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Econometric analysis of forest and coastal savannah transition zones of fruits and vegetable crops

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Policy makers in developing countries have been concerned with the economic and political risks associated with heavy dependence on few 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 reduction strategy. As a result, several African countries have tended to focus on non-traditional agricultural exports (NTEs) which reflect their comparative advantage and for many countries the export of horticultural crops has been favoured. This study focuses on a household survey undertaken in the forest and coastal savannah transition zones of Ghana, where the farming system has undergone a remarkable transition from an established system of food crop farming for sale to urban consumers to an intensive production of fruits and vegetable crops for export to European consumers. Econometric analysis shows that though export horticulture has a positive impact on the wellbeing of the majority of households, the chronically poor households are structurally impeded from seizing the available opportunities due to poor resource endowment and liquidity constraints.

Key words. Export horticulture, food security, household livelihood, non-traditional exports, export diversification, pro-poor growth.

INTRODUCTION

Various studies have shown that countries can improve their welfare by opening up their borders to freer trade. Moreover, 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 a 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. In response to a liberalised trade regime, horticultural exports have grown dramatically in many Sub-Saharan African countries while many other traditional agricultural commodities have faced stagnation and declining world prices. Consequently, several reasons have been advanced for the recent boom in horticultural exports from Africa (Jaffee, 1995; Barrett et al., 1997; Dixie, 1999; Malter et al., 1999). In Ghana, crops such as pineapples, papaya and mangoes appear promising as options to diversify the traditional export base comprising the traditional cocoa, timber and gold because of their high labour intensity and the expanding demand for fruits in industrialized nations, most especially during the winter months. Undoubtedly, the horticultural industry provides an important source of foreign exchange generates substantial employment and has contributed to the upgrading of agricultural production skills. But has the growth in export horticulture contributed significantly to smallholder food security and general livelihood? A number of studies have raised concerns about the microeconomic performance of non- traditional exports in developing economies. Most of such concerns are related to the trade-offs between food and export cash cropping systems due to the possibility of competition for resources between export crops and food crops resulting from a potential re-allocation of resources from

one to the other and their effect on household food availability. Indeed 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). 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.

Within the Ghanaian context, the main effects of the introduction of export cropping has been the significant deterioration in access to land as smallholder food crop farms are being consolidated into larger scale export crop farms. The increased pressure on arable lands for human settlement resulting from the expansion of urban activities from Accra towards surrounding villages are the pressing underlying concerns that need the immediate attention of researchers. So far the major concern of the Ghanaian government and donor institutions has been macroeconomic growth in terms of physical output and export earnings of these new crops. At the microeconomic level, the short and long-term impacts of the booming horticultural exports vis-à-vis their distributional effects still remain under-investigated. In an attempt to fill this void, this paper emphasizes on the linkages between export diversification policies and the microeconomic performance of some horticultural export crop producing communities in southern Ghana.

MATERIALS AND METHODS

The analysis presented in this paper is based on a primary data set collected by a survey of 200 farm households in southern Ghana. The survey was carried out during the 2003/2004 cropping season. In accordance with the importance of the various horticultural crops to total export earnings, 7 villages with 20 households each within the pineapple cultivated based communities of the Akwapim south district and 3 villages 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.

Descriptive statistic tools were initially used to categorize the sampled farm households into three main groups based on the type of crops grown and other socio-economic characteristics. On the 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 export horticulture. Probit regression was used to estimate the determinants of household participation in export horticulture. Results from the field survey gave an initial indication that participation in export horticulture, primarily appears to increase the average per capital income of the household. However, as explained by McCulloch and Ota (2002),

such descriptive statistics do not take account of other possible differences in the characteristics of adopters and non- adopters and it may be these differences that are giving rise to the disparities in income rather than their participation in export horticulture. To account for this, the traditional Log-linear mincerian wage equation was used to construct a model of income determination to analyze the incomes of households producing only horticultural export crops with those producing mainly food crops vis-à-vis those indulged in the combined scenario, while making use of the same explanatory variables employed in the participation determination model. Based on the assumption that households typically distribute their labour and capital resources over a set of productive activities, a reduced form expression for income Y, as a function of the explanatory variables is specified and accordingly estimated as:

$$In(\,Y\,) = _{0} + _{1} HHCrop + _{2} Demog + _{3} Educ + _{4} Employ$$
$$+ _{5} Asset + _{6} Misc + _{7} IntNTE +$$

Where, *HHCrop* is a vector of dummy variables indicating categories of non-horticultural export crops grown by the household; *Demog* is a vector of demographic characteristics; *Educ* is a variable indicating the educational level attained by the household head; *Employ* is a vector of dummy variables indicating whether at least one household member participates in a specific off-farm occupation; *Asset* is a vector of asset and access variables; *Misc* is dummy variable indicating miscellaneous income receipt; *IntNTE* is a vector of variables indicating the intensity of cultivation of non-traditional export crops and e is an error term.

RESULTS AND DISCUSSION

Inter-household landholdings and capital resource distribution

Households decide whether or not to participate in the cultivation of horticultural export crops based on perceived benefits, opportunities and constraints considering the risks and probabilities of occurrence. Generally, horticultural households had the highest land resource in terms of endowment, total cultivated farm size, farm size per capita and fallow land area. This was followed by horticultural and staple households and finally non-horticultural households in chronological order. The Kruskal-Wallis test in Table 1 showed statistically significant differences for the landholding characteristics of the household categories except for the fallow land area. 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 was also highest for horticultural households, followed by horticultural and staple households with non-horticultural households having the lowest income (Afari-Sefa, 2006). It was observed that 78% of the sampled households were cultivators of horticultural export crops. This is an obvious reflection of the magnificent role these crops play in the daily lives of

Table 1. Land holding characteristics per sampled household category,Southern Ghana, 2003/2004.

Household type		Total land Endowment (ha)	Total farm size (ha)	Farm size per capita (ha)	Fallow land area (ha)
Horticultural households (N=38)	Mean	5.61	3.56	0.94	2.05
	SD [a]	5.83	4.24	1.12	2.29
Horticultural and Staple households (N=118)	Mean	4.87	2.98	0.54	1.89
	SD	5.52	4.07	0.55	2.61
Non-horticultural households (N=44)	Mean	2.61	1.52	0.35	1.09
	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	2	16.28 ***	20.24 ***	18.03 ***	4.32

Note: SD denotes standard deviation of corresponding variable.*** denotes significance at 1% probability level.

of most households in the study area. The pooled results of the analysis indicate that pineapple cultivation is the most widely adopted crop by indigenous small scale farmers, whereas the cultivation of crops such as mangoes required a longer investment period and hence mostly adopted by immigrant large-scale commercial farmers.

As would be noted from the agronomic point of view, it is not all fruits which are considered exportable. Depending on a farmers' level of experience, between 50-90% of matured fruits may satisfy requirements for export. The remaining fruits may be rejected because they do not meet the requisite size, weight, and shape specifications. The majority of respondents that do not cultivate horticultural export crops within this risk- prone category were found to be older household heads that have been used to the practice of cultivating staple crops for a minimum of twenty years.

Determinants of participation in horticultural export crop production

In accordance with the major objective of this study, the explanatory variables have been chosen from factors and characteristics related to profitability of the crop or resource requirements for production and exogenous factors (locational and institutional) that are closely associated with input and market access for horticultural export crop produce. As expected the estimated coefficients of the hypothesized explanatory variables have the priori expected signs and most of the coefficients are statistically significant at the 10% (or better) probability level. The likelihood ratio statistic was used to test the significance of the entire Probit model. The model chi-square value of 79.44 at 11 degrees of freedom was found significant at the 1% level implying that the independent variables, taken together, significantly influences a household's de-

cision to cultivate a horticultural export crop (Table 2). The pseudo-R^2 value implies that 60.3% of the original variation of the dependent variable is explained by the fitted model and still there are other determinants of participation in export horticulture that are not included in the model. Nevertheless, the model correctly predicted 82% of participation status in horticultural exports for the sampled households.

The results show that the age of head has a strong negative effect on cultivation of horticultural export crops, implying that households with older heads are unlikely to cultivate non-traditional export crops (NTEs). This is anticipated because the cultivation of export crops requires much care and risk in terms of new technology and precision in the application of various cultural practices that may not be of paramount interest to older farmers. Moreover, the existence of a large cohort of younger farmers in the sample could have attributed to this observation. These were mostly resident natives, city returnee natives and other immigrants, who have basically opted into farming mainly because of the perceived lucrative nature of export horticulture coupled with the lack of equal alternative income earning opportunities compared with the older farmers, who have been engaged in the cultivation of traditional crops as their means of livelihood long before the introduction of export horticulture in the study area. Participation in off-farm occupation has a significant positive effect on the likelihood of cultivating horticultural export crops at the 10% probability level. Thus variables indicating participation in other economic activities (wage employment and the operation of a non-farm enterprise) appear to be positively associated with being a horticultural small-holder. This relationship could be explained by the fact that households with off-farm occupation would easily overcome liquidity constraints and make provisions for holder. This relationship could be explained by the fact that households with off-farm occupation would

Table 2. Probit function for the likelihood of participation in horticultural export crop production, Southern Ghana, 2003/2004.

Variable	Marginal effect	Standard error	T-statistics
Intercept	0.479***	0.149	3.205
Age of head	-0.009***	0.002	-3.734
Educational level of head	0.000	0.006	0.063
Residential status (dummy)	-0.034	0.052	-0.658
Household size	0.002	0.009	0.211
Non-farm occupation (dummy)	0.104*	0.062	1.674
Land endowment	0.050***	0.009	5.472
Nature of road network	-0.049**	0.024	-2.069
Capital input access (dummy)	0.092*	0.055	1.689
Tropical Livestock Unit	0.001	0.003	0.515
Cultivate local cash crops (dummy)	-0.286***	0.060	-4.803
Frequency of extension visits	-0.005	0.014	0.387

Dependent variable: Adoption of Horticultural Export Crop; Model Chi -Square = 79.44*** ; Log Likelihood function = -70.49; Pseudo R^2 = 0.603 ; Households correctly predicted: 82% ; N = 200; *, ** and *** denotes significance at 10%, 5% and 1% levels respectively

easily overcome liquidity constraints and make provisions for the initial investment in capital inputs required for producing the labour intensive horticultural export crops. On the other hand it is also possible that the lucrative nature of the export horticulture industry provides households originally not engaged off-farm with sufficient income to diversify their income sources as a surety for their livelihood needs.

The total land endowment of households is highly significant and positively related to the probability of cultivating horticultural export crops. This seems to indicate that a decision-maker with a higher land access usually cultivates horticultural export crops. Thus households who have more hectares of land could easily afford allocating separate land parcels for cultivating both staples and horticultural export crops. The positive relationship with land endowment could be justified because households with more access to land can also afford fallowing already harvested fields for some years and shift to cultivating other land parcels whiles allowing sufficient time for nutrient regeneration on the temporarily fallowed fields. The same could not be likened to households with a comparatively smaller endowed land moreso if permanent tree crops are to be cultivated.

The nature of the road network from farms to major marketing centres has a negative significant relationship. This seems to indicate that bad roads increase the likelihood of adopting NTEs. However, taking cognizance of the fact that, responses to this variable constituted an ordinal subjective evaluation of households, the interprettation of this rather surprising observation must be done with extreme caution. On a comparative basis, fields where NTEs are cultivated generally have a bad road network than for alternative crops in the study area. Moreover, by the nature of the marketing arrangement for NTEs, transportation of produce is solely the responsibility of exporters and other subsidiary buyers and hence it is rational for farmers to locate staple and other crops on plots closer to their abode where road motorability is comparatively better than for the NTEs. Furthermore, the cultivation of some NTEs such as pineapples usually requires bringing new land under cultivation as compared to the cultivation of other alternative annual crops, most of which could be easily cultivated on continuously cropped fields. In addition, the observed distant location of export crops such as pineapple might reflect household perception of cropping choices by matching crops with appropriate soils as confirmed by Goldstein and Udry (1999).

Access to capital inputs has a positive effect on the probability of adopting NTEs at the 10% level. This means that households with better access to capital inputs or credit access to purchase the requisite inputs for cultivating NTEs are more likely to participate in the sector than those who have relatively poor access to capital inputs and credit. Typically, the cultivation of NTEs requires a higher initial capital outlay in terms of planting material and agrochemicals which cannot be afforded by marginal farmers. Therefore, good access to credit either in the form of inputs or cash for paying hired labour costs or both would increase a household's probability of cultivating horticultural export crops. Finally, cultivating of other local cash crops has a highly significant negative effect on the adoption of NTEs. This means that households cultivating local cash crops of insignificant export value are unlikely to indulge in NTE cultivation be on account

Table 3. Parameter estimates of the determinants of total household income southern Ghana 2003/04.

Variable	Coefficient	Standard error	T-statistics
Intercept	14.7535***	0.3661	40.2996
Land endowment	0.0411**	0.0186	2.2134
Food crop cultivation (dummy)	0.0313	0.1612	0.1931
Other local cash crop (dummy)	0.2625**	0.1040	2.5628
Age of head	0.0014	0.0042	0.3413
Education of head	0.0276**	0.0133	2.0731
Residential status (dummy)	-0.1555	0.1122	-1.3855
Years of cultivating export crop	0.0420***	0.0135	3.1096
Dependency ratio	-0.1810***	0.0644	-2.8116
On-farm family labour capacity	0.0007***	0.0002	3.1588
Labour hired out (dummy)	0.1697	0.1256	1.3511
Credit/Input access (dummy)	0.0367	0.0989	0.3714
Tropical Livestock Units	0.0141***	0.0047	2.9732
Public paid employment (dummy)	0.4405***	0.1082	4.0727
Trade and Services (dummy)	0.2671***	0.0911	2.9311
Miscellaneous income (dummy)	-0.2363*	0.1402	-1.6855
Facilities welfare index	0.0397*	0.0229	1.7348
Ratio of NTEs area to total farm size	1.5941***	0.2299	6.9353

Dependent variable: Natural log of Total household income; F = 26.31; R^2 = 0.711; Adjusted R^2 = 0.684; N = 200 ; Probability >F = 0.00; Breusch-Pagan chi-squared for heteroscedasticity correction = 98.70; *, ** and *** denotes significance at 10%, 5% and 1% levels respectively.

of fact that some households rather opt for cultivating these local cash crops which have a lower profit returns compared to the NTEs but at the same time have a lower marketing risks in terms of produce rejection and payment duration. Since these local cash crops are also equally labour intensive, there is the possibility for them to compete for similar production resources with perceived changes in the comparative advantages for different households.

Determinants of household income

Three different empirical proxies of the influence of human capital are used as explanatory variables. The dependency ratio has a statistically significant negative influence (Table 3) on total household income. This means that the higher the number of children and elderly household members in relation to the number of active adult work force, the lower the household income. Contrary to the findings of the model of participation in export horticulture, the age of household head has a positive, non-significant relationship with household income, emphasizing the role played by other productive activities outside export horticulture in the income earning power of the sampled households.

The residential status of households, though negatively related to household income is not statistically significant. This somehow confirms that, with regards to residential status, there is the potential for immigrants to be more market-oriented than resident natives. Households involved in the production of local cash crop have the propensity to increase their income by 30.1% whereas production of staple crops increases household income by 3.18%, although not statistically significant. This confirms the lower incomes of non-horticultural households, many of whom earn their major incomes from staple crop production. This observation may also explain the observed trend of the food security status of the different household categories.

Generally, variables related to household physical capi-tal endowment turned out to be important determinants influencing agricultural activity choice. As might be expected, the index of welfare facilities has a positive and statistically significant but very small influence on income. Unsurprisingly, the more assets a household has the higher its income, but the dummy variable related to credit access is neither strongly nor statistically significantly associated with higher income. This is a reflection of the inadequate levels of credit required to realize higher incomes from the various productive activities in the study area, a fact that was evident with our respondents. Gene-

rally, hiring out of labour is expected to increase household income. Indeed, incomes from agricultural wage labour are very low, in comparism with other "hard to find" alternatives, thereby leaving most households with the only rational option of utilizing family labour for their own managed productive activities. This is justified by the high positive and significant relationship between family labour capacity for agricultural production and total household income. Consequently, households with the ability to hire-in labour also tend to have higher incomes and returns from crop production. Different occupations have statistically significant implications for income as households engaged in paid public employment and other self employed activities tend to have substantially higher incomes. Not surprisingly, households who were in receipt of miscellaneous income by way of transfers and remittances were found to be those who obtained lower income from own farm and non-farm productive activities. Finally, the explanatory variables that are related to the intensity cultivation of horticultural exports play a very significant role in determining household incomes with a unit increase in the ratio of the area cultivated by horticultural export crops to total farm size, in percentage terms increasing household income by 1.6%. Similarly, an additional year of experience in the cultivation of horticultural export crops increases household income by 4.2%.

Conclusions

Empirical evidence has shown that the horticultural export has increased the opportunity for higher earnings for smallholders and that the much higher land sizes owned by horticultural smallholders are indeed a cause or consequence for their participation in the sector. Households cultivating horticultural export crops are on the average better off than those that do not. Notwithstanding the enormous contribution of horticultural exports to macroeconomic growth as an insulator from sharp and unexpected changes in the terms of trade of Ghana's traditional exports, the micro level distributional effects has not favoured the chronically poor households who are structurally impeded from seizing the existing opportunities of the export boom by virtue of their poor resource endowment and liquidity constraints. These marked differences in resource base between the various household categories further accentuate the imperfections within rural markets.

The majority of households are particularly exposed to the risk of inadequate technological know-how in meeting the ever increasing quality standards and health control traceability requirements by European consumers, price collapse on the export market and a break down of local marketing institutions. The findings from this paper therefore calls for an integrated policy framework approach aimed at improving rural market imperfections. Efforts to achieve the desired impacts requires the strong need for investment in infrastructure and a shift towards value-added export oriented production, whereby small farm households are progressively integrated into the changing preferences of a dynamic global food chain.

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