Gender and Agricultural Productivity in a Surplus Labor, Traditional Economy: Empirical Evidence from Nepal

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GENDER AND AGRICULTURAL PRODUCTIVITY IN A SURPLUS LABOR, TRADITIONAL ECONOMY: EMPIRICAL EVIDENCE FROM NEPAL

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ABSTRACT

In this paper, two approaches (labor efficiency and separate factors approach) and two production functions (a ray-homothetic function and the Cobb-Douglas function), are used to estimate the productivity of female versus male farm laborers in the traditional agricultural economy of Nepal. The hypothesis that female laborers would be less productive than males due to the disparities in physical and human capital, originating from economic and socio-cultural discrimination, is tested. The study results confirm this expectation. However, the study suggests that once differences in irrigation and type of seeds used by male and female farmers are included in the model, the magnitude of the difference is reduced and the estimated coefficient becomes insignificant. The ray-homothetic function does best in yielding realistic results suggesting that congestion is an important feature of Nepalese agriculture supporting the notion that there may be disguised unemployment in the sense that too much labor is used in agriculture and that empirical analysis should accommodate this possibility when considering functional form.

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INTRODUCTION

Gaps in earnings by gender have long been evident both in industrialized countries and in less developed countries. Women's wages are typically only about 60% to 75% of men's wages for equivalent kinds of work. This gap exists either because, in certain occupations, women are less productive than men or because women are paid less than their marginal revenue product. For the most part, the literature has focused on explaining the wage gap in terms of reasons why women may be less productive than men. These reasons stem from two sources- usually confused in the literature: The first is the "different sex", or the innate biological differences in physical strength and alike between men and women; the second is the "different gender", or the socially driven relationship between men and women that arise from the differences in education, training and access to other factors of production along with the economic discrimination that occurs when women are forced into a few occupations.[1] Crowding in these occupations lowers the average marginal product of women's labor and consequently lowers women's wage rate. These explanations basically assume that household members sell their labor to firms in otherwise well functioning labor markets. Much of the labor in rural sectors of less developed countries is performed in family owned and operated enterprises and farms and the explanation of gender wage differences has to be modified accordingly. For instance Jacoby (1992) examines the peasant agriculture of the Peruvian highlands and finds a higher productivity for men relative to women. He argues for the disaggregation for male and female labor inputs, since women typically allocate more time to household and non-farm activities and, therefore, tend to perform different agricultural tasks than men. Similar observations were given in the case of rural China with the female contribution on each farm calculated as three months of labor input per year compared to ten months for men (Buck, 1973). Regional differences were also noted in relation to crop cultivated. The share of female labor in production was significantly higher in areas with rice cultivation. Other studies, such as Benjamin and Brandt (1995), find that men and women are equally productive with their contributions proportional to their labor input. Benjamin and Brandt note a measurement error in Buck's data.

Overall production in the traditional, agricultural sector differs from production in the modern sector in many ways. We will emphasize three chief differences. First, the distribution of output to family members is not made through wages. There is no explicit wage rate for family labor supplied to the family farm. Second, disguised unemployment or surplus labor might exist due, in part to labor acting as if labor earns its average product, and not its marginal product in traditional agriculture (Sen, 1975). It is typically assumed in dualistic models that a worker will seek full-time employment in the modern sector if the wage rate in the modern sector exceeds the average product of labor in the traditional sector. Third, the division of labor within a family might be largely based on socio-cultural criteria instead of being based on economic criteria.

The objective of this study is to contribute to the literature on analyzing female versus male productivity in Less Developed Countries (LDC's) by directly testing the hypothesis that women are less productive than men. A typical, traditional, agricultural, LDC economy (Nepal) will be used in the study. The organization of the paper is as follows: In the next section, a brief overview of Nepal, the country and economy, will be presented. Also, gender roles and women's productivity in agriculture will be discussed. Section three will detail the methodology used to test the hypothesis of the paper with particular attention to explaining the estimation of the production functions used in the study. In the fourth section, the data will be identified and the empirical results will be presented and discussed. Some brief conclusions will be presented in the fifth and concluding section.

NEPAL, GENDER ROLES, AND WOMEN'S PRODUCTIVITY

Nepal is classified among the poorest and least developed countries in the world with almost 31 percent of its population receiving less than one dollar a day (living below the agreed upon international poverty line). Moreover, Nepal has one of the highest unemployment rates in the region (42 percent), and the estimated (official exchange rate)

GDP of Nepal in 2006 was $7.154 billion or zero percent of the USA GDP. Agriculture is the mainstay of the economy, providing a livelihood for three-fourths of the population and accounting for 38 percent of GDP, also employing 76 percent of the labor force. The industry absorbs only 6% of the labor force and the service sector accounts for 18 % (2004). Women are more dependent on agriculture as a source of employment than are males. 91% of employed women are in agriculture verus 64% for men (2004).[2] Consequently, changes in gender roles will have its great impact on women's productivity and earnings in agriculture. The high dependence of women on agriculture in Nepal and other economies dependent on agriculture makes agricultural productivity important ti study if we are to explain the economic status of women. The agricultural based economy if Nepal, with a subsistence sector where women participate in agricultural activities and perform almost all the activities done by their male counterparts, is ideal for comparing the productivities of male and female farmers.

Both women's wage rates and their productivity may be reduced by cultural biases. There have been numerous ways of looking at the economic impact of discrimination against women and their earnings and productivity. One way of viewing discrimination against women is to simply look at the wage rates for males versus females (see Coppin, 1998). While this can be done in developed countries and for the modern sector in developing countries, there is no explicit wage rate for male or female, labor employed on their own farm that can be used in empirical studies. However, two wage rates are available, at least on a survey basis. The wage rate for laborers hired by the farmer and wage rates for part-time, non-farm employment of farm household members employed outside the farm is mostly available. Bardhan (1979) examined the first type of wage differential and found evidence for what appears to be economic discrimination, not only by gender, but by the number of dependants in the laborer's household. The efficiency wage hypothesis is used to explain these results. Singh (1996) also looks at wage differentials for agricultural laborers, but considers these wage differentials through time. Singh found evidence that economic development in general, and the adoption of new technology in particular, narrows the male/female wage differential. Abdulai and Delgado (1999) examine the non-farm earnings of farm household members. They find evidence that wives' earnings are motivated by "coping behavior" where wives participated in the non-farm labor market to deal with shortfalls in family income.[3]

A second way of viewing discrimination against women is to examine the efficiency of male managed versus female managed plots. Udry (1996) argues that, at least for West Africa, the allocation of resources within a farm household is not Pareto efficient. Resources are not allocated efficiently between plots controlled by different household members. The marginal product of land is lower on female managed plots. While differences in crops grown and in land quality may be explaining factors, much of this lower productivity seems to be the result of a misallocation of variable factors between male and female managed plots. Female plots has less access to productivity improving resources such as fertilizer. Both disguised unemployment and a larger role of socio-cultural versus economic forces in determining the division of labor are sources of inefficiency. The assumption that socio-cultural forces may crowd women into a few occupations or into the performance of a few designated tasks implies inefficiency because it would mean that women's marginal product of labor is below the marginal product of labor for men even if there were no differences between female and male workers (Anker and Hein, 1986). This type of discrimination and the resulting inefficiency would imply that employers or farms that do not discriminate are more efficient and presumably more profitable. The reduction of gender discrimination would increase the efficiency of the economy in general and of agriculture in particular resulting in an increase in real output for the economy as a whole. Estimating efficiency, unlike the first approach, which requires data on wage rates in well functioning markets, only requires data on inputs and outputs. Price data are generally not available for agriculture in less developed countries because much of the production is for household consumption. Hence, much of the labor, particularly women's labor, is used for household production and does not enter into the labor market. Consequently, there is no explicit wage rate than can be used to either ascertain wage discrimination or to estimate the supply of labor. A third approach, which will be used in this paper, follows Abdulai and Regmi (2000), who use the marginal product of labor as the shadow wage rate because it represents the opportunity cost of labor time.[4] Whether comparing male and female wage rates, marginal productivity, or efficiency, there are several issues that need to be faced. First, there are two differences between labor markets in the traditional sector and the modern sector that are related and reinforce each other in terms of gender wage inequality. They jointly suggest the possibility that male enters the external labor market if $w > apl$ for males but that the female mainly enters the external job market as a residual supplier of labor due to short-term difficulties with family income. For numerous reasons, females may be discriminated against in that they are crowded into lower paying employment or are actually paid less than their marginal product. If males enter the labor market, the existence of disguised unemployment would imply that females in the farm household are expected to replace the hours the male would have worked on the family's farm in order to maintain agricultural output.

In this paper, we will directly test the hypothesis that women are less productive than men in Nepalese agriculture and, hence, shed light on the possible existence of socio-cultural crowding. Women in agriculture in Nepal are expected to have a lower marginal product than males for three related reasons. First, the gathering of fuel and fodder in Nepal are tasks almost entirely performed by women. Hours spent at those tasks may be more related to the costs of gathering natural resources than to increasing farm output. As fuel and fodder become more difficult to obtain, women may substitute hours that would have been devoted to children and other household activities into gathering fuel and fodder (Kumar and Hotchkiss, 1988; and Cooke, 2000). Such substitution would do nothing to increase farm output. Second, women have less access to credit, tools and human capital than men. This lack of access will lower the relative productivity of female versus male labor. Third, males may have better employment opportunities outside agriculture. Consequently the opportunity cost of women's time would be lower in agriculture, leading to a lower marginal product for women in agriculture.

METHODOLOGY

Previous studies will be extended in three ways. First, two types of agricultural technology will be considered. Nepalese farmers have adopted high yielding variety

(HYV) seeds on some farms or plots while HYV seeds have not been adopted on other farms or plots. This study will examine the impact that the adoption of HYV technology has on the relative productivity of male versus female agricultural workers. Second, previous studies will be extended by substituting a ray-homothetic production function for the more typical Cobb-Douglas production function. One reason for this extension is that the ray-homothetic model allows for congestion where the marginal product of labor could become negative if too much labor is used. In the Cobb-Douglas model, marginal product never changes sign. Congestion and surplus labor are assumed to be features of agricultural production in dualistic models of development and hence marginal products that turn from positive to negative are a possibility. Finally, the relative efficiency of female workers will be estimated directly.

Ray-Homothetic Production Function Approach to Estimate Marginal Productivity

To calculate the marginal productivity of labor (MPL), a linear version of the ray-homothetic production function is estimated. This function can be written as

$$\ln y = \ln\theta + \sum_{i=1}^{n} \alpha_i (x_i / A) \ln x_i + u \qquad (1)$$

where $\underline{y}$ = output, θ and α_i are parameters, X_i = ith input, *ln* denotes the natural logarithm, and $A = \Sigma x_i$ for all *i*.

The above functional form has many advantages over the traditional Cobb-Douglas or Constant Elasticity of Substitution forms. One of them is that it encompasses the homogenous, ray-homogenous, homothetic forms as special cases and allows for the possibility that returns to scale vary with output[5]. There are two ways of entering and female labor into a production function. The first, we will call the *separate factors method*. In this method, male and female labor are introduced as separate inputs into the production function. The second, we will call the *labor efficiency method*. In this method, the sum of male and female labor ($N = M + F$) is introduced into a production function as one labor input, labor, with the efficiency of labor being a function of the proportion of that labor which is female. In other words, the labor input is $L = \lambda(F + M)$, where λ is a function of *F/N*, the proportion of the labor force that is female. Both formulations imply that male and female labor are separable in the normal definition of separability[6]. As we will see, these formulations lead to different functional forms and different verbal interpretations of the marginal product of male versus female labor.

The Approaches used for testing the study's hypothesis

In order to directly test the hypothesis that women are less productive than men in a traditional agricultural society like Nepal, both the *separate factors approach* and the *labor efficiency approach* will be compared. However, for two major reasons the *labor efficiency approach* will be preferred. First, the separate factors of production implies, for the production functions that are typically used, that all factors of production are essential, in that if none of that factor is employed, no output is produced. This restriction does not strike us as being intuitively plausible for male versus female labor. The second reason for preferring the *labor efficiency approach* is that it gives an intuitively plausible interpretation to the possibility of a negative marginal product of labor for the least efficient labor input. This second reason becomes particularly important it if is suspected that there is a possibility of disguised unemployment where the marginal product of labor is low. To illustrate this point, suppose there are three factors of production, land, *R,* labor, *L*, and capital, *K*. Furthermore, let the labor input be

$$L = e^{\gamma(F/N)}N. \quad (2)$$

Finally, let A = R + N + K , so that the number of workers regardless of their efficiency represents the crowding factor. The production function in equation (1), upon substituting (2) as the labor input and upon simplification, becomes

$$\ln Y = \ln\theta + \alpha_1(K/A)\ln K + \alpha_2(R/A)\ln R + \alpha_3(N/A)\ln N + \gamma\alpha_3(F/A), \quad (3)$$

where $\alpha_1, \alpha_2, \alpha_3 > 0$. If women are less productive than men, γ is negative. In this case, an increase in female labor, *ceteris paribus*, would have two opposite effects. It would increase output because it increases *N* but it would decrease output because it increases *F/N.*

The marginal product of female labor is found by taking the partial derivative of (3) yielding

$$\partial Y/\partial F = (1/A)Y\{\alpha_3[1 + \ln N - (N/A)\ln N] - \alpha_1(K/A)\ln K - \alpha_2(R/A)\ln R + \gamma\alpha_3(1 - (F/A))\}. \quad (4)$$

Note that the last term in equation (4) gives the decline in output that would occur by substituting less productive male labor for female labor. This term could make the sign of $\partial Y/\partial F$ negative if the marginal product is low due to the low marginal product that could be found in a surplus labor economy.

DATA AND EMPIRICAL RESULTS

Data

The data come from a two staged modified random sample of farming households in the middle hills of Nepal[7]. In this study only, the data for the rice crop are used, since technological change has been most rapid for this crop. The modern seed varieties, which were introduced during early 1970's have been adopted by about 40% of the rice cultivators.

The sample consists of 377 rice farmers. Out of them, 168 adopted modern varieties, and 209 used traditional (local) varieties. There are nine basic input related variables. Detailed information on the inputs, chemical fertilizer, compost, seed, draft power, labor by gender, irrigated and non-irrigated land, and agricultural implements and output for the rice crop were collected through the use of questionnaires. The data include both factors of production such as labor, land and agricultural implements, and what might be thought of as intermediate inputs such as seed. Capital will be defined as animal power and agricultural implements. Labor includes both the own labor of the farm family and hired labor. Land includes both irrigated and non-irrigated land. These inputs are normalized to the same order of magnitude.

Results

Ordinary least squares is used to estimate a stochastic version of equation (3). The reason for using ordinary least squares, instead of instrumental variables, is that the data do not contain instruments that are typically used to estimate productivity such as education and wage rates. The ray-homothetic production functions to be estimated are, for the separate factor model,

$$\ln Y = \ln\theta + \alpha_1(K/A)\ln K + \alpha_2(R/A)\ln R + \alpha_3(F/A)\ln F + \alpha_4(M/A)\ln M + \alpha_5 IRRIG + \alpha_6 NADOPT + \varepsilon \quad (5)$$

and, for the labor efficiency model,

$$\ln Y = \ln\theta + \alpha_1(K/A)\ln K + \alpha_2(R/A)\ln R + \alpha_3(N/A)\ln N + \gamma\alpha_3(F/A) + \alpha_4 IRRIG + \alpha_5 NADOPT + \varepsilon. \quad (6)$$

ε is a stochastic error term, *IRRIG* is a dummy variable indicating whether the land is irrigated and *NADOPT* a dummy variable indicating whether the old seed varieties are still being used. It is expected that the signs of α_1, α_2, and α_3 will all be positive in equation (6). In addition, we expect $\gamma\alpha_3$ will be negative, α_4 positive and α_5 negative. The signs in equation (5) should be similar with all coefficients positive except for α_6 *and with* $\alpha_3 < \alpha_4$. The results of both estimates are shown in Tables I and II. For comparison, Cobb-Douglas estimates are also shown. The Cobb-Douglas models estimates are, for the separate factor model,

$$\ln Y = \ln\theta + \alpha_1 \ln K + \alpha_2 \ln R + \alpha_3 \ln F + \alpha_4 \ln M + \alpha_5 IRRIG + \alpha_6 NADOPT + \varepsilon \quad (7)$$

and, for the labor efficiency model,

$$\ln Y = \ln\theta + \alpha_1 \ln K + \alpha_2 \ln R + \alpha_3 \ln N + \gamma\alpha_3(F/N) + \alpha_4 IRRIG + \alpha_5 NADOPT + \varepsilon. \quad (8)$$

Note that the labor efficiency variable is different for the Cobb-Douglas function, $\gamma\alpha_3(F/N)$, than for the ray-homothetic function, $\gamma\alpha_3(F/A)$.

The relative marginal product of labor for females versus males will be affected by numerous factors such as access to other inputs, the education of the individual, physical characteristics and discrimination. Data are not available for any of these factors. However, some conjectures will be made as to how these factors affect the estimated results.

The estimates for four basic models are shown in Tables I and II. Estimates for both ray-homothetic and Cobb-Douglas production functions are shown in each table for comparison. In Table I, results using the labor efficiency method are reported. In Table II, results using the separate factors method are shown. In discussing these results, we will begin with the labor variables and then discuss the remaining variables and the results as a whole.

The labor variables in Table I are labor supply and the labor efficiency variable, which is a function of the proportion of the labor force that is female. The labor supply coefficient is positive, as expected and significant. The labor efficiency coefficient is negative indicating that women are less productive than men. Note, however, that when dummy variables for land quality and technology are introduced into the empirical model, the estimated labor efficiency coefficient becomes insignificant and the size of the estimated efficiency coefficient rises toward zero. This result would be expected if women have less access of inputs such as high yield seed and irrigation than do men. Much of the difference in productivity would be explained by lack of access to these inputs. Before we look at the separate factor model estimated in Table II, note that the marginal product of female labor can not be directly observed in Table I. The results in Table I can, however, be substituted into equation (4) to calculate the marginal product of female labor. This is done for Table III below. Before discussing Table III, we will briefly discuss the estimates shown in Table II for the separate factor model. These results are similar to those in Table I in terms of the signs, size and significance of the variables. Women clearly have a lower MPL than men and this difference declines when seeds and irrigation are included in the model. However, the results for the Cobb-Douglas model show a negative MPL for women. This puzzling result does not appear for the ray-homothetic model suggesting that it is a preferable agricultural production function for developing countries.

We will now turn to Table III, which present the calculated MPL for women in Table I. We can see that, the marginal product of female labor, when using the labor efficiency approach and the Ray-Homothetic production function has a mean value of 10.6. For the Cobb-Douglas model, the marginal product of female labor in equation (c) has a mean value of -2.01 and a wider range (from -68.29 to 4.18). Hence, in the Cobb-Douglas model, the positive impact on output of an increase in the labor force on average is more than offset by the decline in the efficiency of the labor force while, for the ray-homothetic model, the decline in efficiency on average is not sufficiently strong to offset the increase in the labor force. The lack of flexibility of the Cobb-Douglas form when it comes to the impact of crowding leads to a lower estimate of the marginal product of labor for the average farm.

For the separate factor model, the estimated coefficients for female labor are positive for the ray-homothetic model. They are, however, negative for the Cobb-Douglas model. From Table III, the ray-homothetic model, the marginal product of female labor has a mean of -1.35 for the estimated coefficients shown in Table II, column (a). For the Cobb-Douglas model, the mean marginal product of female labor is negative for the separate factor, Cobb-Douglas model because the estimated coefficients are negative. The average value of the marginal product of female labor is -6.77 for the estimated coefficients shown in column (c).

Turning to the other coefficients, the estimated coefficients for capital are all positive and significant with positive marginal products in all equations. The estimated coefficients for land are all insignificant but positive. The land variable that has the biggest impact on output is whether the land is irrigated. Irrigated land is more productive than non-irrigated land. Adopters of HYV seeds also produce more than those who do not adopt HYV seeds. Note that in the more complete models, where HYV adoption and irrigation variables are controlled for, there is much less difference between female and male labor. Hence, it is important to control for access to technology and quality inputs when assessing the differences between male and female productivity.

TABLE 1. AGRICULTURAL PRODUCTION IN NEPAL: *LABOR EFFICIENCY* RESULTS

Variable	[a] Ray-homothetic	[b] Ray-homothetic	[c] Cobb-Douglas	[d] Cobb-Douglas
Intercept	1.822 (3.76)	1.580 (3.23)	1.218 (2.131)	0.769 (1.42)
Capital	1.272 (11.3)*	1.911 (10.1)*	1.17 (12.1)*	1.116 (11.0)*
Land	1.805 (3.47)*	1.432 (2.64)*	0.054 (0.61)	-0.003 (-0.04)
Labor	1.096 (11.0)*	1.175 (11.3)*	0.132 (1.22)	0.238 (2.11)*
Labor Efficiency	-1.366 (-1.10)	-0.989 (-2.76)*	-0.463 (-1.35)	-1.054 (-3.03)*
Old Technology	-0.425 (-5.31)*	--------------	-0.443 (-5.60)*	---------------
Irrigated Land	0.246 (3.05)*	---------------	0.222 (2.74)*	----------------
Adjusted R^2	0.35	0.28	0.39	0.32

t-statistics are in parentheses. *Significant at the 5% level or better

TABLE 2. SEPARATE FACTORS METHOD

Variable	[a] Ray-homothetic	[b] Ray-homothetic	[c] Cobb-Douglas	[d] Cobb-Douglas
Intercept	1.732	1.234	0.840	-0.092
	(.395)	(2.84)	(1.60)	(-0.18)
Capital	1.286	1.255	1.172	1.121
	(12.3)*	(11.5)*	(12.2)*	(11.1)*
Land	1.848	1.554	0.052	-0.007
	(3.56)*	(2.87)*	(0.59)	(-0.08)
Male Labor	1.219	1.354	0.307	0.643
	(10.5)*	(11.3)*	(2.35)*	(3.78)*
Female Labor	0.829	0.678	-0.170	-0.395
	(5.22)*	(4.11)*	(-1.36)	(-3.11)*
Old Technology	-0.420	--------------	-0.441	---------------
	(-5.20)*		(-5.67)*	
Irrigated Land	0.240	---------------	0.222	----------------
	(2.89)*		(2.74)*	
Adjusted R^2	0.32	0.29	0.39	0.32

t-statistics are in parentheses. *Significant at the 5% level or better

TABLE 3. ESTIMATION OF FEMALE LABOR MARGINAL PRODUCTIVITY

THE APPROACH/ Type of Production Function	Estimates of Average Female Labor Marginal Productivity
Labor Efficiency / Ray Homothetic	10.6 (0.28 to 68.01)
Labor Efficiency / Cobb-Douglas	-2.01 (-68.29 to 4.18)
Separate Factor/ Ray Homothetic	-1.35 (-102.93 to 7.11)
Separate Factor/ Cobb-Douglas	-6.77 (-333.4 to -0.09)

Note: Ranges are in parentheses

SUMMARY AND CONCLUSIONS

In this paper, we used two production function, a ray-homothetic function and the Cobb-Douglas function, to estimate the productivity of female versus male farm labor. Our use of the restrictive Cobb-Douglas is for the comparative purposes only since most of previous studies have used this functional form. However, we think the ray-homothetic flexible functional form is a methodological improvement in attempting to fit the conditions of the agricultural sectors in the least developed countries where congestion and surplus labor may exist and Nepal is a case in point. Also, most of the previous studies that used the production function approach to estimate gender differences in technical efficiency (Bindlish, and Evenson, 1993), (Bindlish, Evenson, andGbetibouo,1993), (Jamison and Lau, 1982), (Moock,1976), and (Saito, Mekonnen, and Spurling, 1994), are example, have been criticized for using the input dummy variable approach. This means including a dummy variable, in the input side of the production function, for female (or male) household head, farmer, or manger. Needless to say that using the headship, in particular, as a stratifying variable does disguise the particulars of the household structure and the intra-household decision making. Also, it does not provide information on the decisions taken by a family member who is not a household head. Case in point, would be a woman who farms their own plot in a male-headed household (Quisumbing, 1996). To a lesser extent, this criticism colors the use of the dummy variable approach in general for a female farmer or manager. This means stratifying by the dominant sex on the plot rather than the sex of the head of the household is more appropriate. Thus, the labor efficiency method used in this study is another improvement upon than the dummy variable approach used in most of previous studies.

It was expected that females would be less productive than males either because of economic and socio-cultural discrimination, the confinement of female workers to auxiliary kind of farm labor or because of innate physical differences. The results confirm this expectation. There is no way that a study such as this could separate “sex differences” from “gender differences” or the physical differences from economic and socio-cultural discrimination. This advantage in male productivity, however, seems to be partly due to command over better land and access to new technology. Once differences in irrigation and type of seeds are accounted for, the magnitude of the difference is substantially reduced and in the labor efficiency models, the female coefficient becomes insignificant. This conclusion implies that government assistance in making technological improvements available to women is vitally important in eliminating the gap between men and women workers. In our sample, only 17% of the farms adopting new technology employ a majority of females whereas this percentage increases to 25% of farms using traditional technology. This finding is consistent with previous studies as seen in section two. Also, it could also be explained by Boserup's assertion that women have been discriminated against technologically in LDCs since colonial times. Colonial bureaucracies encouraged training men to use new technology and to introduce cash crops where women continued to work the least productive land with the poorest inputs[8].

ENDNOTES

* We are grateful to Krishna Belbase for providing the data and for his helpful suggestions.

[1] For the comparison between sex and gender differences, please see Quisumbing, (1996). Also for treatments of sex inequalities in less developed nations, see UNECE (1980) and Ander and Hein (1986).

[2] The information in this section is collected from various sources: CIA (2007); The World Bank (2002-2005); and The United Nations Development Program (2005-2006).

[3] Other studies include Rosenzweig (1980) and Foster and Rosemzweig (2004).

[4] For a survey and methodological treatment of productivity and efficiency estimates see Quisumbing (1966).

[5] For more discussion about the ray-homothetic production function, see Färe, Jansson and Lovell (1985), Färe and Yoon (1985, Aly, Belbase, Grabowski and Kraft (1987) and Aly and Shields (1999).

[6] In household decision theory, separability is sometimes referred to as the assumption that household production and consumption decisions are independent. For papers concerned with separability in Nepal, see Abdulai and Regmi (2000) and Paolisso, Hallman, Haddad and Regmi (2002).

[7] The data were provided by Krishna Belbase. For a detailed discussion of the data, see Belbase (1991).

[8] See Tinker (1990), Ch 4 for a comprehensive survey of Boserup’s work.

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