HORTICULTURAL EXPORTS AND LIVELIHOOD LINKAGES OF RURAL DWELLERS IN SOUTHERN GHANA: AN AGRICULTURAL HOUSEHOLD MODELING APPLICATION

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ABSTRACT

Increasing foreign exchange problems and the deteriorating prices of traditional export commodities in developing countries are leading agricultural policy makers and donor agencies to seek diversification in export crop production. In Ghana, horticultural crops such as pineapples, mangoes and papaya appear promising because of their high labor intensity and the expanding demand for fruits in industrialized nations. Consequently, few studies have examined the linkage between export diversification and microeconomic performance. In this study, a non-linear programming model of farm-household behavior is applied to households with different resource endowments and socio-economic characteristics by exploring observed responses to alternative factor and output price scenarios. Model results show significant differences in household responses to changes in wages, prices of local staples and world market prices of horticultural crops where, beyond critical price ranges and resource constraints leads to inverse supply responses for poor households. The findings suggest the need to design an integrated policy framework that is orientated towards improving rural market imperfections for sustaining the livelihoods of smallholders.

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BACKGROUND INFORMATION

In response to the deteriorating terms of trade for traditional primary commodity exports from developing countries, and dynamic shifts in the global food chain, market liberalization, export diversification and export-oriented industrialization strategies have become a primary concern of most Sub-Saharan African countries including Ghana. Horticultural produce and semi-processed products from the developing world are becoming increasingly popular source of non-traditional export commodities both in domestic and in international markets. The increasing consumer demand in industrialized countries for out of season fresh fruits and vegetables has opened niche markets for African countries to produce these crops for export during the void period at attractive prices (Diop and Jaffee, 2005). Nevertheless, horticultural products are not immune to international market fluctuations as pertains to other primary commodities. Additionally, agricultural trade policy reforms have a complex range of welfare distributional effects on smallholders in developing economies, where food and agriculture are major sources of income and component of household expenditure.

Ghana is well endowed with natural resources and predominantly an export led economy having about twice the per capita output of the poorer countries (such as Sierra Leone, Niger and Burkina Faso) in West Africa (Thomi, 2001). Even so, it remains heavily dependent on international financial and technical assistance. Gold, Timber and Cocoa are traditionally the major sources of foreign exchange. The domestic economy continues to revolve around subsistence agriculture, which accounts for about two-fifth of GDP and employs 60% of the work force, constituting mainly of smallholders (Institute of Statistical Social and Economic Research, 2005). Following the failure of export policy through a restrictive trade regime and an import substitution industrialization policy of the 1970's, Ghana introduced an Economic Recovery Program (ERP) that was to be achieved through structural adjustment in co-operation with the International Monetary Fund (IMF) between the early 1980's and late 1990's.

As part of the ERP, Ghana in 1984 began to open up its economy to participate in international trade. The policy thrust was towards the development and promotion of non-traditional exports (NTEs) whilst maintaining the country's competitiveness in the traditional export sector. NTEs in this regard refer to crops that prior to the ERP did not have any significant export value. These include horticultural products such as pineapples, papaya, mangoes, various vegetables and condiments, cashew, yam, sheabutter; fish and sea foods as well as some game and wildlife products. The contribution made by non-traditional exports to GDP has been increasing on annual basis possibly due to promotion and support the sector receives from government and the declining terms of trade for traditional exports. In 2004 for example, the agricultural sector comprising mainly of Cocoa, Timber and NTEs accounted for 37.9% of the total GDP whereas industry, services and indirect taxes were represented by 24.7% and 28.6% and 8.8% respectively (Ghana Statistical Service, 2005). The NTE sector alone contributed 23.7% of the total foreign exchange earnings from agriculture (Ghana Export Promotion Council, 2005) with the remaining coming from the traditional cocoa and timber sub-sectors. Horticultural products most especially pineapples continue to be the leading contributor (40%) to export receipts from agricultural NTEs in Ghana (Ghana Export Promotion Council, 2005). While export volumes and foreign exchange earnings of horticultural exports have increased significantly over the years, the economic feasibility of the export booms on the livelihood of smallholders in rural Ghana is not clearly understood.

PROBLEM STATEMENT

Based on the Ricardian comparative advantage principle and the Heckcher-Ohlin trade theory, various studies have shown that countries can improve the growth and welfare of its citizens by opening up their borders to freer trade based. Furthermore, there is a worldwide move toward economic integration, the EU being the most prominent example. Not only is it foreseen that this movement will improve welfare of the country but it's competitiveness could also improve by generating foreign exchange earnings and fiscal revenues, to increase the income of smallholders, and to provide employment for the rural poor.

To this end, policy makers in developing countries have in recent years been concerned with the economic and political risks associated with heavy dependence on specialized raw materials as main sources of government revenue and foreign exchange. Development partners and donor agencies have equally extolled the need for these countries to diversify their export base as a poverty alleviation strategy. In this light, several African countries have tended to expand their foreign trade portfolio by focusing on non-traditional exports which reflect their comparative advantage and for many countries the export of horticultural crops has been favored. Consequently, several

reasons have been advanced for the boom in horticultural exports from Africa over the past decade (Jaffee, 1995; Barrett et al., 1997; Dixie, 1999; Malter et al., 1999).

In Ghana, crops such as pineapple, papaya and mangoes provide an important source of foreign exchange, generates substantial employment and has contributed to the upgrading of agricultural production skills. But has horticultural exports significantly affected smallholder food security and livelihood? Indeed, there is a possible trade-off between export and food crop production because of the possibility of re-allocation of resources from one to the other. Thus, identification of the optimum balance level that will ensure efficiency in resource allocation decisions for increased total agricultural output is of prime importance for policy makers, donor agencies, smallholders in the horticultural export value chain.

Despite this importance, only the macro indicators of increased export volumes and earnings have so far been used to assess responses of NTE crops to government incentives. If research is to contribute to the understanding of export booms and poverty linkages in rural Ghana and other African countries with similar problems at the micro-level, it must do more than just analysing aggregate national data. It should also investigate problems at village and household levels. For the majority of smallholders in rural Ghana who are exposed to high food prices and to low food entitlement attempts at improving their living conditions actually goes beyond self-sufficiency in food production and increasing family incomes, it also entails adjustment to complex market signals.

Overall, the main effects of the introduction of export cropping in the survey zone has been the significant deterioration in access to land as smallholder food crop farms are being consolidated into larger scale export crop plantations. Thus, at the microeconomic level, the short and long-term impacts of the booming non-traditional exports vis-à-vis their micro level distributional effects in terms of household resource allocation patterns, food security and livelihood linkages still remain under-investigated. In an attempt to fill this void, this study emphasizes on the impacts of export diversification policies on household welfare of horticultural export crop producing communities in southern Ghana. With recent emphasis on market based development assistance, a sound understanding of the linkages between export diversification policies and livelihood would help in crafting appropriate policies regarding institutional arrangements and creation of adequate markets and infrastructure which could benefit a large mass of small and marginal land holders dwelling in rural areas of southern Ghana.

To account for the varied interrelationships and trade-offs between production, income and consumption decisions of different commodities within the household requires the use of an agricultural household model in an optimization framework. Based on the pattern and dynamics of resource allocation for various production and consumption commodities, this study seeks specifically to: (i) analyze the behavioral response of rural farm households to alternative factor and product market changes resulting from the boom in horticultural exports; and (ii) suggest entry points for policy interventions aimed at improving the livelihood status of rural smallholders engaged in horticultural export crop production.

LITERATURE REVIEW

Theoretical Orientation of the Study

At the background of this study is the recognition of the prime importance of trade and economic development theories, dating back to works done by Adam Smith and David Ricardo. Nevertheless, the conceptualization of economic development theories and their application to developing country settings have not had an easy path, with the result that different conceptions of the content and pattern of economic development and different

historical, geographical and political circumstances have often caused theoretical contradictions (Addo and Marshall, 2000). Numerous theories and strategies, including those of international trade, have been discussed in the economic development literature from three broad perspectives: neoclassical or modernization, dependency, and state-mediator (Baum and Tolbert, 1985; Grant and Agnew, 1996; Frank, 1966; Hogendorn, 1992; Kirmani, 1995; Park, 1979; Thirwall, 1989; Todaro, 1989). Much as each perspective is relevant, no single theory is adequate to account for all the variations or trends in economic development in developing countries (Addo and Marshall, 2000).

The first school of thought involving mainstream development economists and neoclassical trade theorists argue that international trade is an engine of growth. In order to reap the full benefits of trade there should be, among other things, a reduction in trade barriers, free international mobility of capital, and diffusion of technological know-how and skills. Dependency theorists on the other hand link underdevelopment in developing countries to international trade and argue that natural resources are essentially a "curse" — that they condemn low-income countries to underdevelopment. While developing countries are perceived as producers and exporters of raw materials, industrial nations are producers and exporters of manufactured goods. Dependency theorists also contend that comparative advantage in the agricultural, textile and clothing sectors has not been fully realized because of high trade barriers imposed by developed nations (Frank, 1966; Mabogunje, 1989).

State-mediator theorists, emphasize the poor fit of both neoclassical and dependency theories to developing areas. This third school of thought maintains that local contextual factors are very crucial in understanding the variations in economic performance. Administrative capabilities, political ideologies and practices, perception of economic crises and pitfalls, technocratic autonomy, and power exercised by public officials are important factors that account for the variations in economic performance (Bienen, 1990; Callaghy, 1990; Grant and Agnew, 1996; Mohan, 1996).

Empirical Orientation of the Study

Most studies on the impact of agricultural commercialization and the food security and welfare status of smallholders in developing countries have essentially employed econometric techniques to predict household behaviour using reduced-form equations. Based on switching regression and standard logistic regression analysis, potential synergy effects have been identified between cash-crop investment and food productivity, whereby positive spill over benefits of increased input are made possible for food crops through cash crop delivery channels (Dione, 1989; Goetz, 1993; Goverah and Jayne, 2003; Von Braun, 1995). Using maximum likelihood estimation approaches, McCulloch and Ota (2002) also found that households engaged in horticultural export in Kenya were better off than those that do not. Consequently, there are critics of such policies that advocate cash crop production (Von Braun and Kennedy, 1986; Weber et al., 1988). They argue that the benefits have never materialized with the premise that, in areas where cash crop production has increased, food consumption and the nutritional status of the poorest households have deteriorated.

There is a small body of literature that have also applied numerically estimated agricultural household models to analyze the behavior of households to agricultural commercialization (De Janvry et al., 1991; De Janvry et al., 1992; Taylor and Adelman 2003). Overall, households in developing countries are faced with a complex set of issues that influence, to a very significant extent, their livelihoods and livelihood strategies (Caillavet et al., 1994; Carney, 1998; Ellis, 1993). Numerically estimated agricultural household models provide a flexible framework for explicitly modeling the interrelationship between production, income and consumption within the household.

Barnum and Squire (1979) developed the neoclassical household, which has its roots in Chayanov's work on the impact of demographics in household response in the 1920's (Sadoulet and De Janvry, 1995: 141). The agricultural household model of Barnum and Squire (1979) as extended by Singh et al. (1986) is the starting point for most current microeconomic studies of the agricultural sector in developing countries. Using a programming model, Narayanasamy (1997) found that with increased input prices, rural Indian households shift more resources towards the production of high value crops such as rice. After an initial development of household models for analyzing price policies, applications extended to diverse topics such as off-farm labor, migration, nutrition and health, credit constraints and environmental issues (Taylor and Adelman 2003).

STUDY AREA AND METHODS

The Horticultural Export Industry and Study Area

It has been estimated that about 15% of the population of Ghana depend on horticultural export related production and or marketing for their livelihood (Ghana Export Promotion Council, 2002). Unlike, other non-traditional exports such as frozen fish and sea foods, the vast majority of Ghana's horticultural output is produced by smallholders operating less than 2 ha (Ghana Export Promotion Council, 2002) for whom it represents an important source of cash income. Most suppliers of export fruits and vegetables are found within the Semi-deciduous forest and Coastal savanna agro-climatic zones of the Eastern, Central and Greater Accra Regions of the country. The horticultural exports of significant export importance within southern Ghana are pineapples, mangoes, papaya, chillies and okra. However, this study essentially zeroed on pineapples and mangoes, the two major products with current remarkable export importance and clearly identifiable participating smallholders within the production and marketing chain.

The *Akwapim south* district was selected as the case study zone for pineapple production because it contributes about 60% of the total exportable pineapples from Ghana. The district population density of 289 persons per km^2 is more than 3 times the national average (Ghana Statistical Service, 2000) giving an indication of the extent of pressure on land both for human settlement and farming. Mango production on the other hand is currently dominated by large farm-holders scattered across the Coastal and Guinea savanna agro-climatic zones. This is by virtue of the fact that, it is probably the youngest export perennial crop within the industry with the oldest plantations being just over a decade old. Consequently, the *Dangme west* district has the highest number of smallholders producing mangoes in the country and therefore befits the target group for the purpose of this study. The sampled villages in the 2 districts are all located within a radius of 23km from the capital city, making it easily accessible to the national airport and major seaports at Accra and Tema respectively. Besides, these two districts represent strong regional differences in terms of the agricultural potential within their identified agro-climatic zones in the country. Their closeness to the national capital also explains the high degree of agricultural commercialization in these zones resulting from the strong backward and forward linkages between agricultural growth, employment opportunities and the demand for goods and services arising from both on-farm and off-farm enterprises.

Analytical Methods

The household survey for the study was undertaken in the forest and coastal savanna transition zones of Ghana, where the farming system has undergone a remarkable transition from an established system of food crop (i.e., maize and cassava production)

farming for sale to urban consumers to an intensive production of fruits (pineapples, mangoes) and vegetable crops for export to European consumers.

The analysis presented in this paper is based on a primary data set collected by a survey of 200 farm households. The field survey was carried out from May to October 2004, covering the 2003/2004 cropping season mainly with the use of semi-structured questionnaires. In accordance with the importance of the various horticultural crops to total export earnings, 7 villages (i.e., *Oboadaka, Fotobi, Yaw Duodu, Nsakye, Dago, Ahwerase-Damang* and *Brekuso)* with 20 households each within the pineapple cultivated based communities of the *Akwapim south* district and 3 villages (*Doryumu-Ayikuma, Agomeda* and *Abrampa*) with 20 households each from the mango cultivated based communities of the *Dangme west* district were selected for the survey using the stratified random sampling approach.

Secondary data was obtained from records and documents of various public departments. This included the Ghana Export Promotion Council, Ministry of Food and Agriculture, Ghana Statistical Service, Bank of Ghana, Ghana Investment Promotion Council, Ministry of Trade, and various producer and exporter associations, such as the Horticulturalist Association of Ghana and Sea Freight Pineapple Exporters of Ghana. Information collected consisted of time series export performance of various NTE, time series statistics on macro-economic indicators such as Gross Domestic Product (GDP), investment, inflation, trade balance, exports, imports, tariffs and taxes as well as crop output, farm wages, agrochemical quantities and prices, agricultural credit and interest rates and were collected.

A two-stage methodological approach was employed for the purpose of this paper. Descriptive statistic tools were used to categorize the sampled farm households into three main groups based on the type of crops grown and other socio-economic characteristics. On basis of this typology, the respondents comprised of 44 Non-Horticultural households, 118 Horticultural and Staple households, and 38 Horticultural households. The major differences and similarities among the three household categories have been outlined based on the extent of participation in the horticultural export industry. Based on the household typology from the field survey, a non-linear programming (NLP) household model was formulated in the General Algebraic Modeling System (GAMS, version 21.6) and used to examine the behavioral response of farm households to alternative factor and product market price changes resulting from horticultural export boom.

NLP Model Framework and Structure

Economists have traditionally used a profit function approach to explain farm behavior. In the absence missing or incomplete markets and low transaction costs, a profit function might be used for the analysis of allocation choice in family farms. This function is also useful in analyzing behavior of households engaged in agribusiness-operated commercial and plantation farms. Based on the premise that most farm households in developing economies specialize and sell their products on the market, there is an appealing justification for the use of the profit maximization hypothesis (Henning, 1992; Nakajima, 1986; Singh et al., 1986) whereby the household is assumed to be a price taker in all their production and consumption decisions. Even so, two important counter-arguments have often been raised.

Firstly, as a result of transaction costs in most developing economies, full-time farm households which do not hire additional labor as a substitute for their own work, do not sometimes participate in the labor market. Secondly, it is not obvious that household preferences are related to tradable consumption commodities only. Thus under conditions of market failure or imperfections, the proposition that profit is the principal objective cannot be maintained. Consumption as an objective itself may also pose problems,

because a household may have several and sometimes conflicting goals and aspirations. The choice of objective function in an applied model must reflect all these considerations.

The model presented in this study is a simplified version of the Barnum and Squire (1979) and Singh et al. (1986) class of unitary household models that have been applied to developing country settings. A NLP is used to simulate the small farm economy of each of the three household categories, assuming that the marginal returns to labor decline with increases in production. The model typically assumes that the household maximizes utility subject to set of constraints (a production function, time, full income and factor endowment) linear in the wage rate – inclusion of a function reflecting farm self-employment returns means that the returns to labor are assumed not constant. In this study, utility is a function of the consumption desires three categories of goods: farm produced maize, cassava and other local cash crops; the consumption of market purchased staples, other food and non-food items and leisure. Depending on the household labor endowment and preference for leisure, labor may be bought or sold in the market. The estimation of the household model can be divided into two dependent parts, the production and consumption modules.

Principally, each of the two modules is estimated with standard consumer and producer approaches based on Cobb-Douglas functional forms. Since this study was based on a one-off survey of the sampled households it was sought for the use of the Cobb-Douglas production as opposed to the choice of flexible functional forms, not because it is looked as a simple tool which can be handled easily or is looked as a crude remedy for estimation ills, but because it also possesses various advantages most especially for estimating the productivity of resources estimated from cross-sectional data. A direct non-linear utility function maximization approach based on an underlying production function was specified as the objective function. The main reason for using a direct utility function is the existence of commodity market failures for some specific households. If there exists high price bands between selling and purchasing prices for staple food, the indirect model, where the utility function is solely an argument of the monetary value of consumption fails to provide adequate results. Basically, the use of indirect utility functions under incomplete or missing markets conditions does not guarantee that the local optimum calculated corresponds to the global optimum.

The model includes five crops (maize, cassava, pineapples, mangoes and an aggregate of other local cash crops) and four production factors (labor, land, agrochemicals and, other capital assets). Due to the problems of observed zero inputs for some factors which would otherwise accentuate the extent of biasness and inconsistencies in ordinary least square estimations, production elasticities are computed using the factor shares of value-added approach. This method for estimating input elasticities in Cobb-Douglas models under profit maximization and price-taking behavior involves exploiting only the optimizing conditions. Consumption demands are also modeled using a Cobb-Douglas linear expenditure system (LES) approach based on budget shares of the requisite consumption bundles. The basic model, omitting all complexities, consists of an objective function (equation 1) with a typical household being assumed to maximize a well-behaved unitary utility function, subject to a production technology, land, exogenous market prices, budget and labor time constraints (equations 2-5). Thus for any production cycle, the behavioral equations of the agricultural household are expressed as follows:

$$\max_{f_{ij},Cq,x_i,Cm_i,Cl_i,i_h} U \leq \alpha_u Cm_i^{\alpha_m} Cl_l^{\alpha_l} \prod_i Ca_i^{\alpha_i} \qquad (1)$$

subject to a set of constraints which have to be satisfied:

$$\beta_{i,\,constant} \prod_{j} f_i^{\beta_i\, j} \geq Ca_i + X_i \qquad (2)$$

$$L + l_h \geq \sum_i f_{i,\,labor} + Cl_l \qquad (3)$$

$$A \geq \sum_i f_{i,\,land} \qquad (4)$$

$$Y_x + \sum_i P_i X_i \geq \sum_i (P_i Cm_i + \sum_j q_j f_{ij}) + wl_h \qquad (5)$$

$$f_{ij} \geq 0,\ Ca_i, X_i, Cm_i \geq 0,\ l_l \geq 0,\ l_h \geq -L$$

whereby; C= Set of household produced commodities {maize, cassava, pineapple, mango, other cash crops}; F = Set of production factors {labor, agrochemicals, other capital inputs, land}; U= Utility of consumption of own agricultural produce, market purchased goods and leisure; f_{ij} = Factor input j for the production of commodity i; Ca_i = Consumption of own agricultural produce i; Cm_i = Consumption of market purchased goods i; Cl_l = Consumption of leisure; X_i = Excess supply of own agricultural output i; l_h = Quantity of labor sold (-) or purchased (+); L= Labor capacity of the farm household; A= Land endowment (fixed) of the farm household; Y_x = Exogenous income (non-farm income and transfers payments); P_i = Vector of price of commodity; q_j = Vector of price of factor j; w= Wage rate; $\alpha_i, \alpha_m, \alpha_l, \alpha_u, \ldots$ = Parameters of the utility function; $\beta_i, \beta_i, \ldots$ = Parameters of the production function with ouput i and input j.

Parameter Estimation and Model Calibration

The NLP farm household model used in this paper is written in GAMS and solved with a CONOPT solver. In view of the varied isolated number of different local cash crops cultivated by some observed households in sample, the residual output of all local cash crops were aggregated as one to avoid estimation errors in the commodity balance. Using the factor shares of value-added approach, the inputs and the prices of physical capital and hired labor were observed directly. Family labor value-added was calculated as the value of production minus the costs of intermediate inputs, hired labor, physical capital, and land. Under the assumption of profit maximizing behavior maximization, these are the exponents in household-specific Cobb-Douglas production functions once the cost of intermediate inputs has been netted out of the commodity price. The denominator, total revenue from cropping activity i, was observed in the field surveys and summed across all households in the sample. In the case of labor, the numerator, the value of total (family plus hired) labor inputs, was calculated by aggregating hired and family labor value added (obtained as described above) across all households in the sample (Appendix A1). Having estimated the Cobb-Douglas exponents as outlined above, the intercept, which represents the production shift parameter is computed from the production function, by replacing the elasticity by its estimator while neglecting the stochastic error term usually associated with any typical production function.

The parameters in the model are set to ensure that horticultural export crops do not enter into the utility of consumption function. This restriction is not necessarily to solve the model, but it is intended to make the model reflect the reality of farm households in the study area. Graphically, a utility-maximizing consumer will be at the point where his/her budget line is tangent to his/her highest attainable indifference curve. Realizing that a Cobb-Douglas functional form is homogenous of degree one, the

parameters of the utility function are derived by considering the share of expenditure on each of the commodity bundle. Average consumption shares were calculated from observed consumption (valued at prevailing market prices and summed across all households in a given group). In the case of leisure, time-use data gathered in the survey was valued using the same wage as on the production side of the model (Appendix A2).

In order to ensure a balance for the various factors and output variables, all other cash crops as well as miscellaneous staples were aggregated together. A major drawback of numerically solved models is that constraints cannot have multiplicative variables if an interior solution is to be found. To account for this, some variables in the programming model have been arbitrarily fixed. A clear distinction is also made for the direction of agricultural labor trade. Whereas, Non-horticultural households are modeled as net labor sellers, all two Horticultural based households are considered as net labor purchasers. For each set of values of exogenous variables GAMS gives a solution for output supply, factor demand, quantity of labor hired purchased or sold, consumption, excess supply and consumption of leisure, consumption of marketed purchased goods and consumption of own produced goods.

Simulations of Market and Policy Shocks

The basic model was applied to each of the three household categories, with observable differences only arising from their parameter estimates. The derived results are then used for the characterization of optimal values. Following a validation of the baseline model, appropriate policy scenarios were formulated. A centerpiece of policy reforms arising from the Economic Recovery Program (ERP) in Ghana has been a phase-out of subsidies for all agrochemicals with the associated increases in prices of most agricultural inputs. Through the introduction of export diversification policies, it was hoped that farm household welfare would be improved through the adoption of new farming technology and increased market access to high value export crops. The consequence has been a reduction in the quantity of produced staples thereby increasing food crop prices. As a result, the household-farm model in the present study was used to test this proposition under alternative market scenarios. The major experiments considered were; changes in factor prices (scenario 1), changes in output prices driven by both local and world market expectations (scenario 2), combined factor and output price changes (scenario 3) and a with and without" export crop comparison (scenario 4).

RESULTS AND DISCUSSION

Descriptive Statistics

The field study results indicate the given situation of households, particularly the cultivation of horticultural export crops based on perceived benefits, opportunities and constraints by considering the risks and probabilities of occurrence. Generally, Horticultural households have the highest land resource in terms of total endowment, total cultivated farm area, farm size per capita and fallow land area. This is followed by Horticultural and Staple households and finally Non-horticultural households in chronological order. The Kruskal-Wallis test in Table 1 shows statistically significant differences for the landholding characteristics of the household categories except for the fallow land area.

TABLE 1. LANDHOLDING CHARACTERISTICS PER SAMPLED HOUSEHOLD CATEGORY, 2003/2004

Household type		Total land endowment (ha)	Total farm size (ha)	Farm size per capita (ha)	Fallow land area (ha)
Horticultural households	Mean	5.61	3.56	0.94	2.05
(N=38)	SD [a]	5.83	4.24	1.12	2.29
Horticultural and	Mean	4.87	2.98	0.54	1.89
Staple households (N=118)	SD	5.52	4.07	0.55	2.61
Non-horticultural	Mean	2.61	1.52	0.35	1.09
households (N=44)	SD	2.40	1.47	0.44	1.42
Total (N=200)	Mean	4.52	2.77	0.57	1.75
	SD	5.16	3.75	0.70	2.35
Kruskal-Wallis test	χ^2	16.28***	20.24***	18.03***	4.32

Note: [a]. SD denotes standard deviation of corresponding variable; *** denotes significance at 1% probability level. Chi-square values are based on the Mean ranks of the Kruskal-Wallis test

This might be expected because land ownership status of some households in the various categories are based on traditional inheritance patterns or asset symbolization status of land as a result of which some households possess parcels of land that are not necessarily under current cultivation. Per capita income is also highest for Horticultural households, followed by Horticultural and Staple households with Non-horticultural households having the lowest income (Afari-Sefa, 2006).

NLP Household Model

The household model was validated against the observed field situation and finally used for sensitivity analysis. The model results describe the responses of production, factor allocation and welfare of the households under different scenarios. Whereas, increases in the prices of factors such as wages and staple prices under the various categories of scenario 1 tend to benefit the net labor selling Non-Horticultural households, the net labor purchasing Horticultural and Staple, and Horticultural households are not much negatively affected than might be expected. Obviously, as the opportunity cost of labor increases, staple production is reduced such that Non-Horticultural households, who are mostly net labor sellers even reduce their own labor demand so as to hire out labor to the labor-deficit Horticultural households, and Horticultural and Staple households. Horticultural households also respond to the wage rate increases by reducing the production of local cash crops while maintaining the production levels of pineapple and mango. Increased agrochemical and other capital input prices tend to accentuate the problem of input access by the various household categories.

Results of Input Price Policy Scenarios

Impact on Crop Production and Diversification

The four simulations considered under this scenario involve an increase in the prices of wages and capital inputs. Increasing the labor wage rate by 50% (scenario 1a) has varied impacts on various crops within the different households. Whereas, Non-Horticultural

households reduce maize production by 6%, Horticultural and Staple households reduce maize production by 8% (Table 2). This is apparently due to the fact that with increasing factor prices, it is rational for farm households to shift more resources from staples to the production of the more profitable horticultural export crops. Obviously, as the opportunity cost of labor increases, staple production is reduced such that Non-Horticultural households who are mostly net labor sellers even reduce their own labor demand so as to hire-out labor to the labor-deficit Horticultural households, and Horticultural and Staple households. Horticultural households also respond to the wage rate increases by reducing the production of local cash crops while maintaining the production levels of pineapple and mango. The impact of increased agrochemical and other capital input prices are depicted by scenario 1b. Pineapple is most affected in terms of reduction in production volume because its cultivation requires more intensive use of agrochemicals than any of the remaining crops. Whereas Horticultural and Staple households tend to reduce pineapple production by 12%, Horticultural households tend to maintain their production volume while reducing the cultivated levels of local cash crops.

An increase in land rental value under scenario 1c is generally associated with reduction in the production volumes of staple crops whereas the horticultural export crops do not seem to be much affected. This could be expected because most households cultivating horticultural export crops are better endowed than Non-horticultural households as a result of which they might not experience shocks due to increase in land rental value. Under combined effects in scenario 1d, farm households tend to be still rational by adjusting their food and cash income needs in response to factor price policy shocks. It can generally be observed that households are more inclined towards high value crops when the prices of specific inputs are raised. Similar observations were made by Narayanasamy (1997) in a survey of small farm households in India.

TABLE 2. IMPACT OF FACTOR PRICE POLICY SCENARIOS ON CROP PRODUCTION (BASE RUN = 100)

Commodity/Farm type	Scenario 1a	Scenario 1b	Scenario 1c	Scenario 1d
Maize				
Non-Horticultural	94.09	94.04	96.34	84.24
Horticultural and Staple	91.53	80.05	95.03	70.46
Cassava				
Non-Horticultural	93.89	94.28	96.49	84.40
Horticultural and Staple	92.22	83.96	93.59	75.18
Local cash crops				
Non-Horticultural	98.50	104.66	102.86	105.97
Horticultural and Staple	91.94	77.38	95.02	68.78
Horticultural	99.76	99.07	99.82	98.65
Pineapple				
Horticultural and Staple	87.66	88.05	101.52	46.68
Horticultural	100.19	100.75	100.14	101.08
Mango				
Horticultural and Staple	96.02	98.67	100.00	82.86
Horticultural	100.02	100.08	100.02	100.12

Note: Scenario 1a=50% increase in wages; Scenario 1b=40% increase each in prices of agrochemicals and other capital inputs; Scenario 1c=50% increase in land rental value; Scenario 1d=50% increase in wages, 40% increase each in prices of agrochemical and other capital inputs and 50% increase in land rental value.

Impact on Excess Supply and Consumption

The impact of the various factor price policy scenarios on excess supply and consumption is shown in Table 3. Generally, an increase in factor prices such as the wage rate and capital inputs tends to decrease the consumption of own produced crops in all the household categories. However, since Non-Horticultural households are net labor sellers, they are likely to benefit more from an increased wage rate by selling out more labor to the other two categories of households engaged in the horticultural export industry.

Results from the model generally indicate that, the cultivation of staple crops is not profitable within the study zone as indicated by zero values for the excess supply of both the base and most simulation runs. Whereas, this result may be true for Horticultural and Staple households, observations from the field study indicate that Non-Horticultural households do still market a substantial portion of their staple produce. The divergent results are attributed to non-separability in household production and consumption decisions associated with the observed problem of risk aversion and seasonal imperfections in food crop markets in the study area. In the study area, there are seasonal fluctuations in the price and perceived quality of food crops in the course of the year. As noted by Sadoulet et al., (1996) the lack of markets, the existence of mixed markets and the presence of risk in developing and transition economies, are well accepted problems that result in non-tradable outputs or factors of production. Similarly, household production and consumption decisions are non-separable whenever the household shadow price of at least one production-consumption good is not given exogenously by the market but instead is determined endogenously by the interaction between household demand and supply (Löfgren and Robinson 1999).

Impact on Factor Demand

It is generally known that factor market failures isolate subsistence producers from output market shocks. Based on this premise, producer households respond rationally to incentives within their operating constraints. On the basis of the underlying assumptions of model, the impact of the various scenarios on factor inputs can is analyzed by estimating the shadow prices of factors. Microeconomic theory posits that, the price that the farmer is willing to pay to rent an additional unit of each resource is equivalent to the marginal value product. In mathematical programming these values are known as shadow prices. The marginal utilities of the various factors and income are directly obtained from the model solution in utility units and then converted into the marginal utility in monetary value terms or the shadow price of factor.

The model results (not reported) show clear differences in the internal behavioral adjustment of households to the various scenarios. The shadow price of labor for the Non-Horticultural households (net labor sellers) was zero for all the scenarios. The results are thus in conformity with the assertion that poorly resourced households in developing economies tend to work until their marginal product of labor equates to zero. This is further supported by the observation that the shadow price of the better resourced Horticultural households (net labor purchasers) was more than four times the market wage rate of ¢1.20/manday in all the scenarios. This observation also confirms the lower agricultural labor wage rates obtained by Non-Horticultural households as compared to Horticultural based households who have the propensity to make additional on-farm and off-farm investments in their labor resource. Interestingly, the scenario results strongly confirm the hypothesis of acute land scarcity in the study area. The shadow price of land in the majority of scenarios was more than two times higher than the prevailing market price, with the highest being observed among Horticultural households. This is not surprising, giving the high proportion of land leasing tenants among this category of the sampled households.

TABLE 3. IMPACT OF FACTOR PRICE POLICY SCENARIOS ON CONSUMPTION AND EXCESS SUPPLY (BASE RUN = 100)

	Scenario 1a	Scenario1b	Scenario 1c	Scenario 1d
Consumption				
Maize				
Non-Horticultural	94.09	94.04	96.34	84.24
Horticultural and Staple	91.53	80.05	95.03	70.46
Cassava				
Non-Horticultural	93.89	94.28	96.49	84.40
Horticultural and Staple	92.22	83.96	93.59	75.18
Local cash crops				
Non-Horticultural	95.34	93.18	95.79	84.12
Horticultural and Staple	91.94	77.38	95.02	68.78
Horticultural	97.60	99.07	99.82	98.65
Market purchased goods				
Non-Horticultural	95.34	93.18	95.79	84.12
Horticultural and Staple	93.28	76.07	95.01	68.76
Horticultural	99.75	99.04	99.82	112.26
Excess supply				
Maize[a]				
Non-Horticultural	100.00	100.00	100.00	100.00
Horticultural and Staple	100.00	100.00	100.00	100.00
Cassava[a]				
Non-Horticultural	100.00	100.00	100.00	100.00
Horticultural and Staple	100.00	100.00	100.00	100.00
Local cash crops				
Non-Horticultural	99.21	107.22	104.44	110.85
Horticultural and Staple	100.00	100.00	100.00	100.00
Horticultural	100.00	100.00	100.00	100.00

Note: [a] Excess supply was zero in the base run; Scenario 1a=50% increase in wages; Scenario 1b=40% increase each in prices of agrochemicals and other capital inputs; Scenario 1c=50% increase in land rental value; Scenario 1d=50% increase in wages, 40% increase each in prices of agrochemical and other capital inputs and 50% increase in land rental value.

Results of Output Price Policy Scenarios

Impact on Crop Production and Diversification

An increase in the price of staples as noted from Scenario 2a in Table 4 is associated with a sharp increase in the production levels of maize (229%), cassava (114%) and decreased level of local cash crops (20%) for Non-Horticultural households. Interestingly, the impact of the increased staple price has only minimal negative impacts on production levels of all crops cultivated by the two categories of households engaged in the horticultural export industry. A 10% reduction in the world market price of horticultural export crops also results in only a slight reduction in the production of pineapple and mangoes, confirming the results of the field study that the majority of horticultural based households are still better-off even under imperfect market conditions.

TABLE 4. IMPACT OF OUTPUT PRICE POLICY SCENARIOS ON CROP PRODUCTION (BASE RUN = 100)

	Scenario 2a	Scenario 2b	Scenario 2c	Scenario 2d
Maize				
Non-Horticultural	328.48	100.00	100.00	328.48
Horticultural and Staple	213.53	95.52	84.50	95.55
Cassava				
Non-Horticultural	97.32	100.00	100.00	97.32
Horticultural and Staple	105.97	96.35	81.82	97.32
Local cash crops				
Non-Horticultural	19.97		100.00	19.97
Horticultural and Staple	99.93	100.00	99.85	95.43
Horticultural	100.00	94.23	90.79	99.89
Pineapple		99.89		
Horticultural and Staple	82.67		107.35	95.13
Horticultural	100.00	99.13	112.30	89.08
Mango		89.08		
Horticultural and Staple	97.13		102.69	100.26
Horticultural	100.00	101.12	104.59	100.48
		100.48		

Note: Scenario 2a = 40% increase in staple crop prices; Scenario 2b=10% reduction in the world market price of horticultural export crops; Scenario 2c=10% increase in the world market price of horticultural export crops; Scenario 2d= 40% increase in staple crop prices and 10% reduction in the world market price of horticultural export crops.

Impact on Excess Supply and Consumption

The discussion in this section centers on the interdependence between food crops and horticultural export crops and the impacts of output price changes on each. Results from Table 5 indicate that an increase in the price of staples (Scenario 2a) leads to a much increased consumption of maize and cassava by Non-Horticultural households but only a small considerable impact on Horticultural and Staple households. This is consistent with the conventional view that the supply of subsistence staple food crops with a small excess supply is not very responsive to price changes. The increased food prices initially aims at raising the income levels of net food sellers and lower the income of net food buyers. Except for maize however, the rise in staple prices did not bring about any positive significant impact in the excess supply of the various crops. Whereas, the excess supply of maize increased by 128% and 136% for Non-Horticultural households, and Horticultural and Staple households respectively, the increase in food crop price actually leads to a reduction in the excess supply of local cash crops by 65% for Non-horticultural households (Scenario 2a).

Impact on Factor Demand

A higher increase in the price of staples by 40 percent in Scenario 2a has a remarked effect on factor allocation by increasing the level of resource use for only the Horticultural households. Conversely, Horticultural and Staples households respond to the increased price incentive by making only minimal shift of resources for staple production. Except for Non-Horticultural households, the large increase in staple price does not seem to elicit a much higher attraction of resource demand for staple production.

TABLE 5. IMPACT OF OUTPUT PRICE POLICY SCENARIOS ON CONSUMPTION AND EXCESS SUPPLY (BASE RUN = 100)

	Scenario 2a	Scenario 2b	Scenario 2c	Scenario 2d
Consumption				
Maize				
Non-Horticultural	333.33	100.00	100.00	333.33
Horticultural and Staple	106.89	95.22	84.50	98.55
Cassava				
Non-Horticultural	97.32	100.00	100.00	97.32
Horticultural and Staple	105.97	96.35	81.82	97.32
Local cash crops				
Non-Horticultural	109.45	100.00	100.00	109.45
Horticultural and Staple	99.93	94.23	99.85	95.43
Horticultural	100.00	99.89	90.79	99.89
Market purchased goods				
Non-Horticultural	118.82	100.00	100.00	118.82
Horticultural and Staple	100.07	84.59	115.44	94.31
Horticultural	100.00	89.79	110.21	89.79
Excess supply				
Maize[a]				
Non-Horticultural	227.57	100.00	100.00	227.57
Horticultural and Staple	236.40	100.00	100.00	100.00
Cassava[a]				
Non-Horticultural	100.00	100.00	100.00	100.00
Horticultural and Staple	100.00	100.00	100.00	100.00
Local cash crops				
Non-Horticultural	34.82	100.00	100.00	34.82
Horticultural and Staple	100.00	100.00	100.00	100.00
Horticultural	100.00	100.00	100.00	100.00

Note: [a] Excess supply was zero in the base run; Scenario 2a = 40% increase in staple crop prices; Scenario 2b=10% reduction in the world market price of horticultural export crops; Scenario 2c =10% increase in the world market price of horticultural export crops; Scenario 2d= 40% increase in staple crop prices and 10% reduction in the world market price of horticultural export crops.

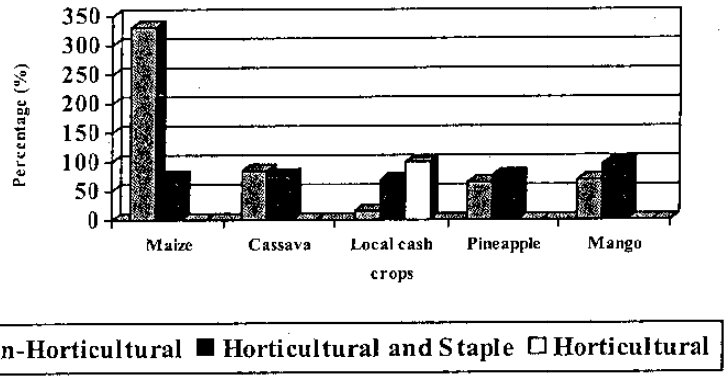
Similarly, Horticultural households do not seem to be much negatively affected when the world market price of export crops are slightly reduced (10 percent) as was noted in Scenario 2b. However, when the world market price for horticultural export crops are increased by just 10 percent, Horticultural households respond more rapidly by committing more factors into the production of pineapple and mangoes.

Results of Combined Policy Scenario

To assess the net effects of expected policy impacts resulting from the introduction of horticultural exports on crop diversification and household welfare, we simulate a combined effect of factor and staple crop price increases with a reduction in the world market prices of pineapple and mango. While the majority of subsistence households are not affected directly by price shocks in markets in which they do not participate, the shadow prices that guide their behavior are affected by the market. Here we explore the combination of associated loss in welfare as reminiscent of the prediction power of the model. Clearly, the combined effects of the various selected scenarios tend to drastically

reduce the ability of Non-Horticultural households to cultivate their otherwise perceived high-value local cash crops. Figure 1 shows that, Non-Horticultural households tend to increase their production of maize by 232% while reducing cassava production by 15% and local cash crop production by 73% under the combined policy scenario.

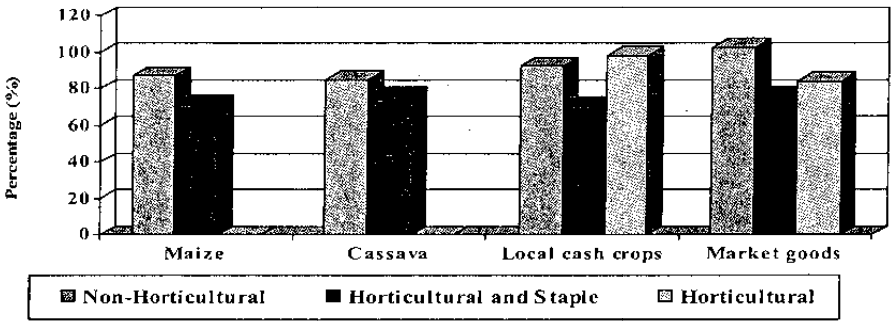
FIGURE 1. IMPACT OF COMBINED POLICY SCENARIO ON CROP PRODUCTION (BASE RUN =100)



Note: Scenario 3=50% increase in wages, 40% increase each in prices of agrochemicals and other capital inputs, 50% increase in land rental value, 40% increase in staple crop prices, and 10% reduction in the world market price of horticultural export crops.

The impact of the combined policy scenario generally shows a decreased trend of consumption and excess supply for the majority of crops. The majority of sampled households in all three categories decreased their consumption of most goods. The only notable exception is Non-Horticultural households who increase their consumption of market purchased goods by about 3% (Figure 2) primarily due to the accrued income benefits obtained from higher staple prices and higher wages from hired-out agricultural labor. Horticultural and Staple households are however more affected than Horticultural households, suggesting that specialization in horticultural export crop production might offer farmers a higher incentive to increase their productivity, income and investment opportunities. This result could however be only confirmed upon an analysis of the expenditure budget of Horticultural households as price takers in staple crop markets. Such an analysis is however beyond the scope of the disaggregated household modeling framework used in this study. The excess supply response for the majority of crops cultivated by the various households did not show much significant differences in the combined scenario either. Ideally, a higher supply response can only be elicited if more land and other productive factors are committed in production. Notwithstanding, the combination of factor and product market changes leads to increases in the excess supply of maize and local cash crops for Non-Horticultural and Horticultural households respectively.

FIGURE 2. IMPACT OF COMBINED POLICY SCENARIO ON CONSUMPTION (BASE RUN = 100)



Note: Scenario 3=50% increase in wages, 40% increase each in prices of agrochemicals and other capital inputs, 50% increase in land rental value, 40% increase in staple crop prices, and 10% reduction in the world market price of horticultural export crops.

Results of "With and Without" Export Crop Scenario

In order to consider export diversification as a stepwise adoption process, the potential impacts of horticultural export crop production on the livelihood of Non-horticultural households is simulated by introducing horticultural export crop production functions into their production and consumption decisions. The objective is to explore the possibility of a decrease or increase in household welfare if these households are to engage in NTE crop production. This framework for such a policy experiment is accomplished by adapting the computed export crop production function parameters used in modeling Horticultural and Staple households for Non-horticultural households, while maintaining the existing levels of resource limits and allowing for the endogenous estimation of the key behavioral response variables in the model. This assumption is based on the premise that the majority of farm households currently not engaged in NTE crop production would at the initial phase of adopting horticultural export crops combine them with staple crop production and might possibly only consider specialization in the long run.

Clearly, the simulated results in Table 6 indicate that Non-Horticultural households would be able increase of their welfare by engaging in horticultural export crop production by about 30.5% utility units from the baseline, even if they do not increase their existing levels of factor resources. The success of the expected increase in welfare from the cultivation of the high-value export crops however depends on their ability to make the necessary adjustments by reducing the production of maize by 7% and cassava by 5%. The results also confirm that it would be no longer profitable for Non-horticultural households to sell out family labor[1] (if the consider shifting to export crop production) to other households as the returns to labor per unit would be higher when invested into the cultivation of export crops. Under this circumstance, there is the tendency of Non-horticultural households to also enjoy more leisure provided they would have the much needed financial resources to purchase labor at prevailing market wage. Results from Table 6 suggest that this could partly be achieved by possibly reducing

current consumption of other commodities within the household. Interestingly, the excess supply of other local cash crops is expected to increase by about 34% which will also result in an overall increase in household income through crop sales.

The simulation considered in this section did however not take into account the ability of Non-horticultural households to raise the need capital for investment as well as other production and marketing risks that might be encountered by new entrants on the world market for the high value fruit crops. Thus, much as there is a growing demand in the EU for fresh fruits and vegetables, the accrued micro-level distributional effects could only be best realized by smallholders, if appropriate sequencing of important input and output market reforms are undertaken by the various stakeholders concerned. Farm households would also have to be in the position to orient themselves towards good farm record keeping, getting better product information with regards to changing trends in consumer preferences, safety standards and making the necessary investment adjustments in investment behavior towards possible world market shocks.

TABLE 6. IMPACT OF INTRODUCTION OF HORTICULTURAL EXPORT PRODUCTION ON THE WELFARE OF NON HORTICULTURAL HOUSEHOLDS (BASE RUN = 100)

Variable	Scenario 4
Production	
Maize	92.81
Cassava	94.65
Local cash crops	197.11
Pineapple	156.74
Mango	124.68
Consumption	
Maize	92.81
Cassava	94.65
Local cash crops	84.61
Leisure	140.82
Market purchased goods	95.88
Utility index	130.52
Excess supply	
Maize[a]	100.00
Cassava[a]	100.00
Local cash crops	133.62

Note: [a] Excess supply was zero in the base run; Scenario 4 = Introduction of export crop production into the utility bundle of Non-horticultural households by adapting the export crop production functions of Horticultural and Staple households.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The field study and model scenario results taken together show that, export diversification has created better livelihood opportunities for smallholders. Thus, the results from the study clearly rejects the hypothesis that trade in agricultural products has negative impacts on participating households and rather underscores the importance of the theory of comparative advantage and economic integration as proposed by neoclassical economists. However, the chronically poor households are structurally impeded from seizing these opportunities due to their poor resource and liquidity constraints that further widens the imperfections in rural markets. The findings therefore suggest a policy framework for improving rural market imperfections.

The bulk of Ghana's horticultural produce is still sold raw without any value added on. Post harvest and export fruit rejection losses are thus very high for the majority of inexperienced farmers. The high levels of unprocessed produce and possibilities to reduce export rejected produce offer clear opportunities for the agro-processing sector, especially in the area of food, and the industrial processing of roots, tubers, grains, fruit, and vegetables. Undoubtedly, the very few export processing companies in the study zone are currently operating in a sellers market. There is therefore a strong need for foreign direct investment and establishment of more export-oriented agro-processing industries to improve technology transfer and payment duration for smallholder produce. Non traditional exports enjoys the support of the government and donor agencies but they are not immune to the same international trade regulations and irregularities that traditional exports have been subjected to (for example, declining prices, worsening terms of trade). A major constraint facing smallholders hampers on information asymmetry between the better informed European consumers and the ignorant producers in Ghana, who are hardly familiar with the produce quality and safety standards demanded. The current practice whereby farmers rely on produce quality specification by exporters does not seem laudable taking cognizance of the fact that, international trade is increasingly taking place in coordinated forms. With recent technological advancements in the produce marketing systems, it is prudent for smallholders to be integrated into the global value chains through public-private partnerships. This is on account of the need for a policy debate to improve horticultural export crop profitability and efficiency in the light of the ever increasing consumer awareness and demand for easily traceable and healthy conscious produce in importing nations. In line with this, the Ghana Private-Public Partnership Food Industry Development Program (GHPPP), a USAID-funded program set up in 2002 by the Partnership for Food Industry Development (PFID) for fruits and vegetables sounds laudable. It is expected that more of such initiatives would be facilitated, while particular emphasis is placed on improving technology transfer, market access, and establishment of specialist nurseries to improve the supply and quality of new planting material such as the MD-2 pineapple variety. Attempts should also be made to directly link smallholders with both export and local processing industries through extensive training, workshops and seminars so as to meet Euro-Retailer Produce Working Group, Good Agricultural Practices (EUREGAP)[2] certification requirements.

Currently smallholder farmers who are not in official organized groups rely solely on social capital and networking as their only means of accessing credit and markets. Organizing farmers into recognized groups would empower smallholders to pool their risks, increase their bargaining power so as to gain better access to input and commodity markets, reduce enforcement costs, and thereby reduce transaction costs. Also the facilitation and formation of strong producer-exporter associations would play an important role in the development of a logistical chain to achieve products of specified consistency, quality and safety; the development of skills and capabilities for all participants in the horticultural supply chain and the provision of technical assistance. This will help inculcate entrepreneurship awareness among smallholders. The formation of these associations and their activities could be facilitated and supported by national and international NGOs and bilateral donors. With the recent influx on numerous national and regional radio stations, farm households could easily be educated on the usefulness of group formation and dynamics, while also improving farmer's awareness and reducing market information asymmetries between rural producers and European consumers.

Against the background of the observed higher shadow price of land in the study area, there is the need for a policy review on land ownership status. This is also important in the wake of the smaller land size holdings for the majority of farm households. Evidence from the econometric estimation also showed that, the larger land sizes owned by horticultural based households are indeed a consequence of their participation in the sector. This implies that the majority of the poor could possibly increase their income from horticultural exports through more effective access to land. This is not likely to

happen under the current dispensation, whereby lands are owned by a few families who lease them out at exorbitant prices. Thus a policy that would ensure equitable distribution of land to the chronically poor and marginalized would thus enhance household resilience and decrease their vulnerability.

ENDNOTES

[1] In the scenario considered for the "with and without" comparison, Non-horticultural households are modeled as net labor purchasers as opposed to their behavior as net labor sellers in the baseline.

[2] EUREGAP is an association of some European supermarkets that advocate for producers in developing countries to obtain certification based on certain farm maintenance standards in order to obtain access to their markets.

APPENDICES

APPENDIX A1. FACTOR SHARES IN VALUE-ADDED BY HOUSEHOLD GROUP, SOUTHERN GHANA

Commodities	Labor	Land	Agrochemicals	Other Capital
Non-Horticultural households				
Maize	0.35055	0.22697	0.05288	0.36960
Cassava	0.37386	0.22676	0.00000	0.39938
Pineapple	0.00000	0.00000	0.00000	0.00000
Mango	0.00000	0.00000	0.00000	0.00000
Local cash crops	0.22451	0.22146	0.17043	0.38360
Horticultural and Staple households				
Maize	0.35626	0.23132	0.06047	0.35195
Cassava	0.34216	0.23419	0.00000	0.32365
Pineapple	0.27056	0.21605	0.16435	0.34904
Mango	0.21428	0.22350	0.06154	0.30068
Local cash crops	0.31725	0.21978	0.14351	0.31946
Horticultural households				
Maize	0.00000	0.00000	0.00000	0.00000
Cassava	0.00000	0.00000	0.00000	0.00000
Pineapple	0.27227	0.21543	0.16926	0.54304
Mango	0.19458	0.21286	0.04161	0.55095
Local cash crops	0.31697	0.22156	0.13942	0.32205

APPENDIX A2. COMPUTED ELASTICITIES OF THE UTILITY FUNCTION OF SAMPLED HOUSEHOLDS

Household category	Maize (α_1)	Cassava (α_2)	Local cash crops (α_3)	Market goods (α_4)	Leisure (α_5)
Non-Horticultural	0.14679	0.06024	0.06882	0.38615	0.33800
Horticultural and Staple	0.15914	0.05421	0.11709	0.43755	0.23201
Horticultural	0.00000	0.00000	0.10803	0.69397	0.19800

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