Land tenure, market, and the establishment of forest plantations in Ghana

Daowei Zhang*, Eric Aboagye Owiredu

School of Forestry 30, and Wildlife Sciences, Auburn University, Alabama 36849-5418, United States

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Abstract

This paper presents an empirical study on the relationship among land tenure, market incentives, and forest plantation establishment in Ghana based on a two stage selectivity model. Our results show that the total amount of land owned and/or cultivated by farmers, amount of land owned by farmers outright, and use of government extension services by the farmers have a significant positive influence on plantation establishment. In addition, lands owned outright by farmers and the prices of plantation products have a significant positive effect on silvicultural investment in plantation. These results demonstrate the potential for land market reforms and market incentives in enhancing forest plantation establishment.

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Keywords: Forest plantation establishment; Land tenure; Market incentives; Two stage selectivity model

1. Introduction

The past decades have witnessed a significant decrease in the world’s forest cover. FAO (2003) shows that between 1990 and 2000, 9.3 million ha (0.38%) of the world’s forest were lost annually. At the same time, some non-forest lands reverted to forest cover, leaving a net loss of forest cover by 0.22% worldwide. Most forest losses occurred in tropical countries despite international campaigns aimed at addressing tropical deforestation. As natural forests decline, the establishments of plantations have become necessary to meet the increasing demand for forests products (Evans and Turnbull, 2004). Governments have been urged to channel development resources into such endeavors.

In a bid to restore a significant proportion of Ghana’s original forest cover, Ghana’s 1994 Forest and Wildlife Policy laid emphasis on reforestation initiatives. This has led individuals, communities, and organizations to establish forest plantations, in addition to that being undertaken by the Forest Services Division (FSD) to replenish degraded forest reserves. Ghana’s total forest area comprising natural and artificial forests as of 2000 was 6.3
million ha. The net forest loss between 1990 and 2000 was 120,000 ha or 1.9% per annum (FAO, 2003). Ghana’s total area of artificial forests in private and public ownership was 76,000 ha in 2000 (FAO, 2003).

Several studies have been conducted on forest plantation development in Ghana, including the design, location, species composition, management, biodiversity conservation, and the role of forest plantations in poverty alleviation (Asibey and Siaw, 1999); a discussion on land tenure systems, methods of land acquisition, and management models for forest plantations (Odoom, 1999); and farmers’ willingness to establish plantations (Owubah et al., 2001). However, none can be found on the impact of land tenure and market incentives on farmers’ actual forest plantation activities. The purposes of this study are to identify factors influencing plantation establishment by farmers and to search for factors affecting silvicultural investment by farmers who have established plantations. This study differs from others insofar as it utilizes survey data and employs a two stage selectivity model comprising a probit model and a selection model.

Specifically we seek to evaluate quantitatively the impact of land tenure on whether farmers choose to establish forest plantations, and the impact of land tenure and market incentives on silvicultural investment by farmers who have established plantations. The next section provides a review of the benefits of plantations and previous studies on the economics of tree planting. This is followed by our analytical framework, data, and empirical findings. The final section presents conclusions and policy implications.

2. Literature review

2.1. Plantation establishment

In this study plantation means a forest crop or stand raised artificially. Plantations of a wide range of tree species satisfy social, production and economic needs, which arise as a result of the demand for timber and other forest products, diminishing natural forests, and readily available land and labor (Shepherd, 1986; Arnold and Dewees, 1995; Nyland, 1996; Evans and Turnbull, 2004). Most plantations only use marginal agricultural lands, provide employment, and improve rural economy (Evans and Turnbull, 2004). Well-conceived plantation projects can yield attractive economic rates of return (Evans and Turnbull, 2004), and a wide range of benefits of plantations can be obtained through multiple uses (Shepherd, 1986; Nyland, 1996).

The main objectives for establishing forest plantations in Ghana were to produce raw materials for the timber industry, to reduce pressure on the natural forests, and to serve as an interface or buffer for excluding fires and other damaging effects of the encroaching savanna. Teak (Tectona grandis), cedrela (Cedrela odorata), and wawa (Triplochiton scleroxylon), are the most widely planted species. The planting of indigenous timber species do not attain much success (IIED, 1993). In recent years, interests in plantation development in Ghana are growing because of an attractive market for teak poles, increasing land denudation, high labor cost associated with alternative cash crops, and a shortage of naturally occurring timber. On the other hand, there are barriers that limit the development of commercial tree planting, including land acquisition, lack of technical expertise and extension services, ambiguous and insecure tree tenure arrangements, high establishment costs, long rotation period, lack of credit facilities, uncertainty over markets for the final produce, inability to control wildfire, and ineffective management and supervision (Forestry Department Head Office, 1998).

2.2. Economics of tree planting

Like any economic activity, an investment in forest plantation is motivated by the potential profits it brings. Factors influencing the potential benefits and costs of a plantation would be relevant to forest plantation development. Market incentive such as market access, stable or sustained price appreciation in timber (Dewees, 1995; Scherr, 1995; Mercer and Pattanayak, 2003; Amacher et al., 1993), and distance to market (Otsuka et al., 2001) thus have an impact on tree plantings. Cubbage et al. (2003) report that farmers usually increase both harvesting and tree planting when output prices increase. Not all of these effects are equally strong. Pulpwood prices
affect decisions more or less than saw-timber prices; sometimes prices are not significant (Li and Zhang, 2005). Furthermore, policy variables such as incentives (cost–share) and technical assistance usually have significant effects, sometimes stronger than market or owner characteristic variables (Li and Zhang, 2005).

Lack of secured land and tree tenure have been documented as a significant constraint to tree cultivation as it impacts the potential benefit accrued to farmers (e.g., Zhang and Pearse, 1996, 1997; Place and Otsuka, 2000; Owubah et al., 2001; Quisumbing et al., 2001a). Intuitively, other things being equal, farmers who hold a secured title to land are more likely to participate in tree planting activities than those who do not. The forms of tenure that have longer terms, are more clearly defined, provide more of the economic benefits to their holders, are likely to simulate planting (Zhang and Pearse, 1996). The duration of tenure determines whether farmers plant trees or short term crops (Sellers, 1988). Within the same village, farmers respond differently to tree planting programs depending on the tenure they hold to farmlands, while the same farmers respond differently to tree planting programs on lands he or she cultivates under different types of tenure (Pasic-olan et al., 1997).

As farmers rarely participate in tree planting programs when they have no rights to trees (Fortmann and Bruce, 1988), the strongest incentives for promoting timber production are to give farmers full rights over trees they cultivate (Treue, 2001). Besley (1995) reports that the evolution of property rights and their effect on investment are central issues in the political economy of development in Ghana, and when farmers’ rights over trees they have planted or preserved are not clearly defined, they stay away from participating in tree planting and conservation exercises.

The asset holdings (e.g., land, labor and wealth) that a farming household possesses are a measure of resources available to the household for implementing a new agroforestry practice such as tree planting. Household wealth has a positive influence on agroforestry adoption and conservation investments (Glendinning et al., 2001; Pattanayak et al., 2003). Large farm sizes often play a role in farming households’ participation in tree planting programs (Thacher et al., 1997; Salam et al., 2000). However, Otsuka et al. (2001) report that size of tract did not influence tree planting.

Finally, sociodemographic variables such as the age, gender, and educational level of farmers might influence whether they engage in tree planting activities (Mercer and Pattanayak, 2003). Older farmers are often viewed as less flexible, more risk averse and less willing to engage in a new, innovative activity. Thacher et al. (1997) and Zhang and Flick (2001) report that age has no influence on planting while Romm et al. (1987) state that older age reduces the probability of silvicultural investment. Education has been reported to influence significantly tree planting and conservation by farmers because it is a medium of learning about a resource (Thacher et al., 1997; Glendinning et al., 2001; Owubah et al., 2001). However, the educational level of heads of households was found not to impact tree planting in studies in Sumatra and the Philippines (Otsuka et al., 2001; Mercer and Pattanayak, 2003). Access to information and forestry technical assistance improves the quality of household labor, and their willingness to engage in forestry activities including tree planting (Amacher et al., 1993).

2.3. Land tenure systems in the study area

Farmers in the study area operate under various land tenure systems. Some operate under the “indigenous land-use rights” system in which land is acquired for farming by virtue of one being a subject of a landowning community or family. The acquisition of a determinable title in a plot of land by a farmer requires continuous occupation although this does not confer absolute ownership (Odoom, 1999). The current cultivator of a field under “indigenous land-use rights” has no discretionary land transfer rights because the land belongs to a corporate body (Benneh, 1989). Individuals can sometimes enhance their rights in such holdings by making some long-term investments (Aidoo, 1996).

Some farmers hold “outright ownership” over lands they cultivate. These farmers with freehold interests in their lands have an absolute right to deal with them. “Outright ownership” confers on these farmers secured land rights (Benneh, 1989; Aidoo, 1996). Although trees growing naturally on all lands
belong to the Ghana government, plantations on land under outright ownership (and other tenure) belong to the landowners as these plantations are associated with identifiable personal efforts and investment.

Other farmers, usually migrants, lease lands for farming. Unlike indigenes, migrants do not have a right in communal lands. They acquire land by outright purchase, gift, tenancy, caretaker or labor arrangements. The long, undisturbed possession of land by a migrant or a trespasser with limited interests cannot ripen into title to land (Kasanga, 1988). Indigenes also have resorted to leasing lands when there is a shortage of family lands (Aidoo, 1996).

Leaseholds take two forms: sharecropping and annual land rental payment. Sometimes land rental payment is small or merely symbiotic. Leaseholds are restrictive and do not offer any security of land tenure to the farmers (Benneh, 1989). The period of leasehold ranges from a year for the cultivation of annuals to 50 years for the establishment of tree plantations. Because the rotation period of tree crops are long, some landowners do not give out their lands for tree cropping. Landowners often see tree planting as a ploy by lessee farmers to perpetuating their stay on land, which in turn may indirectly imply ownership of the land (Odoom, 1999).

For the purpose of this study, the land tenure under which households operate was categorized into “outright ownership,” “indigenous (communal or family) land-use rights” and “leasehold.” Leasehold includes sharecropping and land rental.

3. Analytical framework

The analytical approach adopted in this research draws from previous literature on the economics of farmers’ participation in tree planting activities. Previous research on tree planting activities have modeled farmers’ participation in tree planting as a function of a variety of economic, social, demographic and farm system variables (Mercer and Miller, 1998; Otsuka et al., 2001; Zhang and Flick, 2001; Mercer and Pattanayak, 2003; Pattanayak et al., 2003). Profit maximization is the primary motivation for farmers who establish forest plantations for commercial purposes (Cubbage et al., 2003). Our model can be generalized as

\[ I = f(T, M, E, B, C) \]  \hspace{1cm} (1)

where, \( I \)= Whether a household has established a forest plantation or the amount of investment per hectare in establishing a plantation; \( T \)= Forms of land tenure; \( M \)= Market incentives; \( E \)= Technical assistance or extension services; \( B \)= Bio-physical factors; \( C \)= Farmers’ characteristics.

We sought to find out whether male headed households undertake forest plantation establishment more compared to female headed households by using a dummy variable for gender. Most of the indigenous people in the forest belt of Ghana practice the uterine matrilineal inheritance system. Under this system, land is either bequeathed to nephews or allocated to other male members of one’s maternal family, in accordance with the decision of the family head. Transfer of family lands operates within and not across the land-owning group (Aidoo, 1996). We also decided to include “indigene” as a farmers’ characteristic variable because the interests and rights of indigenes or subjects in communal lands are fully secured, but not those of migrants (Kasanga, 1988).

In this study, a two stage selectivity model is employed. The probit model was employed to ascertain factors influencing whether farmers have actually established plantations. The selection model was then employed utilizing OLS techniques after retaining residuals from the probit model to determine factors influencing silvicultural investment by farmers who have established plantations. Two dependent variables are PLANT (a dummy variable) in the establishment model and silvicultural INVESTMENT in the selection model for farmers who actually planted. The two stage model allows different variables to be incorporated in each stage thereby providing more detailed information. For example, the

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1 In general there is little public subsidy in tree planting in Ghana. Before 1999, there was a small amount of subsidy in the form of reducing seedling costs. This subsidy was later removed (in 1999). About one-fifth plantations in our sample took place in the period when subsidy existed. We are not sure if and how many of these plantations were actually subsidized. We believe the bias introduced by not using a subsidy variable in our model, if any, is small.
selling price of the plantation product per bole was included in the INVESTMENT model.\textsuperscript{2}

INVESTMENT was calculated as the initial cost per hectare of all silvicultural treatments undertaken during the year in which the plantation was established. This includes manual and chemical site preparation, cost of seedlings, and the cost of hand planting. These costs were then converted to their equivalent 2003 Ghanaian cedis using the Ghanaian consumer price index.

### 4. Data

Data used in this study were collected from June to August of 2004 in the Asante Bekwai Forest District within the forest belt of Ghana. Interviews were conducted with 40 individual plantation owners in the study area using a pre-tested, semi-structured, uniform questionnaire.\textsuperscript{3} In addition, two non-plantation owners were selected and interviewed in each village in

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variables</td>
<td>Dummy: 1 if a farmer has established a forest plantation, 0 otherwise</td>
<td>0.408</td>
<td>0.493</td>
<td></td>
</tr>
<tr>
<td>INVESTMENT</td>
<td>Cost per hectare (in millions of Ghanaian cedis in 2003) of all silvicultural treatments undertaken during the year of plantation establishment*</td>
<td>7.063</td>
<td>26.768</td>
<td></td>
</tr>
<tr>
<td>Independent variables tenure</td>
<td>Percentage of the total land area owned outright</td>
<td>2.514</td>
<td>3.140</td>
<td>+</td>
</tr>
<tr>
<td>POUCHRIGHT</td>
<td>Percentage of the total land area cultivated by farmer that are communal or family lands</td>
<td>4.785</td>
<td>9.913</td>
<td></td>
</tr>
<tr>
<td>PCOMMUNAL</td>
<td>Dummy: 1 if a farmer holds outright ownership over plantation tract, 0 otherwise</td>
<td>0.192</td>
<td>0.396</td>
<td>+</td>
</tr>
<tr>
<td>OUGHRIGHT</td>
<td>Dummy: 1 if a farmer holds indigenous land-use rights over plantation tract, 0 otherwise</td>
<td>0.154</td>
<td>0.362</td>
<td>–</td>
</tr>
<tr>
<td>COMMUNAL</td>
<td>Selling price of tree species (in millions of constant 2003 cedis) per bole when the farmer established the plantation*</td>
<td>0.052</td>
<td>0.119</td>
<td>+</td>
</tr>
<tr>
<td>PRICE</td>
<td>Distance from the house of farmer to the plantation tract in kilometers</td>
<td>0.742</td>
<td>2.202</td>
<td>–</td>
</tr>
<tr>
<td>DISTANCE</td>
<td>Total land area owned and/or cultivated by farmer in hectares</td>
<td>7.472</td>
<td>4.411</td>
<td>+</td>
</tr>
<tr>
<td>LANDAREA</td>
<td>Area of plantation tract in hectares</td>
<td>0.472</td>
<td>0.915</td>
<td>+</td>
</tr>
<tr>
<td>PLOTSIZE</td>
<td>Dummy: 1 if a farmer was aware of and used forestry extension services before, during and after the establishment of his/her plantation, 0 otherwise</td>
<td>0.415</td>
<td>0.495</td>
<td>+</td>
</tr>
<tr>
<td>EXTENSION</td>
<td>Per capita income of the household in millions of cedis for 2003*</td>
<td>1.672</td>
<td>2.069</td>
<td>+</td>
</tr>
<tr>
<td>PCINCOME</td>
<td>Number of years spent in school by farmer</td>
<td>8.577</td>
<td>4.759</td>
<td>+</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>Age of farmer in years</td>
<td>52.931</td>
<td>14.696</td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>Dummy: 1 for indigene, 0 otherwise</td>
<td>0.831</td>
<td>0.376</td>
<td>+</td>
</tr>
<tr>
<td>INDIGENE</td>
<td>Dummy: 1 for male, 0 otherwise</td>
<td>8.577</td>
<td>4.759</td>
<td>+</td>
</tr>
<tr>
<td>GENDER</td>
<td>US$1 = 9200 Ghanaian Cedis.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{2} In theory this product price variable should be included in the probit model as well. Information on this variable was provided by individual farmers and therefore not uniform, and farmers who did not plant trees often do not have this information. However, since we did not ask farmers if they had the price information when they decided to plant trees or if they had the information when we conducted the interview, it is not possible to use a dummy variable in the probit model.

\textsuperscript{3} According to Ghana Forestry Commission, these are all of the farmers who have established plantation forests in the study area.
which a plantation owner was interviewed. Seventy-eight non-plantation owners were identified. The criteria for selecting the non-plantation owners were “households of the same social and economic status” as the plantation owners interviewed in terms of the total area of farming tracts owned and/or cultivated and per capita income. This allowed us to have a comparison group.

Some farmers have more than one plantation plot. Each plot was treated as a homogenous unit with respect to the land tenure, stand characteristics, and location. Data were collected on a total of 54 separate plantation tracts. We excluded two observations due to suspected data inaccuracies—manifested in one case by unbelievably large initial investments per hectare and in another case large areas of farm tracts and per capita income. The final number of observations was 39 plantation owners, who have cultivated 53 plantation plots, and 77 non-plantation owners. Thus the number of observations in the first stage was 130.

The variables employed in the model are defined, along with their descriptive statistics in Table 1. With the exception of “outright ownership” of plantation tracts and tracts under “indigenous land-use rights,” which had a correlation coefficient of — 0.74, all the other variables had fairly low correlation coefficients.

5. Empirical findings

The results of the selectivity model are presented in Table 2. The probit (establishment) model, which utilized 130 observations and the selectivity model, which utilized 53 observations, fits reasonably well (with the pseudo and adjusted R2 of 0.449 and 0.523, respectively). As the Lambda is insignificant, there may not be a strong linkage between them.

For the probit (establishment) model, regression coefficients of all the tenure variables and regression coefficients of the variable for total land owned and/or cultivated by the households were positive, as expected. The coefficient for percentage of total land which falls under “outright ownership” was significant at the 5% level. Thus the amount of land that households own outright impacts positively the households’ decision to establish plantations. Everything else being equal, for a 1% increase in land under “outright ownership,” there is a 7.6% increase in the probability that farmers will establish forest plantations.

The coefficient of the age variable was positive and significant at the 10% level. Because of low labor requirements in the latter stage of its establishment, Dewees (1992) observes that farmers approaching retirement are more likely to plant trees. The coefficient of the education variable was positive and significant at the 5% level, confirming the report by Owubah et al. (2001) that education level influences farmers’ willingness to plant and conserve trees. The coefficient of the extension service variable was positive and significant at the 5% level. This result is not surprising because there is a tree growers association in the study area and most of the plantation owners attribute their involvement in plantation establishment to this group. This result provides some support for institutional mechanisms aimed at providing aid for the diffusion of knowledge among farmers. Farmers participate actively in tree planting programs when their technical knowledge about an agroforestry practice has been enhanced through extension and educational programs (Salam et al., 2000; Glendinning et al., 2001). The coefficient for indigene farmers was negative but insignificant, implying that indigenes and migrants behave in a similar way with respect to plantation establishment. The per capita income of households and gender of household heads was negative but insignificant. The magnitude of these significant variables other than land tenure on plantation establishment is reflected in their marginal effects, which are in this order—the use of extension services, age, indigene, education, and per-capita income (Table 2).

For the INVESTMENT model, the coefficients for plantation tracts over which farmers hold “outright ownership” and “indigenous land-use rights” were positive and significant at the 5% and 10% levels, respectively. Compared to plantation tracts over which farmers hold leasehold tenure arrangements, farmers

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4 Other functional forms have been tried. While the results are not much different from those reported here, the log-linear functional form of Eq. (1) was chosen empirically on the basis of R2 and the signs of coefficient of variables.

5 The selectivity model was also run by treating a household with multiple plantation plots as a single observation. The results are similar to those reported here. The drawback for that approach is that the probit and the selectivity models would not be linked.
tend to invest more in plantation tracts over which they hold “outright ownership” and “indigenous land-use rights.” This is consistent with findings by Zhang and Pearse (1996), Place and Otsuka (2000), and Owubah et al. (2001). The result on “indigenous land-use rights” variable can be explained by the fact that indigenes have use rights to a communal land so far as they continue to cultivate that land (Benneh, 1989; Aidoo, 1996).

The coefficient for the product price variable was positive and significant at the 5% level. This supports the notion that landowners increase investment in tree planting when output prices increase (Cubbage et al., 2003). Since a log-linear form is used, the coefficients of the INVESTMENT model are elasticities. Thus, for a 1% increase in the selling price of the tree species, there is an increase of 0.99% in silvicultural investment in plantation.

The coefficient for the size of the plantation tract variable was negative and significant at the 5% level, possibly due to economy of scale in tree planting. The coefficient for the per capita income variable was negative and significant at the 5% level. This result is contrary to what was expected and that reported in other studies (Amacher et al., 1993; Cubbage et al., 2003). A likely explanation for this may be that households with high income in the study area are less risk averse and tend to invest more in ventures or activities that yield quicker returns than plantations.

The coefficient for the age variable was insignificant in the investment model. Although “age” positively impacts farmers’ plantation decisions, it has no impact on how much they invest. The coefficient for the education variable was positive but insignificant while that for the gender variable was negative and marginally significant at the 20% level in the investment model. Thus, male headed households who have established plantations tend to invest less in silviculture than female headed households. A likely explanation for this may be due to the matrilineal mode of inheritance in the study area. Males cannot directly transfer heir properties to their wives and children, but to their maternal family members (Aidoo, 1996). Hence they may be reluctant to undertake such ventures. The coefficient for the extension service variable was positive and marginally

| Table 2 |
| Results of the selectivity model on forest plantation establishment in Ghana |
| **Variable** | **Probit (plantation establishment) model** | **Plantation investment** |
| | **Coefficient** | **t-ratio** | **Marginal effect** | **t-ratio** | **Coefficient** | **t-ratio** |
| POUCHRIGHT | 0.207 | 2.402*** | 0.076 | 2.474*** |
| PCOMMUNAL | 0.040 | 0.416 | 0.014 | 0.417 |
| LANDAREA | 0.363 | 1.265 | 0.133 | 1.273 |
| OUGHTRIGHT | 1.483 | 2.593*** |
| COMMUNAL | 0.096 | 1.719** |
| PRICE | 0.993 | 4.370*** |
| PLOTSIZE | -1.269 | -5.405*** |
| DISTANCE | -0.037 | -0.288 |
| INDIGENE | -0.609 | -1.338* | -0.223 | -1.342* | 0.080 | 0.118 |
| PCINCOME | -0.195 | -1.333* | -0.071 | -1.336* | -0.501 | -2.706* |
| AGE | 1.029 | 1.808*** | 0.376 | 1.802** | 0.361 | -0.314 |
| GENDER | -0.699 | -1.228 | -0.255 | -1.230 | -1.195 | -1.640* |
| EDUCATION | 0.467 | 2.080*** | 0.171 | 2.123** | 0.340 | 0.852 |
| EXTENSION | 1.975 | 6.488*** | 0.722 | 6.464*** | 2.131 | 1.564* |
| CONSTANT | -6.293 | -2.467*** | -2.299 | -2.499*** | 1.806 | 0.287 |
| LAMBDA | 1.320 | 1.066 |
| $R^2$ | 0.488 | 0.033 |
| $R^2$ adjusted | 0.449 | 0.523 |
| F-test | 12.700 | 5.750 |
| $\chi^2$ | 75.030 | 107.966 |
| Log-likelihood | -50.366 | -50.366 |
| No. of observations | 130 | 53 |

*, **, and *** denote statistical significance at the 20%, 10% and 5% levels, respectively.
significant. Access to and use of extension services has a positive impact on silvicultural investment by farmers who have established plantations.

Based on the coefficient estimates, it is evident that the variables having the largest marginal effects on plantation investment are in this order—the use of extension services, outright ownership, plot size, gender, prices, indigenous land-use rights, and per-capita income. Land tenure, use of extension services, and farmers' characteristics appear to be significant in both models.

6. Conclusions

This study provides some empirical evidence to the fact that secured rights to land and market factors influence positively on farmers forest plantation activities and investment. Households with a higher percentage of their cultivable lands under “outright ownership” are more likely to establish plantations than households with a higher percentage of their cultivable lands under leasehold tenure arrangements. Household heads who are older, with a higher level of education, and who have access to extension services, are more likely to establish plantations than others.

Households that hold “outright ownership” and “indigenous land-use rights” over their plantation plots invest more silviculturally than households that hold leasehold tenure arrangements over their plantation plots. The selling price of plantation product has a significant, positive impact on households’ investment in silviculture. Market incentives do motivate households to invest more in silviculture.

The policy implications of this study are that increased amount of freehold land tenure would stimulate forest plantation establishment by farmers. Because numerous interests exist in communally owned lands, these lands are prone to conflicts, making it insecure for would-be farmers/investors to invest in long-term projects such as forest plantations on these lands. If secured rights in land conducive for plantation establishment can be granted, more farmers would be motivated to participate in plantation establishment. Farmers also react positively to market incentives by investing and transacting in forest plantation establishment when market forces are conducive. Should the Government of Ghana implement measures that ensure improved transferability and security of land and tree rights and allow market to function, investment in forest plantations would increase in the future. This will be to a considerable help in alleviating the country’s ever increasing demand on timber and thereby reducing the pressure on dwindling natural tropical forest resources.

Because of the small and restricted sample size of this study, we caution against making broad inference and too strong conclusions. Nonetheless, to the extent that Ghana can be considered representative of the tropics, the Ghanaian experience in forest plantations may be informative to other countries. Ghana has generally been one of the most stable countries with one of the better economies in Africa. The study suggests that under these conditions, secure land tenure conditions and market development for forest plantations can be successful, and provide commodity benefits to landowners, consumers, and the country. Expansion of such analyses to other countries with poorer political and economic situations would be useful as well to see and determine how robust our findings are. Further study could also be extended to large and sometimes multinational corporations which are the driving forces behind establishing plantation forests globally.

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