Varieties, Attributes and Marketed Surplus of a Subsistence Crop:

Bananas in Uganda

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Introduction

The complexity of market participation decisions of rural households in developing countries has received ample attention in theoretical formulations and empirical models of behavior in the presence of market imperfections. It is well recognized that limitations to participation are imposed by imperfections in input and output markets, giving rise to transactions costs, and by heterogeneity of household resource endowments (de Janvry and Sadoulet, 2003). The decision to participate in markets or remain autarkic has been postulated to be household- rather than commodity-specific (de Janvry, Fafchamps, Sadoulet, 1991). In the context of market failure, production decisions are affected by the characteristics of the household and commodity-specific marketed surpluses are jointly defined by production and consumption factors (Strauss, 1984). Improvements in infrastructure (leading to the reduction in transactions costs) and development of new technology, e.g. improved varieties, (leading to the increase in farm output) have been found to increase the marketed surplus of subsistence crops (Toquero et al., 1975; Ahmed et al., 2001). Separating the household decision into a discrete component (whether to participate in markets) and a continuous component (how much to sell or buy, or marketed surplus) for two types of market actors (buyers and sellers) has provided further understanding of the underlying factors that govern these processes (Goetz, 1992).

An important aspect of the household market participation decision that has received limited attention in the literature is the composition of the marketed surplus and its determinants. Although households are heterogeneous in terms of transactions costs and other characteristics that determine their participation behavior, they also differ in their production choices of crops, or varieties of a crop, and hence in their involvement in markets with a portfolio of crops, or varieties of a crop. Empirical studies of marketed surplus in different development contexts have generally considered food commodities as an aggregate; for example, food grains (Bardhan, 1970; Haessel, 1975; Goetz,

1992), sorghum (Medani, 1975), rice (Toquero et al., 1975; Chinn, 1976) and other food commodity aggregates (Strauss, 1984; Renkow, 1990; Ahmed et al., 2001). Though these studies provide desired inferences about the responsiveness of marketed surpluses to changes in prices, output and income, and in some instances, to non-price factors, such as household characteristics or production technology, they do not consider the role of specific attributes of the different food commodities.

In this paper, the heterogeneity of crops is recognized and food commodities are disaggregated into varieties of a crop in order to test whether variety attributes influence the size of the marketed surplus of selling households, while controlling for other common factors. Two sources of market failure are hypothesized to influence the behavior of households: 1) transactions costs (hindering participation); and, 2) incomplete or missing (input and output) markets for variety attributes (constraining the composition of participation). Examples of imperfect (or altogether missing) markets for inputs to production have typically focused on labor, credit and insurance markets, rather than on markets for planting material of different crops and varieties and their attributes. Considering the latter has important policy implications. If markets for planting material are missing or imperfect and product markets fail to capture and reward quality differentials, alleviation of constraints to market participation (e.g. reduction in transactions costs through infrastructural improvements) alone, though beneficial, may have only a limited effect on the composition of participation. This could reduce the intended impact of technological interventions (e.g. improved crops and varieties), inhibiting income generation for adopting households.

While the paper adheres to the literature in identifying the determinants of household market participation, it distinguishes itself by providing a greater insight into the composition of participation dynamics by focusing on marketed surpluses and variety attributes. The market participation behavior of semi-subsistence banana producing households in Uganda is examined using farm-level survey data collected in 2003. Bananas, the staple crop of the country, are

important for meeting immediate consumption requirements and for income generation of semi-subsistence households. The composition of sales of households participating in banana markets is heterogeneous in terms of both the levels of participation (the size of the marketed surplus) and the composition of their sales (the types of varieties they supply). Marketed surpluses are evaluated for each variety in the set of grown varieties for those households who participate in banana markets as sellers.

Variety attributes (consumption quality and bunch size) are found to be important determinants of the composition of market participation and should be included in inferences of marketed surplus of subsistence crops in developing economies. The inverse relationship between the magnitude of the marketed surplus and cooking quality is a clear indication of subsistence behavior. This result may also be suggestive of farm-gate prices for some varieties being below the farmer reservation price for the attributes embodied in these varieties, hence inducing households to keep varieties with better quality attributes for own consumption rather than for market sale. This finding poses questions on the scope of technological interventions and, in particular, on the impact of crop improvement beyond on-farm production decisions and adoption behavior in the presence of market failure. There are implications for income generation of households growing quality bananas, as well as for the stock of different bundles of variety attributes available to consumers.

Modeling Marketed Surplus with Attributes

The theoretical framework builds on the model of the agricultural household with imperfect markets with household production decisions being influenced by consumption preferences (Singh, Squire and Strauss, 1986). Drawing from the Lancaster's theory of consumer choice (1966) and models of demand for farm input and output characteristics (Ladd and Suvannunt, 1976; Ladd and Martin, 1976), the non-separable agricultural household model has been augmented by the inclusion of

consumption attributes in the preference structure of households and agronomic traits in their farm production technology (Hintze, 2002; Edmeades, 2003). The trait-based agricultural household model facilitates the formulation of the relationship between household production decisions and market participation choices.

The agricultural household maximizes utility from the set of intrinsic quality attributes (z^C) of the banana bunches it consumes (x), the consumption of an aggregate purchased good (g), and leisure (h), choosing the type and amount of banana bunches it consumes and produces: $u\left[x(z^c), g, h \mid \Omega_{HH}, \Omega_M \right]$, where Ω_{HH} captures the heterogeneity in household characteristics. The household is constrained by its production and budget limitations (full income constraint), as well as by market imperfections. The production technology is defined by variable inputs, including the agronomic traits of banana planting material (z^P) and labor (l), used for the production of banana bunches (q) from each variety i, on a pre-allocated, fixed amount of land: $q_i(z^p, l \mid \Omega_F, \Omega_M)$. The production technology is conditioned on the physical characteristics of the farm, denoted by Ω_F. The primary source of labor for crop production is typically the family (with total endowment of time for labor and leisure denoted by T). As bananas are vegetatively propagated, planting material is either reproduced on-farm or obtained from farmer-to-farmer exchange, rather than through formal market mechanisms. Farmers' choices of varieties are thus limited by the range of traits and attributes available to them locally. The number of distinct varieties existing in the village, denoted by V, represents the local stock (or endowment) of variety attributes. Although the bundles and levels of attributes provided by varieties are fixed from the perspective of an individual household, the household can vary the type and amount of consumption and production attributes by changing the combination of varieties and quantities of planting material grown. Hence, corner solutions are possible for specific varieties, since the set of planted varieties need not be the same across

households. Since banana bunches perish quickly after being harvested, the model does not consider storage decisions.

Household preferences and production choices are conditioned on market characteristics (Ω_M) as market imperfections can affect both consumer and producer behavior within the framework of non-separable decision-making. Markets for banana bunches exist in Uganda. However, households are often located far from markets and the bulkiness of banana bunches constrain market participation. Furthermore, premiums for quality differentials across varieties (concerning the taste rather than the size of the bunch) are seldom observed, constraining the composition of participation. This is depicted by the tradability constraint for each variety *i* that the household grows, expressed as the difference between household output and consumption of bunches, or marketed surplus:

$$ms_i = q_i - x_i \qquad (1)$$

Although market failure is specific to households, it is binding for some varieties, with respect to which the household remains autarkic, i.e. $ms_i = 0 \forall i \in not-traded$, while it is relaxed for other varieties, of which the household sells a proportion at the market, i.e. $ms_i > 0 \forall i \in traded$. Hence, while participation in markets is defined as a household-specific decision, composition of participation is expressed at the variety level.

Following Strauss (1984) and Edmeades (2003), optimal levels of household consumption and output of *i* are defined, respectively, as $x_i = x_i(z^c, p_i, Y^*(z^p, p_i, \Omega_F, T, V, I) \mid \Omega_{HH}, \Omega_M)$ and $q_i = q_i(z^p, p_i, V \mid \Omega_F, \Omega_M)$. Household full income Y^* is defined by production technology parameters (e.g. agronomic traits of planted varieties, banana bunch prices, farm characteristics), total endowments of time and stock of attributes, as well as exogenous sources of income, *I*. Aggregate goods are a numeraire commodity. Shadow values of family labor, planting material and

non-traded varieties are functions of prices, household, farm and market characteristics, and total endowments of inputs (T and V). Households are price takers in banana markets. While exogenously determined, prices reflect the implicit marginal valuation of both consumption and production attributes jointly (Dalton, 2004; Edmeades, 2006). Following the household hedonic model, banana bunch prices are expressed as functions of attributes: $p_i(z^c, z^p)$. Combining the information, household output and consumption of i are given by:

$$q_i = q_i(z^p, p_i(z^c, z^p), V \mid \Omega_F, \Omega_M) \qquad (2)$$

$$x_i = x_i(z^c, z^p, p_i(z^c, z^p), T, V, I \mid \Omega_{HH}, \Omega_F, \Omega_M) \qquad (3)$$

Recognizing that agricultural households make consumption and production decisions simultaneously, and using the tradability constraint (1) and the expressions for banana bunches produced (2) and consumed (3), the variety-specific marketed surplus is defined as a reduced-form function of attributes, other exogenous factors and a set of household, farm and market characteristics:

$$ms_i = ms_i(z^c, z^p, p_i, T, V, I \mid \Omega_{HH}, \Omega_F, \Omega_M) \qquad (4)$$

This equation is the basis for the empirical analysis in the paper. Marketed surplus is measured as the number of bunches from variety i sold by households participating in banana markets.

Comparative Statics

Several marginal relationships can be formulated to help predict behavior toward marketed surplus of agricultural households that simultaneously make consumption and production decisions. Using equations (1), (2) and (3) above, the following expressions are derived for the marginal relationship between marketed surplus and production traits and marketed surplus and consumption attributes:

$$\frac{\partial ms}{\partial z^p} = \frac{\partial q}{\partial z^p} + \left(\frac{\partial q}{\partial p} - \frac{\partial x}{\partial p} \right) \frac{\partial p}{\partial z^p} \qquad (5)$$

$$\frac{\partial ms}{\partial z^c} = \frac{\partial q}{\partial z^c} - \frac{\partial x}{\partial z^c} + \left(\frac{\partial q}{\partial p} - \frac{\partial x}{\partial p} \right) \frac{\partial p}{\partial z^c} \qquad (6)$$

If households respond to prices by producing more and consuming less when prices rise, the term in the brackets will be positive in both (5) and (6). For desirable attributes, the change in price with respect to changes in the level of a given attribute will also be positive. Furthermore, if the household produces more of varieties that supply greater levels of both consumption and production attributes, and consumed more of those varieties, the first term in both equations will be positive and so will be the second term in equation (6). Therefore, *a priori* expectations for the relationship between marketed surplus and attributes are suggestive of an unambiguous positive relationship between marketed surplus and production attributes, while there is no clear indication of the direction of association of marketed surplus and consumption attributes.

Data

The data, collected in 2003, are drawn from a geo-referenced multi-stage random sample of banana-growing households in Uganda. The sample domain spans the major banana producing areas in Eastern, Central, and Southwestern Uganda. The sample was stratified according to elevation, with a threshold of 1,400 meters above sea level. Prior biophysical information suggests that elevation is correlated with factors contributing to variation in productivity. A total of 27 primary sampling units were defined at the sub-county level and allocated proportionately with respect to elevation. One village was randomly selected per sub-county. A total of 20 households with access to land were selected randomly in each village. The total sample comprises 540 rural households in Uganda, of which 517 are identified as banana growers, 197 of whom are net sellers and are used in

the analysis. These households are spread across the sample domain with 46 households in Eastern Uganda, 88 in the Central region and 63 in the Southwestern highlands.

Market Participation and Banana Varieties

Bananas are produced for home consumption with excess production sold in local markets. Bananas are typically sold in bunches. The bulky nature of banana bunches constrains their transportation to local trading centers or urban markets. All households sell at farm-gate, with only a few also selling at local markets. Bunches are transported to local collection centers on bicycles, with an average load of 4 bunches per bicycle. At the farm-gate, transportation costs (charged per bunch or per load) are borne by buyers (middle men) and are reflected in the level of farm-gate prices received by selling households. Per unit costs of transportation are similar across varieties, and so are fixed transactions costs as banana bunches from different varieties are sold at the same time and search, negotiating, bargaining costs are borne concurrently.

The majority of the banana bunches sold (64%) are from traditional varieties that are endemic to the region. Cooking varieties dominate banana markets in terms of volume sold (in kg), followed by beer varieties. Of all banana types sold, cooking varieties represent 54%, with beer varieties capturing 26% and sweet varieties representing 17%, with the remaining 3% made up of multi-use (hybrid) and roasting banana types. Bunches from 61 different varieties are sold in the sample (11 of those are single observations, i.e. only one household sells this particular variety in the sample); while the market share for cooking banana bunches sold is comprised of 40 different cooking varieties, the number of beer and sweet varieties sold is 18 and 3, respectively. The large number of different types of banana bunches sold reflects differences in the combination of attributes embodied in the varieties sold.

Half of the households in the sample (51%) participate in banana markets as sellers. A third of the households in the sample (38%) are net sellers, 21% are net buyers, and 13% participate in banana markets as both sellers and buyers. More than a quarter of the households in the sample (28%) remain autarkic with respect to banana markets.

Econometric Approach

The composition of market participation is analyzed for those households who participate as sellers. There are several reasons for focusing on the behavior of net sellers[1]. First, farmers selling their excess production are aware, through experience and own consumption, of the intrinsic attributes of the banana varieties they grow. Second, different factors have been identified to influence the behavior of sellers and buyers (Goetz, 1992; Key, Sadoulet and de Janvry, 2000). Hence, households that both sell and buy bananas are not considered because of possible unobserved interdependencies in their market behavior. Third, the decision to focus on net sellers is also partly driven by data limitations. Disaggregated data on prices, quantities and attributes of varieties were collected only for banana bunches sold. Though buyers were identified, no such data were obtained for varieties bought.

Marketed surpluses are estimated for households participating in banana markets as net sellers using a two-stage econometric approach. This method enables the separate estimation of two processes of household behavior toward banana markets – the decision to participate as net sellers of banana bunches and the composition and scale of participation - recognizing differences in their determinants. The two-stage approach recognizes two more important aspects of the data. First,

[1] Though household behavior toward market participation may change over time, crossing the threshold from non-participation to either selling or buying, or becoming a net seller after being a net buyer the previous year, the present analysis does not capture such dynamics. Instead, the base for inference is household behavior during the previous year as a single cross-section of time.

different data generating processes may determine zero outcomes in each stage - a zero outcome in the first stage indicates that households participate in markets as buyers or remain autarkic, while in the second stage it indicates that no positive quantities of a given variety are sold, though the household participates as a seller with a subset of varieties. Second, the units of observation may differ between stages – while market participation decisions are made by households, marketed surpluses of those who sell are defined at the level of the variety.

In the first stage, a Probit model is used to identify the determinants of household participation as sellers. The second stage uses the truncated sample of all net sellers to study the relationship between marketed surpluses and variety attributes. The residuals from the household participation decisions are included to account for the non-random sample used in the second stage estimation. In the second stage, two estimators of the censored regression model are compared: the Tobit and a semi-parametric censored quantile estimator, defined by Powell (1984). Standard errors in both regression models are bootstrapped to account for truncation and censoring of the estimated sample.

Variables

The dependent variable in the first stage of the estimation approach is defined as a binary outcome of those households that participate in banana markets as net sellers (=1) and those that participate as buyers or remain autarkic. The unit of observation in the first stage is the household (N=517 households). The dependent variable in the second stage is the level of excess production sold by households. Marketed surplus is measured as the number of bunches sold of a given variety by each selling household. Hence, marketed surplus is measured at the variety level. There are 1651

household-variety observations[2]. Zero marketed surplus results from differences in the size of the portfolio of grown varieties and that of sold varieties. Net selling households participate in banana markets with some varieties (i.e. have positive marketed surplus with respect to a subset of varieties they grow), while keeping others for only home consumption (i.e. they choose to remain autarkic with respect to a subset of varieties they grow). Zero marketed surplus outcomes represent 56 percent of the sub-sample used in the second-stage estimation. Explanatory variables are defined in Table 1 separately at the household (e.g. household, farm, market characteristics) and at the variety levels (e.g. production and consumption attributes and prices).

Table 1. Summary information of explanatory variables

Variable		**Mean**	**St. D.**
Household level (N=517)			
Age	Age of household member in charge of banana production	41.41	15.53
Gender	Gender of household member in charge of banana production (1=male)	0.62	0.49
Education	Years of schooling of household member in charge of banana production	5.21	4.02
Experience	Years of experience of household member in charge of banana production	10.21	10.62
Household size	Total number of household members	5.78	2.67
Dependency ratio	The proportion of children and elderly members to household size	0.48	0.24
Farm area	Total farm area (in acres)	4.58	7.84
Banana share	Proportion of farm area allocated to banana production (intensity of banana production)	0.38	0.28
Exogenous income	Income received in previous year from sources other than farm production (in 10,000's Ugandan Shillings	90.88	282.60
Value of livestock	Value of livestock owned by the household (in 10,000's Ugandan Shillings)	42.19	96.18
Stock of attributes	Number of distinct banana varieties available in the village	23.41	5.53
Time to market	Time to nearest banana market (in hours)	1.00	0.53
Distance to market	Distance to nearest banana market (in kms)	1.89	1.43
Southwest region	Household located in the Southwestern region of Uganda (=1)	0.23	0.42

[2] There are 197 net sellers in the second-stage sub-sample. Households, on average, grow 7 different varieties, but sell the bunches of only 2 varieties, with the sets of grown and sold varieties being different across households.

Eastern region	Household located in the Eastern region of Uganda (=1)	0.30	0.46
Variety level (N=1651)			
Cooking quality	Farmer's perceptions of taste, softness, color (1=bad; 2=neither good nor bad; 3=good)	2.21	0.90
Bunch size	Maximum expected size of a banana bunch (in kg)	14.07	6.56
Farm-gate price	Average bunch price received by household during the year at farm-gate, by variety (in 1,000's Ugandan Shillings)	1.70	0.99

Results

Estimation results are summarized in Table 2. Different factors are found to determine the household decision to participate in banana markets as a seller and the extent of its participation, supporting findings in the literature (Goetz, 1992). Households more likely to participate as sellers in banana markets are those with fewer dependents, larger farms and more intensive banana production, and those located in the highlands of Southwestern Uganda. More exogenous income reduces the likelihood of selling, as it provides an alternative source of income (rather than cash from banana sales). Acquired human capital, through formal schooling, increases the likelihood of selling. Households are less likely to sell the longer the time required to reach a market, as the bulky nature of banana bunches makes them difficult to transport.

The normality of the error term of the Tobit regression is rejected at the 1 percent level (Pagan-Vella test p=0.000). Hence, a semi-parametric median censored quantile regression is used for inferences. The quintiles are adjusted (at the 50%, 75% and 90%) to test for the robustness of results to different specifications. Farm and market characteristics appear to play no role in the extent of participation in markets as a seller, with some household characteristics affecting the magnitude of marketed surplus. The most robust results across econometric specifications, in terms of the direction, significance and, to some extent, the magnitude of the effect, are variety-specific attributes and farm-gate prices. Households appear to sell excess production of varieties that yield

larger bunches, while keeping the bunches or varieties with perceived superior quality attributes for own consumption. The inverse relationship between the size of marketed surplus and farm-gate prices may be indicative of subsistence behavior. A price increase may signal shortage in availability of bundles of attributes, making farmers keep more bunches for own consumption, while supplying fewer bunches at farm-gate.

Table 2. Regression estimates for the two-stage estimation approach (standard errors in parenthesis)

Variable	**Probit**	**Tobit**	**Censored Quantile Regression**		
			50% quintile	***75% quintile***	***90% quintile***
Constant	-0.0771	-23.8759	-37.8996	42.4716	-188.2435
	(0.3762)	(178.1346)	(152.3435)	(93.8833)	(243.1731)
Age	0.0029	0.0073	-0.4605	0.4026^	-0.0006
	(0.0040)	(0.4583)	(0.3797)	(0.2174)	(0.5668)
Gender	-0.0300	8.0069	20.3604**	5.4812	17.3210^
	(0.1300)	(7.3597)	(6.9372)	(3.7403)	(10.1987)
Education	0.0393*	-0.1110	-4.4337	1.8403	-4.1342
	(0.0166)	(5.9014)	(4.6643)	(2.7848)	(7.1106)
Experience		-0.4273^	0.8930**	-0.3671**	-0.0864
		(0.2329)	(0.2718)	(0.1334)	(0.3395)
Household size	-0.0279	-0.6055	3.6639	-0.4928	3.1969
	(0.0247)	(4.2951)	(3.5821)	(2.1033)	(5.4458)
Dependency ratio	-0.7231*	-6.8031	65.8513	-17.3735	135.9684
	(0.2804)	(110.2876)	(86.1379)	(51.9099)	(134.3485)
Farm area	0.0173*	0.2938	-1.3067	0.5251	-1.5988
	(0.0081)	(2.5125)	(2.0484)	(1.2189)	(3.1442)
Banana share	0.5252*	5.6240	-9.1817	20.7757	-79.5568
	(0.2517)	(78.2108)	(64.5405)	(38.2508)	(98.5669)
Exogenous income	-0.0007*	0.0324	0.1690*	-0.0031	0.1431
	(0.0003)	(0.1005)	(0.0745)	(0.0495)	(0.1265)
Value of livestock	-0.0002	0.0031	0.0249	0.0128	0.0044
	(0.0007)	(0.0348)	(0.0331)	(0.0182)	(0.0468)
Stock of attributes		0.5046	-2.0200**	-0.4447^	-0.4467
		(0.4208)	(0.6412)	(0.2355)	(0.6003)
Time to market	-0.4199**	-12.8803	22.7884	-14.0931	75.5245
	(0.1342)	(64.2301)	(50.7367)	(31.2980)	(80.7623)
Distance to market	0.0299	-1.0473	-5.2045	-1.0117	-5.7349
	(0.0443)	(5.0326)	(4.1227)	(2.4243)	(6.1856)
Southwest region	0.4288**	-41.6051	-107.1826^	-11.0402	-96.0284
	(0.1644)	(66.6006)	(59.9614)	(31.7013)	(82.0363)
Eastern region	0.0132	4.9645	-14.2076*	6.4754^	10.8049
	(0.1497)	(8.6037)	(6.8527)	(3.9427)	(10.9621)
Cooking quality		-5.9443*	-6.6263*	-5.6306**	-12.4169**
		(3.1032)	(2.7436)	(1.5124)	(3.9933)
Bunch size		2.9039**	1.4896**	1.8148**	1.6803**

		(0.4429)	(0.4188)	(0.2079)	(0.5291)
Farm-gate price		-0.0172**	-0.0375**	-0.0097**	-0.0102*
		(0.0027)	(0.0066)	(0.0018)	(0.0045)
Residuals		33.7148	260.9082	-39.3011	487.0725
		(393.8449)	(325.9982)	(194.2886)	(499.801))
Sample size (N)	517	917 left-cen. 734 uncen.	340	1443	1645

Implications

The analysis in this paper is unique in its emphasis on variety attributes as determinants of the size of marketed surpluses disaggregated across varieties. Indeed, farmer's perceptions of variety attributes appear to strongly affect the size of marketed surpluses. Hence, failing to include attributes in the analysis would lead to omitted variable bias. Policy implications can be drawn from the results. Public investments in education and market access have the potential to stimulate participation in banana markets, though their direct effect on the composition and volume of participation appears to be limited. Reducing transactions costs (by improving road infrastructure or means of transportation) may motivate more farmers to sell banana bunches, making them price responsive. However, the impact of reducing transactions costs on the composition of participation is not immediately apparent. With lower transactions costs the price captured by selling households at farm-gate may exceed their reservation price for bundles of attributes of subsets of varieties. This can stimulate households to sell not only the excess production of bunches of larger size, but also sell bunches with good cooking quality characteristics. Inevitably, this will benefit consumers of bananas by providing greater variation in the bundles of attributes available in the market place. Reducing transactions costs is perhaps a necessary condition for stimulating participation, but it is not a sufficient condition for explaining the composition of participation. Provision of information and improvement of market signals related to quality characteristics of specific varieties may also be required in order to stimulate a more disaggregated supply response across different bundles of attributes. This can, consequently, have implications for crop improvement strategies.

References

Ahmed, M., Preckel, P., Baker, T. and M. Lopez-Pereira. 2001. Modeling the impact of technological change on nutrition and marketed surplus. *Agricultural Economics* 25: 103-118.

Bardhan, K. 1970. Price and Output Response of Marketed Surplus of Foodgrains: A Cross-Sectional Study of Some North Indian Villages. *American Journal of Agricultural Economic*s 52 (1): 51-61.

Chinn, D. 1976. The Marketed Surplus of a Subsistence Crop: Paddy Rice in Taiwan. *American Journal of Agricultural Economic*s 58 (3): 583-587.

Dalton, T. 2004. A Household Hedonic Model of Rice Traits: Economic Values from Farmers in West Africa. *Agricultural Economics* 31: 149-159.

de Janvry, A., Fafchamps, M. and E. Sadoulet. 1991. Peasant Behaviour with Missing Markets: Some Paradoxes Explained. *The Economic Journal* 101: 1400-1417.

de Janvry, A. and E. Sadoulet. 2003. Progress in the Modeling of Rural Households' Behavior under Market Failures. In: de Janvry, A. and R. Kanbur (eds.). Poverty, Inequality and Development: Essays in Honor of Erik Thorbecke. Chapter 8, Kluwer publishing.

Edmeades, S. 2003. *Variety Choice and Attribute Trade-Offs within the Framework of Agricultural Household Models: The Case of Bananas in Uganda*. Ph.D. Dissertation, North Carolina State University.

Edmeades, S. 2006. A Hedonic Approach to Estimating the Supply of Variety Attributes of a Subsistence Crop. *EPT Discussion Paper* No. 148, Washington D.C.: IFPRI.

Goetz, S. 1992. A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa. *American Journal of Agricultural Economic*s 74: 444-452.

Haessel, W. 1975. The Price and Income Elasticities of Home Consumption and Marketed Surplus of Foodgrains. *American Journal of Agricultural Economics* 57 (1): 111-115.

Hintze, H. 2002. *Characteristics, Transactions Costs, and Adoption of Modern Varieties in Honduras*. Ph.D. Dissertation, North Carolina State University.

Key, N., Sadoulet, E. and A. de Janvry. 2000. Transactions Costs and Agricultural Household Supply Response. *American Journal of Agricultural Economic*s 82: 245-259

Ladd, G. and M. Martin. 1976. Prices and Demands for Input Characteristics. *American Journal of Agricultural Economic*s 58: 21-30.

Ladd, G. and V. Suvannunt. 1976. A Model of Consumer Goods Characteristics. *American Journal of Agricultural Economics* 58: 504-510.

Lancaster,K. 1966. A New Approach to Consumer Theory. *The Journal of Political Economy* 74: 132-157.

Medani, A. 1975. Elasticity of the Marketable Surplus of a Subsistence Crop at Various Stages of Development. *Economic Development and Cultural Change* 23 (3): 421-429.

Powell, J. 1984. Least Absolute Deviation Estimation for the Censored Regression Model. *Journal of Econometrics* 25: 303-325.

Renkow, M. 1990. Household Inventories and marketed Surplus in Semisubsistence Agriculture. *American Journal of Agricultural Economics* 72 (3): 664-675.

Singh, I., Squire, L. and J. Strauss (eds.). 1986. *Agricultural Household Models: Extensions, Applications, and Policy*. Baltimore: Johns Hopkins University Press.

Strauss, J. Marketed Surpluses of Agricultural Households in Sierra Leone. *American Journal of Agricultural Economics* 66 (3): 321-331.

Toquero, Z., Duff, B., Anden-Lacsina, T. and Y. Hayami. 1975. Marketable Surplus Functions for a Subsistence Crop: Rice in the Philippines. *American Journal of Agricultural Economics* 57 (4): 705-709.