INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2006/08–6–783–787
http://www.fspublishers.org

Estimating Indicators of Higher Yield in Radish Cultivation

KHUDA BAKHSH[1], BASHIR AHMAD†, ZULFIQAR AHMAD GILL‡ AND SARFRAZ HASSAN†
†*Department of Environmental and Resource Economics, and* †*Development Economics, University of Agriculture, Faisalabad–38040, Pakistan*
[1]Corresponding author's e-mail: kbmultan@hotmail.com

ABSTRACT

The present study was designed to estimate the effects of various variables affecting radish yield. Two districts were selected for detailed information and a total of 97 radish growers were interviewed from these districts. Cobb-Douglas production function was applied and it was found that seed, fertilizer, labour used for weeding, education, availability of good quality seed and plant protection problems were all important factors affecting the yield of radish. Provision of good quality of seed and appropriate quantity of seed would increase radish yield, while educating the vegetable growers to adopt modern technology is an important factor that may result substantial rise in the production of vegetables.

Key Words: Cobb-Douglas production function; Factors; Yield; Radish; Punjab

INTRODUCTION

Pakistan being one of the agro-based developing countries possesses diverse climatic conditions, fertile land the world best canal irrigation system, etc. suitable for growing a variety of crops. In spite of all these endowments, Pakistan is facing shortage of food supply and has to import grains and other food items. It increases burden on the economy. Further the rising poverty in rural and urban areas has remained one of the serious problems effecting economic growth of Pakistan in recent years. The increasing rate of poverty in the country is associated with the lack of productive employment opportunities and malnutrition. Whatever little is earned, is spent on food and that is still insufficient. This results in serious malnutrition that further lowers labour productivity. According to AVRDC (2000) the root cause of micronutrient deficiency is the mono crop farming system and low employment opportunities. In Pakistan, wheat is a dominant crop in cropping pattern. Only two % of the total cropped area in Punjab province was under vegetables (Government of Punjab, 2000) compared to 15% in Taiwan (Ali, 2000). This means that a small quantity of vegetables per person per year is available from farm sources. Average annual per capita vegetable consumption was 45.6 kg in Pakistan (Government of Pakistan, 2001).

A variety of vegetables are cultivated in Pakistan. Potatoes, onions, tomatoes, melons and other cucurbits are some of the major vegetable species grown in Pakistan. Mainly vegetables are concentrated in the vicinities of big urban centers like Lahore, Karachi and Peshawar. Area and production of radish is concentrated in Sheikhupura around Lahore. Similarly production of potato is specialized in Okara, Sahiwal and Kasur around Lahore (Chaudhry & Ahmad, 2000).

The radish (*Raphanus sativus* L.) belongs to the family of Cruciferae. The radish probably originated in central and western China and the Indo-Pakistan subcontinent. Radish is a favourite crop for kitchen gardening, because it is easily grown and is ready for use in three to six weeks after sowing. It is grown for its fleshy edible roots, which are eaten raw as salad, or cooked as a vegetable. Radish has a cooling effect, prevents constipation increases appetite and is tasty. Radish contains mostly protein, sugar, vitamin C and other important nutrients. It is recommended to patients suffering from piles, liver trouble, enlarged spleen and jaundice. Its leaves are cooked as leafy vegetables in different forms and are very rich in minerals and vitamins A and C (Baloch, 1994).

Radish can be grown on all soil types, but grows well in light rich and moist soils. The major identified districts for radish production are Sheikhupura, Sahiwal, R.Y. Khan, T.T. Singh and Okara. According to an estimate Radish was sown on an area of 14729 acres, whereas the production was 111753 tonnes during 2001 - 02 (Government of Punjab, 2002).

Very little research effort has been made pertaining to the input use, seasonal pattern of production and other practices followed by the farmers and nurserymen for the production of radish vegetable. Similarly very little is known about the various factors affecting the radish yield. The above is perhaps being ignored due to the fact that radish is a minor crop and occupies a small proportion of the total cropped area in the country. Radish research is needed to explore the ways and means to put this remunerative industry on scientific lines and to ensure that it can bring prosperity to the growers on the one hand and to the country on the other.

The radish cultivation suits well for those, who possess small chunks of land holdings and the limited financial resources. Cultivation of this vegetable fetch huge amount of returns to such farmers in a short duration of time and enable these farmers to meet their day to day financial needs on one hand and provide essential nutrients on the

other hand. Keeping in view the monetary and dietary importance of radish vegetable, the present study was planned with an aim to investigate the direction and the extent of the effects of various factors that influence the production of this vegetable.

MATERIALS AND METHODS

Sampling and data collection. Radish is cultivated mostly in the surrounding of urban cities, where adequate marketing facilities and cheap labour force are easily available. The present study was confined to the irrigated areas of the Punjab province. For the purpose of this study, two districts were selected on the basis of area of concentration. Sheikhupura and Sahiwal, were the most important in terms of area and production of radish in Punjab. Share of Sheikhupura and Sahiwal in total radish area in the Punjab province was found to be 11.54 and 9.17%, respectively (Ahmad *et al.,* 2004). Sheikhupura district is situated in the Central Punjab and is one of the most important districts of Collar Tract, whereas Sahiwal district is among the districts of Cotton Belt in the Punjab Province. The climate of these districts is well suited for the radish cultivation. Two tehsils from each district were chosen for the purpose of data collection. Radish growing villages were selected with the consultation of Department of Agriculture in Sheikhupura and Sahiwal districts. The villages having the highest percentage of radish growers were selected. In this way, two villages each from Ferozewala Tehsil of Sheikhupura and Sahiwal and Chichawatni Tehsils of Sahiwal districts were taken, while three villages were taken from Sheikhupura Tehsil. A total of 97 farmers, 50 from Sheikhupura district and 47 from Sahiwal district were taken. The radish-growing farmers were purposively selected from the selected villages. Purpose sampling technique was employed, because of the fact that the area under radish vegetable was small in each village and the radish growers were scattered throughout the village. So, while considering the results and conclusions this short coming should be kept in mind. The survey was conducted in July-August 2003.

Radish was mainly grown around the surroundings of Mananwala in Tehsil Sheikhupura on Faisalabad-Sheikhupura Road. So, major portion of our sample comprised the respondents belonging to that particular area. Thirty-one respondents were interviewed from Sheikhupura and the remaining nineteen from Ferozewala Tehsil. In case of district Sahiwal, radish was grown in Tehsils of Sahiwal and Chichawatni. Farmers were concentrated predominantly around the cities of both Tehsils. Twenty-one farmers from Chichawatni and twenty-six from Sahiwal were taken.

A well structured, field pre-tested comprehensive interviewing schedule was used for the collection of detailed information on various aspects of radish. Survey data contained information on socio-economic characteristics of the farmers, land tenurial status, source of irrigation, management practices, input and output quantities etc.

Analytical framework. Various factors affecting the yield of radish during the survey were identified. To estimate the impact of these factors on the yield of radish, production function analysis was used to estimate the extent of effects of various factors influencing radish yield. Cobb-Douglas production function was used to determine the impact of various independent variables on yield due to its ease in computation and interpretation. Quantitative inputs such as seed, land preparation, irrigation, labour used for weeding and fertilizer were included in the function. Farmyard manure was not incorporated in the function, because the respondents of radish growers made no use of farmyard manure. Also, a number of qualitative variables were included in the model in order to take into account yield variation due to these variables. Important factors affecting yield were incorporated in the analysis many were still left out.

Consider the following Cobb-Douglas production function in general form:

$$y_i = \prod_{i=1}^{m} \chi_{ij}^{b_i} e^{u_i}$$

Where,

i = 1, 2, …., m are inputs; j = 1, 2, ….., n are farms, y_i is output of the j-th farm; χ_{ij} is the level of i-th input on the j-th farm, b_i are the parameters to be estimated, u_i is error term and e is the natural exponent (Ali & Chaudhry, 1990). We can write the above production function in log linear form as:

$$\ln y = A + \sum_{i=1}^{m} b_i \ln \chi_{ij} + \mu$$

Where,

A = lna and all other notations are as previously defined.

Land preparation, seed, fertilizer, irrigation, plant protection measures and labour used for weeding were included in the function and a positive influence on radish yield was expected for these variables. Farm size could have positive or negative effect on the radish yield, because as increase in farm size results economies of scale and it is also possible that modern technology would be applied, on the other hand, the possibility exists that with increased farm size, farmers would not be able to manage the farm more efficiently due to the limited resource availability or lack of knowledge, information and education especially technically one. Sowing method and varieties could have positive or negative effects, while in the case of education a positive effect could result. As a priori a negative sign was expected for disease attack and inadequate availability of good quality seed. More detail is given in Table I.

Despite incorporation of these factors affecting yield many were still left out. Existence of positive correlation between incorporated inputs and missing variables are likely to result in an up-ward bias to co-efficient estimation of the

inputs included in the model. Moreover, data are based on farmer's willingness and memory. Inputs are usually over-estimated and output is often underestimated. The results reported in this study may be viewed under these limitations.

RESULTS AND DISCUSSION

Descriptive statistics. The present study seeks to explore the influence of various factors affecting the radish yield in the economy of Punjab, Pakistan. Data gathered from Sheikhupura and Sahiwal was analyzed. Descriptive statistics are given in Table II. Descriptive statistics are followed by the results of production function analysis.

The radish growing farmers were obtaining the yield in the range of 2400 kg per acre to 9440 kg per acre with an average of 6068 kg per acre. This shows that there exists a large gap between minimum and maximum yield per acre of the selected respondents and there is a dire need to minimize this gap.

Tractor hours used to prepare seed beds for radish cultivation were calculated and they ranged between 1.75 to 8.50 h per acre having an average of 5.6 h. A viable certified seed of any crop improves the yield per acre. Three types of varieties namely local *Japanese* and *Chinese* varieties were reported in the study area. Method of sowing is an important factor in radish production. It was recorded during the survey that 22 respondents were adopting kera method, while the remaining were using pora and/or broadcast methods in the selected districts. Maximum number of pesticide and weedicide applied were four in number with an average of 1.40 per acre. Chemical fertilizer is an important input for higher production of radish vegetable. The maximum amount of fertilizer (NP) applied was estimated as 105 kg per acre and the minimum was 9 kg per acre only, while the overall average stood at 51 kg per acre. This result showed a lot of variation in the application of fertilizer among the radish growers. Number of irrigation ranged from 3 to 10 with overall average of 5.76 number of irrigation per acre. Labour used to eradicate weeds from the radish field was 16 and 256 h per acre as minimum and maximum, respectively while the average labour hours were estimated at 84.7 h per acre.

Farm size is an indicative of availability of resources and their impact on productivity. The small farmers have an advantage in labour availability over large farmers. However, small farmers have the limited financial resources and they are not ready to take risk. The land holding of the sampled farmers ranged between 2 - 62 acres with an average of 16.68 acres.

The level of education of farmers is likely to influence the ability and rate at which farmers adopt new technology. It was recorded that the respondents having primary and above primary education were 55 in numbers in both districts.

Production function analysis. Cobb-Douglas production function was used to estimate the effects of various factors influencing radish yield. Our main interest was to investigate the direction and the extent of various factors affecting the radish yield. Value of F test indicated that our overall model was significantly different from zero highlighting that the variables included in the model were substantially explaining the radish yield per acre. Similarly, value of R^2 (0.52) was quiet good for our cross sectional data showing that 52% variation in the yield was due to independent variables that were incorporated in the multiple regression equation. The individual significance of the independent variables is explained below and given in Table III. Although statistically non-significant, the estimate for the coefficient of land preparation (LnLP) was negative depicting that the more use of tractor hours would decrease the radish yield. However, a positive sign was expected for this variable. The reason may be that the farmers applied more number of tractor hours for land preparation, while the nature of the crop and type of soil were such that growing radish required less number of tractor hours. Quantity of seed determines the population density in the field. The appropriate quantity of seed coupled with other inputs increases output to a great extent. The value of coefficient of quantity of seed (LnSEED) was significant and had a positive sign as it was expected. The value was found to be 0.260. This indicated that one % increase in the seed rate of radish increased yield of radish by 0.260% meaning thereby that well populated fields increased per acre yield. Vegetables need substantial amounts of nutrients in the form of either organic or inorganic. It was reported that the radish growers were not applying farmyard manure and were making only the use of chemical fertilizer. Results of the production function concluded that the coefficient of fertilizer (LnFERT) was 0.116 and it was highly significant, whereas the sign of the coefficient of this variable was according to our expectation. It indicated that on an average one % increase in fertilizer nutrients (kg) could cause an increase in the yield of radish by 0.116%. Studies indicated that seed and fertilizer increased vegetable yields substantially (Ahmad *et al.,* 2003; Bakhsh *et al.,* 2004; Ahmad *et al.,* 2005; Bakhsh *et al.,* 2005) and our findings are in full agreement with these studies. The coefficient of irrigation (LnIRRI) was -0.100, the direction of the effect of this variable was opposite to priori; however, it was statistically non-significant. It indicated that each additional number of irrigation could result a decrease in the yield of radish by 0.100%. It was due to the fact that the radish-growing farmers were over irrigating the radish fields. It was also observed that some respondents were applying sewerage water. This practice also affected badly the radish yield. Bakhsh and Hassan (2005 & 2005a) determined that the application of sewage water influenced the radish yield substantially. Moreover, Ahmad *et al.* (2005) conducted detailed study on carrot in the districts of Sheikhupura and Kasur and concluded that the irrigation had negative effect on carrot cultivation and they reported that this effect

Table I. Definition of variables

Variable	Description	Expected sign
LnYLD	Natural logarithm of yield of radish in Kg per acre	
LnLP	Natural logarithm of number of tractor hours for land preparation	+
LnSEED	Natural logarithm of seed rate in Kg per acre	+
LnFERT	Natural logarithm of fertilizer nutrients in Kg per acre	+
LnIRRI	Natural logarithm of number of irrigation per acre	+
LnPPM	Natural logarithm of number of plant protection measures per acre	+
LnWEED	Natural logarithm of labour hours for weeding per acre	+
LnFRMSZ	Natural logarithm of farm size in acre	±
DSWMTHD	Dummy variable for sowing method. It was taken as 1 if kera method was adopted otherwise zero	±
DVJAPAN	Dummy variable for Japanese variety. It was taken as 1 if Japanese variety was planted otherwise zero	±
DVCHIN	Dummy variable for Chinese variety. It was taken as 1 if Chinese variety was planted otherwise zero	±
DEDUC	Dummy variable for education. It was taken as 1 if the farmer was educated otherwise zero	+
DQLTYSED	Dummy variable for inadequate availability of good quality seed. It was taken as 1 if this problem was reported otherwise zero	-
DINSDISAT	Dummy variable for insect or disease attack. It was taken as 1 if this problem was reported otherwise zero	-

resulted due to poor quality of ground water. The coefficient of plant protection measures (LnPPM) had a negative sign and was statistically non-significant; however a positive effect was expected for this variable. The value of coefficient was -0.028. This implied that each additional pesticide application was decreasing the yield of radish by 0.028%. The negative influence of plant protection measure on the yield may be because of its excessive application without consulting any expert (Table III).

It is a priori that the labour used to control weeds in any field crop increases output. In our case, it was estimated that the direction of the effect of weeding was according to our expectation. The coefficient of weeding (LnWEED) was significant at seven % probability level. The value was 0.054 indicating that one % increase in labor hours used for weeding could cause an increase in the yield by 0.054%. The coefficient of farm size (LnFRMSZ) was negative (-0.087) showing that an increase in farm size declined yield of radish. Chattha (2005) estimated that the small farmers growing vegetables were more efficient as compared to the large farmers. The major reason was non-availability of labour force to carry out different farm operations and inadequate availability of financial resources. However, its coefficient was statistically non-significant. The coefficient for the kera method of sowing dummy variable (DSWMTHD) had a positive value indicating that kera method gave higher yield over the other methods of sowing, however its coefficient was statistically non-significant. The coefficients of dummy variables for Japanese (DVJAPAN) and Chinese (DVCHIN) varieties were negative indicating that Desi Varieties i.e. White and Red had edge over Japanese and Chinese varieties. The dummy variable of education (DEDUC) had a positive coefficient as expected and was statistically significant at six % probability level. Many studies showed that education had a positive effect on the farm production and adoption of modern inputs and technology (Jamison & Lau, 1982; Cotlear, 1990; Raza & Ramachandran, 1990; World Bank, 1991; Lin, 1991; Tilak, 1992; Ali & Hau, 2001). The dummy for inadequate availability of good seed (DQLTYSEED) was negative according to priori and was significant at two % significance level. Non-availability or inadequate availability of radish seed was a serious problem in the selected districts particularly in Sahiwal district. The coefficient of dummy variable for plant protection problems (DINSDISATT) was also negative and its value was –0.134. This coefficient was statistically significant (Table III). Plant protection problems included disease and insect attacks on the radish crop. This result indicated that the radish yield decreased by 0.134% due to these problems. Disease and insect attacks problems

Table II. Descriptive Statistics of Various Variables

Variables	Mean	Standard deviation	Minimum	Maximum
Yield (kg/ac)	6068	35.73	2400	9440
Land preparation (tractor hours/ac)	5.6	1.20	1.75	8.50
Seed (kg/ac)	1.43	0.46	0.75	2.50
Fertilizer (kg/ac)	51	23.25	9	105
Irrigation (no./ac)	5.76	1.76	3	10
Plant protection measure (no./ac)	1.40	1.38	0	4
Weeding (labour hours/ac)	84.7	57.70	16	256
Farm size (ac)	16.68	16.06	2	62
Adopting kera method (no.)	22	-	-	-
Sowing Japanese variety (no.)	33	-	-	-
Sowing Chinese variety (no.)	15	-	-	-
Educated farmers (no.)	55	-	-	-
Claiming about seed quality (no.)	38	-	-	-
Claiming disease attack (no.)	43	-	-	-

Table III. Estimates of Cobb-Douglas Type Production Function

Variable	Parameter	Standard Error	T-value	Significance
Constant	8.352	0.228	36.648	0.000
LnLP	-0.044	0.081	-0.554	0.581
LnSEED	0.260	0.071	3.670	0.000
LnFERT	0.116	0.038	3.045	0.003
LnIRRI	-0.100	0.079	-1.266	0.209
LnPPM	-0.028	0.054	-0.518	0.606
LnWEED	0.054	0.030	1.839	0.070
LnFRMSZ	-0.087	0.026	-0.340	0.735
DSWMTHD	0.006	0.057	0.121	0.904
DVJAPAN	-0.098	0.056	-1.748	0.084
DVCHINA	-0.084	0.068	-1.231	0.222
DEDUC	0.088	0.042	1.923	0.058
DQLTYSEED	-0.095	0.043	-2.236	0.028
DINSDISATT	-0.134	0.045	-2.993	0.004
No. of observation				97
R^2				0.52
Adjusted R^2				0.48
F value				7.86

(Dependent variable= Ln of radish yield in kg per acre)

were more serious in Sahiwal district.

CONCLUSIONS AND SUGGESTIONS

Results of production function analysis showed that seed played an important role in increasing the yield of radish. The more use of seed means the more number of plants per acre and hence, the more yield of radish. Appropriate use of seed should be applied to obtain higher output and in turn maximum income from growing this enterprise.

The use of fertilizer nutrients positively affected the yield of radish. On the basis of this result, the farmers can increase the yield of radish by applying more quantity of nitrogen and phosphorus nutrients.

The radish crop is sensitive to disease and insect attacks. Diagnosis of disease and insect attack at the right time is the foremost element in crop management practices. A delay may cause disaster to the crop and ultimately the producer will suffer from it. After diagnosis, the selection and dose of pesticide required for specific attack is the next important step in crop management. Consulting the extension staff or any other specialist in this field may help in the right selection and application of pesticide.

Weeds in any crop negatively affect the production. The production function results indicated that weeding practicing was important in increasing the yield of radish. Therefore, it is suggested that radish growers should use more labour for weeding to get higher yields.

Planting of Japanese and Chinese varieties were reported in the sampled districts. Production function analysis indicated that the coefficients of these varieties were negative. It may be due to improper time of sowing and low quantities of seed and fertilizer. Moreover, sowing was also an important factor affecting radish yield on the selected farms. The radish growers adopting kera method was obtaining higher yield as compared to other methods of sowing. So, it is suggested that extension workers should emphasize to introduce new technologies and modern practices including sowing methods to the radish growers. They should motivate the farmers to plant different varieties at their appropriate time. In this way, the above-mentioned varieties could cause increase in the yield of radish. There is also a need to evolve high yielding and disease resistant varieties of radish. These varieties should suit existing climatic conditions of different radish growing districts. Tested technologies for timely radish planting need to be promoted.

It was concluded from the production function that the non-availability of good quality seed was a serious factor causing a decline in the radish production in the study areas. Mixing of poor quality seeds with the healthy ones was the crucial problem for the radish growers. At present, Deputy District Officer (Agriculture) is responsible for checking the quality of pesticide. His role should be strengthened and broadened to check malpractices prevailing in agricultural marketing.

REFERENCES

Ahmad, B., S. Hassan and K. Bakhsh, 2005. Factors affecting yield and profitability of carrot in two districts of Punjab. *Int. J. Agric. Biol*., 5: 794–8

Ahmad, B., K. Bakhsh and S. Hassan, 2004. *Economics of Growing Radish*. Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad

Ahmad, B., K. Bakhsh, S. Hassan and S.B. Khokhar, 2003. *Economics of Growing Muskmelon*. Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad

Ali, M., 2000. *Dynamics of Vegetable Production, Distribution and Consumption in Asia*, P: 13. Asian Vegetable Research and Development Center, Tainan, Taiwan

Ali, M. and M.A. Chaudhry, 1990. Inter-regional farm efficiency in Pakistan's Punjab: A frontier production function study. *J. Agric. Econo*., 41: 62–74

Ali, M. and V.T.H. Hau, 2001. *Vegetables in Bangladesh: Economic and Nutritional Impact of New Varieties and Technologies*. Asian Vegetable Research and Development Center, Tainan, Taiwan

Asian Vegetable Research and Development Center (AVRDC), 2000. *AVRDC-USAID Bangladesh Project*: *Introduction and Development of Adaptive Technologies for Sustainable Year-round Vegetable Production and Consumption in Bangladesh*. AVRDC-USAID Bangladesh project completion report. AVRDC (Tainan, Taiwan)/Asian Regional Center (Bangkok, Thailand)/Bangladesh Agriculture Research Institute

Bakhsh, K. and S. Hassan, 2005. Use of sewage water for radish cultivation: a case study of Punjab, Pakistan. *J. Agric. Soc. Sci*., 4: 322–6

Bakhsh, K. and S. Hassan, 2005a. Assessment of the impact of sewage water on radish yield in Punjab: A use of dummy. *Proceedings of 1st International Conference on Environmentally Sustainable Development, Abbatabad, Pakistan*, III: 792–8

Bakhsh, K., M. Ashfaq and M.W.A. Chattha, 2005. Effects of poor quality of ground water on carrot production: A comparative study. *J. Agric. Soc. Sci*., 1: 52–4

Bakhsh, K., W. Akram, M.A. Raza and I. Hassan, 2004. Determination of factors affecting cauliflower cultivation. *Int. J. Agric. Biol*., 2: 36–8

Baloch, A.F., 1994. *Vegetable Crops*. Horticulture, National Book Foundation, Islamabad

Chattha, M.W.A., 2005. Economics of growing summer vegetables. *M.Sc. Thesis*, Department of Agricultural Economics, University of Agriculture, Faisalabad, Pakistan

Chaudhry, M.G. and B. Ahmad, 2000. *Dynamics of Vegetable Production, Distribution and Consumption in Pakistan*. Asian Vegetable Research and Development Center, Tainan, Taiwan

Cotlear, D., 1990. The effects of education on farm productivity. *In*: Griffin, K. and J. Knight (eds.), *Human Development and the International Development Strategy for the 1990s*, Macmillan, London

Government of Pakistan, 2001. *Agricultural Statistics of Pakistan 2000 - 01*. Ministry of Food, Agriculture, Livestock, Food, Agriculture and Livestock Division (Economic Wing), Islamabad

Government of Punjab, 2002. *Directorate of Agriculture*, Crop Reporting Service, Punjab, Lahore, Pakistan

Government of Punjab, 2000. *Punjab Development Statistics*, Bureau of Statistics, Lahore, Pakistan

Jamison, D.T. and L.J. Lau, 1982. *Farmer Education and Farm Efficiency*. The Johns Hopkins University Press, Baltimore

Lin, J.Y., 1991. Education and innovation adoption in agriculture: Evidence from Hybrid rice in China. *American J. Agric. Econ*, 73

Raza, M. and H. Ramachandran, 1990. *Schooling and Rural Transformation*. Vikas Publishing House Pvt. Ltd., New Delhi

Tilak, J.B.G., 1992. *Education and its Relation to Economic Growth, Poverty and Income Distribution*. Discussion paper No. 46, World Bank Comparative Studies: The political economy of poverty, equity and growth, Research paper No. 3. The World Bank, Washington, D.C., U.S.A

World Bank, 1991. *World Development Report*. Washington, D.C., U.S.A

(Received 04 May 2006; Accepted 09 July 2006)