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Prospects of Adopting Eco-Friendly Measures of Soil Sustainability among Vegetable Producers in Dhading, Nepal

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Abstract:
Using simple random sampling technique, primary data were collected from 120 vegetable producers in Dhading district of Nepal with aid of pre-tested semi-structured interview schedule. Household income analysis resulted increased in income from vegetable farming significantly by 35.21% with increased area of 2.24 Ropani after adopting measures of soil sustainability. Among four different soil sustainability measures used for the study, use of improved FYM (99.17%) was highly adopted followed by improved cattle shed and urine use, legume integration and use of botanical pesticides. Scaling technique ranked problems of high cost of constructing house for dung storage, lack of improved cattle shed lack of detailed knowledge and unavailability of raw materials as the most severe on the adoption of improved FYM, use of cattle urine, legume integration and use of botanical pesticides respectively. About 75% of farmers were found satisfied with the measures and 69.2% were willing to continue and promote in the future. Observation in neighbors (96.7%) was the most motivating factor of adoption. Adoption had changed cropping pattern and varieties and showed positive impact on livestock sector, women empowerment, soil properties, crop diversification, utilization of local resources and climatic hazards in the study area.

Keywords: Vegetable, Soil sustainability, Scaling, Adoption, Nepal.

1.0 Introduction:
Sustainable soil management is important, both directly and indirectly, to crop productivity, environmental sustainability and human health affecting cropping systems, food security, nutrition, incomes, and livelihoods. The challenge for agriculture over the coming decades will be to meet the world's increasing demand for food in a sustainable way. Declining soil fertility and mismanagement of plant nutrients have made this task more difficult as these are the most important biophysical constraints for increasing agricultural productivity. Smallholder agriculture in much of the low-income tropics is nonetheless characterized by widespread failure to make sufficient soil fertility replenishment and soil conservation investments in order to sustain the quality of farmland (World Bank, 2003). The need to enhance food production while maintaining the agricultural resource base and the resilience of the agro ecosystem is most important to address in the foreseeable future.

Accelerated soil erosion and decline in soil fertility are the major constraints to agricultural production in many areas of Nepal. In Nepal, excessive application of chemical fertilizers and pesticides is causing the partial desertification in many pocket areas of agriculture. The indiscriminate use of chemical fertilizers increases soil acidification, impairs soil physical condition, reduces organic matter content, creates micro nutrient deficiencies, increases susceptibility to pests and diseases, decreases soil lives, increases soil, water and air pollution via agricultural runoff and leaching (Joshi and Singh, 2004). Among commercial vegetable growers in Dhading district extremely hazardous pesticides are being used in vegetables which were banned for normal agriculture use by Government of Nepal (Shrestha et al., 2010). Sustainable practices seek to ensure the future of agriculture by promoting environmental stewardship, generating an acceptable level of income, and maintaining stable farm families and communities (SARE, 2002). Soil conservation practices are the techniques that are built on integrating local resources and indigenous knowledge farmers have gained from long period of time (Dumanski et al., 2006). These practices are primarily concerned with judicious application of agriculture inputs without deteriorating the soil quality (Regmi et al., 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. SSM based agriculture is cost effective, affordable and does not require expensive technical investment but provides more employment opportunity. It is a viable solution for preventing global hunger by providing comparatively higher yields from low input agriculture in food deficit regions (Leu, 2004).

As food safety, rich soil fertility status and environment protection with organic farming is today's concern; the findings of this study will contribute to the overall practical aspects of sustainable soil management, environment protection, ecological balance as well as rural development efforts by maintaining healthy people, plants, animals and the environment. This study would also furnish some kind of conclusion, recommendation and feedback, which could be useful basis for future research and also in planning, implementing and evaluating a development-oriented policy and programs for all sectors engaged in soil management, environmental protection, food security and livelihood improvement. The objectives of this research work were to

a) Analyse impact of soil sustainability measures on household income among vegetable producers.
b) Explore status and challenges on adopting different practices of soil sustainability among the adopters.
c) Identify the satisfaction level and factors motivating the adoption.
d) Study overall impacts of adopting soil sustainability measures on household and farming system.

2.0 Materials and Methods:

2.1 Sampling Procedure and Data:

The simple random sampling technique was used in the study. Two Village Development Committees namely; Nalang and Salang from Dhading district, Nepal were selected. In total 120 vegetable farmers of which 60 from each VDC adopting eco-friendly measures of soil sustainability were randomly selected. It should be noted here that initially population lists of adopters from the selected area was collected from the concerned officials of Sustainable soil management project (SSMP).

2.2 Field Survey:

The primary data was collected through household survey from May to June, 2012**.** The semi-structured interview schedule was constructed to ask for details about the crop production, household income, status, impact and constraints on adoption of soil sustainability measures etc.

2.3 Data Analysis:

The survey data were analyzed to obtain summaries, averages, frequency counts and percentage of the important data pertaining to farm families. The data entered in Microsoft Excel, were then transferred to another computer package STATA 12 for using Paired t-test and scaling technique. Household income analysis among the adopters of soil sustainability measures was done by comparing mean with before-after approach using paired t-test. Challenges faced by farmers on the adoption of soil sustainability measures were ranked by the help of scaling technique comparing intensity of severity using scale values 1, (1-1/n), (1-2/n), (1-3/n) and so on where;
n= Number of categories in ranking.
And the calculation was done using formula;

$$I = \sum S_i f_i / N$$

Where,

I = index $0 \angle I \angle 1$
Si = scale value at i^{th} severity
fi= frequency of the i^{th} severity
N = total number of respondents = ∑fi

3.0 Result and Discussions:

3.1 Household Income Analysis:

Table 1 presents the comparison of household income before and after the adoption of eco-friendly measures of soil sustainability. The off farm income considered the income except from the farm such as services, business, pension etc. Using paired sample t-test, on farm income, off farm income and total household income were found significant different after the adoption of such practices. In total, the share of farm income in total household income increased from 44.7 percent to 47.3 percent whereas off farm income decreased from 55.3 percent to 52.7 percent. Similarly, the household income analysis further revealed that 35.21 percent significantly increased in total income from vegetable farming after the adoption of measures compared to before. This increased in income may be due to reduction in cost of production of vegetable with minimized use of chemical fertilizers and pesticides and increased use of locally available resources in the study area. Finding is in line with the result of (Sharma, 2011).

3.2 Status of Adopting Different Measures of Soil Sustainability:

The study revealed that majority of household was practicing different methods of soil sustainability which were taken under study. Improved FYM practice was best adopted by the sampled household which was 99.17 percent. Similarly, 85 percent of the sampled household adopted improved cattle shed and urine use practice followed by legume integration (82.5%) and use of botanical pesticides (63.33%). The lower percentage of adoption of botanical pesticides may be due to the complexity of preparation and unavailability of local resources for its preparation.

Table 1: Household income before and after adopting eco-friendly measures of soil sustainability in the study area (2012)

Terms	After Adoption	Before Adoption	Mean difference	t-value	P value
On farm income(NRs)	82158.3(47.3)	65966.7(44.7)	16191.7***	11.453	0.000
Off farm income(NRs)	91458.3(52.7)	81475.0(55.3)	99883.3***	4.824	0.000
Household income(NRs)	173616.7(100)	147441.7(100)	26175.0***	10.775	0.000
Income from vegetable(NRs)	72183.3(41.6)	53383.3(36.2)	18800	14.876	0.000
% increase in income = 35.21%					
df (degree of freedom) = 119					

Figures in parentheses indicate percentage share, *** Significant at 1%

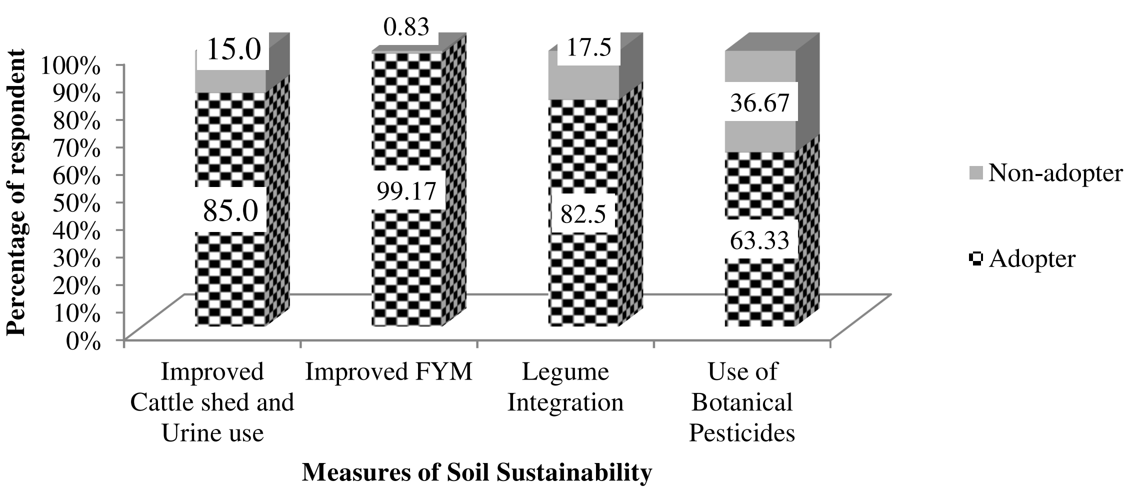

Figure 1: Status of Adopting sustainable soil management practices by the sampled household in the study area (2012)

3.3 Constraints/ Challenges on Adopting Different Measures of Soil Sustainability:

3.3.1 Constraints on Adopting Improved FYM Practice:

Table 1 above concluded that the improved FYM was highly adopted among the practices of soil sustainability. On the adoption of this practice, responded ranked high cost for constructing house for dung storage as the major problem (Table 2). Since the dung storage process in the study area was of traditional type and to adopt this needs high cost for constructing house. Similarly, complex process for using improved practices was ranked as second severe problems. Proper use of FYM needs great knowledge to preserve its nutrient such that respondent put lack of trainings as the third most severe problems of adoption. Lastly the unavailability of labor was ranked as least severe one.

3.3.2 Constraints in the Collection and Use of Cattle Urine:

From table 2, it could be drawn that the sampled farmers expressed lack of improved shed was the major problem for the collection and use of cattle urine. The cattle sheds were of traditional type and the rain water caused the urine drain away due to lack of improved shed in the study area. Similarly, difficulty in time to time collection was ranked as the second major problem. Expensive plastic drum was the third most followed by mixing of urine with other farm products like grass, straw etc.

3.3.3 Constraints on Adopting Legume Integration Practice:

Legume integration practice plays important role in maintaining continuous soil fertility. When respondent were asked to specify problems of adopting such practice, they ranked lack of knowledge as the major one. Lacking knowledge about the different legumes and their nutrient supplying capacity was the factors hindering its adoption by the vegetable growers. Likewise, unavailability of legume seeds on time was the second major problem. Following them, increased cost of production and small farm size were responded as third and the least severe (table 2).

Table 2: Constraints/problems on the adoption of different practices of soil sustainability in the study area (2012)

S.N	Problems	Index value	Rank
A.	**Adoption of Improved FYM practices**		
1.	High cost for constructing house for dung storage	0.74	I
2.	Complex process	0.61	II
3.	Lack of trainings	0.49	III
4.	Labor unavailability	0.17	IV
B.	**Collection and use of cattle urine**		
1.	Lack of improved shed	0.78	I
2.	Difficulty in time to time collection	0.65	II
3.	Expensive plastic drum	0.31	III
4.	Mixing with other farm products	0.27	IV
C.	**Adopting legume integration practice**		
1.	Lack of knowledge	0.67	I
2.	Unavailability of legumes seed on time	0.55	II
3.	Increases cost of production	0.48	III
4.	Small farm size	0.30	IV
D.	**Adopting botanical pesticides application practice**		
1.	Unavailability of raw materials	0.76	I
2.	No control of disease and pest	0.49	II
3.	Lack of knowledge and trainings	0.41	III
4.	Difficult to handle and use	0.35	IV

3.3.4 Constraints in Adopting Use of Botanical Pesticides:

Botanical pesticide preparation and application in vegetables controls the overuse of chemical pesticides and is the means of organic farming. Adopters in the study area pointed unavailability of raw materials for the preparation of botanical pesticides and ranked as a major constraint on adoption. Similarly, no control of disease and pest was pointed as the second most following lack of knowledge and trainings and difficulty in handling and use in the study area (table 2).

3.4 Satisfaction Level of Respondents on Sustainable Soil Management Practices:

Figure 2 revealed that the major percentage of the sampled respondent in the study area was satisfied with the eco-friendly measures of sustainable soil management. Study showed that 27.5 percent of the respondents were highly satisfied with the practices. Similarly, majority of the respondents i.e. 47.5 per cent were satisfied with the practices. The reason for high level of satisfaction was may be due to increased household income, low cost of vegetable production and high net income compared to conventional vegetable production. No respondents were strongly dissatisfied with the measures.

3.5 Willingness to Continue and Promote SSM Practices:

Sustainability of any technologies lies behind the willingness of farmers to adopt, continue and to promote such practices. In this study, majority of sampled household were positively willing to continue and promote the practices. About 69 percent of household were willing to continue and only 10.0 percent were willing to discontinue followed by 20.0 percent indifferent with the situation (Figure 3).

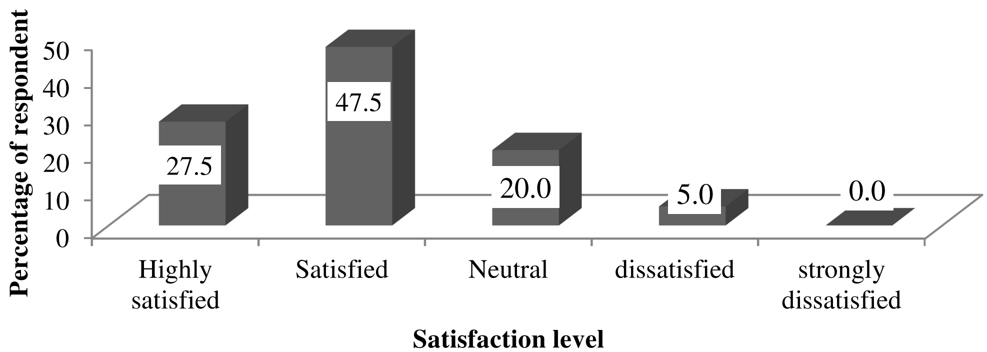

Figure 2: Satisfaction level of respondents on sustainable soil management practices in the study area (2012)

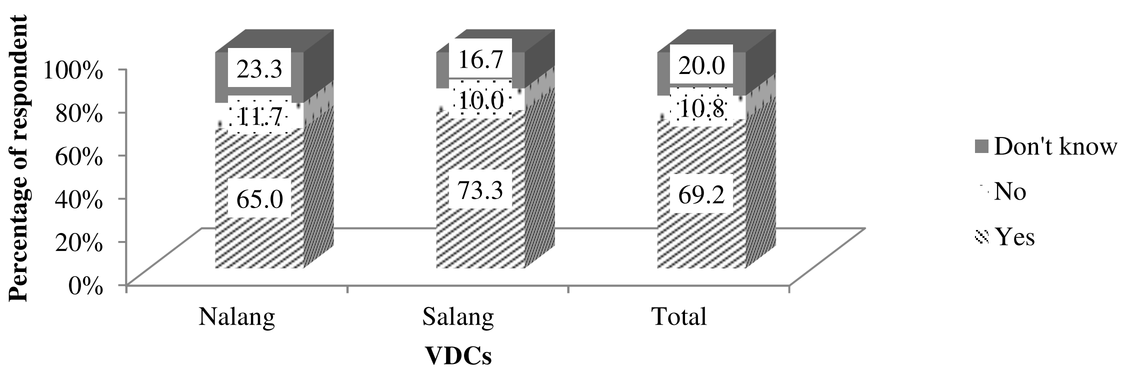

Figure 3: Willingness to continue and promote measures of soil sustainability by sampled household in the study area (2012)

3.6 Factors Motivating To Adopt SSM Practices:

There exist numbers of factors that directly affects the technology adoption. Observation in neighbors (96.7%) was found as the major motivated factor of adoption among vegetable farmers in the study area. Similar to this, Adhikari (2009) reported trainings and neighbor as major source of information on organic farming in Nepal. Kafle (2007) also reported neighbors as the most effective communication channel for diffusion of organic vegetable production technology in Nepal. About 74 percent of respondent respond support from organization i.e. SSMP as the second important motivating factor of adoption. Following them trainings, self-practice, demonstration effect and experience were the motivating factors affecting adoption for which 68.3, 59.2, 57.5 and 55.0 percent of respondent responds respectively (Table 3).

3.7 Impact of SSM Practices on Household and Farming:

3.7.1 Impact on Livestock Sector

Study revealed that adoption of soil sustainability measures showed positive impact on livestock sector. In total 65.84% of the sampled household perceived that there was increased in the livestock number after the adoption of soil sustainability measures. Increased in livestock number may be due to high requirement of organic manure while adopting soil management practices (Table 4).

3.7.2 Changed in Cropping Pattern:

The cropping pattern of the study site was changed after the adoption of soil sustainability measures. In most of the cases, cereals had been replaced by vegetable cultivation because of economic benefits of soil management practices (table 5). Likewise, due to awareness inclusion of legume crops by replacing cereals and also through mixed cropping was observed in the study area. Some of the fallow lands were also brought under sustainable soil management based vegetable farming.

Table 3: Respondent responses about the factors motivating to adopt measures of soil sustainability in the study area (2012)

Motivation Factors for the adoption	Frequency/ Percentage
Observation in neighbors	116(96.7)
Support from organization (SSMP)	89(74.2)
Trainings	82(68.3)
Self-practice	71(59.2)
Demonstration effect	69(57.5)
Experience	66(55.0)

Note: Figures in parentheses indicate percentage

Table 4: Trend in livestock number after adopting soil sustainability measures in the study area (2012)

Trend in livestock number	VDCs		
	Nalang	Salang	Total
Increased	47(78.33)	32(53.33)	79(65.84)
Decreased	1(1.67)	0(0.00)	1(0.83)
Same	12(20.00)	28(46.67)	40(30.33)
Total	60(100)	60(100)	120(100)

Figures in parentheses indicate percentage

Table 5: Change in the cropping pattern after adopting measures of soil sustainability in the study area (2012)

Before Adoption	After Adoption
Rice-fallow-maize	Rice-vegetable-maize
Cereal-vegetable-cereal	Vegetable-vegetable-cereal
Rice-maize-cauliflower/vegetable	Vegetable-maize-vegetable
Rice-fallow-maize/vegetables	Rice -vegetable-vegetable
Cereal-vegetable-fallow	Cereal-vegetable-vegetable
Cereal-vegetable	Legume-vegetable
Cereal-cereal+vegetable	Cereal-legume+vegetable
Cereal-vegetable	Cereal-vegetable-vegetable
Rice-vegetable-finger millet	Rice-vegetable/legumes
Maize -vegetable	Maize-vegetable+legumes
Rice-wheat-maize	Rice-vegetable-maize
Rice-wheat-maize	Rice-cauliflower-cucumber/legumes
Maize-vegetable-maize	Maize-vegetable-maize
Maize-finger millet-paddy	Maize-fingermillet -vegetable
Maize-legume-paddy	Maize-legume+vegetable-vegetable

Table 6: Change in variety of vegetable after adopting different measures of sustainable soil management in the study area (2012)

S.N.	Vegetable	Varieties before adoption	Varieties after adoption
1.	Cauliflower	Local, Kathmandu local	White top
2.	Cabbage	Local, Green Coronet	Green Coronet, Super Green
3.	Bittergourd	Local	*Paali*
4.	Cucumber	local	Long Green
5.	Tomato	Local, *Manisha*	*Srijana*

3.7.3 Changed in Crop Variety:

After the adoption of measures, variety of some of the vegetables had been changed. The change in variety may be due to incompatibility of local varieties with soil management practices in case of production. Thus, SSM practices played positive impact in introduction of improved variety in the study area. Variety had been changed in some of the vegetables like cauliflower, cabbage, bitter gourd, cucumber, tomato etc. which is presented in table 6. Local varieties had been replaced by improved one. In some of the cases area under local varieties had also decreased. The changed in variety of vegetables in the study area may be due to the impact of trainings and active participation of farmers in groups and increased in production by adopting technology suited varieties.

3.7.4 Impact on Soil:

Farmers in the study area perceived that, before adoption of sustainable soil management practices, excessive use of urea and other chemical inputs led to difficulty in ploughing and during ploughing, large clods were used to form. But later, the soil has become friable, much easier to work and there was no big clod formation and also workability has increased with increase in water holding capacity of soil (field survey, 2012). Similar to this, Khadak Bahadur Malla of Sindhupalchok district has emphasized the use of cattle urine because it deters insects, increases microorganisms and makes the soil more friable, conserves water and promotes good growth of plants and improves all types of soil (SSMP, 2010).

4. Conclusion and Recommendations:

Soil fertility is a major determinant of increased crop yields in Nepal. The adoption of soil sustainability measures offers practical solutions to sustainable soil fertility management. The results of this study have indicated that adoption of eco-friendly measures of soil sustainability among vegetable farmers had positive impact on household income, farming system, environment protection and use of local resources. Although farmers in the study area have some traditional knowledge about the use of various practices and their contribution to soil fertility management, detailed knowledge on preparation and use of such practices was lacking. Farmers indicated high cost of house construction for dung storage, lack of improved cattle shed, lack of detailed knowledge and unavailability of raw materials were the major constraints limiting the adoption of different measures of soil sustainability. Subsidy should be provided for improved shed construction and purchase of plastic drum for urine collection from Government level. On the other hand, to increase the adoption level programs like trainings, workshops, demonstrations, visits and seminars should be formulated and made implementation from Government as well as from concerned institutions working in this sector. There is also a need to study each farmers socio-economic situation and promote only those measures which are feasible considering the labor, household income, land holding size, resource availability and soil type owned by the different farming households. Varietal change had showed positive impact on production but the farmers should be provided guidelines on detailed cultivation method of such newly adopted varieties. Increased in livestock number had shown positive sign for its commercialization in the future, such that a great attention should be made for this sector along with sustainable soil management based vegetable farming.

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