Economic Affairs: 58(4): 325-336 December, 2013 **DOI Number** 10.5958/J.0976-4666.58.4.016

Impact of Sustainable Soil Management Practices on Tomato M (*Lycopersicon esculentum*, Mill) production in Dhading District of Nepal

Binod Ghimire[1] and Shiva Chandra Dhakal[2]

[1]Agriculture Extension Officer, Ministry of Agricultural Development(MoAD), Government of Nepal, Nepal
[2]Assistant Professor (Department of Agricultural Economics) Institute of Agriculture and Animal Science (IAAS) Rampur, Chitwan, Nepal

Email: nepal_dhakal@ymail.com

Paper no: 84 **Received:** 12 August, 2013 **Revised:** 20 October, 2013 **Accepted:** 18 December, 2013

Abstract

Sustainable management of soil is a benchmark of organic and sustainable agriculture. A research on economic impact of sustainable soil management practices on tomato production in Dhading district of Nepal was carried out in 2012 where sustainable soil management (SSM) program was successfully launched for five years. Altogether, 60 tomato producers were selected randomly for the study. Primary data were obtained using pre-tested semi-structured interview schedule, focus group discussion and key informant interview. Per ropani expenditure on seed, manure and average cost in tomato production were found significantly increased whereas, cost of chemical fertilizers, cost of pesticides and total cost were significantly decreased after the adoption of SSM practices as compared to before adopting SSM practices. Gross margin was higher by NRs.1472.31 compared to before SSM practices. Similarly, B: C ratio was significantly higher by 0.32 after using SSM practices whereas, return to scale was 1.098 and 0.719 for after and before adopting SSM practices respectively. Cobb-Douglas production function revealed human labor and organic manure for after SSM practices and seed including organic manure for before SSM practices as the significant factors determining tomato production. All the resources were not utilized to optimum economic level in tomato production and for optimum allocation human labor, expenditure on seed and organic manure is required to increase by 42.1 per cent, 64.1 per cent, 79.6 per cent respectively whereas, expenditure on chemical inputs is required to decrease by 137.1 per cent. For healthy soil and environment and achieving sustainable production and quality product farmers were adopting SSM practices.

Keywords: Cobb-Douglas, Economic impact, Return to scale, Sustainable soil management, Tomato

Introduction

The diverse agro-climatic conditions of Nepal both among the different ecological regions and within an ecological region have provided nearly unlimited scope for growing all types of vegetables throughout the year. The total area, production and productivity of the vegetable in Nepal are 245037 ha, 3298816 mt. and 13.46 ton/ha respectively and the contribution of vegetables in AGDP is 20.74% (MoAD, 2012). Horticultural crops are important and indispensable components of farming systems in Nepal, providing human nutrition, employment, cash generation and environmental protection, and can benefit not only commercial farmers but also low income and other disadvantaged groups (Subedi *et al*., 1998). Increasing human health consciousness and market demand, vegetable farming has tremendous potential for commercialization in Nepal. Tomato, cauliflower, cabbage, cucumber, onion and chili are the major off-season vegetables of Nepal. Among them, the cultivation of tomato, cauliflower, and cabbage are the most popular and the most profitable (NARC, 2006). Although, the Terai region produces and sells more vegetables, vegetables grown in the hilly region have greater value; these vegetables are produced during the rainy season when prices are higher (Prasai, 2011).

Dhading district, one of the potential hilly districts in vegetable production of Nepal has topped for supplying highest quantity of vegetables to capital city for last eight consecutive years. Its contribution in total vegetable supply to *Kalimati* vegetable market, Kathmandu was 17.68 percent in 2012/13 with total supply of 41,555 Mt. including 7,560 tons of tomato, 8,533 tons of cauliflower, 2,588 tons of beans and 2,752 tons of bitter gourd (KFVMDB, 2012). The total production of vegetables in Dhading district in year 2011/12 is 74797 metric tons under total area of 6051 hectare with the yield of 12361 kg/ha (MoAD, 2012). Tomato is one of the most commonly grown vegetable in Dhading district. Sustainable Soil Management Program (SSMP) targets improvements in soil fertility and productivity in rain fed upland-dominated farming systems in the mid hills of Nepal with the aim of increasing food production, food security and farm incomes (SSMP, 2009). SSM practices includes improved farm yard manure, improved cattle sheds and urine use, legume integration, use of bio-pesticide, botanical pesticides, integrated plant nutrient systems, fodder promotion for livestock, SSM-based vegetable production etc.

The general objective of this research was to assess the economic impact of sustainable soil management practices on tomato production However, the specific objectives were;

i. To identify socio-demographic information of selected tomato producers.

ii. To compare cost and return in tomato production before and after adoption of SSM practices.

iii. To determine the factors affecting the production of tomato before and after adoption of SSM practices.

iv. To analyze resource use efficiency in tomato production.

v. To find out the reasons of adopting SSM practices among producers.

Materials and Methods

Study area, Sample Size and Data Collection Procedure

Salang VDC of Dhading district of Nepal was purposively selected for the study. Altogether, 60 tomato producers adopting sustainable soil management practices were taken for the study using simple random sampling technique. The field survey was conducted in June, 2012. Semi-structured interview schedule was prepared and survey was conducted to collect primary data of the year 2011. Focus group discussion and key informant survey were also carried out. The final analysis was done by using computer software Statistical Package for Social Sciences (SPSS), Microsoft Excel and STATA 12

Gross Margin Analysis

Gross margin analysis is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprise in the case of small scale subsistence agriculture. Gross margin analysis is one of the methods of calculating profitability of small scale cropping enterprises (Olukosi *et al.*, 2006).

Gross margin was calculated as;

Gross Margin (NRs.) = Gross farm income (NRs.) - Total variable cost (NRs.)

Where, Gross income (NRs.) = Price of tomato (NRs.) × total quantity sold (Kg.)

Total variable cost (NRs.) = Summation of cost on all variable inputs.

Benefit Cost Analysis

Benefit cost analysis was done using the total variable cost and gross return from the cultivated vegetable. Cost of production was calculated by summing all the variable cost items in the production process. For calculating gross return, income from the sale was accounted. Thus the benefit cost analysis was carried out by using formula;

$$B/C\ ratio = \frac{Gross\ return\ (NRs.)}{Total\ variable\ cost\ (NRs.)}$$

For the impact evaluation, before-after approach was used for the study. Paired t-test was applied to test the mean difference of cost and return items in the production of tomato before and after the adoption of SSM practices in the study site.

Production function and return to scale analysis

The Cobb-Douglas type of production function was used in this study as it is the most widely used in the agricultural research and is convenient for the comparison of the partial elasticity coefficient (Prajneshu, 2008). The following form of Cobb- Douglas production function was used to determine the contribution of different factors on production and to estimate the efficiency of the variable factors of producing tomato before and after the adoption of SSM practices.

$Y= aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}e^u$

Where,

Y= Total tomato production (Kg.)

X_1= Labor (Man-days)

X_2= Expenditure on seed (NRs.)

X_3= Expenditure on Chemical inputs (NRs.)

X_4= Organic manure (*Doko*)

u = Random disturbance term and b_1 ...b_4 are the coefficient to be estimated.

The Cobb- Douglas production function in the form expressed above was linearised in to a logarithmic function with a view of getting a form amenable to practical purposes as expresses below;

$\ln Y= \ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+u$

Where,

ln= Natural logarithm, a= constant and u= Error term

 Print ISSN: 0424-2513 Online ISSN: 0976-4666

Table 1: Descriptions of the variables used in the Cobb-Douglas production function analysis

Variables	Unit	Description
Tomato production	Kg	It indicates the total production of tomato in kilogram.
Hired human labor	Man-days	It includes total hired human labor for tomato production
Expenditure on seed	NRs.	This includes total expenditure on seed for tomato production.
Expenditure on chemical inputs	NRs.	It includes the total expenditure on chemical inputs used in tomato production i.e expenditure on chemical fertilizers, chemical pesticides and micronutrients.
Organic manure	*Doko*	It indicates the total quantity of organic manure i.e FYM in *doko* used for tomato production.

For the calculation of return to scale from tomato cultivation before and after SSM practices, Cobb-Douglas production function was used and calculated using formula;

Return to scale (RTS)= "b_i

Where, $b_{i =}$ Coefficient of i^{th} variables.

Resource use Efficiency

The efficiency of resource use in production of tomato was determined by the ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of variable inputs based on the estimated regression coefficients. Following, Rahman and Lawal (2003) efficiency of resource use was calculated using formula;

r= MVP/MFC

Where,

r= Efficiency ratio

MVP= Marginal value product of a variable input.

MFC= Marginal factor cost (Price per unit input)

The value of MVP was estimated using the regression coefficient of each input and the price of the output.

MVP= MPPxi × Py (Unit price of output)

But, MPPxi= dy/dxi = biy^ / X^i

Where; bi= Estimated regression coefficient of input Xi

y>= Arithmatic mean value of output.

x>i = Arithmatic mean value of input being considered.

The prevailing market price of input was used as the Marginal Factor Cost (MFC).

MFC= Pxi Where, Pxi= Unit price of input xi.

The decision rule for the efficiency analysis was as;

r=1; Efficient use of a resource

$r>1$; Underutilization of a resource

$r<1$; Overutilization of a resource

Again the relative percentage change in MVP of each resource required so as to obtain optimal resource allocation i.e r=1 or MVP= MFC was estimated using the following equation below;

$D= (1-MFC/MVP) \times 100$

Or, $D= (1-1/r)\times 100$

Where, D= absolute value of percentage change in MVP of each resource and r = efficiency ratio.

Results and Discussion

Socio-demographic Features of Sampled Households

In the study area, out of 369 total sampled population male populations was 53.65 percent and was higher than the female population i.e. 46.35 percent. Average family size was 6.15 and was higher than the national average 4.5 (CBS, 2011). About 62 percent of the study population was economically active as classified by the Government of Nepal and agriculture was the major occupation of those economically active populations. About 82 percent of household were male headed and 65 percent of the household were found with nuclear family and remaining only 35 percent were living jointly. About 64 percent were found literate while others 36 percent were illiterate. Higher illiteracy rate may be due to poor economic status and geographical situation of the study area. The Socio-demographic feature of the sampled household is presented in table 2.

Table 2: Socio-demographic features of the study area

Characteristics	Salang (n=60)
Sampled population	
Male	198(53.65)
Female	171(46.35)
Average Family size	6.15
Total	369(100)
Age group of the sampled population	
d”15 years	113(19.24)
16-59 years	197(62.15)
e”60 years	59(18.61)
Gender of the household head	
Male	49(81.67)
Female	11(18.33)
Family type	
Joint	25(41.67)
Nuclear	35(58.33)
Education level of sampled population	
Illiterate	132(35.77)
Literate	237(64.23)

Figures in parentheses indicate percentage *Source: Field survey 2012*

Economics of tomato production before and after adopting SSM practices

Area of tomato under cultivation was significantly increased by 0.64 ropani after adopting SSM practices. No significant different on labor cost was found as there was decreased in cost by NRs. 49.33. Other cost items like expenditure on seed, total manure cost, expenditure on chemical fertilizers, expenditure on pesticides, total cost of production and average cost were significant difference at 1% and 5% level of significance. Expenditure on seed and cost of manure was increased by NRs. 71.25 and 676.85 respectively after the adoption of SSM practices. Likewise, per ropani expenditure on chemical fertilizers, pesticides and total cost of cultivation were decreased by NRs. 580.87, NRs. 525.86 and NRs. 342.16 respectively. Per ropani total cost of cultivation of tomato was significantly lower by NRs. 342.16 after the adoption of SSM practices. Mehamood *et al.*, (2011) also resulted per acre cost of production of organic wheat system was lesser than inorganic. Finding of Kawasaki and Fujimoto (2009) also support this result which concluded lower total cost of production of organic Yard long bean compared to conventional system. The average cost (NRs./kg) was significantly higher by NRs. 1.04 after practicing SSM than before (Table 3).

Similarly, table 4 depicted that productivity (qtl/ropani) and benefit cost ratio were significant different before and after adopting SSM Practices. Productivity of tomato was decreased by 0.56 quintal per ropani after practicing SSM. This finding is in line with the finding of Kshirsagar (2006) who reported that the organic farmers realized 7.17 percent lower yield than inorganic farmers in India. Gross margin (NRs./ropani) was significantly increased by NRs. 1472.31 whereas; gross income (NRs./ropani) was insignificant and increased by NRs. 1130.15. The benefit cost ratio was also significantly increased by 0.32 after practicing SSM in the study area. This result agrees with the findings of Kawasaki and Fujimoto (2009) that the B:C ratio of organic yard long bean production was higher(1.9) compared to conventional (1.5). Also Naik (2010) reported higher B: C ratio of tomato and chilli production on organic farms compared to inorganic farms.

Table 3: Comparative cost of tomato cultivation before and after SSM practices in the study area

Particulars	After SSMP	Before SSMP	Mean Difference	t-value	Level of Significance
Area (Ropani)	2.49	3.13	0.64***	4.846	0.0000
Labor Cost (NRs./Ropani)	1486.49	1535.83	-49.33	1.211	0.1152
Cost of Seed (NRs./Ropani)	364.52	293.27	71.24***	4.467	0.0000
Total Manure cost (NRs./Ropani)	2705.39	2028.53	676.85***	7.9801	0.0000
Cost of Chemical fertilizer (NRs./Ropani)	448.19	1029.06	-580.87***	-12.764	0.0000
Cost of pesticides (NRs./Ropani)	200.43	726.30	-525.86***	-13.784	0.0000
Total cost of cultivation (NRs./Ropani)	5769.15	6111.31	-342.16**	-2.059	0.0219
Average cost (NRs./Kg)	12.906	11.85	1.04**	1.935	0.0288

*** Significant at 1% level *Source: Field survey 2012*
** Significant at 5% level
SSMP= Sustainable soil management program
NRs.= Nepali rupees

Table 4: Comparative return from tomato cultivation before and after SSM practices in the study area

Particulars	After SSMP	Before SSMP	Mean Difference	t-value	Level of Significance
Productivity (qtl/Ropani)	5.08	5.64	-0.56**	-1.766	0.0413
Gross Income (NRs./Ropani)	17684.93	16554.78	1130.15	1.042	0.1507
Gross margin (NRs./Ropani)	11915.78	10443.47	1472.31	1.496	0.0700
B:C Ratio	3.13	2.81	0.32***	2.500	0.0076

*** Significant at 1% level *Source: Field survey 2012*
** Significant at 5% level
SSMP= Sustainable soil management program

Factors Affecting Tomato Production Before and After Adopting SSM Practices

The coefficient of multiple determinations (R^2) of the Cobb-Douglas regression function was 0.62 and 0.59 for after and before SSMP respectively. R^2 value of 0.62 for after SSM practices indicates that 62 percent of the variation in yield was explained by the independent variables which were included in the model. This value was 59 percent for before SSM practices.

The F- values of the equation derived for after and before SSM practices were 22.17 and 19.97 which were highly significant at 1% level implying that the variation of yield mainly depends on the explanatory variables included in the model. The estimated value of coefficients and related statistics of Cobb-Douglas production function were presented in table 5.

Hired Human Labor (X_1)

It was clear from the model that the coefficient of hired human labor after adopting SSMP was 0.182 which was positive and significant at 5% level of confidence indicating that 1 percent increase in the use of hired human labor, keeping other factors constant would increase the production of tomato by 0.182 per cent. In case of tomato cultivation before SSM practices, coefficient of hired human labor was positive but non-significant. Similar to this, Dodamani *et al.* (2009) reported that Cobb-Douglas production function estimates output elasticities of human labour, land and farm yard manure was significant but seed, bullock labor, biopesticides and trichord were positive but insignificant. But the result contradicts with the findings of Stephen *et al.*, (2004), who studied resource use efficiency in cowpea production and resulted inverse relationship between labour use and output.

Expenditure on seed (X_2)

The coefficients of expenditure on seed were positive for both before and after SSM practices. For before the coefficient was 0.380 and was significant at 5% level of confidence which indicates that keeping all other factor constant, 1% increase in expenditure on seed would increase the yield of tomato by 0.380 per cent. But in case of after SSM practices seed cost was non-significant.

Print ISSN: 0424-2513 Online ISSN: 0976-4666

Table 5: Estimated coefficients and their related statistics of production function for tomato in the study area

Explanatory variables	After SSMP	Before SSMP		
	Coefficient	t-value	Coefficient	t-value
Constant	1.342(0.602)	2.23	4.060(1.583)	2.56
Human labor (X_1)	0.182(0.096)**	1.88	0.156(0.098)	1.58
Seed cost (X_2)	0.062(0.133)	0.47	0.380(0.127)**	2.97
Chemical inputs (X_3)	0.105(0.078)	1.35	-0.345(0.251)	-1.38
Organic manure (X_4)	0.750(0.159)***	4.71	0.528(0.129)***	4.07
R^2	0.617		0.592	
F-value	22.17		19.97	
Return to Scale (“bi)	1.098		0.719	

Figure in parentheses indicate standard error. *Source: Field survey 2012*
SSMP= Sustainable soil management program
*** Significant at 1% level
** Significant at 5% level

Expenditure on chemical inputs (X_3)

Coefficients of expenditure on chemical inputs were non-significant for both before and after SSMP. In case of before SSMP the value of coefficient was 0.345 and was negative which indicates that 1% increase in expenditure on chemical inputs, keeping all other factors constant there would be decrease in production by 0.345 per cent. But for after SSM practices, the coefficient value was 0.105 and was positive (Table 5). Similar to this finding, Tambo and Gbemu (2010) reported fertilizer as non significant factor of tomato production in Ghana. Also using Cobb-Douglas production function, Khayer *et al.,* (2011) found the regression coefficient of human labour, draft power, cost of seed and cost of fertilizer positive and significant for bottle gourd and beans production.

Organic manure (X_4)

The regression coefficients of organic manure were positive and significant at 1% level of confidence for both before and after SSM practices. It indicates that keeping all other factors constant, a unit increase in organic manure would increase yield of tomato by 0.750 and 0.525 percent for after and before SSM practices respectively (Table 5). Similar to this, Akter *et al*., (2011) using revenue type of Cobb-Douglas production function resulted manure cost as significant factor in tomato production.

Return to Scale

The summation of all the regression coefficients of the estimated production function of tomato for after and before SSM practices were 1.098 and 0.719 respectively (Table 5). This result implies that the production function for before SSM practices exhibits decreasing return to scale and for after SSM practices exhibits constant return to scale. In this case if all the variables specified in the production function were increased by one percent, production of tomato would increase by 1.098 percent and 0.719 percent for after and before SSM practices respectively. Similarly, Khayer *et al.*, (2011) resulted decreasing return to scale in bottle gourd and bean production with value 0.676 and 0.709 respectively. Similarly, Akter *et al.*, (2011) also reported decreasing return to scale in tomato production with value 0.571.

Resource use efficiency and required adjustment in Marginal Value Product (MVP) of each resource in tomato production.

The ratio of the MVP to MFC was greater than unity for all the variable inputs in tomato production except in expenditure on chemical inputs after adopting SSM practices as presented in table 6. This implies that expenditure on chemical inputs in tomato production was over utilized whereas, human labor, expenditure on seed and organic manure were underutilized. Result showed that all the inputs were not utilized to optimum economic advantage. There is need for adjustment in the marginal value product of all the inputs to ensure optimal use.

Table 6: Estimated resource use efficiency and required adjustment in Marginal Value Product (MVP) in percentage for tomato production in the study area

Variable inputs	Coefficient value	MVP	MFC	r	D
Human labor (Man-days)	0.182	517.75	300	1.73	42.1
Expenditure on seed (NRs.)	0.062	2.78	1	2.78	64.1
Expenditure on chemical inputs (NRs.)	0.105	0.42	1	0.42	137.1
Organic Manure (*Doko*)	0.750	375.14	76.41	4.91	79.6

MVP= Marginal Value Product *Source: Field survey 2012*
MFC= Marginal Factor Cost
r= Efficiency ratio (MVP/MFC)
D= Absolute value of percentage change in MVP of each resource

Result revealed that human labor, seed and organic manure were underutilized whereas chemical inputs was over utilized by the producers in tomato production. For optimum use of resources in tomato production, human labor, expenditure on seed and organic manure is required to increase by 42.1 per cent, 64.1 per cent and 79.6 percent respectively whereas, expenditure on chemical inputs is required to decrease by 137.1 percent to achieve optimum economic advantage (Table 6). Similar to this, Tambo and Gbemu (2010), reported that seed, land, hired labor, fertilizer and pesticides were underutilized in tomato production in Ghana. Also, Kehinde *et al.,* (2012) reported underutilization of seed and overutilization of family and hired human labor in quality protein maize production in Nigeria. Likewise, for optimum allocation of resources more than 88 percent increase in fertilizer, 76 percent in labor and 30 percent in agrochemicals was needed whereas, 127 percent and 114 percent reduction was required for seed and irrigation for sorghum production in India (Chapke *et* al., 2011).

Although there is huge reduction in chemical inputs after the adoption of SSM practices compared to before, there needs further reduction of this input to reach optimum level in tomato production. For adjustment of resources in tomato production, human labor is also needed to increase and this will also help to provide employment to local people.

Reasons of adopting sustainable soil management practices for vegetable production in the study area

Behind the adoption of any agricultural practices there lies numbers of reasons. The reasons for adopting SSM practices for the cultivation of vegetables by ignoring conventional system were obtained from the sampled farmers by conducting opinion survey and the results are presented in the Table 7.

 Print ISSN: 0424-2513 Online ISSN: 0976-4666

Table 7: Reasons for adopting sustainable soil management practices for vegetable production in the study area

Reasons for adoption of SSM Practices	Frequency/ Percentage
For sustainable production	119(99.1)
For healthy soil and environment	118(98.3)
Minimize side effects on health and quality product	117(97.5)
Due to decline in soil fertility and addition of organic matter	116(96.7)
Due to external support training, subsidy, etc	98(81.7)
Due to expensive inorganic inputs/For minimizing cost	83(69.2)
For higher yield	82(68.3)
For higher price	74(61.7)
For adaptation to climatic adversities	59(49.2)
For more employment	54(45.0)

Figures in parentheses indicate percentage *Source:* *Field survey 2012*

Table 7 depicted that 100.0 percent of sampled farmers expressed for healthy soil and environment as a reason of adopting SSM practices. This finding is exactly in line with the finding of Karki *et al.,* (2011) which concluded environmental awareness of farmers is most important factor responsible for conversion to organic production in Nepal. Whereas, 98.3 percent of the sampled farmers expressed the reason of adopting sustainable soil management practices was for sustainable production of vegetable and to minimize side effects on health and quality product. This finding is similar with that of Sarker and Itohara (2008) in Bangladesh which concluded health consciousness as motivational factor in adoption of organic system.

About 96.7 percent put opinion due to decline in soil fertility and addition of soil organic matter. Kafle (2007) also reported production of healthy vegetables as first reason followed by maintenance of soil fertility as a reason for adoption of organic vegetable production.

Due to external support; training, subsidy, etc was the reason for 83.3 percent of household and due to expensive inorganic inputs for 66.7 percent. For higher yield, higher price, adaptation to climatic adversities and employment was the reason for 71.7, 56.7, 45.0 and 40.0 percent of the household respectively.

Conclusion

Tomato production is one of the indispensable components of vegetable farming system in Dhading district of Nepal. Adoption of SSM technology in the study area had reduced the amount of fertilizer and pesticides use in tomato production and this had result an increase in net income. The adoption of SSM practices had been found quite effective and successful in the study area and had offered several positive impacts in tomato production as compared to conventional system. Human labor, cost of seed, cost of chemical inputs and organic manure were the determining factors in tomato production. Resources aren't utilized to their optimum level and there is a great scope of increasing tomato production such that tomato farmers of the study area are suggested to use resources to their optimum level. The study has concluded that the tomato cultivation using sustainable soil management practices is a highly profitable enterprise in the study area. In case of after SSM practices, decreased cost of production with higher benefit, higher return to scale and required increase in labor and organic manure for adjustment in resource for tomato production shows opportunities of employment as labor to the rural populace. As farmers were adopting SSM practices as a reason for sustainable production and for healthy soil and environment will lead to continuation of the practices and minimize soil and environmental hazards. The adoption of SSM practices had been found quite effective, economically viable and successful in the study area compared to conventional system which can be used as alternative to expensive chemical inputs. Thus, realizing the positive impact of the SSM practices in tomato production, its further extension to produce diverse crops in different district of the country is suggested.

Acknowledgement

We are thankful to Academic Dean, IAAS (Institute of Agriculture and Animal Science) Chitwan, Nepal, Department of Agricultural Economics (IAAS), SSMP, HELVETAS, Nepal and respondents of the study site for providing their valuable time and genuine information.

References

Akter, S., M. S. Islam and M. S. Rahman. 2011. An economic analysis of winter vegetable production in some selected areas of Narsingdi district. *Journal of Bangladesh Agriculture University* **9**(2): 241-246.

CBS. 2011. Population census report. Central Bureau of Statistics, Singha Durbar, Kathmandu Nepal. pp. 120-268

Chapke, R. R., B. Mondal and J. S. Mishra. 2011. Resource use efficiency of sorghum production in Rice- fallows in Andhra Pradesh. *Indian Journal of Human Ecology* **34**(2): 87-90.

Dodamani, M. T., L. B. Kunnal and H. Basavarja. 2009. Resource use efficiency in organically produced naturally cotton under contract farming. *Karanata Journal of Agriculture Science*, **22**(5):1041-1045.

Kafle, B. 2007. Diffusion of organic vegetable production in phoolbari VDC of Chitwan district, Nepal. Thesis M.Sc.(Sg). Institute of Agriculture and Animal Science (IAAS), Department of Agriculture Extension and Rural Sociology Rampur, Chitwan Nepal.

KFVMDB. 2012. Annual report. Kalimati Fruit and Vegetable Market Development Board. Ministry of Agricultural Development, Kathmandu, Nepal.

Karki, L., S. Rosa and H. Ulrich. 2011. Factors influencing conversion to organic farming in Nepalese tea farms. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, **112**(2):113-123.

Kawasaki, J. and F. Akimi. 2009. Economic and technical assessment of organic vegetable farming in comparision with other production systems in Chiang Mai, Thiland. *Journal of ISSAAS* **15**(1):144-169.

Kehinde, F. T., J. O. Olukosi, A. L. Ala, M. A. Maikasuwa and A. A. Odunsi. 2012. Determinants of the level of resource use efficiency in quality protein maize production in Kaduna State, Nigeria. *International Journal of Applied Agricultural and Apicultural Research*. **8**(2): 24-30.

Khayer, U., S. Akhtar and R. K. Mondal. 2011. Comparative economics of bean and bottle gourd production in some selected areas of Bangladesh. *Developing Country Studies*, **1**(2):35-37.

Kshirsagar, K. G. 2006. Organic sugarcane farming for development of sustainable agriculture in Maharastra. *Journal of Agriculture Ecology*, **19**:145-153.

Mehamood, Y., M. B. Anjum, M. Sabir and M. Arshad. 2011. Benefit cost ratio of organic and inorganic wheat production: a case study of district Sheikhupura. Journal of world applied Science 13(1): 175-180.

MoAD. 2012. Statistical information on Nepalese agriculture. Ministry of Agriculture and Development. Agri-Business Promotion and Statistics Division (ABPSD), Kathmandu, Nepal.

Naik, V. R. 2010. Comparative economics of vegetable production under organic and inorganic farming in Belgum district.Unpublished M.Sc. Thesis. University of Agricultural Science. Dharwad, India.

NARC. 2006. A Quarterly Newsletter of Nepal Agricultural Research Council (NARC) from April-June 2006. Vol. 13 No. 2.

Olukosi, J. O., S. U. Isitor, and M. O. Ode. 2006. Introduction to agricultural marketing and prices: principle and application. Living Book Series, GU publications Abuja, 115 p.

Prajneshu, G. 2008. Fitting of Cobb-Douglas production functions: Revisited.Agricultural Economics Research Review. 21: 289-292.

Prasai, S. 2011. Nepal produces veggies worth NRs. 45 billion annuallyhttp://www.ekantipur.com/the-kathmandu-post/2011/02/15/money/nepal-produces-veggiesworth-rs-45-billion-annually report/218494.html; Retrieved on (27th March, 2013).

Rahman, S. A. and A. B. Lawal. 2003. Economic analysis of maize based cropping systems in Giwi local Government area of Kaduna state, Nigeria. *An international Journal of Agriculture Science Environment and Technology*, **3**(2): 139-148.

SSMP. 2009. Farmer Profiles from the Mid-hills of Nepal. Sustainable Soil Management Program, Kathmandu, Nepal. 112p.

Sarker, A. and Y. Itohara. 2008. Factors influencing the extent of practice of organic farming technologies: A case study of Tangail District in Bangladesh.

Subedi, P. P., H. B. Gurung, T. B. Gurung, P. P. Subedi and Y. D. G.C. 1998. Constraints to production and marketing of fresh fruits and vegetables in the western development region of Nepal. In Proceeding of first National Horticulture Research Workshop. 1-2 May, Nepal Agriculture Research Council.

Tambo, J. A. and G. Theresa. 2010. Resource use efficiency in Tomato production in the Dangme West District, Ghana. In proceeding of International Research on Food Security, Natural Resource Management and Rural Development,14-16 September, 2010.