# Labour Allocation and Productivity of Men and Women on Thai Farms

*Stephen K. Pollard and Richard L. Meyer*[1]

**Abstract:** This paper examines the efficiency of labour allocation and the productivity of labour by gender between and within farm and nonfarm enterprises on Thai farms. Cobb-Douglas production functions are estimated for both types of enterprises, using disaggregated data. The estimated parameters of those functions are utilized to analyze efficiency and productivity issues. The results showed that interenterprise efficiency can be enhanced by allocating more male labour to nonfarm enterprises and more female labour to farm enterprises, but cultural constraints may impede such substitution. Policy makers need to improve incentives for nonfarm enterprises.

## Introduction

Rural development analysts and decision makers have placed increased emphasis on expanding rural nonfarm employment in recent years. One area of concern has been rural industrialization and small scale enterprises (Anderson and Leiserson, 1980; and World Bank, 1980). Another has been the allocation of labour in farm households, including work on nonfarm enterprises (Evenson, 1978; and Onchan and Chalamwong, 1981). Numerous programmes have been designed to enhance rural incomes through both farm and nonfarm employment, but the allocative efficiency impacts of such programmes have been largely ignored (Chalamwong *et al.*, 1983).

This paper reports on an analysis of resource use for a sample of Thai farms. The sample is particularly well suited for this study because detailed data were carefully collected on both farm and nonfarm enterprises within the household. The purpose of the analysis is to analyze the efficiency of labour allocation by gender between and within farm and nonfarm enterprises and the productivity of labour by gender in those enterprises. Those issues are analyzed by estimation of a Cobb-Douglas production function and derivation of marginal productivity and efficiency criteria. The efficiency criteria utilized assume that farm households allocate resources consistent with the opportunity cost of those resources and allow for a test of the hypothesis that farm households allocate resources to different activities so that the opportunity cost of each resource is equalized across activities.

The framework used in this study also allows for an analysis of how market incentives can influence labour productivity of farm households. Recent contributions to the economic development literature have stressed that improving such market incentives can lead to increased productivity of input use in the agricultural sector (Schultz, 1978). The relationship between incentives and women's productivity has received little attention in the literature on women's role in development (Cloud and Overholt, 1983).

## Analytical Framework

Consider a farm household producing two outputs: an agricultural good (i.e., rice) and a nonagricultural good (i.e., bamboo baskets). The production function for each good is assumed to be the Cobb-Douglas form:

$$(1)\quad \ln Y_i = \ln A_i + \sum_{j=1}^{N} b_{ij} \ln X_{ij},$$

where $i = 1$ for the farm good, $i = 2$ for the nonfarm good, $\ln Y_i$ is the natural log of the value of output of the respective good, $b_{ij}$ is the output elasticity of the $j$th input used in the $i$th enterprise, and $\ln X_{ij}$ is the natural log of the $j$th input used in the $i$th enterprise.

Profit maximization and economic rationality require that farm households allocate resources among competing activities so that the opportunity cost of each resource is equalized across activities. The opportunity cost of each input used in production is given by the value of its marginal product (*MVP*) (Ferguson, 1979):

$$(2)\quad MVP_{ij} = b_{ij}(Y_i/X_{ij}).$$

Efficient allocation of resources requires:

$$(3)\quad b_{2j}(Y_2/X_{2j}) - b_{1j}(Y_1/X_{1j}) = 0.$$

If the difference in equation *(3)* is positive, then farm households use too much of the *j*th input in farm production *vis-à-vis* nonfarm production. If equation *(3)* is negative, then too much of the *j*th input is used in nonfarm production. Resource misallocations that occur can then be explained by either the lack of economic rationality or due to the incentives and/or constraints that farm households face (i.e., distorted product and input prices). Disincentives are reflected directly through the *MVP* of the input and reduce the opportunity cost and value of using an input in a particular enterprise.

## Statistical Methodology and Results

The Cobb-Douglas production function presented in equation *(1)* is estimated by ordinary least squares separately for nonfarm and farm enterprises, due to the availability of input use data by enterprise type. That approach overcomes the drawbacks of alternative methods utilized in recent studies of multiproduct firms and farms (e.g., Just *et al.*, 1983; and Shumway *et al.*, 1984), such as lack of disaggregation of inputs used in different products and not considering the allocation of inputs that are constrained within the farm household to different enterprises. Those problems can lead to biases in the results or imposition of restrictions that may not be substantiated empirically.

The specification of equation *(1)* differs between farm and nonfarm enterprises in terms of the inputs utilized. A six-input production function is specified for farm production, while a four-input production function is specified for nonfarm production. The inputs used are:

$X_{i1}$ = the total number of hours of family male labour used in the *i*th enterprise,
$X_{i2}$ = the total number of hours of family female labour used in the *i*th enterprise,
$X_{i3}$ = the amount of hours of hired labour used in the *i*th enterprise,
$X_{i4}$ = the intermediate input expense (in baht[2]) incurred in the *i*th enterprise,
$X_{i5}$ = the value of capital services (in baht[2]) used in farming,
$X_{i6}$ = the amount of land cropped (in rai[3]), and
$Y_i$ = the total value of production of the *i*th enterprise.

This study departs from previous work that weighted female labour contributions by a factor of 0.75 to 0.80 with respect to a male's labour contribution. That weighting scheme assumes that a woman's labour productivity is lower than a man's, but such differences have been challenged by recent empirical work (Cloud and Overholt, 1983). The reason why women's productivity is low is explained away by such a weighting scheme before it can be analyzed. Measures of capital services and land utilized in nonfarm enterprises were not available, although the magnitudes of each are small compared to farm enterprises.

The data were part of an exceptionally rich data set collected from 424 farm households in 25 villages in the Thai provinces of Chiang Mai, Khonkaen, Roi Et, and Suphan Buri during the 1980/81 crop year.[4] A total of 250 farm households met the data requirements for the farm production function estimation, and 91 satisfied the data requirements necessary for estimation of the nonfarm enterprise production function.

The results of the estimated Cobb-Douglas production functions are presented in Table 1 for both farm and nonfarm enterprises.[5] The estimates of the parameters $b_{ij}$ are the estimates of the output elasticities of the disaggregated inputs. The estimated parameters for the farm production function are all significant at the 5-percent level and are of reasonable magnitude. For the nonfarm production function, only the coefficient for the estimated output elasticity for hired labour is not significant at the 5-percent level.

The estimated marginal value products calculated by equation *(2)* for each input by enterprise type are presented in Table 2. An analysis of intrafarm enterprise efficiency reveals that hired labour and intermediate inputs are underutilized, and capital services and land are overutilized when the value of the marginal product is compared to the opportunity cost of using those inputs (which is the relevant market input price). Both male and female labour are overutilized on farm enterprises, given the market wage rate for farm labour. However, the opportunity cost of using another hour of a woman's labour time is twice as much as using another hour of a man's labour time in farming.

Examination of intra-nonfarm enterprise efficiency reveals that intermediate inputs are overutilized (again comparing the marginal value product and market cost of these inputs), while male labour time is underallocated and female labour time is overallocated based on the market wage rate. The insignificance of the variable for hired labour implies that farm households will not hire labour for nonfarm production.

**Table 1—Estimates of the Cobb-Douglas Production Function for Farm and Nonfarm Enterprises**

| Parameter (variable) | Farm | Nonfarm |
|---|---|---|
| Constant | 6.0304<br>(0.3713) | -2.1696<br>(0.10386) |
| $b_{i1}$ (male labour) | 0.1143<br>(0.0430) | 0.5572<br>(0.1099) |
| $b_{i2}$ (female labour) | 0.1839<br>(0.0534) | 0.5668<br>(0.1471) |
| $b_{i3}$ (hired labour) | 0.0720<br>(0.0235) | 0.0599<br>(0.0952) |
| $b_{i4}$ (intermediate inputs) | 0.1225<br>(0.0341) | 0.3887<br>(0.1217) |
| $b_{i5}$ (capital services) | 0.0502<br>(0.0279) | |
| $b_{i6}$ (land) | 0.1996<br>(0.0456) | |
| $R^2$ | 0.4694 | 0.5769 |
| $F$ | 35.8223 | 29.3202 |
| Number of observations | 250 | 91 |

[Note: Standard errors are in parentheses.]

**Table 2—Estimated Marginal Value Products and Market Input Prices**

| Input | Farm MVP* | Nonfarm MVP* | Market Input Price† |
|---|---|---|---|
| Male labour (baht/hr) | 1.1013 | 6.175 | 4.65 |
| Female labour (baht/hr) | 2.1213 | 3.056 | 4.65 |
| Hired labour (baht/hr) | 142.824 | ‡n.s. | 4.65 |
| Intermediate inputs (baht) | 215.779 | 0.3870 | §1 |
| Capital services (baht) | 0.5232 | n.a. | §1 |
| Land (baht/rai) | 191.992 | n.a. | 500-900 |

[*The MVP is calculated using equation *(2)* at the point of geometric means. †Taken from Chalamwong *et al.* (1983, p. 11). ‡Not significant. §1 baht of capital services or intermediate inputs should return 1 baht (assuming no interest rate charges).]

Applying equation *(3)* reveals that allocation of both male and female labour time is too high in farm production *vis-à-vis* nonfarm production. That misallocation is more serious in the allocation of male labour time than female labour time. That finding appears to contradict the main assumption incorporated in the framework of the new household economics models; i.e., that economic agents allocate resources (including time and labour) so that the opportunity cost of each resource in any activity is equalized (Evenson, 1978; and Sumner, 1982).

The results can be interpreted in relation to what is generally known about labour allocation patterns in Thai farm households. The overutilization of resources in farming has been explained in other studies by the risk aversion behaviour of farmers. The rice crop is the most important farm enterprise on most farms, both in terms of proportion of total crop area and source of food for family consumption. Therefore, households first devote resources to assure family rice subsistence, then to other enterprises to generate cash income.

Women tend to allocate relatively more time to nonfarm enterprises than men. Banno (1982) confirmed that result for the entire sample of this study. Traditions as well as logic influence that pattern. Men traditionally perform some farm tasks such as ploughing and harvesting, while women transplant rice. On the other hand, women tend to stay closer to the house in order to care for children, garden plots, and animals and to prepare food. They work on nonfarm enterprises during periods when household tasks demand less labour. Men also work on some nonfarm enterprises, such as blacksmithing and wood carving, which earn a good return but for which some specialized skills are required and product demand is limited and seasonal. They will not, however, generally work on silk and cotton weaving and embroidery, which provide much nonfarm employment for women.

Both men and women take off-farm jobs. Frequently that work is not available at the average wage rate used in this study, or it is available just at the time of peak labour demand on the farm. In many cases, men migrate seasonally to bigger cities where they obtain employment in relatively high-paying construction jobs. Someone must stay at home to protect the property, tend children and livestock, and care for gardens—usually the wife because of her lower income-earning potential in the labour force (Blaug, 1974).

## Implications

Thai farm households appear to allocate their labour resources rationally within the limits of cultural constraints but not consistent with market opportunities. Those findings suggest that labour allocative efficiency can be enhanced by substituting more labour time of men for women in nonfarm enterprises and more labour time of women for men in farm enterprises. Thai farmers also lag behind some other Asian farmers in the use of modern varieties, fertilizers, and other modern inputs. That underutilization of intermediate inputs is confirmed for the farms studied. The challenge for Thai decision makers, therefore, is to find ways to increase productivity of farm and nonfarm rural enterprises, rather than simply increase low productivity employment. The productivity and income-earning potential of women would be enhanced through improvement of incentives in nonfarm activities (particularly product prices) that raise the productivity and value of women's labour. The specific ways to do this are still being explored. Mead (1982) discusses how subcontracting with urban firms could contribute to improving the quality of production, improving production technology, and increasing demand. A challenge that must be faced is that many products of several nonfarm enterprises, such as pottery and bamboo products, face sharp competition from substitutes produced in the expanding manufacturing sector.

## Notes

[1]California State University and Ohio State University, respectively.

[2]Approximately 20 baht = US$ 1.00.

[3]1 rai = 0.4 acres.

[4]See Mead and Meyer (1981) for a description of sampling procedures and characteristics of the farm households interviewed.

[5]A translog production function was fitted and estimated, but a test of the null hypothesis (the Cobb-Douglas is the appropriate production function) could not be rejected for either enterprise type.

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