although there is a positive change in farming practices from shifting cultivation to settled agriculture (Rugumamu & Kishimba, 1993). Bilsborrow (1992) also observed a decline in the size of agricultural land in association to intensification process. In a study on food security in Arumeru district, Mbonile (2000) noted that population increase results into man-land pressure, leading into an imbalance between man and land resources. Studies by Maro (1974) and Mallya (1996) show that use of intensification and diversification are the key alternatives to population pressure. A study by Ruthenberg (1968) on the impact of land shortage on husbandry

practice in Ukara island, Ukerewe district (Tanzania), observed that a share of 98.6% of the area was used for agriculture and 1.4% was unproductive (rocky, hilly, sandy, and river-course). The average number of persons per holding was 10.9. Due to increasing land shortage in the island, resulting from high population density, the Wakara devoted to land-conserving method. The practices included intensification of agriculture system that ranged from cultivation in steeply sloping pediments, use of manure, soil erosion control, crop rotation, and river-course irrigation farming system. This has raised special concerns on the implication of continuing rapid population growth in Ukerewe islands on the scarce natural resources and a stable source of food availability in the households.

Although the world food problem has always existed, its magnitude has increased partly due to population growth. The extent by which changes in household demographic characteristics affect/influence food availability is the central concern of our study. Much of the surveyed literature have concentrated on showing this relationship only at macro level. In the case of Africa, the relationship between population change and food availability is still vague. Population growth may influence technological advancement as a positive response or cause depletion of resources. The labour shortage in the rural economy jointly with rapid population increase, out-migration and structural obstacle such as imposed negative economic policies and institutional ineffectiveness are seen as the leading obstacles to food availability in the sub-Saharan Africa (SSA).

Objective of the Study

The general objective of this study is to examine the relationship between population change and food availability in relation to household demographic characteristics, using a case study of one of the most highly densely populated areas of Tanzania—the Ukerewe islands. The specific objectives are to:

(1) To investigate whether land shortage at household level contributes to shortage of food and deterioration of household's economic status.

(2) To examine the extent by which hunger in the rural household is a function of labour shortage attributed by out-migration.

(3) To examine the relationship between food availability and intra-household demographic characteristics such as size and sex composition, stage of family life development and education attainment of the family members

The Hypotheses

This research was guided by the following hypotheses:

(1) Food availability at household level is a function of household composition by:
   (i) Sex and age of the head of household
   (ii) Sex of the members of household
   (iii) Education attainment of household members
(2) A rural household which faces shortage of land is likely to face shortage of food.
(3) Shortage of food in the rural households is the function of seasonal out-migration which deprives labour from agricultural activities.
(4) Remittance contributions by permanent out-migrants does not improve the welfare of the household producing them.
(5) Small-sized households are food self-sufficient compared to big-sized households.

Materials and Methods

The Study Area

The study area is Ukerewe district, one of the eight districts in Mwanza region. It consists of ten islands found in Lake Victoria, namely Ukerewe, Ukara, Kweru, Sizu, Irungwa, Lyamwenge, Maremera, Bwiru, Nafub'ha and Kamasi. Ukerewe is the largest, followed by Ukara.

According to the 1967 population census, Ukerewe district, with a total area of 640km^2, had a total population of 109,242 persons; and a growing rate of 2.2% and 170.7 persons per km^2. The size of the population in the district has never been static as shown in the 1978, 1988, and 2002 population censuses. In the 2002 population census, the Ukerewe population rose to 261,944 persons; with an annual average growth rate of 3.0% , and population density rising to 409 persons per km^2 (NBS, 2003).

Data Sources - Sample Selection

The focus of analysis in this study is the household and its members. The sampling strategies employed were the geographical and administrative-multistage cluster design. The sampling design had an advantage of ensuring informative sampling frame so as to reduce sampling variance. Geographically, two cluster areas of sample surveys of Ukerewe and Ukara islands were identified. Three wards were then selected from a list of 24 wards in both islands. These islands were chosen because they were easily accessible. In the second stage, one village was selected randomly from each of the selected wards. Since ten-cell leaders no longer exist at the village level, we used a list of Hamlet Executive Officers to select randomly a

sample of two. All households selected had equal chance to be the study units. Data of interest were selected from the various households. The data collected were household head sex, age, marital status, number and sex of children, education level attained, permanent migrants and seasonal migrants by sex, land acreage, type of crops grown, quality of housing, availability and quality of toilet, type/quality and availability of water including distance from source, and possession of various assets.

Methods

Proxy to Food Availability

Food production level does not necessarily signify the extent of food availability at the household level, but depends on the extent at which the household relies on this production. In market-integrated societies, cash income can be used to purchase food. Therefore, the measurement of the extent of food availability at household level is a complex phenomenon. This study employed poverty indictor variables used by Malogo (2005) as the proximate determinants to trace the history of the extent of food availability at household level. Through history, a poor household is likely to have encountered shortage of food frequently as compared to less poor and rich household. Poverty is the root cause of chronic hunger, and whenever poverty decreases, hunger also decreases.

Construction of Poverty Index

To determine the poverty status of the rural household, the Principal Component Analysis was used to construct possession index as adopted by Malogo (2005). The first principal component, which was the linear combination capturing the greater variation among the set of variables, were converted into factor scores, which then served as a weights for each respective asset for the creation of weighted poverty index for each household. The poverty index created based on the formula by Filmer and Pritchett (1998):

$$A_j = \sum_n F_i\{ (a_{ji} - a_i)/s_i)\}$$

Where: F_i is the factor score for asset;
i, a_{ji} is the j^{th} cluster island's value for the asset i, and
a_i and s_i the mean and standard deviation of asset i variable over the two Islands

To avoid subjectivity, cluster analysis techniques as described by Johnson and Wichern(1992) were employed to create three categories of poverty status based on the marginality index scored by each household, namely, 'extremely poor', 'poor', and 'less poor'. These categories were then used as response variables.

The study employed multilevel model techniques to quantify the effect of population variables on food availability. The multilevel multinomial cumulative modelling approach was considered appropriate so as to provide better parameter estimates due to its recognition of the existence of variation at each level of study units (Goldstein, 1995). This is a modelling technique that takes care of the hierarchical structure of data. In this case the households were classified as the lower level, and islands as the second level of the study units. Both study units were treated as random variables. The cumulative logistic regression was used because the dependent variable was an ordered polytomous response variable with three categories, which is whether or not a household is classified as 'extremely poor', 'poor' or 'less poor'. The odds ratio $\{\exp(B_i)\}$ are used as indicators to quantify the effect of significant independent variable on the dependent variable, when all other factors included in a model are held constant.

A two level random intercept model, with a response variable ordered in three categories indexed by "S" whereby the third category is chosen as the reference category, is specified as:

$$\text{Logit}\ (\gamma_{ij}^{(s)}) = \alpha^{(s)} + (XB)_{ij} + Z_{ij}U_j\ ;\ i = 1,2,3 \ldots\ldots 151,\ j = 1,2\ s = 1,2$$

The model is based on cumulative response probabilities (γ_{ij}) rather than the response probabilities (Π_{ij}) for each response category such that:

$$E(y_{ij}^{(S)}) = \gamma_{ij}^{(s)} = \sum_s \Pi_{ij}^{(h)}$$
$$\Pi_{ij}^{(h)} = \gamma_{ij}^{(h)} - \gamma_{ij}^{(h-1)}\ ;\ 1 < h < 3$$
$$\Pi_{ij}^{(1)} = \gamma_{ij}^{(1)}\ ;\ \gamma_{ij}^{(3)} = 1$$

The model has the underlying assumption of multinomial distribution for the category probabilities. For two categories "r"and "s", the covariance matrix of the observed cumulative proportion is:

$$\text{Cov}(y_{ij}^{(s)}, y_{ij}^{(r)}) = \gamma_{ij}^{(s)}\ (1 - \gamma_{ij}^{(r)})/\ n_{ij}\ ,\ s \leq r\ ,\ E(y_{ij}^{s}) = \gamma_{ij}^{(s}$$

Whereby

- γ_{ij} represents the cumulative probability of i^{th} household from j^{th} island to fall in any of the S-response categories
- $y_{ij}^{(s)}$ is the observed cumulative proportions for the i^{th} household from j^{th} island
- Π_{ij} represents the probability of i^{th} household from j^{th}island to fall in any of the S-response categories
- X_{ij} is a set independent variables, U_j is Islands-level explanatory variable
- α, B_{ij} and Z_{ij} are parameters to be estimated.

The model was fitted by using MLwiN statistical package. The non-linear regression estimates were computed by running the first order marginal quasi-likelihood estimation techniques.

To check for multicollinearity, the correlation matrix of the independent variables was computed. Significance testing used advanced statistics testing procedures. These are the Bayesian deviance information criterion (DIC), and the likelihood ratio statistic for the significance of the model fitted. The Wald test statistic was used for univariate significance of the parameter estimates.

The variables of interest in this study were classified into two major groups, i.e., explanatory variables, and dependent variable. The household poverty level, which was regarded as response variable, had 3-categories or outcomes. The independent variables were household family size (fsize), number of persons in a household attained secondary or post-a secondary education (nsecondr), number of persons in a household not attended any formal education (nschnoatt), number of seasonal migrants (nseasmg), number of permanent migrants in a household (npermg), age categories of the household head (young, middle, or old age category), size of farmland owned by the household (szland), household head sex categories (male, female, and male without a wife), and household sex ratio(hhsexrat). Two levels were used in this study: the households (level one), and the geographical surveyed areas (level two).

Results and Discussion

Logistic Regression Model

The results of the estimated coefficients for the two-level random intercept model with an ordered categorical response variable are presented in Appendix 1. Table 4 gives a summary of the results, and the Wald test for the univariate parameter estimate and Odds ratio. The Bayesian deviance information criterion (DIC) was used to assess the Goodness-of-fit of the model. These results indicate that the overall fit for the estimated model is satisfactory.

The DIC diagnostic criterion for the fitted model (saturated model) gave DIC = 256.62 and deviance (Dbar) = 241.28, which are less than the diagnostic statistics for the model without parameter estimates (unsaturated model).

Dbar D	(thetabar)	P^D	DIC
264.56	261.73	2.83	267.39(unsaturated model)
241.28	225.95	15.33	256.62 (saturated model)

Table 4:1 Results of Wald test and Odds ratio from Fitting 2-level Logistic Model

Variable	Estimated coefficient	S.E	Wald test $(B/S.E)^2$	Odds ratio (e^B)
Const. Poorest Bo	0.399	0.631	0.3998	1.490334
Poor B1	1.930	0.661	8.525**	6.88951
hhage old B4	1.210	0.590	4.2059***	3.35348
hhage middle B5	1.734	0.523	10.9924*	5.66326
nschnoatt B6	-0. 211	0.128	2.7173****	0.80977
nscondr B7	-.0.750	0.233	11.3113*	0.47237
hhsexrat B8	-0.079	0.219	0.13013	1.0822
Szland B9	-0.198	0.112	3.1253****	0.820369
npermg B10	-0.016	0.105	0.02322	1.016128
nseamg B11	-0.322	0.243	1.7559*****	0.72469
Small household B12	1.212	0.604	4.02653***	3.36019
Medium household B13	0.325	0.427	0.57931	1.38403
Sex of household head: female B14	0.203	0.655	0.09605	1.225072
Male B15	0.387	0.866	0.1997	1.472556

Levels of significance:
* significant at α=0.001
** significant at α=0.02
*** significant at α=0.05
**** significant at α=0.1
***** significant at α=0.2

Either, the likelihood ratio statistics $G^2 = 46.56$ at significance level $\alpha = 0.0001$ allow the rejection of the null hypothesis for testing of goodness of fit, $B = 0$ since $X^2_{0.001} = 31.264 < 46.566$

The coefficient of estimate for the variable of household head age categories was highly significant. The coefficient for the variable in the category of old-age-headed household with age-group 56-80years was significant at 5% level; and appeared not statistically significant at 1% level in explaining its effect on the household food availability as it was for the middle-age-headed household. The findings show that the young age headed household of 18-35 years of age was approximately 3 times less likely to be extremely poor or poor, as compared to old-headed-household of age group 56-80 years. Also, it was 5 times less likely of being extremely poor or poor as compared to middle-age-headed household of age group 35-55 years. However, it appeared that the old age headed households were roughly 2 (5.60131/3.30355) times better off being extremely poor or poor than their counterpart with middle-age-headed household of age group 36-55 years. These results show that food availability at the household is associated with the age of the household head. The poorer conditions of middle-aged-head of households than any other age group of household head is an issue of great concern. The condition can be explained by the net benefit and cost of children through the family life cycle at different

stages of development, as it has been shown by Kamuzora (1984) and Lorimer (1967) in Tanzania; Caldwell (1977) in Ghana; and Nag. White and Peet (1978) in Nepal, India.

The association between the household sex ratio (number of female/number of male) and poverty level was found to be statistically insignificant. Household food availability is not a function of household composition by sex.

The odds ratio for the estimated coefficient for the sex categories of the household head suggest that the male-headed household with a wife was 1.2 and 1.5 less likely of being extremely poor or poor than a counterpart household headed by female and male without a wife respectively. Similarly, a female headed household was found to be 1.2 (1.472556/1.225072) times less likely of being extremely poor or poor as compared to male-headed household without a wife. These results are indifferent from findings by Kamuzora and Gwalema (1998) who observed that the female-headed household were less poor compared to male-headed household without a wife.

The household composition by education attainment of family members had gross significant effects on the state of household food availability. The net effect of number of persons in a family with secondary or post-secondary education on food availability was found to be highly significant at 1% level. An increase of a person in the household with such a level of education reduced the odds ratio of the household of being extremely poor or poor by 52.8%. On the other hand, it was observed that an increase of a person in the household without any formal education (i.e. illiterates) significant at 10% level reduced the odds ratio of the household being extremely poor or poor by 19.0%. Thus, food availability at the household level is a function of household composition by education attainment of the household members. This is in line with the findings by Wangwe et al. (1986), Man (1974), and Sen et al. (1989).

As regards to farmland size owned by a household, results show that the increase of farmland owned by a household by one hectare was likely to reduce the odds ratio of being extremely poor or poor by 17.4%. Such findings are in line with findings by Hunt (1977) and Sadik (1989) who observed that food availability in developing countries is undermined by shrinking landholdings due to land fragmentation, unequal land distribution and deepening rural poverty in Kenya and Africa respectively.

The association between the household seasonal migrations on the food availability was significant at 20%. According to the findings, a seasonal

migrant was likely to reduce the odds ratio of a household he/she belongs of being extremely poor or poor by 27.7%. Therefore, the null hypothesis that seasonal migrants cause shortage of food is rejected in favour of the alternative that, seasonal migrants improves household state of food availability. Seasonal migration in Ukerewe islands is largely due the fishing activities in the Lake Victoria, which accounts for 67.44% of all seasonal migration. This is in line with the observation by Mabogunje (1970) that rural residents tend to migrate when faced with population pressure or structural change. Brock and Coulibalyl (2002) and Ellis (2000) in Mali and Niger, respectively found that the rural poor migrate in search of alternative livelihoods in response to harmful effect of impairing home productions and increasing vulnerability.

The coefficient of effect for a household proportion number of permanent migrants on food availability was found to be statistically insignificant. Possibly low income, salaries, and wage received by permanent migrants in their employment may have accounted for this insignificance association as pointed out by Omari and Mbilinyi (1996). Studies by Caldwell (1968) in Ghana, Knowles and Anker (1981) in Kenya, Oberai and Singh (1980) in India, show that remittances from permanent migrants improve the life of rural from which they come.

Our findings show that a large household (of more than 7) was approximately 3 times less likely of being extremely poor or poor than a small household of 1-4 persons. However, it was equally significant with the medium-sized household of 5-7 persons. Indeed, the donor community is always in the fore in advising households to have fewer children without considering the economies of scale enhanced in the African cultural set-up, whereby a brother will manifest a fellow brother to flourish and a family to live in comfort.

Conclusion and Recommendations

The net benefit and cost of children through the life cycle at different stages of development are greatly associated with the state of household food availability. A household head in the middle age category of 35-55 years seemed to be more food insecure because the cost of caring children as whole in the family is higher than their labour contribution. This gives a new light on family planning efforts. The emphasis should be on child spacing rather than population control. Education should be given priority as an inter-generation inheritance, rather than traditional land inheritance.

In response to population pressure, the Ukerewe inhabitants resort to seasonal migration activities such as fishing in Lake Victoria, and search for seasonal employment and business in nearby towns to obtain cash to purchase food.

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Appendix 1: Results of the 2-level random intercept equations.

$Resp \sim Ordered\ Multinomial(Cons_{jk}, \prod_{jk})$

$\gamma_{1jk} = \Pi_{1jk}$, $\gamma_{2jk} = \Pi_{1jk} + \Pi_{2jk}$, $\gamma_{3jk} = 1$

$Logit(\gamma_{1jk}) = 0.400(0.631)Cons.(<=Poorest)_{ijk} + h_{jk}$

$Logit(\gamma_{2jk}) = 1.931(0.661)Cons.(<=Poor)_{ijk} + h_{jk}$

$h_{jk} = -0.211(0.128)nschnoatt.12_{jk} - 0.750(0.223)nsecondr.12_{jk} +$
$0.079(0.219)hhsexrat.12_{jk} - 0.198(0.112)szland.12_{jk} +$
$0.016(0.105)npermg.12_{jk} - 0.322(0.243)nseasmg.12_{jk} +$
$1.733(0.523)middle.12_{jk} + 1.210(0.590)old.12_{jk} +$
$1.211(0.604)small\ household.12_{jk} + 0.325(0.427)medium.12_{jk} +$
$0.387(0.866)male.12_{jk} + 0.203(0.655)female.12_{jk} + v\ 2k\ Cons.12$

$[v_{2k}] \sim N(0, \Omega_v) : \Omega_v = [0.057(0.123)]$

$Cov(y_{sjk}, y_{rjk}) = \gamma_{sjk} (1- \gamma_{rjk}) / Cons_{jk}$, $s<=r$