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Impact of Health on Farm Production in West Bengal, India

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The paper examines the impact of farmers' health status on farm production at selected villages in West Bengal, India. Using a household production function model, the study finds that health status as measured by the number of sick-days reduces farm production. However, nutritional dimension of health indicated by BMI does not influence the farm production significantly. The issue has been further analysed using a profit function approach. The findings are consistent with other studies in which individuals with BMI as low as 16 are found to be healthy and actively participating in agricultural work. Although health status appears to be a significant determinant of farm profit for the marginal farmers, it is not so significant for the farmers with relatively large holdings of cultivable land. The study further reports that the disparity between agricultural wages and wages offered by MGNREGS programmes in the sample villages makes the farming activity less attractive and hence, increase in enrolment in MGNREGS work seems to have a negative impact on farm profit per unit of land.

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I. INTRODUCTION

Economic impacts of health at the household level are much discussed in terms of costs of illness indicated by expenditure and loss in labour productivity. However, labour productivity or labour supply and expenditure are not the only yardsticks by which the nexus between individual's health and economic well-being can be measured. For own farm workers, health influences primarily their productivity which, in turn, influences the output or farm production. Most of the

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studies on health and labour productivity owe their genesis to the household production model developed by Becker (1965). The model is further extended by several scholars such as Grossman (1972a, 1972b), Cropper (1977), Pitt and Rosenzweig (1986) where the impacts of health are discussed not only on labour productivity and labour supply but also on the farmers' income. It laid the framework for analysis, wherein health is incorporated as a variable in the utility function following an explicit health production function. As far as agricultural household models are concerned, Barnum and Squire (1979) use the household utility maximisation framework to derive demand function for own-produced and market-purchased food commodities. Their study is based on cross section data collected from Muda river valley of Malaysia. The household demand functions are specified within the linear expenditure systems of Cobb-Douglas production function framework. There are a handful of studies, such as Lau, Lin and Yotopoulos (1978), Yotopoulos, Lau and Lin (1976), Adulavidhaya, Kuroda, Lau and Yotopoulos (1984) and Adulavidhaya, Kuroda, Lau, Lerttamrab and Yotopoulos (1979), that use the agricultural household model or the Cobb-Douglas production function to derive the profit function for estimation purpose. However, some studies, such as Ahn, Singh and Squire (1981) and Singh and Janakiram (1986), use linear programming technique to model the production side, and linear expenditure system for consumption side. Their studies are based on data from Korea and Nigeria. The basic agricultural household model has further been modified by Pitt and Rosenzweig (1986) to study the interaction among prices, health and farm profit. Using the data from Indonesia, the effects of farmers' illness on farm profit and labour supply have been estimated (Pitt and Rosenzweig 1986). Farm profit function is estimated with OLS and Instrumental variable techniques. The empirical results in a nutshell suggest that the illness of farmers reduces the farm output, either marginally or not at all.

Studies on health, farm production and labour supply are scant in the Indian context. However, there are a few studies that assert the interdependence between household and farm production. These include studies based on Agricultural Labour Enquiry (ALE) and Rural Labour Enquiry (RLE) by Unni (1988); based on Census and NSS data by Visaria and Minhas (1991), Visaria and Visaria (1996) and Jayadevan (1996); and based on primary data collected at different time periods by Srinivasan (1981), Sukhatme (1982), Payne and Cutler (1984), and Visaria and Gumber (1993). However, their studies are mostly based on the Southern regions of India, where the average landholding size is much larger than those in West Bengal. The present analysis, therefore, examines the impact of poor health status of farmers on agricultural production within the context of West Bengal.

II. THE MODEL: A HOUSEHOLD PRODUCTION FUNCTION APPROACH

An agricultural household is comprised of two fundamental units of microeconomic analysis—the household (consumption unit) and the farm (production unit). When the household is a price taker in all markets, for all commodities which it both consumes and produces, optimal household production can be determined independent of leisure and consumption choices (Singh, Squire and Strauss 1986). Barnum and Squire (1979) are the first to derive a household model for agricultural sector, incorporating the own-farm produced and market-purchased commodities as choice variables along with other choice variables in the utility function. A farm production constraint is also specified along with the other constraints in the model.

The theoretical model used in the present study is based on Singh *et al*. (1986), Strauss (1986) and Pitt and Rosenzweig (1986). Production and consumption decisions in a rural farm household are integrated in this framework. It demands a complex theoretical structure as well as much data for empirical work.

The utility of the farm household is assumed to depend upon the consumption of on-farm produced and market-purchased food commodities, health status and leisure of the members of the household. It is assumed that the household maximises utility where health is incorporated as one of the element in the utility function. In this approach, the family is assumed to possess utility function, which is a function of "basic commodities." It is also assumed that the household maximises its utility subject to a set of time and income constraints. The health status of individual is incorporated as a conditioning factor in the utility function. The current cumulative health status depends upon the past and current investment in areas such as preventive health care, nutritional in-take, living environment, etc.

The utility function of the household can be written as:

$$U = U\,(X_a, X_m, L, H) \qquad (1)$$

Where X_a is the own-farm produced commodity, X_m is the market-purchased commodity, L is the leisure time of adult members in the household and H is the health status of adult members.

The health of the adult male and female household members is assumed to be influenced by own-farm produced and market-purchased commodities, health inputs, time inputs of the adult members and environmental factors, given the individual's initial health endowment.

The health production function can be written as:

$$H_j = H_j(X_a, X_m, X_z, L; \mu) \quad (2)$$

Where X_z is the vector of health inputs, which yield no direct utility and μ is a vector of individual's endowment and environmental factors which are beyond the control of the household but which affect the health status of the household members. It is assumed that the own-farm produced and market-purchased food commodities as well as health inputs and leisure time of adult members increase the health status of the household members.

The farm output production conventionally depends on a set of variable and fixed factors. In addition to these factors, the human capital of the farm household is assumed to influence the farm production.

The farm production function for the own-farm produced food commodity can be specified as:

$$Q = Q\,(B, G, V, F; H, E) \quad (3)$$

Where Q is the value of farm output, which is the sum of the commodities used for own-consumption (X_a) and marketable surplus (N), B is the labour input of adult family members, G is the hired labour inputs, V is the vector of other variable inputs such as fertiliser, seeds, bullock labour, etc., F is the vector of fixed inputs namely area of land, capital, etc., H is the health status of adult members of the household and E is the vector of other human capital variables, namely education, extension contact, farming experience, etc., of adult members in the household. The agricultural output production function is assumed to be riskless. The prices P_a, P_m and P_z are assumed to be not affected by actions of the household. It is also assumed that the family labour and hired labour are perfect substitutes and can be added directly.

Family and hired labour are assumed to have the same effective labour function, but they are at different points of the function due to the difference in their intakes. Effective labour is specified with the help of efficiency wages literature (Bliss and Stern 1978a, 1978b). Effective labour is conceptualised as the product of labour hours and a function of efficiency per hour worked to calorie intake reflected in health status of the individual.

The effective family labour input days (B_E), depend upon the actual family labour input days (B) and calorie intake or the health status (H) of the adult members, can be specified as:

$$B_E = \theta\,(B, H) \quad (4)$$

Any change in the actual labour input (labour days) and health status of the individuals are assumed to increase their effective labour inputs. The efficiency per work hour function is often hypothesised to have a component that is increasing at an rising rate followed by a component increasing at a decreasing rate (Figure 1).

The health status of farm family members may be expected to increase the quantity of healthy days available for work or leisure. The total available healthy days may be used for own-farm production as labour inputs, for wage work and for leisure.

The time constraint can be written as:

$$B + M + L = T(H) \quad (5)$$

Where M is the total wage-work days of adult members of the farm household and T(H) is the total available healthy days.

Using (5), (4) can be rewritten as:

$$B_E = \theta\, [\, T(H) - M - L, H] \quad (6)$$

The budget constraint of the farm household is

$$P_aX_a + P_mX_m + P_zX_z = \pi + \sum WB_E + A \quad (7)$$

From (6) and (7), the budget constrained can be rewritten as:

$$P_aX_a + P_mX_m + P_zX_z = \pi + \sum W\, \theta\, [T(H) - M - L, H] + A \quad (8)$$

$$\text{or, } P_aX_a + P_mX_m + P_zX_z = Y^* \quad (9)$$

Where Y* is the full income (Becker 1965). The household is assumed to maximise the utility function (1) subject to budget constraint (8), which implicitly includes health (2), farm production (3) and time (6) constraints.

The Lagrangian function can be written as:

$$£ = U = U(X_a, X_m, L, H) - \lambda\, [P_aX_a + P_mX_m + P_zX_z - \pi - \sum W\, \theta\, [\, T(H) - M - L, H] - A] \quad (10)$$

From the first order conditions of optimisation, we get the marginal rates of substitution between own produced and market commodities are equal to their price ratio:

$$\frac{\delta U(.)}{\delta X_a} \Big/ \frac{\delta U(.)}{\delta X_m} = \frac{P_a}{P_m}$$

On the one hand, it indicates that the utility of the farm households is influenced directly by the changes in the consumption of own-farm produced commodities and leisure of adult members of the households, and indirectly through the changes in the health status of adult members. On the other hand, changes in the effective labour time and total healthy days available to the farm household members for leisure or work influence income of the household adult members indirectly.

Again, π is the farm profit, which can be measured as:

$$\Pi = P_a\, Q\,(B, G, V, F; H, E) - P_g\, G - P_v\, V - P_e\, E \quad (11)$$

Where, P_a is the price of output and P_g is the wages for hired labourers. P_v is the vector of prices for variable inputs like fertilisers, etc., and P_e is the vector of prices for other human capitals, such as education, extension programmes, etc.

Therefore, from the optimisation exercise, we get:

$$P_a\, \delta Q\,(.)/\delta\, G = P_g \quad (12)$$

$$P_a\, \delta Q\,(.)/\delta\, V = P_v \quad (13)$$

$$P_a\, \delta\, Q\,(.)/\delta E = P_e \quad (14)$$

Equations (12), (13) and (14) show that the household will equate the marginal revenue products for labour, fertiliser and other human capitals. The farm labour, fertilisers, health and other human capital demand can be determined as a function of prices (P_g, P_v and P_e), the technological parameters of the production function, and the fixed area of land and quantity of capital. As equations (12), (13) and (14) depict the standard conditions for profit maximisation, it can be concluded that the household's production decisions are consistent with profit maximisation and independent of the household's utility function.

Now, maximised value of profit can be put into equation (8) to yield:

$$P_aX_a + P_mX_m + P_zX_z = Y^* \quad (15)$$

Where Y* is the value of full income associated with profit-maximising behaviour. The whole optimisation system works in two ways: first, we maximise profits, and then, the household maximises utility subject to its full income incorporating the maximised value of profit into it.

The demand equations for the own-farm produced and market purchased commodities (X_a and X_m), leisure (L) and health status (H) of the adult male and female members of the household are derived from the utility maximisation exercise. They are expressed in the reduced form as:

$$X_a = f_{k1}\,(P_a, P_m, P_z, \pi, W, A, \mu)$$

$$X_m = f_{k2}\,(P_a, P_m, P_z, \pi, W, A, \mu)$$

$$L_j = f_{k3}\,(P_a, P_m, P_z, \pi, W, A, \mu)$$

$$H_j = f_{k5}\,(P_a, P_m, P_z, \pi, W, A, \mu) \quad (16)$$

III. SAMPLE DESIGN

Paucity of data required for this study necessitates a primary survey. We have conducted a survey during 2009-2010 (June 2009 to May 2010) at selected villages in West Bengal. A multi stage sampling is used to select the sample villages. Based on the agro-climatic conditions, National Sample Survey Organisation divided West Bengal into four regions, namely "Himalayan," "Eastern Plains," "Central Plains" and "Western Plains." Considering the proximity and feasibility to conduct a primary survey, the backward region, namely "Western Plains," and the developed region namely "Eastern Plains," are selected. From the "Western Plains" region, one backward district namely "Bankura" and one relatively developed district namely "East Midnapore" are selected. Similarly, from the "Eastern Plains," one developed district namely "Nadia" and one comparatively backward district namely "Birbhum" are selected.

At the second stage, blocks have been selected. Based on the information available in the Primary Census Abstract 2001, blocks are selected according to the percentages share of main workers (cultivators plus agricultural labourers) involved in agricultural activities to the total number of main workers. The blocks that show more than 50 percentages of total main workers involved in agricultural activities are considered. Thus, at least one block has been selected from each district.

At the third stage, villages are selected. Considering the time and resource constraints, villages are selected in each of the selected blocks at random. The local labour market characteristics, such as distance from the main road, distance from the market area, presence of any factory or cottage industries and so on, are kept in mind while selecting the villages. Given the nature of the field area in terms of employment, the households are selected at random. This is primarily because most of the households in rural West Bengal depend largely on agricultural practices. Finally, at the fourth stage, 676 respondents have been interviewed out of 350 sample households for this study.

IV. DESCRIPTIVE ANALYSIS

Income in rural areas is linked with access to cultivable land and health status of farmers. The analysis in this section is done with the help of statistical tables to show how the burden of loss of farm output varies across different group of individuals, indicating towards their economic well-being. The pattern and extent of loss of farm production due to illness across households by income quintiles, land size quintiles and farmers' health status indicated by BMI, self-rated health status and number of sick-days have already been discussed. Instead of its absolute physical quantity, the burden of loss of farm output at the household level is measured by its annual percentage share in total household expenditure (proxy for income) expressed in monetary terms. The burden is relevant particularly in the context of the economic opportunities in the sample villages of West Bengal, where agriculture is still the primary source of livelihood and occupations outside the agricultural sector are few in rural areas.

Health is considered as a factor that could significantly impact labour productivity and result in not only a reduced wage income for the farmer but also a reduction in farm output. Paddy is the main crop in the study areas, and it is undeniable that timing in each stage of paddy farming is important for optimum yield. For instance, sowing, if missed by a couple of days or weeks, may result in loss of output. This is why illness tends to be crucial for marginal and small farmers who work in their own field and cannot afford to hire alternative labour during the time of illness. However, it is also important, to a certain extent, to the relatively large farmers as the illness hampers their monitoring activity; this could lead to reduced production. The burden of loss of farm income, measured as a percentage of the household expenditure, is used to identify the most vulnerable group within the farmer community in terms of poverty. The household expenditure is used here as an alternative for household income. Hence, the economic well-being is measured by the monthly per capita expenditure, which is taken as a proxy for monthly per capita income.

Land based rural life is dependent not only on the size of land but also on the quality of it. The soil type does not vary substantially across the selected villages. However, availability of irrigation facilities influences the yield of paddy in the study area. Certain areas have also been found to be fallow and waste land. Hence, instead of total land size, the size of cultivable land or the area under cultivation accessed by the household on the date of survey has been taken into consideration. The average size of cultivable land accessed by each household is found to vary widely across income groups. Land size is found to be the smallest in the poorest income group (Table I).

It highlights the fact that in a rural set up where the livelihood depends largely on agriculture, the economic well-being of farmers is linked with the size of cultivable land they own or have access to. The loss of farm output due to illness is considerably high among the poorest of the poor group of individuals who are engaged in small or marginal farming. It is found that the loss incurred by the poorest individuals owning small size of land is primarily due to lack of appropriate alternatives to the family labour. On the contrary, the amount of loss of production for relatively large farmers is primarily because of the large landholding size and problems associated with large quantity of yield.

TABLE I

AVERAGE SIZE OF CULTIVABLE LAND, LOSS OF FARM PRODUCTION AND PERCENTAGE SHARE OF LOSS OF FARM PRODUCTION IN ANNUAL HOUSEHOLD EXPENDITURE FOR EACH MPCE QUINTILE GROUPS

MPCE (Quintiles)	Average size of cultivable land (in decimal points)*	Average of loss of farm production (in Kg)	% share of annual loss of farm production to annual household expenditure
Poorest income group	66.93	1214.00	21.93
Poor income group	118.38	995.26	16.29
Middle income group	99.38	442.91	7.95
Richer income group	193.33	615.93	6.20
Richest income group	247.44	1769.85	11.41

Note: * 52 decimal points = 1 Bigha; 3 Bighas = 1 acre.
Source: Field Survey.

The burden as measured by the percentage share of loss of farm output to the household expenditure is the highest among the poorest income group. The small landholding size coupled with considerably high burden of loss of production due to ailment heightens the vulnerability of the poorest group of individuals (Table I). Further, the bottom two quintiles of cultivable land size evidently show the highest burdens of production loss due to ailment. Interestingly, the highest absolute loss of farm output due to ailment is found to have been incurred by the households belonging to the group of the highest quintile of cultivable land size, though the burden of this loss is highest among the households belonging to the groups of bottom quintiles of the cultivable land size (Table II).

TABLE II

AVERAGE LOSS OF FARM PRODUCTION, PERCENTAGE SHARE OF ANNUAL LOSS OF FARM PRODUCTION IN ANNUAL HOUSEHOLD EXPENDITURE AND AVERAGE SIZE OF CULTIVABLE LAND IN EACH QUINTILE GROUPS OF LAND SIZE

Size of cultivable land (Quintiles)	Average of loss of farm production (in Kg)	% share of annual loss of farm production to annual household expenditure	Average size of cultivable land (in decimal points)
Smallest land size	494.15	9.69	23.35
Smaller land size	1527.17	25.40	45.26
Middle land size	294.28	04.87	91.13
Larger land size	1461.94	12.70	182.14
Largest land size	505.24	2.064	444.41

Note: * 52 decimal points = 1 Bigha; 3 Bighas = 1 acre.
Source: Field Survey.

For a better understanding, the households are categorised into four groups based on income and land size quintiles:(a) with lowest income and smallest size of cultivable land, (b) with lowest income and largest size of cultivable land, (c) with highest income and smallest size of cultivable land, and (d) with highest income and largest size of cultivable land. Rest of the households is included in the "others" category. It is clear that households belonging to the first category i.e., the households in the lowest quintiles of income and cultivable land size, are the most vulnerable group; they incur the highest burden of loss of farm production due to illness (Table III).

TABLE III
AVERAGE PERCENTAGE SHARE OF ANNUAL LOSS OF FARM PRODUCTION DUE TO ILLNESS IN THE ANNUAL HOUSEHOLD EXPENDITURE

Categories	Average of % share of annual loss of farm production to annual household expenditure
Poorest in income and with smallest size of cultivable land	13.44
Poorest in income with largest amount of cultivable land	5.58
Richest in income with smallest size of cultivable land	0.00
Richest in income with largest size of cultivable land	3.53
others	12.89

Source:.Field Survey.

The analysis so far has indicated the link between economic well-being and loss of farm output due to illness. However, the health status is indicated here by the number of sick-days, BMI (Body Mass Index) and the individual's perception of health as indicated by self-rated health status. The BMI and the number of sick-days do not vary widely across the income quintiles, but their impact varies widely across income group. Evidently, the poorest of the poor incurs the highest burden of loss of farm production due to ailment (Table IV).

The self-rated health status is further classified into three groups: (a) perception about health as good or very good, (b) perception about health as moderate, and (c) perception about health as poor or very poor. It is observed that within each category of perceptions, the poorest of the poor income group suffers from the highest burden of loss of farm output due to ailment (Table V).

TABLE IV

AVERAGE LOSS OF FARM PRODUCTION, PERCENTAGE SHARE OF ANNUAL LOSS OF FARM PRODUCTION DUE TO ILLNESS IN THE ANNUAL HOUSEHOLD EXPENDITURE AND BODY MASS INDEX (BMI) FOR EACH QUINTILE OF MPCE

MPCE (Quintiles)	Body Mass Index (BMI)	Average number of days lost due to illness	Average of loss of farm output (in Kg)	Average of % share of annual loss of farm production to annual household expenditure
Poorest income group	18.91	50.60	1253.93	24.92
Poor income group	18.99	44.80	1190.32	17.78
Middle income group	19.09	48.20	528.00	9.65
Richer income group	19.51	35.46	196.14	2.48
Richest income group	19.66	50.48	1527.55	9.18

Source: Field Survey.

TABLE V

AVERAGE LOSS OF FARM PRODUCTION, PERCENTAGE SHARE OF ANNUAL LOSS OF FARM OUTPUT DUE TO ILLNESS IN THE ANNUAL HOUSEHOLD EXPENDITURE BY EACH QUINTILE OF MPCE AND PERCEPTION ABOUT HEALTH

MPCE (Quintiles)	Average of loss of farm output (in Kg)	Average of % share of annual loss of farm production to annual household expenditure
Perception about health is good or very good		
Poorest income group	770.00	14.74
Poor income group	553.21	11.49
Middle income group	409.76	6.41
Richer income group	92.86	1.24
Richest income group	395.17	3.85
Perception about health is moderate		
Poorest income group	1135.08	25.96
Poor income group	672.20	13.96
Middle income group	362.33	8.43
Richer income group	202.52	2.57
Richest income group	1269.36	4.70

(Contd. Table V)

MPCE (Quintiles)	Average of loss of farm output (in Kg)	Average of % share of annual loss of farm production to annual household expenditure
Perception about health is bad or very bad		
Poorest income group	1643.75	27.51
Poor income group	2648.50	30.04
Middle income group	859.26	13.93
Richer income group	268.27	3.33
Richest income group	2694.50	17.57

Source: Field Survey.

The analysis hitherto has shown that the loss of agricultural output, though not the highest in absolute sense, generates the highest burden on the economic well-being in the poor income group. The profit (normalised) per unit of cultivable land varies across land size. In terms of the argument of land size-productivity, it is found that relatively large size of cultivable land often derives small amount of normalised profit (Table VI).

TABLE VI
AVERAGE OF NORMALISED PROFIT PER UNIT OF CULTIVABLE LAND SIZE AND AVERAGE SIZE OF CULTIVABLE LAND ACROSS QUINTILE GROUPS OF NORMALISED PROFIT PER UNIT OF LAND

Normalised profit per unit of cultivable land size in quintile groups	Mean value of normalised profit per unit of cultivable land size (in Rs)	Mean value of the cultivable land size (in decimal points)
Lowest quintile	4.60	266.26
Lower quintile	5.82	170.96
Middle quintile	7.47	214.68
Upper quintile	9.07	216.98
Upper most quintile	16.23	167.83

Source: Field Survey.

The average of normalised profit per unit of land size goes up with increase in land size for individuals belonging to the three middle quintiles of profit. However, in the case of the lowest and highest quintiles of normalised profit per unit of land, there is an inverse relationship with land size.

Ill health not only reduces labour productivity and the functioning ability of individual but it also hampers the agricultural output, particularly in the areas where the primary crop is labour intensive. For any health plan meant to render economic support to the small and marginal farmers to succeed, it should take the issue of farmers' livelihood into account.

V. ECONOMETRIC ANALYSIS

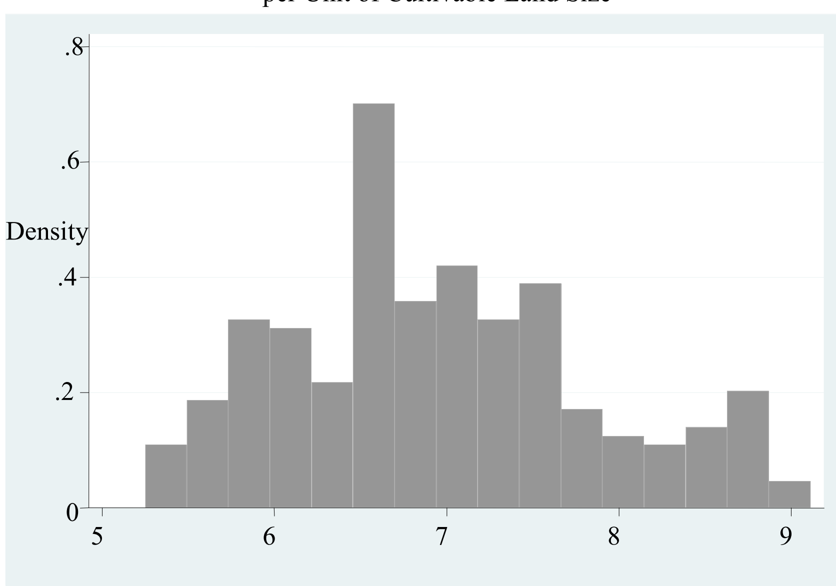
The model is based on the household production framework as discussed in Section II of this paper. In the previous section, we saw the effect of farm output on health. As implied by agricultural household model, an increase in sick-days is expected to reduce the marginal efficiency of farm operators, which, in turn, is expected to reduce the output. In order to estimate the effect of health on farm output, the study uses profit function approach, i.e., dual of the production function approach (Shaphard 1953, Uzawa 1964). It uses the normalised profit function. The rationale for using the normalised profit function lies with the evidence in literature, which suggests that it is handier from the theoretical and econometric points of view. The normalised profit function is obtained by dividing the ordinary profit function by the price of output. It is interesting to note that the application of Hottelings–Shephards Lemmas to the profit function provides the corresponding factor demand and output supply equations (Okoruwa, Akindeinda and Salimonu 2009).

A number of functional forms exist in literature for estimation of profit function. It includes the Cobb-Douglas and flexible functional forms such as normalised quadratic, normalised translog, generalised Leontief, etc. The Cobb-Douglas functional form is widely used to estimate farm production in spite of certain inherent limitations (Saleem 1988, Kalirajan and Obwona 1994, Dawson and Lingard 1991, Yilma 1996, Nsanzugwanko, Battesse and Fleming 1996, Battese and Safraz 1998). On the contrary, the translog form is widely used as well, though it has limitations, i.e., because of its susceptibility to multicollinearity and potential problems of insufficient degrees of freedom due to the presence of interaction terms, it often does not produce any economic meaning (Abdulai and Wallace 2000, Okoruwa *et al.* 2009). However, in the present context, the interaction terms are not found to be significant and therefore, Cobb-Douglas form has been found to be appropriate for the analysis.

We have incorporated explanatory variables which are widely used to estimate the farm profit function. In addition to the input-output information of farm production, information on health status of the farmers and on the local institution is incorporated in the model. Body Mass Index (BMI) and number of sick-days have been used to indicate the health status of respondent farmers. Participation in agriculture extension and demonstration programmes and distance from Krishi Vigyan Kendra (KVK) or agriculture extension office have been used to capture the impact of knowledge imparted by agricultural institutions on the farm production and profit. Local political environment or institutional arrangements were observed to play a crucial role. In particular, the role of Gram Panchayat in disbursing inputs for paddy cultivation, enabling access to labour market, credit, product market and, most importantly, access to land was found to be crucial. Hence, satisfaction about the functioning of Gram Panchayats as expressed by the respondents has also been included in the model.

The dependent variable viz., the normalised profit in its logarithmic form, takes the shape close to the normal distribution bar (Figure 1) when there is endogeneity present in the model, as we explained in the methodology section. It suggests that the model may be estimated using a Two-Stage Least Square one (2-SLS) method.

FIGURE 1: Distribution of the Dependent Variable – Logarithm of Normalised Profit per Unit of Cultivable Land Size



Logarithm of normalised profit

5.1 The Econometric Model

Deolalikar (1984) uses Zellner's Seemingly Unrelated Regression method to estimate the impact of health on farm production. However, as there has been no contemporaneous correlation present between the error terms, the present study follows profit function approach, which is also followed by Pitt and Rosenzweig (1986). In this study we specify the profit function in order to estimate the impact of health on farm profit and treat health status of the male and female farmers as endogenous variable. The normalised restricted profit function underlying the Cobb-Douglas form of production may be written as:

$$\ln \pi^*_t = \ln A^*_t + \sum^n_{i=1} \gamma_i \ln F_{it} + \sum^n_{i=1} \delta_i H_t + \theta_i E + u_i \quad (17)$$

where π^* is the normalised restricted profit per unit land, A^* is the neutral shift parameter, F_i is the vector of fixed variables such as land, H_t is the vector of health of males and females, E is the vector of other human capital variables such as age, education, participation in extension and demonstration programme and u_i is the random error term, which is assumed to be normally distributed with zero expectation and finite variance. The variables are normalised by paddy price. The model is estimated using 2-SLS technique.

5.2 Econometric Results

The estimation results obtained by taking two different types of health indicators namely BMI and Ill-days are presented in Tables VII and VIII respectively. The analysis is done for male and female farmers separately.

Body Mass Index, though, is an important determinant of normalised profit per unit of land for male farmers, for females it is not so (Table VII). However, number of sick-days has a significant and negative impact on profit for both the male and female farmers (Table VIII). It concurs with the literature wherein it is argued that agricultural labourers with BMI as low as 16 are found healthy and hard-working in India (Shetty 1988). In another study of 199 male conducted in Bangladesh, it was shown that the risk of illness rose sharply when BMI fell below 17 (Pryer 1990). Bangladesh being a neighbouring country sharing political border with West Bengal, it has many socio-cultural as well as geographic similarities with India, particularly the State of West Bengal. Therefore, the findings about BMI in Bangladesh are equally applicable to West Bengal Agricultural workers having BMI 16 or above are often found to be hard-working and functioning with vigour.

Price per unit of output, as expected, is found to be a positive and significant determinant of normalised profit per unit of land size. The distance from market place indicates the accessibility to the wholesale market for paddy, which is also a positive and significant determinant of profit. It was observed that late sale of produce made possible due to information about and accessibility to the market resulted in realising of relatively high selling price. As information and accessibility both depend largely on the distance the nearer the market, the bigger will be the profit.

As far as the social groups are concerned, scheduled tribes are likely to get less profit per unit of land size with reference to schedule caste male individuals. For females, it is the other way round. This is primarily because of the location of scheduled tribe villages. In our selected sample, schedule tribe individuals, both in Bankura and Birbhum districts, are concentrated in villages far from the river or canal irrigation facility and often without the facility of ground water irrigation as well. Apart from that, the relatively poor quality of soil here does not allow them reap the highest possible yield from high yielding varieties of paddy that most of the farmers use. However, this comparative scenario with reference to schedule caste individuals is different for women farmers primarily because of the cultural reasons that allow more active participation and access to land by a tribal woman than by a SC woman respondent.

In our sample, there were very few women who functioned as farmer or own farm worker. This paper focuses on the individuals who are the tillers of the soil not as mere labourers, but with some sort of ownership on land such as being complete owner, share cropper, bargadar, lease holder or tenant under some contract. As the present analysis focuses on farm production, profit and health, its scope is limited only to respondent farmers who enjoy at least some positive marketable surplus.

Thus, the total number of respondents under this category is 266, of which 210 are males and 56 are females. Out of the 56 female respondents in the present analysis, the numbers of OBCs, General and Muslim Minority categories are 3, 2 and 5 respectively, while 24 are from ST category (the largest group) in the sample. This is reflective of the ethos of tribal culture according to which women are more involved in economic activity and enjoy certain ownership on land compared to their counterparts in other caste and social groups. However, farmers of both OBC and general caste groups are to be reaping higher farm profit per unit of land than their counterparts in SC/ST category.

The land size is found to be a significant determinant of per unit of land farm profit with a non-linear impact. Increase in land size is significantly and positively associated with per unit land profit; however, it has a threshold level and hence the square term of land size shows a negative impact on the farm profit. The much celebrated argument regarding land size-productivity the in literature finds validation in the above case.

We intend to examine the impact of certain institutional and political factors on the farm profit, because agricultural outcomes are often dependent on the vagaries of the local rural political economy. We have incorporated three channels of institutional arrangements that may influence the farm production at the village level: (a) interventions through knowledge base upgradation as indicated by participation in agricultural extension programme, demonstration programme, existence of Krishi Vigyan Kendra (KVK) or Agricultural Extension Office (AEO), (b) impact through other rural developmental programmes such as MGNREGS aimed at improving the sustenance and maintenance of rural livelihood, and (c) political awareness and consciousness as indicated by participation in gram sabha, panchayat, etc., and satisfaction in the functioning of gram Panchayat as reflected in the statements of respondents.

Participation in agricultural extension programmes and demonstration programmes is considered to ascertain whether the knowledge disseminated through these institutional channels has any impact on farm production and profit. Presence of KVK or AEO is also an indicator of the effectiveness of agricultural institutions. It is found that participation in extension programme has a positive and significant effect on the farm profit both for male and female respondents. Presence of KVK, though weakly significant, is also found to have a positive impact on the farm profit. Satisfaction of respondents about the functioning of gram panchayat is specifically important in view of the overriding role of local politics in the matter of procuring inputs such as seeds, fertilisers, pesticides, insecticides, etc., through both the panchayat and agricultural extension offices. Though the functioning of panchayat and KVK or AEO is independent of each other and is not supposed to collude, there are implicit linkages often found between the two. Sometimes ruling party in the panchayat gets the privilege to decide about the beneficiary of government support and subsidies for agriculture from time to time. The results, however, rightly show that the satisfaction about gram panchayat is associated positively and significantly with the farm profit. This political nexus between the panchayat and the beneficiary at different levels operates through other schemes as well. For example, selection of workers for work under MGNREGS is also a local political decision. A significant finding of our study is that participation in MGNREGS often results in lack of attention in farm activity (owner or as labour) and results in reduction of farm profit per unit of land.

TABLE VII
IMPACT OF HEALTH ON FARM PROFIT (HEALTH INDICATOR: BMI)

2-SLS estimation	For All	For female	For male
Dependent variable	Logarithmic value of normalised profit per unit size of cultivable land		
Explanatory variables	Coeff. (Std. Err)	Coeff. (Std. Err)	Coeff. (Std. Err)
Body Mass Index (BMI)[1]	0.018 (0.028)	0.0002 (0.578)	0.0179 (0.303)
Price of per unit output	0.024*** (0.005)	0.091** (0.035)	0.0238*** (0.0050)
Distance from the market place	-0.069*** (0.014)	-0.089*** (0.028)	-0.0702*** (0.0168)
Schedule Tribe	-0.082 (0.071)	0.004 (0.094)	-0.0674 (0.0959)
Other backward caste	0.278*** (0.074)	-0.322* (0.169)	0.2361*** (0.0880)
General	0.441*** (0.072)	-0.851*** (0.267)	0.4057*** (0.0848)
Muslim minority	0.111[w] (0.074)	-0.176 (0.150)	0.0676 (0.0875)
Total cultivable land size	0.001*** (0.000)	0.001 (0.001)	0.0015*** (0.0005)
Squared term of cultivable land size	-0.0001*** (0.000)	-0.000 (0.000)	-0.0000** (0.0000)
Participation in extension programme	0.176*** (0.063)	0.421* (0.213)	0.1496** (0.0713)
Participation in demonstration programme	0.043 (0.056)	-0.131 (0.195)	0.0387 (0.0621)
Presence of KVK	0.076[w] (0.055)	0.059 (0.142)	0.0747 (0.0635)
Participation in MGNREGS	-0.060[w] (0.046)	0.124[w] (0.093)	-0.1140* (0.0579)
Satisfaction about Gram Panchayat	0.027* (0.042)	0.109* (0.062)	0.0499[w] (0.0519)
Backward region dummy	0.248*** (0.062)	0.127** (0.035)	0.201*** (0.003)

(Contd. Table VII)

2-SLS estimation	For All	For female	For male
Years of education	0.000	0.020*	0.0000
	(0.000)	(0.012)	(0.0000)
Male family labour	-0.001[w]	-0.002*	-0.0008[w]
	(0.000)	(0.001)	(0.0005)
Female family labour	-0.002***	0.000	-0.0025**
	(0.001)	(0.001)	(0.0010)
constant	2.001***	1.821***	1.7560***
	(0.419)	(0.578)	(0.5069)
	[1] instrumented		
No. of observations	266	56	210
Adjusted R^2	0.5844	0.6148	0.5367

Note: Standard errors are in parentheses. ***, ** and * indicate levels of significance at less than 1%, less than 5% and less than 10% respectively. [w]indicates weakly significant at less than 20 per cent.

TABLE VIII

IMPACT OF HEALTH ON FARM PROFIT (HEALTH INDICATOR: NUMBER OF ILL/SICK DAYS)

2-SLS estimation	For Male	For Female
Dependent variable	Logarithmic value of normalised profit per unit size of cultivable land	
Explanatory variables	Coeff. (Std. Err)	Coeff. (Std. Err)
Ill-days[1]	-0.0017*	-0.0029*
	(0.0007)	(0.0005)
Price of per unit output	0.0238***	0.1052**
	(0.0049)	(0.0498)
Distance from the market place	0.0745***	0.0516
	(0.0167)	(0.0568)
Schedule Tribe	-0.0507	0.0123
	(0.0990)	(0.1222)
Other backward caste	0.1985**	-0.1526
	(0.0933)	(0.2979)
General	0.3698***	-0.5670**
	(0.0900)	(0.2646)
Muslim minority	0.0629	-0.0652
	(0.0852)	(0.1686)

(Contd. Table VIII)

2-SLS estimation	For Male	For Female
Total cultivable land size	0.0015***	0.0018^{w}
	(0.0005)	(0.0015)
Squared term of cultivable land size	-0.0000**	-0.0000
	(0.0000)	(0.0000)
Participation in extension programme	0.1317*	0.2761
	(0.0711)	(0.4416)
Participation in demonstration programme	0.0482	0.2509
	(0.0617)	(0.7515)
Presence of KVK	0.0813^{w}	0.0562
	(0.0644)	(0.2483)
Participation in MGNREGS	-0.1223**	0.0652
	(0.0580)	(0.1324)
Satisfaction about Gram Panchayat	0.0537*	0.1263^{w}
	(0.0052)	(0.0818)
Years of education	0.0000	0.0098
	(0.0000)	(0.0228)
Male family labour	-0.0007^{w}	-0.0013
	(0.0005)	(0.0011)
Female family labour	-0.0025**	0.0001
	(0.0010)	(0.0015)
constant	1.8167***	1.1230**
	(0.1311)	(0.3903)
[1] instrumented		
No. of observations	210	56
Adjusted R^2	0.5312	0.3693

Note: Standard errors are in parentheses. ***, ** and * indicate levels of significance at less than 1%, less than 5% and less than 10% respectively. ^{w} indicates weakly significant at less than 20 per cent.

VI. SUMMARY AND CONCLUSION

This paper makes an attempt to link the health and farm production in a framework of agricultural household model. The profit function approach has been adopted to analyse the issue econometrically. The analysis is, however, done both with the help of descriptive tables and econometric tools. Health status is found to be an important determinant of farm profit. Number of sick-days reduces the farm profit significantly, but impact of BMI is not significant. The finding of this study is in line with the studies by Pitt and Roosenzweig (1986), but at variance with the study by Deolalikar (1988), wherein farm output was found to be highly elastic with the weight for height. As found by Shetty (1988) about India and Pryer (1990) about Bangladesh, individuals with BMI as low as 16 were found to be healthy and actively participating in agricultural work in the study area also. Though health is found to be a significant determinant of farm profit for the marginal farmers, for the farmers with relatively large holding of cultivable land it is not so. Coefficients of land size from the sample are in line with the established relationship between farm size and productivity. Interestingly, institutional factors such as participation in agricultural extension programme, distance from market place and presence of KVK in the village influence the farm profit significantly. Participation in MGNREGS is also significant and shows a negative impact on farm profit. It indicates that the disparity between agricultural wages and wages offered by MGNREGS programmes in the sample villages makes the farming activity less attractive and hence, increase in enrolment in MGNREGS work evidently has a negative impact on farm profit per unit of land size.

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