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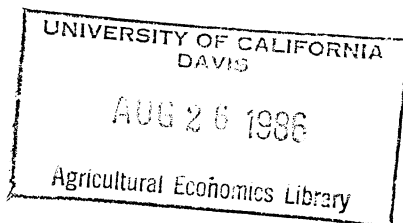
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Food Aid Impacts in Rural Kenya

by

Mesfin Bezuneh, Brady J. Deaton,  
and George W. Norton\*



Kenya

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\*Mesfin Bezuneh is a research associate, Department of Agricultural Economics, University of Illinois, stationed in Kabwe, Zambia. Brady J. Deaton, and George W. Norton are professor and associate professor respectively, in the Department of Agricultural Economics, Virginia Polytechnic Institute and State University. This research was supported in part by a grant from the National Science Foundation, Science in Developing Countries (Project No. INT-8312018). The authors would like to thank Jug Capps for many helpful comments and suggestions. They also express appreciation to the Department of Economics, Egerton College, Njoro, Kenya, and to the World Food Program/Kenya for logistical support.

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## Food Aid Impacts in Rural Kenya

The role of food aid in economic development has been the subject of substantial debate for many years (Maxwell and Singer, Mellor, Deaton, Hall). Food aid is important, constituting approximately 15% of official development assistance (Maxwell and Singer), and recently has been used extensively to lessen the effects of severe food shortages in sub-saharan Africa. Many observers question its potential, however, for accelerating long term growth in less developed countries. Concern has been expressed over possible disincentive effects on agricultural production, both as a result of price reductions due to increased food supplies and because of dependency effects that reduce recipient country government incentives to emphasize agricultural development.

Others have argued that as a long term development tool, food aid can be used by governments to generate capital for development through sales of the food and by saving foreign exchange that would otherwise have gone for food imports. Human capital improvements also can be realized through nutritional gains and through job skills acquired on food aid projects. It has been reasoned that if food aid can make a contribution to employment, nutrition, and income, then it may provide incentives to reduce family size and thereby help reduce population pressures. The importance of careful program planning and project implementation as requisites of success is universally recognized.

Evidence to substantiate these (and other) claims is uneven and inconclusive (Maxwell and Singer). Policy measures that have been used to avoid the most severe negative effects and to encourage economic development have rarely been identified and most likely are specific to social and political conditions in individual countries (Deaton). The

effectiveness of food aid in promoting development clearly depends on the conditions under which food aid is disseminated and the skill with which it is administered (Schuh).

The purpose of this paper is to examine, in a microeconomic framework, the effects of a particular type of food aid program, food-for-work (FFW), on agricultural production, income, capital investment, employment, and the mix of foods consumed by participants in the project. The study is based on primary survey data collected in the Baringo District, Rift Valley Province, Kenya. The analysis addresses how FFW affects the allocation of household time between production and leisure activities and the relative effects of FFW on landed as opposed to landless households. The program is addressed theoretically and assessed empirically using a peasant-household-firm model which incorporates a linear programming model on the production side and an Almost Ideal Demand System (AIDS) on the consumption side of the model.

### Food-For-Work in the Baringo District

Food-for-work in the Baringo District provides payment-in-kind directly to people who provide labor for local public works projects, particularly erosion control and water harvesting devices. The purpose is to provide basic food needs while utilizing "surplus" labor to create production capital for longer term income growth. The hope is that income earned on the projects (food received by participants can be consumed or sold) will also ease the capital constraints of individual farmers without diverting needed labor from on-farm production. Ideally, the program would lead to higher levels of food consumption and improved nutritional status of rural households over a longer time period.

The UN/FAO World Food Program (WFP) supports the FFW project as part of the Baringo Pilot Semi-Arid Project (BPSAP), an integrated rural development project, sponsored by the Government of Kenya (GOK) and the World Bank. FFW began in 1981 and was designed to utilize 800 workers per month within the BPSAP.

The WFP provides the food and the GOK implements the project by providing necessary management personnel and financial inputs including storage and transport. Maize, beans, and vegetable oil are the main food items provided to WFP-supported FFW projects in Kenya.

All participants are adults and most of them work from 8:00 am to 1:00 pm, twenty days per month. Participants are employed on a first come, first serve basis on the assumption that FFW will attract only the very poor, a residual labor force not engaged in either own-production activities or other wage-earning activities at the time of participation.

### The Study Area

Farm production activities in the study area occur primarily on rainfed farms planted near the farmer's homestead once a year during the wet season, and on irrigated farms located near a river, usually far from the farmer's homestead. The major crop activities in the area are finger millet, sorghum, and maize. Both a traditional technology which depends on own seed, family labor, simple hand tools, and own work animals as well as an intermediate technology which utilizes improved seed are employed in the study area. The use of fertilizer or other chemical inputs, other than manure, is almost negligible.

Farms in the area average .75 hectares of cropland and livestock, particularly goats, are a major economic enterprise and are grazed on common pastureland, though there appears to be certain grazing patterns

based on historical use by a particular family or community. Households have, on average, 29 goats, primarily small local East African breeds. Much of the crop and livestock production is consumed in the same household where it is produced, but farmers engage in buying and selling activities for both crops and livestock during surplus or deficit periods. In general, the study area is the most food deficit region in the Baringo District.

### Theoretical Model

An analysis of the developmental consequences of international food assistance as it impacts peasant-household behavior must consider both production and consumption effects. Interpretations of the impact of such programs must be seriously questioned in the absence of either set of effects. Building on earlier theoretical analyses of peasant-household behavior by Chayanov, Sen, Nakajima, and Hymer and Resnick, there have been a number of recent theoretical and empirical household firm models (HFM) which have incorporated both production and consumption (Barnum and Squire; Ahn, Singh, and Squire; Strauss, 1981). The dual nature of the farm-household as both a producing and consuming unit makes the HFM a particularly attractive approach for studying the micro-level impacts of food assistance. To our knowledge, this approach has not been used elsewhere to evaluate the effects of FFW.

The typical or basic theoretical HFM consists of four elements: a household utility function, a production function, an income constraint, and a time constraint:

$$U = U (C, M, L; a), \quad (1)$$

$$F = F (D, I; A, K), \quad (2)$$

$$T = V + D + L, \text{ and} \quad (3)$$

$$qM = wV + P (F - C) - rI + Y. \quad (4)$$

Utility (U) is a function of own-consumption of agricultural output (C), consumption of market purchased goods (M), leisure (L), and a set of household characteristics (a). Agricultural output is a function of labor (D), other variable inputs (I), land (A), and capital (K). Total time (T) is spent in production, leisure, and can be sold or purchased (V). The income constraint specifies the value of market purchased goods (qM) equal to the value of labor sold (wV), plus the value of agricultural products sold (P(F - C)), minus the cost of inputs purchased (rI), plus net income from other sources (Y).

The planning horizon for the model is assumed to be one agricultural cycle, land and certain types of capital are assumed to be fixed in the short run, and risk is excluded. Utility is maximized subject to the production function and time and income constraints.

The above model can be modified to include the effects of introducing FFW into the rural economy. The utility function can be modified to include a variable (G) for consumption of food from FFW programs:

$$U = U(C, M, L, G; a). \quad (5)$$

The introduction of G into the utility function implies that food under the FFW program is not a perfect substitute for either food from own production (C) or for market purchased goods (M) since it may be of different quality and hold certain social characteristics that give it less than "normal" appeal.

Relaxation of a capital constraint facing farm households may occur as a result of FFW. If so, then FFW may allow for purchase of additional inputs (I) or may stimulate additional longer term investment (K), perhaps with a lagged effect. The FFW projects themselves may generate

productivity enhancing physical capital items that affect multiple farms such as erosion control devices, irrigation infrastructure, or fences. A variable (X) can be included in the production function to capture the distributed lag effect of the latter type of investment:

$$F = F(D, I; A, K, X). \quad (6)$$

The introduction of a FFW program expands the number of productive activities to which the household can choose to allocate its time. Therefore, a variable J for time spent on FFW projects can be included in the time constraint:

$$T = V + D + L + J. \quad (7)$$

The quantity of food from FFW available to the household is a function of J and can be represented by the production function:

$$Z = Z(J). \quad (8)$$

Finally, the total quantity of food earned under FFW can be valued at market prices (n) and included in the full income constraint as both a production and consumption good:

$$qM = wV + P(F - C) - rI + n(Z - G) + Y \quad (9)$$

Equations (1)-(4) can be considered a theoretical model for non-participants in FFW programs, while equations (5)-(9) a model for participant households. Simplified versions of these models without the production component can be used to represent landless households.



The peasant farm-household participating in a FFW program is assumed to maximize its utility function (equation 5) subject to the production functions (equations 6 and 7) and time and income constraints (equations 8 and 9). Maximizing (5) subject to (6), (7), (8), and (9), assuming capital (K and X) are fixed for the moment, and eliminating the Lagrangian multipliers yields the following first order conditions:

$$U_C/U_M = P/q \quad (10)$$

$$U_L/U_M = w/q \quad (11)$$

$$U_L/U_G = w/n \quad (12)$$

$$PF_D = w \quad (13)$$

$$PF_I = r \quad (14)$$

$$nZ_j = w \quad (15)$$

$$qM + PC + WL + nG = PF(D, I; A, K, X) - WD - WJ + Y - rI + nZ \quad (16)$$

Equations (10)-(12) represent traditional first-order conditions from consumer demand theory. Equation 12 explicitly indicates that the marginal rate of substitution between consumption of leisure and consumption of food generated by FFW should equal the ratio of the wage rate to the price of the food. Equations (13)-(15) represent profit maximizing conditions for the allocation of labor in F production, other variable inputs in F production, and labor in food for work. The marginal value product of labor used in FFW activities must equal the wage rate. Equation (16) combines the time and income constraints with the technological relationships presented in the two production functions. The left hand side says that the expenditures on market purchased goods, leisure, and the value of home consumption of own food production

including FFW equals the value of own farm production, the value of FFW produced, and other income minus the cost of labor and other variable inputs.

In this model, total labor demand is determined by the profit maximizing conditions. Given an estimate of the production function for F, equations (13) and (14) can be used to determine the variable inputs into F production and the total output of F. Given an estimate of the production function for Z, equation (15) can be used to determine the level of J and the total output of Z. These results can then be used to calculate net farm profit and net income from FFW. The impacts of own-farm production and of FFW activities on the consumption side of the model are transmitted through the income constraint.

Turning to the consumption side of the model, assuming the second-order conditions are fulfilled, equations (10), (11), (12), and (16) can be solved for the demand functions for the four consumption goods C, M, L, and G in terms of the four prices q, p, w, and n, the household characteristics, a, and the total household expenditures. The latter are the sum of the right hand side components of equation (16).

Before considering the empirical implementation of the model, let's return to the assumption of fixed own-farm capital (K). The model can be extended by including an investment equation for K such as:

$$K = K(K_{t-1}, S, B) \quad (17)$$

where  $K_{t-1}$  is capital in the prior period, S is accumulated savings, and B is accumulated debt. Income generated through FFW could increase S or reduce B and affect K with a 1 period lag. Consequently, K, or the service flow of capital, could be included as a variable factor of production.

In equations (4) and (9), the value of interest earned on savings or paid on debt is assumed to be included in  $Y$ . Those interest earnings or payments could be explicitly separated out in the income constraint. Maximization of the model to derive the first-order conditions would then consider explicitly the effect on production and consumption in more than one agricultural cycle due to the lagged investment effect.

The above discussion illustrates the diversity of theoretical effects at the farm-household level from FFW. The potential impacts of FFW on output, employment, and consumption depends not only on the pattern of household time allocation in the short run, but on the extent to which FFW draws into production an idle or underemployed resource (labor) and uses it to increase the productivity of that very resource. That productivity enhancement could occur with a lagged effect and be based on capital investment and nutrition effects (although nutrition effects are not explicitly included in the above model).

The theoretical model incorporating FFW is empirically implemented in the next section. It is possible to state theoretically and unambiguously that household income will increase when all resources used in FFW were previously idle. However, when those resources were previously employed in other productive activities, an empirical assessment must be made to determine if expected net returns are higher with FFW participation. Furthermore, changes in the quantity and mix of goods produced and/or consumed, and the effects on hired farm labor and capital investment can only be evaluated empirically.

### Empirical Model

The empirical model employed to implement the above theoretical HFM requires both production and consumption components. The assumption that

markets exist for all goods and for labor and that prices are exogenous to the farm-household enables the production and consumption sides of the model to be estimated separately (Strauss, 1984b). The farm-household is assumed to maximize profits subject to its production functions and then to maximize utility subject to its time and income constraints with the latter affected by income generated on the production side.

Previous empirical HFM's have employed different approaches for both the production and consumption components. Using data from Taiwan, Lau, Lin, and Yotopoulos estimated a profit function model with one output (rice) and one variable input (labor). They then estimated a linear logarithmic expenditure system (LLES) on the demand side for three aggregate commodities (agricultural, non-agricultural, and leisure). Barnum and Squire, using data from the Muda River Valley in Malaysia, estimated a production function for a single commodity (rice) and a single variable input (labor). They estimated a linear expenditure system (LES) for rice, non-agricultural goods, and leisure. Ahn, Singh, and Squire used data from South Korea and a linear programming model on the production side with farm output disaggregated into rice, barley, and other farm produce. They employed an LES on the consumption side for six commodities. Strauss (1982, 1984a, 1984b) also used a profit function approach and jointly estimated six output supply functions and a labor input demand function. On the consumer demand side, he employed a quadratic expenditure system (QES) for those same six commodities and leisure.

To summarize, previous empirical peasant household firm studies have used three basic approaches on the production side (production function, profit function, and linear programming) and three types of expenditure

systems, LES, LLES, and QES, on the demand side. Each of these approaches has advantages and disadvantages which are discussed in depth in literature dealing with the individual techniques. Rather than discuss that literature here, the most important criteria influencing the choice of particular production and consumption models for the current study are presented below along with descriptions of the models used.

### Production Model

Important criteria influencing the choice of the production model for the current study were the ease with which (1) commodities could be disaggregated, (2) capital investment due to FFW could be incorporated, and (3) data could be collected in a cost-effective manner. A production function approach presents difficulties for commodity disaggregation. A profit function approach is at a disadvantage compared to linear programming with respect to criteria (2) and (3). The LP approach has the disadvantage of being normative and it assumes a fixed proportions production function, but it meets all three criteria above and facilitates sensitivity analysis. Consequently an LP model is employed in the current study.

A two-year planning horizon is used in the model to capture the lagged investment effect of FFW. The objective is to determine levels of production activities, with and without FFW, that maximize income subject to available resources and minimum subsistence requirements. The model is presented in aggregate form in Table 1 and contains 96 activities and 82 constraints. Crop activities include maize, millet, and sorghum at two technology levels while livestock activities include goats and cows. Because livestock feed on non-arable community grazing land, input

Table 1. Aggregated LP Tableau for Participant Households.

Obj.Fn.	Year 1													Year 2													
	CP	CS	CC	LP	LS	LC	FR	FS	FC	LT	HL	BO	SA	CP	CS	CC	LP	LS	LC	FR	FS	FC	HL	BO	SA	ET	RHS
Obj.Fn.	-C	C		-C	C			C			-C	-C		-C	C		-C	C			C		-C	-C	C	1	Max
<u>Year 1</u>																											
Resource Con.	A			A			A				-1																≤ B
Capital Con.	A			A							A	-1	1														≤ B
Crop Trans.	-A	1	1																								≤ 0
Live Trans.				-A	1	1					1																≤ 0
FFH Trans.							-A	1	1																		≤ 0
Nutrient Tr.			A			A			A																		≥ B
<u>Year 2</u>																											
Resource Con.														A		A			A			-1					≤ B
Capital Con.	A	-A		A	-A		-A				-A			A		A						A	-1	1			≤ B
Crop Trans.														-A	1	1											≤ 0
Live Trans.									-1								-A	1	1								≤ 0
FFH Trans.																				-A	1	1					≤ 0
Nutrient Tr.														A		A						A					≥ B
Equity				-A													-A									1	≤ 0

Definitions: CP, crop production; CS, crop selling; CC, crop consumption; LP, livestock production or purchase; LS, livestock selling; LC, livestock consumption; FR, food for work received; FS, food for work sold; FC, food for work consumed; LT, livestock transfer; HL, hire labor; BO, borrowing; SA, savings; ET, equity transfer; RHS, right hand side; A, B, and C, non-zero or one coefficient.

requirements, except labor, are minimal. Crops, milk, and meat are sold or consumed. Purchase of goats and cows is allowed.

The FFW commodities, maize, beans, and oil, can be either consumed or sold each month. Representative participant households are allowed to work on FFW activities up to 100 hours per month. A full 100 hours earns 45 kgs. of maize, 4 kgs. of beans, and 1.5 kgs. of oil. Participant households must receive all three items in these proportions. Consequently, the production function for FFW presented above,  $Z = Z(J)$ , is consistent with the fixed proportions assumption implicit in the L.P. formulation.

Although the family supplies most of the labor, several farm-households hire labor during land preparation, planting, weeding, and harvesting. Thus, activities are included to allow hiring-in labor in several months. An arable land constraint of .75 hectares per farm household and a capital constraint of 1000 Kenya Shillings (Kshs.) are included in the model. In addition, households are allowed to borrow up to 1000 Kshs. per year at 20% interest or save at 5%.

Minimum subsistence requirements that conform to the farm household's basic nutrient requirements (protein, fat, and carbohydrate) are incorporated into the analysis.<sup>1</sup> These requirements (based on UN/FAO statistics) are calculated using the average size of the study area family of 4.4 people and are included in the model as nutrient transfer rows.

### Consumption Model

The consumption side of the model is specified econometrically to conform to the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer. Unlike the LES, LLES, and QES models, the AIDS allows for flexibility in both price and income elasticities. Flexibility with respect to the

income elasticity is particularly important to allow for the possibility that FFW is an inferior good. The AIDS model has been shown to be consistent with household budget data in at least one less-developed country (Ray) and the system is relatively easy to estimate.

The form of a typical demand equation for a typical household using the model is:

$$W_{ih} = \alpha_i + \beta_i \log(Y_h/P) + \sum \gamma_{ij} \log P_j + \theta \log K_h. \quad (18)$$

where  $W_{ih}$  is the average budget share of good  $i$  for household  $h$ ,  $Y_h$  is income of household  $h$ ,  $P$  is a price index,  $P_j$  is the price of good  $j$ , and  $K_h$  is the number of household members. The parameters to be estimated are  $\alpha_i$ ,  $\beta_j$ ,  $\gamma_{ij}$ , and  $\theta$ . Stone's approximation based on an expenditure share weighted price index is used to keep the price index ( $P$ ) linear. Adding up, homogeneity of degree zero in prices, and Slutsky Symmetry restrictions are imposed on the model to preserve the normal properties of demand theory. The model allows the measurement of the impact of FFW on the demand for various crops and the demand for leisure. Net income in the model is a full income concept which incorporates the effects of income earned on the production side of the model and the effects of labor supply decisions.

The estimation was performed on seven groups of commodities: millet and sorghum; maize and beans; meat, milk, eggs, and fish; other food; food for work; non-food items; and leisure. Six out of the seven equations are estimated using the non-linear iterative Zellner's procedure because of cross-equation restrictions. This procedure leads to maximum likelihood estimates for a model such as (18). The parameters of the seventh equation are determined using the restrictions in the model.



Expenditure and both uncompensated and compensated own- and cross-price elasticities and household-size elasticities are obtained from the model.

### Data

Data for this study were collected during seven months of field work (August 1983 through February 1984) using 16 trained local residents. A comprehensive census of households for the study area was taken and a representative sample of 300 households selected from the 1030 households identified in the census. Of these 300 households, 100 were found to be participants in FFW projects during the study period (February, 1983 through January, 1984).

Households were visited monthly from October to December and asked to provide recall information on crop and livestock inputs used, quantities and price of foods harvested and disposed of, food and non-food items consumed, and labor use by activity. Although it was a long recall period, households seemed to respond with a relatively high degree of certainty about inputs to own production. Quantifying yield per acre, and the amount consumed versus sold was more difficult. Some questionable figures obtained in the survey were compared with data from secondary sources. Additional details are available from the authors.

### Results

The results of the linear programming model project net returns for representative farm households with FFW 52 percent higher than for those without FFW.<sup>2</sup> Returns for participants are constrained by capital in the first year and by land in the second. Returns for non-participants are restricted by arable land in both years. FFW increases capital for participants so that it is no longer a constraining factor in year 2.

Forty-four percent of the increase in net returns for participant households results directly from the food paid under FFW, while 56 percent results from the induced effect of capital formation on agricultural production.

Labor utilization is identical in both years for non-participants. Participants hire 160 hours more labor in year 1 and 438 hours more labor in year 2. They hire more labor because they produce the more labor intensive millet. While participants expand employment from year 1 to year 2, they decrease their FFW activity by 11%. This reflects an increase in the marginal value of their time in farming activities as the capital constraint is relaxed. Labor use in own-farm production is 3928 hours in years 1 and 2 for non-participants and 4063 in year 1 and 4138 in year 2 for participants.

The activities in the optimal plan for both non-participants and participants are maize, millet, milk, and goats (Table 2). Non-participants produce substantially more maize, substantially less millet, and slightly more milk and goats. Non-participants consume all maize and milk produced in both years and sell their millet and goats. Participants consume their maize, including that received for FFW, oil and milk to satisfy their basic nutrient requirements. They earn cash from selling millet, goats, and beans. Participants earn 5245 kshs. in year 1 and 6026 kshs. in year 2 compared to 4214 kshs. for non-participants in each year. As a result, participants save 891 kshs. while non-participants do not save. In summary, FFW increases own-farm production, income, and employment in this food deficit, labor surplus area. It induces a shift from maize to millet production as maize from

Table 2. Enterprise Mix and Net Income with and without Food For Work

Enterprise	Without Food For Work				
	Hectares Used	Own-Farm Production	Marketable Surplus	Total Income (kshs)	
<u>Year 1</u>					
Maize <sup>a</sup>	.7	560	0	0	
Millet <sup>a</sup>	.05	42	42	155.40	
Milk <sup>b</sup>	N/A	1412	0	0	
Goats <sup>c</sup>	N/A	28	28	4064.00	
<u>Year 2</u>					
Maize <sup>a</sup>	.7	560	0	0	
Millet <sup>a</sup>	.05	42	42	155.40	
Milk <sup>b</sup>	N/A	1412	0	0	
Goats <sup>c</sup>	N/A	28	28	4064.00	
Enterprise	With Food For Work				
	Hectares Used	Own-Farm Production	FFW Production	Marketable Surplus	Total Income (kshs)
<u>Year 1</u>					
Maize <sup>a</sup>	.03	24	512	0	0
Millet <sup>a</sup>	.66	528	N/A	528	1953.60
Beans <sup>a</sup>	N/A	0	46	46	195.5
Oil <sup>a</sup>	N/A	0	17	0	0
Milk <sup>b</sup>	N/A	1074	N/A	0	0
Goats <sup>c</sup>	N/A	21	N/A	21	3096.00
<u>Year 2</u>					
Maize <sup>a</sup>	.07	56	456	0	0
Millet <sup>a</sup>	.68	544	N/A	544	2013.00
Beans <sup>a</sup>	N/A	0	41	41	174.25
Oil <sup>a</sup>	N/A	0	15	0	0
Milk <sup>b</sup>	N/A	1245	N/A	111	255.30
Goats <sup>c</sup>	N/A	25	N/A	25	3584.00

<sup>a</sup>Kilograms    <sup>b</sup>Liters    <sup>c</sup>Head

FFW is used to meet minimum nutrient requirements and millet is the more profitable crop to sell.

The results of the consumption side of the model are summarized in elasticity form in Tables 3 and 4. The Almost Ideal Demand System is estimated for FFW participants for millet and sorghum (MS); Maize and beans (MB); meat, milk, eggs, and fish (MD); other food (OF); food for work (FA); non-food (NF); and leisure (L). The AIDS model is also estimated for non-participants without FFW. Eighty-five out of 124 parameters in the two AIDS models are twice their standard errors and only 16 have t-values less than one. Tables of parameter estimates and their standard errors are available from the authors. Own- and cross-price elasticities for which the associated parameters are at least twice their standard errors are indicated in Tables 3 and 4. All own-price elasticities, except for millet and sorghum for participants have the expected signs. The Theil and Mnoukin information inaccuracy (II) measure is calculated to assess how well the AIDS specification fits the sample data. The II for the  $h^{\text{th}}$  household is given by:

$$II = \sum_{ih} W_{ih} \log(W_{ih}/W_{ih}^*). \quad (19)$$

where  $W_{ih}$  is the observed budget share of the  $i^{\text{th}}$  commodity and  $W_{ih}^*$  is the predicted average budget share. A measure of II that is close to zero indicates a good fit. The average II measures for participants and non-participants are 0.020 and 0.018 respectively, suggesting the AIDS fits both sets of sample data well.

Focusing first on the uncompensated elasticities, all commodities are own-price inelastic except maize and beans (for both groups) and other food (for non-participants). As suggested by consumer theory, own price

Table 3. Uncompensated Own-Price and Cross-Price Elasticities, Expenditure Elasticities and Household Size Elasticities for participants (1) and non-participants (0).

Items	MS	MB	MD	OF	FA	NF	L	E	HS
MS(1)	.6731*	-.9401*	.2399	.1545	-1.5374*	.3823*	.0912	1.5322*	-.0645
(0)	-.5321*	-.7403	.0832	-.4657		-.0403	.1150*	1.0416*	-.2860*
MB(1)	-.4850*	-1.7515	-.4373	.1417	.6112*	.8441*	.1094	1.5839*	-.6350*
(0)	-.3961	-1.1943*	-.0264	-.4095		.5139*	.0515	1.2069*	-.3015*
MD(1)	-.2065*	.2907*	-.8408*	-.0878	-.1227	.0957*	-.1081	.5789*	.5220*
(0)	-.0060	.3018*	-.8537*	-.0730		.0783*	-.2587*	.2993*	.1108
OF(1)	.0446	-1.7971*	-1.1684*	-.7609	.5771	.4175	1.1014	1.6530*	-.1868*
(0)	.1493	-1.2594*	-.2448*	-1.2118		-.0873*	1.1135	.4230	1.3324*
FA(1)	.0831*	.5713*	.3556	-.0085	-.8450*	-.9117*	-.1265*	.5176*	.5927*
NF(1)	.0831	-.1576*	.0140*	.0286	.2202*	-.6958*	-.2127*	.1356*	.2492*
(0)	.0240	-.0142	-.1786*	.0988		-.7223*	-.0543*	.7493*	.1012
L (1)	.0024	.0057	-.0311*	-.0033	-.2190*	-.0158*	-.9696*	1.2491*	-.1761*
(0)	.0089*	.0074	-.0146*	.1196*		-.1346*	-.9335*	1.4331*	.0984*

Definitions: MS = Millet and Sorghum; MB = Maize and Beans; MD = Meat, Milk, Eggs and Fish; OF = Other Food; FA = FFW Items; NF = Non-food; L = Leisure; E = Expenditure; HS = Household Size.

\*Associated parameter estimate is at least twice its standard error.

Table 4. Compensated Own-Price and Cross-Price Elasticities for participants (1) and non-participants (0).

Items	MS	MB	MD	OF	FA	NF	L
MS(1)	.69981*	-.91378*	.26635	.18093	-1.51111*	.40853*	.11760
(0)	-.49313*	-.70129*	.12223	-.42667*		-.00127	.15405*
MB(1)	-.43217*	-1.66216*	-.38450	.19463	.66405*	.89696*	.16225
(0)	-.31159*	-1.10982*	.05810	-.32502*		.59844*	.13607
MD(1)	-.13236*	.36491*	-.76668*	.01364	-.04860	.16994*	-.03401
(0)	.06921	.37707*	-.75161*	.00216		.15358*	-.18349*
OF(1)	.07248	-1.76928*	-1.14058*	-.73310	.60497	.44543	1.12929
(0)	.16154	-1.24728*	-.23270*	-1.19970		-.07521*	1.12576
FA(1)	.12409*	.61235*	.39663	.03240	-.80405*	-.87073*	-.08556*
NF(1)	.07054	-.17017*	.00148*	.01607	.20770*	-.70835*	-.22526*
(0)	.12122	.08282	-.08150*	.19604		-.62516*	.04285*
L(1)	.79278	.79607	.75918*	.78692	.57122*	.77446*	-.17938*
(0)	.70083*	.69938	.67730*	.81156*		.55725*	-.24167*

Definitions: MS = Millet and Sorghum; MB = Maize and Beans; MD = Meat, Milk, Eggs and Fish; OF = Other Food; FA = FFW Items; NF = Non-food; L = Leisure.

\*Associated parameter estimate is at least twice its standard error.

effects of all commodities, except for millet and sorghum for FFW participants, are negative (i.e. negative price effects more than offset positive income effects). For millet and sorghum, an increase in price would result in a positive demand effect for participants because a higher price also means higher income for farm-households. Thus, while increasing millet and sorghum prices may have a negative effect on the nutritional status of non-participants, it is likely to have a positive nutritional impact on participant households.

As expected, the uncompensated and compensated cross-price elasticities exhibit a diverse pattern of signs and magnitudes. Again, focusing on the uncompensated elasticities for FFW, increasing the price of FFW would decrease the consumption of other food, non-food, and leisure, but increase the consumption of maize and beans, millet and sorghum, and meat, milk, eggs, and fish. The food from FFW should be thought of as own production and price increases of that food increases its sales and reduces own consumption while causing these cross-price effects.

With the exception of non-food and leisure, the magnitude of the income elasticities for participants are larger than for non-participants. Participants spend a larger proportion of increased income on maize, beans, millet, sorghum, milk, eggs, and fish than do non-participants, while non-participants spend a higher proportion of income increases on non-food and leisure than do participants. The latter may reflect the fact that non-participants have relatively limited income generating activities which reduce the opportunity cost of their leisure. Again, this has important nutritional implications and also reduces the concern that income generated by FFW may result in work disincentives.

The household size elasticities indicate positive effects of household size on the demand for normal goods but a negative influence on the demand for luxuries (goods with an income elasticity greater than one). This result makes intuitive sense and is consistent with the results found by Ray in India.

It is useful to examine the compensated elasticities as well, which eliminate the income effects of price changes, to enable the classification of commodities into substitutes, complements, or independent goods (Table 4). Food received under FFW is a complement to millet and sorghum with a cross-price elasticity of demand of -1.51 and also to meat, milk, eggs, and fish with a cross-price elasticity of -0.05, but substitutes for maize and beans, other food items, non-food, and leisure with cross-price elasticities of demand of 0.66, 0.60, 0.21, and 0.57, respectively.

### Conclusions and Implications

The results of this study indicate that FFW in the Baringo District, Kenya increases agricultural production, income, capital investment, employment (including hired labor), and marketable surplus. It causes a shift from maize to millet production as maize received through FFW substitutes for own-production of maize, allowing millet to be sold. Maize is more nutritious but lower priced than millet.

Participants in FFW increased own-farm production in year 2 compared to year 1, reducing the hours devoted to FFW activities. One might expect this decline to continue in future years as the opportunity cost of their time increases with the generation of additional capital to work with in their own farm enterprises. This suggests that the FFW program itself



may encourage a transition from FFW dependence to greater own-farm production in the long run.

On the consumption side, the primary effects of FFW are to increase the demand for food by participants as their incomes grow both due to participation and to the related production response. Participants spend a larger portion of their increased income on food items as compared to non-participants. The latter spend a greater proportion of their increased income on leisure than do participants.

Consumption of millet and sorghum is positively related to price for participants. With the integrated production and consumption model, raising the price of millet increases income which in turn leads to increased own-consumption. The FFW program helps the household to meet its minimum nutritional requirements and increases its response to market price changes.

Although this study did not explicitly measure nutritional changes, the estimated effects of FFW on both the quantity and quality of food consumed indicate that the program does have positive nutritional implications. The results of the study are consistent with the hypothesized, potentially positive, effects of food aid discussed by Deaton, Maxwell and Singer, Schuh, and others. These authors have argued that targeted food aid programs can augment employment and income and lead to the formation of productive human and physical capital.

The majority of participants in FFW in the Baringo District are from low-income strata in the population which implies that the program may be narrowing the income gap between participants and non-participants. The effects on landed as opposed to landless laborers are ambiguous because farmers with land benefit through increased production and

income, but the landless benefit through increased demand for hired labor on farms as well as through direct hire on FFW projects.

The results indicate that FFW can contribute positively to local development efforts in terms of both employment and nutrition, and it can lead to longer term income growth through facilitating on-farm investment. Other potential longer term effects are not included in the model and should be the focus of future research. One is the effect of FFW on increasing productive physical capital such as erosion control devices, fences, etc. The effects of these public investments cut across several farms and may have distributional implications. A second effect is the longer term nutrition and other human capital influences. Better nutrition can lead to higher quality of life generally and to improved quality of the labor force as can the skills acquired on FFW projects. Third, there are undoubtedly social structure influences which are not captured in the current research.

The importance of the results of the current (case) study could be minimized on the basis of uniqueness. The study presents only one example, and the success of the particular FFW program examined may be due to a variety of factors such as its integration into an existing agricultural and rural development project, relatively high priority placed on the project by the GOK, etc. A comparison of this FFW program with those in other locations should help delineate the factors that cause this one to be relatively successful.

A separate issue is the need to compare FFW with other direct intervention programs with similar goals. Since FFW itself requires scarce resources, its returns compared to other programs such as school feeding, education, or cash supplements should be examined. When

participants were asked their preferences, not a single individual (all were males) preferred food over cash. However, there may be other nutritional (based on propensity to consume food when paid in food rather than cash), political, and social reasons for preferring FFW to a cash supplement. Indeed, the nutritional implication is supported by the results of the demand model, and political considerations clearly affect foreign aid decisions.

Future research also should address the issue of FFW impacts on production risk and food security. The possibility that FFW reduces income risk might influence the decisions of semi-subsistence farm-households to adopt new technologies, to reduce seasonal migration, and to make other production and consumption changes.

## Footnotes

<sup>1</sup>Although production decisions can be separated from consumption decisions due to the existence of output and labor markets, minimum consumption requirements are included to account for the existence of marketing costs which drive a wedge between sales and purchase (farm and retail) prices.

<sup>2</sup>The linear programming model was validated by comparing observed and predicted values of farm production and input use.

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