IMPACT STUDY OF THE PROJECT

Organic Matter Management for Sustainable Agriculture

UNDP GEF SGP SORDEC

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ORGANIC MATTER MANAGEMENT FOR SUSTAINABLE AGRICULTURE

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Abbreviations and acronyms

CBS	:	Central Bureau of Statistics
DADO	:	District Agriculture Development Office
DDC	:	District Development Committee
DFO	:	District Forest Office
DLSO	:	District Livestock Support Office
FSD	:	Forum for Sustainable Development
FYM	:	Farm Yard Manure
GDP	:	Gross Domestic Production
Ha	:	Hectare
LFP	:	Livelihood and Forestry Programme
LSGA	:	Local Self-Governance Act
ND	:	No Date
OM	:	Organic Matter
SAARC:		South Asian Association for Regional Cooperation
SSMP	:	Sustainable Soil Management Programme
STSS	:	Soil Testing Service Section
UNDP	:	United Nations Development Programme
UT	:	University of Tenessessee
VDC	:	Village Development Committee
WB	:	World Bank

CONTENT

CHAPTER 1

INTRODUCTION

1.1 Background

Mountainous country Nepal divided from east to west in to three parallel ecological regions: the *terai*, the hills and the mountains. Within its total geographical area of 147,181 sq. km, it presents a varied topography and micro-climatic condition. Of the total population, one fourth still live in rural areas and more than 70 per cent households are still rely on agriculture for their livelihoods. Agricultural sector still contributes more in GDP. Sixty per cent of the economically active people are engaged in agriculture. But agriculture sector could not be commercial and young generations are not interested enough in this.

In Nepal, the lowland contain about 50 per cent population and have about 48 per cent of the arable land. It is due to such reasons that about 70 per cent of the total landholdings in these regions are less than one hectare in size and account for about 31 per cent of the total cropped area (Lekhak, 2003). In other words, the majority of farmers have very small or marginal land (less productive) areas. Along with the growth in population and the number of households, the holdings tend to be further smaller and scattered, thus becoming less convenient as well as less productive for cultivation. Agriculture, rural development and livelihood are intrinsically intertwined elsewhere in the developing countries. This is especially true for Nepal, which is heavily dependent on agriculture for the sustenance, income generation and prosperity of its people most of whom are economically poor and socially backward (Sharma, 2009).

In Nepal agriculture is the predominant occupation that follows traditional system and, contributes almost all food-grains needed for people. It also provides necessary raw materials to most of the agro-based industries. Thus the agricultural sector plays a vital role in the economic development of Nepal. However, small size of arable land, low productivity, and low cropping intensity, a subsistence mode of production and lack of crop diversification characterize Nepalese agriculture. With the increasing population, the sustainability of agriculture in the mountains has become a major concern.

A great challenge that confronts mountain agriculture at present is feed the growing population by using the available land without degrading the environment. In order to use scarce land resource more efficiently, so as to provide gainful employment and increased income to the labor force in the hills development of market-oriented multiple cropping system presents a major potential.

According to population census 1991, the rate of population growth was 2.08 per cent whereas, the food grain production was increasing at 1.7 per cent per annum. The census of 2001 shows that population growth rate was 2.25 per cent, whereas the food production, that is required to feed growing population is not increasing. Similar situation still prevalent in national figure. It shows the imbalanced relationship between population growth and food production, which may bring economic crisis in the country. In all five years plans of Nepal, top priority has been given to develop agriculture. However, results are far from satisfaction.

In total crop production of Nepal, the percentage contributions of the mountains, hills and *terai* zones are 6.7, 37.9, and 55.4, respectively. Paddy (49.6%), maize (17.9%), potato (14.9%) and wheat (14.1%) are among the major crops (Ojha, 2014). Other various minor

crops make up the remainder. Geologically, Nepal's land structure is said to be relatively new, evolving, unstable and weak. Moreover, the terrain structure is very irregular. Nearly 60 per cent of the area is steep to very steep, with the slope gradient of as high as 20 to 35 per cent. Another 22 per cent is moderate to steep. Only about 14 per cent has very gentle slope and the rest falls under dissected and gentle categories (Lekhak, 2003).

Even today traditional farming system, prevail in Nepal. On the other hand, in some areas use of chemical fertilizers, ill-managed use of organic manure, and use of huge amount of chemical pesticides to control pests and weeds, is common, which is against the notion of sustainable development. In this respect, sustainability of agriculture disserves special attention because food is the basis of all human. Hence, sustainability of Nepalese agriculture practically means the quality of agriculture that can feed us and our future generation while keeping our land alive and productive. It means, an agriculture that will continue to conserve natural resources and protect the environment indefinitely, enhance the health and safety of public, and produce adequate qualities of food for the present generation while keeping potentiality to produce the same for the generations to come.

1.2 Significance of the study

Human beings and agriculture are two parts of a same coin. That is because they live on agricultural products, and in absence of human beings, agriculture is also impossible. Agricultural production plays an important role in the economy of the country as well as livelihood improvement of its people. Sufficient production of food grains meets basic needs of farmers, whereas cash crops provide some extra income for them. In various case landless people can earn money by selling the compost manure that is crucial for sustainable agriculture. Developing countries like Nepal, with limited resources cannot afford such a high growth rate of population. Thus, there is an urgent need to analysis of factors affecting sustainable livelihood improvement and resource capacity.

In Parbat district, the major source of livelihood is agriculture in which farmers are depend upon chemical inputs for their farming system due to reduction in agricultural labor, reduction of livestock, and access to market. Present trends of production are not sufficient for the people. They neither sell food products nor can fulfill their basic needs (food) from it. Nowadays, food production ratio is low in comparison with growing population. If this situation would continue in the future, a serious food scarcity problem will be created. Therefore, to overcome this problem, we have a great challenge of increasing agricultural production and productivity.

No doubt, organic matter management technology is indispensable for sustainable agricultural development and sustainable agriculture is also indispensable for sustainable livelihood. Nepal is an agricultural country and livestock farming is one of the major components of agriculture. Various kinds of plant species are easily available around the farm land that can be used to make compost and organic pesticide. Organic matter management technology is not new for Nepal. Farmers used Farm Yard Manure (FYM) and they need not have to depend on any other sources till few decades ago. But, peoples are highly depended on chemical sources nowadays, and new generation has lost awareness about the importance of organic matter and the potentiality of sustainable farming. According to soil testing report 2013 of study area, more than 85 per cent soil samples are acidic. Organic matter management is a simple and rural technology for agricultural development but many farmers have not fully utilized the excreta of animals and leftover local plant species

that decompose in short period. Thus, this study is focused on the organic matter management practice in Shankarpokhari VDC of Parbat district.

1.3 Statement of the problem

Rapid growth of population in developing countries is conceived to be one of the challenges, Nepal is not an exception in this context. Whether it increases or decreases, excessive population growth does not only restrict the development path, it plays a very significant role in creating unemployment, hunger, poverty, malnutrition in underdeveloped countries. These countries are unable even to provide the basic needs such as health facilities, education, housing and nutritional facilities. In this situation, a country becomes economically weak. It is obvious that due to population growth, the pressure on the agricultural land has been increasing, but the agricultural land is static and farming system is very traditional. For instance, the cropland had expanded only by 1.5 per cent in the period of 1983-1993 basically through deforestation in *terai* (Ojha 2004). Growing population is heavily depended on agriculture for their livelihood. However small size of arable landholding, low productivity, subsistence mode of production, and lack of crop diversification characterize Nepalese agriculture. With the growing population, the sustainability of agriculture for their sustainable livelihood in the mountainous country has become a major concern.

Sustainable soil management and sustainable livelihood depend on the harmony among people, other organisms and the nature. The current conventional overall agricultural development fails because it meets human needs often by destroying or degrading the resource base. It also has created many specific problems such as increased use of chemical fertilizers and pesticides, toxic residues in food products, destruction and degradation of natural resources, resulting in loss in biodiversity, lowering ground water level, causing water, air and land pollution, loss of production or productivity, and so on (Devkota, 2004).

Organic matter management is comparatively more advantageous than other chemical sources like nitrogen (NO_3), phosphorous (P_2O_5), potash (K_2O). It improves soil productivity in sustainable manner and it also improves people's health through reduction in pollution. As we have seen, organic manure is an important asset to the farm. It can help maintain and improve the fertility and physical condition of the soil. At present, the major concern is to feed the growing population by using limited arable land without degrading the environment. In short underdeveloped countries are facing following problems: increasing population; depleting natural resources, such as forest, water source, fertility of the soil, and rise in several problems of unemployment, poverty, hunger and diseases, declining economic developmental activities, decreasing agricultural productivity. This project "organic matter management for sustainable agriculture" supported by UNDP GEF SGP was implemented in Shankarpokhari VDC of Parbat district to address over stated concern in sustainable agriculture.

1.4 Objective of the study

The objective of the study is to find out the overall achievement and impact of the project in enhancing the production and productivity of the agricultural land and improving beneficiary's level of empowerment or livelihood condition, and the specific objectives are:

1. Mapping the state of physical conditions and quality of soil;
2. Assessing the organic manure preparation methods adopted by the farmers; and
3. Evaluating the socio-economic empowerment level of beneficiaries.

1.5 Limitation of the study

This study is mainly based on the impact and perceptions of project beneficiaries "organic matter management for sustainable agriculture" in Shankarpokhari of Parbat district. The study is very specific, like a case study. It is only concentrated to the impact of UNDP GEF SGP supported project which was implemented in this VDC for 18 months (January 2014 to July 2015). It is done within a very short span of time or very soon to found impacts of the project activities before 6 months of completion. Thus, the conclusion drawn from this study is only indicative rather than conclusive. The conclusion might not be generalized for the whole district and nation. But, the inference might be valid to some extent to areas that have similar geographic, socio- economic and environmental settings.

1.6 Organization of the study

This study is presented in seven chapters. The first chapter deals with introductory aspects of the study. It discusses the background of the study, statement of the problem, rationale or significance of the study, general and specific research objectives, limitations of the study.

The second chapter is for methodology adopted for this study which is divided into four subchapters: research design, study area and sample size, information generation methods an analysis of collected raw information.

Chapter three is for literature review. This chapter is also divided into three subsections such as soil and organic matter, organic matter and agriculture, and livelihood and agriculture. Chapter four briefly highlighted about the study area district and project VDC. The structure and practice of organic matter management system and the major constraints they have faced are explained in brief in this chapter.

Fifth chapter is for analysis and discussion of the information. Result of the study is presented in different eight subheadings. Information collected from different questions are presented in these sub headings. It tabulates, describes, and analyses the data and findings as scheduled in questionnaire.

The sixth and seventh chapter is mainly belongs to major findings the study, conclusion, and recommendations for further study and for policy decision.

CHAPTER 2

RESEARCH METHODOLOGY

2.1 Research Design

For research purpose, primarily a qualitative type of descriptive research design was applied for this study. As per the nature of an empirical study, it was mainly based upon primary data collection through field survey. A survey instrument – open ended questionnaire (annex 1) was framed and used to generate information at community level. The responses of the local people about the project activities and its impacts were obtained through face-to-face interview. It involved the systematic collection and presentation of data to give a clear picture of project status during of the project period. It is a fact-finding operation i.e. searching for adequate information. Qualitative method was used more, rather than quantitative method as per the nature of the study. The principal components of the research methodology and design, namely, selection of the study area, the sample design, the survey design, and the method of processing and analysing the data are presented hereafter.

2.2 Study area and sample size

All ward of the Shankarpokhari VDC was selected for this study. Project activities were implemented except in ward number 8 but and wards were selected purposively and data were generated and processed accordingly. Among the directly benefited 200 households of this project 53 households were selected from eight wards for field survey on sampling basis. The key information about project activities, adopted organic matter management methods and its impact on soil and production; means of income generation adopted by farmers and its impact in their socio-economic life; and benefit sharing of the project were observed. Similarly, people's observation regarding the project were tried to obtain through informal discussion. A stratified random sampling method was applied to select the respondent. Wards of project VDC were considered as strata of diversities. Among the 53 respondents 51 are from Brahimin Chhetri community and 2 are from *dalit* community. There were 28 (52.8 per cent) women and 25 or 47.2 per cent men were men respondents.

Table 1 : Respondents by ward

Ward number	Sex		
	Man	Woman	Total
1	1	8	9
	11.1	88.9	100
2	4	1	5
	80.0	20.0	100
3	0	4	4
	0.0	100.0	100.0
4	6	5	11
	54.5	45.5	100
5	2	5	7
	28.6	71.4	100
6	4	1	5
	80.0	20.0	100
7	5	3	8
	62.5	37.5	100
8	3	1	4
	75.0	25.0	100
Total	**25**	**28**	**53**
Per cent	**47.2**	**52.8**	**100**

Source : Field survey, 2015

To conduct the field survey, households were considered as the lowest level sample units, no more than one member of each sampled household were identified and consulted as the respondent. Thus, the total numbers of respondents were 53 from grassroots. Similarly, consideration was given to make more inclusive nature of respondent from different caste, ethnic society, and sex. The number of respondents from each institution was varied and were selected based on population distribution of the concerning VDCs and municipalities.

2.3 Methods of information generation

This study was carried out and completed using the following set of methodology. Both primary and secondary data/information are collected to fulfil the basic requirements of the study. As per the nature of the study, it was mainly based on primary data, although secondary data are also used for conceptual clearance and shaping the primary information. Therefore, it is a combination of both sources of information generation.

A. Secondary information

Secondary information are needed right from the conception of the study, that is, to identify the problem under study, to base the research rationale, to decide the tools which are used in the study (data generation to analysis), demarcate and describe the study area. Besides, they are useful in comprehending and comparing against certain fresh findings in order to draw more realistic inferences.

The principal sources of secondary information comprising relevant literature/documents published or unpublished books, research reports, seminar papers, academic and professional journals, newspapers, news magazines were studied and analysed. Report of strategic partners of related project to the project nature such as District Agriculture Development Office (DADO), District Livestock Support Office (DLSO), Ministry of Agriculture and Department of Agriculture were consulted duly. Similarly, report of Central Soil Testing Lab were also observed.

B. Primary Data/Information

Primary data are collected by means of standardized questionnaires and completed through interviewing the sampled respondents in community level. Questionnaire for field survey were finalized after pre-testing them in the appropriate field. Likewise, an informal talk and consultation was done with the agencies/stakeholders those are also indirectly related to such practice in study area. All sets of questionnaire for field survey were translated into Nepalese language, printed and photo copied with adequate number of copies. The researcher himself visited all respondents and collected information to omit possible errors. To standardize the research outcomes and making the task more valid and sensitive, few other relevant data collection tools were also used before-during-after process of information collection. Opinions and ideas of local officials, especially teachers, community people, leaders were also mentioned during generalizing the findings.

2.4 Analysis and presentation of information

The quality of research output depends not only on the accuracy of information collection, but also on how the collected information is handled. Careful scrutiny, editing, and standardizing of the data are therefore the prerequisites for processing data.

Completed questionnaires were cleaned immediately after the interview and corrections were made wherever required. Therefore, all verified or checked raw data were sorted, presented, interpreted, and analysed with the help of computer methods and those were truly and sincerely looked or checked before presenting them into report. Analysis was done both qualitatively and quantitatively. To begin with, simple descriptive and frequencies were used to get the general analytical outlook of the information. As the main statistical tool Microsoft excel is used.

CHAPTER 3

LITERATURE REVIEW

3.1 Soil and its organic matter

Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition). Most of our productive agricultural soils have between 3 and 6 per cent organic matter. Soil is the basis of all living creatures. Organic matter is the foundation for productive soil and it is the mixture of mineral and organic matter. A cubic foot of productive surface soil contains approximately 2 pounds of organic materials (Donahue, 1999). Organic matter support to produce healthy crops in a sustainable manner. It also supplies resources for microbes and other soil organism, and regulates the supply of water, air and nutrients to plants. Soil organic matter can deliver over half of the nitrogen and quarter of the phosphorus crops require, thus strongly influencing fertilizer requirements. Any effort to improve soil quality and function needs to start with restoring soil organic matter, which is the primary influence on soil's physical, biological, and chemical characteristics. At any time, half of organic matter consists of dead body remains to former soil life, the other half is very much alive. The living part consists of plant roots, bacteria, earthworms, algae, fungi, actinomycetes, nematodes and many other forms of soil life.

According to the Agronomy Fact Sheet Series 41 of Cornell University, the living biomass includes the microorganisms responsible for decomposition of both plant residues and active soil organic matter. Humus is the final product of decomposition process. The first two types of organic matter contribute to soil fertility because the breakdown of these fractions results in the release of plant nutrients such as nitrogen, phosphorus, potassium, etc. The humus fraction has less influence on soil fertility because it is the final product of decomposition. However, it is still important for soil fertility management because it contributes to soil structures, and exchange capacity. Soil's fraction process darkens its' color.

Our soils are important primarily because plants grow in them. Plants are the pipelines through which essential minerals, proteins and vitamins from the soil flow to animals and man. And thus, there are numerous benefits (physical, chemical, and biological benefits) to having a relatively high stable organic matter level in an agricultural soil. A cubic foot of productive soil contains several miles of plant roots, which feed mainly from the surface of soil particles. At first thought a mile of roots is a lot of to feed from 1 cubic foot of soil. The total soil surface in a cubic foot of productive loam, if spread out flat, would cover 1,000 acres or 1.56 square miles. Productive soils work hard in raising food crops. The soil and air must supply all 16 essential elements at the exact time a plant is ready to draw them (Donahue 1999). If the soil is not productive and does not feed the plants, the plants will die of starvation and animals, including man, will also die. Soils are productive when they contain adequate amounts of all 16 essential elements in forms readily available to plants, are in good physical condition to support plants and contain just the right amount of water and air for desirable root growth.

Department of primary industries of Australia focus in its online newsletter (2005) "Soil biology basis" to grow more plant biomass. Biomass increases the input of organic material to help balance the continual loss of organic matter through decomposition. It highlights, as organic matter levels decline, the storage and supply of major plant nutrients such as

nitrogen, phosphorous and sulfur diminish. This reduces the potential for plant production. When reduces the potential for plant production. When plant production declines, there is less organic matter available for soil organisms, so their activity declines, leading to a downward spiral of production. It also suggested few means for building up the soil organic matter. Crop rotations, green manure crops, rotation in pastures, increase use of animal manure and recycled waste, retain crop residues, reduce tillage and erosion and reduce periods of bare fallow, for instance.

Soil, as we have seen, is a mixture of weathered rock, organic matter, living forms, air and water. Generally, it contains 50 per cent air and water, 45 per cent minerals, and the remaining 5 per cent is organic matter (STSS, 1999). However all soils do not have equal amount of organic matter. All plant and animal residues in the soil constitute organic matter. Besides crop residues, farmyard manure, green manure, compost and dead roots, it includes the decomposed parts of insects, worms and larger animals. Another important part includes dead soil microorganisms such as bacteria, fungi and protozoa. Chemically, organic matter contains carbohydrates, proteins, fats, waxes and similar compounds. Since the beginning of farming system, farmers have used one form of organic matter. They use only FYM to increase the production and productivity of their soils (Knuti 1970).

The University of Tennessee (UT) highlights organic matter management practice in its online publication "organic and sustainable crop production" (n.d). It observes that organic crop production relies on using preventive management practices to reduce problems with weeds, diseases, pests and plant nutrition, and is done through integrating a variety of cultural, biological and mechanical management practices. Healthy soil is the foundation of organic cropping systems further added that newsletter. Organic systems build soil quality by increasing soil organic matter; promoting soil biological activity; and building soil fertility through management practices like incorporating compost, animal residues, cover crops and green manures. Soil quality is maintained by regularly replenishing organic matter.

Soils rich in organic matter have better tilth and productivity than those containing chiefly weathered rock materials. Soil erosion, along with continuous cropping, has lowered the organic content of many soils. Organic matter as used as in a discussion of soils has a very broad meaning because it includes all materials of vegetable and animal origin developing in or applied to the soil regardless of the stage of decomposition. Thus, the term includes the highly decomposed and colloidal soil fraction known as humus, as well as the roots and tops of plants containing much easily decay able carbohydrate, protein and in addition the bodies of microorganisms, worms, insects and other animal and also animal manures and similar materials applied to the soil. It is well understood, however, that the protein of the organic matter that has reached the humus stage is the fraction that contributes most to the chemical and physical properties of soil and the greatest significance in crop production (Sen, 1998).

Meanwhile, many people wondered about the ingredients in soil, which nourish plants. In the 16th century, Bernard Pallissy, a porter to the French royalty, argued that plant residues contained the ‘salt’ or the ‘principle’, which supports plant growth. While Jan Baptista, Van Helment believed that water was the ‘principle’ capable of supporting the growth of plants. Later, the idea that certain ingredients in soil dissolved in water and actually supported plant growth was established by experiments of John Woodward of England. Some other considered ‘humus’ the supporter of plant growth.

The experiment of J.B. Boussingault, a French agriculturalist, in 1834 revealed the important chemical constituents of both plants and soil. This was followed by the work of Justus Von Liebig, a German chemist, who was able to prepare a balance sheet of plant nutrition in relation to soil (Rao, 2005).

Organic matter consists of manure, compost, crop residues, and the remains of dead bacteria, fungi, protozoa, earthworms, rodents, ants and other plant and animal life. A more modern trend is to consider organic matter as contributing the most toward crop nutrition when it is decomposing and well managed. Undecomposed organic matter also aids in crop production by acting physically to provide a blanket of protection against heat, cold and against the violence of beating raindrops. In these days, by the use of various other chemical fertilizers, farmer may increase production but they cannot improve the soil productivity because chemical sources provide nutrients to plant but not to soil. So, everyone will agree that the most efficient way to grow plants is to maintain a productive soil rich in fresh, decomposing organic matter.

3.2 Organic matter and agriculture

Agriculture is the backbone of Nepalese economy and providing livelihood for more than 77 per cent of its population. Population growth rate is 2.5 per cent while growth rate of food grain is not more than population growth over the period of 1980s (Jaisy, 1997). As we have very little chance to increase cultivable land, the food crises must be resolved by raising the productivity of existing arable land. Among the different means of increasing productivity, soil fertility management through organic matter management is one key factor. Therefore, improvement of soil fertility and increased plant nutrients supplied through organic manure increase food production and farmers income.

The importance of organic matter in the soil is implicit in the definition of soil, which recognizes fertility as the unique and constant features distinguishing soil from the parent rock. According to Williams, soil fertility is the simultaneous and complete provision of all the plant requirements in water and nutrients. In the formation of fertile soil, organic substances play a direct part, as they are the sources of plant nutrients, which are liberated, in available forms, during mineralization. But organic substances also play an indirect part.

Besides being a source of nutrients for the plant and the most important factor in structure formation, organic matter has also a fundamental effect on the physical properties of the soil (water holding capacity, heat regime) and determines to a large degree, such physiochemical properties. These properties are of great importance not only in controlling the uptake of nutrients by the plant and their retention in the soil but also in suppressing the deleterious effect of soil acidity.

Increasing soil organic matter will result in a 'win-win' situation with respect to positively influencing soil fertility and quality and maintaining the physical, chemical and biological conditions necessary in sustainable continuous tillage practices. A number of factors influence the rate of decline of soil organic matter levels including soil type and physical properties, climate, topography, vegetation and land management practice. Soils with organic matter levels above 3.4 per cent are not considered to be vulnerable. This equates to a soil organic carbon content of 2 per cent. The conversion factor from soil organic carbon to soil organic matter is approximately 1.72.

Organic matter is considered a reservoir of nutrients including nitrogen and phosphorous that can be released to the soil through the mineralization process. Each per cent of organic matter in the soil represents about 1000kg of organic nitrogen in addition to other nutrients. The gradual mineralization of this nitrogen provides an important supply of crop nutrient requirement. Similarly, organic matter is a useful aid in limiting PH fluctuations. It also plays a fundamental role in sustaining soil biodiversity by providing, for example a source of energy and nutrients for soil microorganisms.

In a nutshell, the level of organic matter affects agriculturally important property of soil and often the effects are complex and not easily separated. Some major importance of OM become clear from the following function it can perform: (a) storehouse of nutrients; (b) water holding capacity; (c) supply of nutrients; (d) control over compaction; (e) stability of structure; and (f) reduce soil erosion by reducing the speed of runoff water. It should not be forgotten however, that manure is a perishable product and must be handled quickly and properly in order to conserve the plant nutrients for use by crops.

3.3 Livelihood and agriculture

Livelihood refers to earning something to maintain daily life of human being. According to the Oxford Advanced Learners' Dictionary, livelihood refers to a means of earning money in order to live. When an individual can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and for future, while not undermining the natural resource base, then sustainable livelihood may be obtained (LFP 2002). It is a social and economic phenomenon that all attempt to possess in their daily life. In Nepalese context, agriculture sector plays the vital role for our livelihood and economic development of nations. In this regard, the development of agriculture sector has become a prerequisite to improving the living standard of the vast majority of the people of Nepal (Dahal, 2000).

Agriculture provides, among others, food for domestic consumption, raw materials for industrial development, market for industrial products and foreign currency needed to import capital and technology for development, and thus creates employment (FSD, 2002). An operational meaning of sustainability, inferred from descriptions and definitions of the term by ecologists, environmentalists, economists and others could be as follows: "sustainability" is the ability of a system (e.g. mountain agriculture) to maintain a certain well defined level of performance (output) overtime, and, if required, enhance the same through linkages with other systems without damaging its own long-term potential (Sapkota, 1998). Thus, sustainable agricultural means a pattern or system of agricultural development that can enable products and services from land to meet current needs and increasing levels of demand without damaging its long-term production potential. Above description creates a linkage between sustainable resource uses for sustainable livelihood.

Sustainable agriculture is generally concerned with the need for agricultural practices to be economically viable, and environmentally positive, and concerned with quality of life. In these days, different artificial and external inputs are integrated to grow more food to feed growing population, which is against the notion of sustainable agricultural development. Nepal is a good example where high external input in agriculture has sought to increase production, but has lowered sustainability, stability and productivity of the agriculture system (Jha, 2000). Many farmers practice off-season vegetable production to fetch higher price and heavily uses chemical fertilizer and pesticides to control pests and weeds. Most of those users do not have technical knowledge about chemicals and their safety level (Baker and Gyawali, 1994).

In regards to agriculture to enhance the production and its long-term sustainability, careful management of soil through the use of organic matter is crucial. Hence, management of soil organic matter has received top priority in making agriculture sustainable. This management strategy should be based on local resources to the most possible extent. These efforts are beginning to show some effect in terms of awareness of population and environmental issues and also in terms of resources conservation. Organic matter management practices are important to sustainable development in general and sustainable agriculture development in particular. In this respect, sustainability of agriculture deserves special attention because food is the basis of all human activities and conceptual notion of agricultural sustainability is to maintain the long-term potential of agriculture to produce healthy food while keeping the environment productive.

Hence, sustainability of Nepalese agriculture practically means the quality of agriculture that can feed us and our future generations while keeping our land and water resource alive and productive. It means agriculture that will continue to conserve natural resources and protect the environment indefinitely, enhance the health and safety of the public and produce adequate quantities of food for the present generation while keeping potentiality to produce the same for the generations to come. So, for the betterment of human beings and sustainable livelihood improvement of farmer's sustainable agriculture is one of the major concerns in our context.

CHAPTER 4

THE STUDY AREA

The socio-economic and ecological outlook of the study area is briefly explained in subsequent sub sections.

4.1 The introduction of Parbat district

Parbat is one of the hilly districts of the nation. It lies between 28^0 00'19" south to 28^0 23'58" north latitude and 83^0 33' 40" east to 83^0 49' 29" west longitude in world map. It is situated in the middle part of the Western Development Region and it is of the small district of the country. Kaski and Syangja districts border the district from east. Myagdi and Baglung are in west, Myagdi district is in north as well, Syangja and Gulmi districts are in south. Parbat district with Kushma as it's headquarter, belongs to the Dhaulagiri zone.

The elevation of Parbat is 520 m from the sea level (Sedbini), with highest elevation of 3300 m near Jaljala of Salija VDC. The total area of Parbat district is 53,686 ha, of which 28,592 ha is arable (*khet* land: occupies 9,021 ha and *bari* land 19,571 ha, and forest area 1997 ha). There is a great vertical differentiation in the land where 233.4 ha is above 40^o in steepness (Gaudel 2004). Only 34.46 percent of arable land in Parbat has irrigation facility. Temperate and sub-temperate types of climate prevail in Parbat district where average maximum temperature is 32.3^o c and minimum 7.5^oc.

Due to less area of *khet* both crop intensity and cereal production are low. In this district, 141 households are landless and average per capita arable land is 0.7 ha. Agriculture sector contributes 43.64 per cent to total GDP and the major crops are maize (25,863 ton), paddy (19,529 ton), millet (8,948 ton) and wheat (5,250 ton) (CBS, 2011). Among cash crops potato covered 1,270 ha of land with the total production of 10,500 ton. In Parbat, a total of 174,357 people live in 32,731 households (CBS, 2011).The average HH size is 4.82 (DDC, 2013). The soil types include loam, sandy loam, silty loam, loamy sand. The average condition of the soil is moderate. Almost all of the crops are widely cultivated in this area. Generally, maize, rice, millet and potatoes are the major ones. The number of economically active population in Parbat is only 83,564, which is 47.93 per cent of the total population.

To provide agricultural services to farmers, the District Agriculture Development Office (DADO) was established in Parbat in 2034 B.S. DADO provides services and extension of technology through four Service Centers and seven Sub Centers in this district. To achieve long-term agricultural goal, the following major programme have been executed since 2059/60 fiscal year: (a) vegetable seed production programme, (b) potato seed production programme, (c) highway area fresh vegetable production programme, (d) fruit development programme, (e) intensive crop development and productivity increasing programme, (f) sustainable soil management programme, (g) market development programme, (h) coffee extension programme, (i) nepal irrigation sector programme, and (j) micro irrigation special programme.

Since 1999 Sustainable Soil Management Programme (SSMP) was implemented in Parbat for six year to broaden organic farming or to contribute in following issues: (a) maintenance of soil fertility status through a sustainable manner; (b) management of crop pests, disease and

weeds through non-chemical means; (c) optimization recycling of natural resources of agro ecosystem (d) maintenance of biodiversity, stability, productivity and profitability of farming system; (e) regularity in supply of hygienic food products free from toxic residues; and (f) output maximization from limited external inputs. And this project "organic matter management for sustainable agriculture" was implemented in Shankarpokhari VDC with the support of UNDP GEF SGP.

4.2 An overview of Shankarpokhari VDC

Shankarpokhari VDC is one of the nearest VDCs from the district headquarter. The name of this VDC is called by one historical *pokhari* which was constructed by respecting god *shiva* (Shankar). As one of the nearest VDC from district headquarter, people of this VDC have easy access to services those are available in the Kushma Bazar. Two motorable road passes through the VDC and electricity, schools, health center, post office, telephone and other economic and social infrastructures are developed in the VDC. But irrigation facility is poor. The climatic condition is sub-tropical as found in the plain region. Shankarpokhari is situated at 880 m to 1940 m elevation from the sea level.

A. Climate

Generally the climatic condition of this VDC is sub-tropical as found in the plain region. The mean temperature in the hottest months of the year, viz. July and August is 28^{o} c and in the coldest month viz. December and January, it is 14^{o} c. The annual mean temperature is 20.5^{o}c. Precipitation during the course of a year is very uneven. Near about 90 per cent of the annual precipitation occurs during the summer months from May to September.

B. Soil type

Soil is the most important things for natural vegetation and agricultural activities. The plain land of this VDC is more fertile with alluvial soil. In general, most part of the VDC has the similar quality. The soil types here are loams, sandy loam, silt loam and coarse etc. Almost all the crops are widely cultivated in this area/VDC. In the north eastern part of the Shankarpokhari VDC, soil is somewhat coarse or grovels where important crops like paddy, maize, wheat, oil seed, potatoes and vegetables are cultivated in the study area. More than 90 per cent soil samples were found acidic. Soil testing camp was organized in February 2014. The main cause of acidic in soil is may be the heavy use of chemical fertilizer everywhere in the district as well as Shankarpokhari VDC.

C. Agriculture and vegetation

Gentle features of land, warm, and moist climate support to the growth of tropical and subtropical plants and crops. The forest occupies approximately 17 Percent of the total land to the southeast part of this VDC. Nowadays, rising growth of the population has become the threat for the forest. In the southeast part of this VDC, the forest type is combination various types i.e. chilaune (Schima walichi), katush (Castanopsis ssp) sallo (Pipnus indica), sal (Shorea robusta), and other types of vegetation are also found. In or around the residential area and boarder of farmland there are various types of trees, fodder plants for livestock and fruits. As regards to fruits, oranges, bananas, lemons and mangoes are found all over the VDC.

People grow different types of summer and winter crops in this VDC. Paddy, wheat, maize are the major food grains. Vegetable and dairy products are the main cash crops in this area. Most of the farmer grows potatoes in large scales; cauliflowers, cabbages, bitter gourds,

cucumber, ladies finger and radishes etc. are mainly grown in this area. Many other seasonal or off season vegetable farming also practice in this VDC due to the buying and selling facility in nearest market town Kushma bazzar. Since few year peoples of Shankarpokhari are practicing the organic matter management technology. By this, most of the farmer are well managed the Farm Yard Manure (FYM) and make compost and organic pesticide by the use of locally available species.

D. Population

Population distribution is one of the basis for many development interventions. In some settlements density of population is high and other are low density as households are scattered however, area is larger. Number of major *toles* or settlements are 20. The total population size of Shankarpokhari VDC is 3842 in 908 households. Highest 16.1 per cent population is found in ward no 8 and ward no 4 followed it's by 14.8 per cent. Typically *dalit* peoples are reside in this ward no 8 and *Brahimin* and *Chhetri* in ward 4. By population size ward no 2 is smallest and 6 is second last among 9 wards. 200 households are directly benefited by this project and other 100 are benefited indirectly from this project. Among the indirectly benefited households, some are land less and other know about this practices through group member of nearest neighbor.

Table 2: Number of households and population

Ward no	Number of HHs	Population distribution	
		Number	Per cent
1	92	439	11.4
2	53	228	5.9
3	99	409	10.6
4	142	568	14.8
5	126	495	12.9
6	59	265	6.9
7	83	395	10.3
8	163	619	16.1
9	91	424	11.0
Total	**908**	**3842**	**100.0**

Source : CBS, 2011

E. Organic matter management practices

Farmers of this study area are usually rely on following different modes of nutrition supply practice aiming to enhance production of their agricultural land. Some of them are organic, improved or scientific in some extend or some of them are traditional or haphazardly collecting manure without considering its scientific features and heavily depends on chemical fertilizer. Few of them are discussed hereunder in different points:

(i) FYM (Farm Yard Manure)

It is commonly practicing all over the study area. FYM, manure and livestock dung urine and bedding material (litter) are the major sources of fertilizer in Shankarpokhari. Bedding materials are easily available in this VDC and farmers are using these in regular basis. FYM is normally dumped in front of the *goth* (cattle shed) in a 3-4 feet deep pit, which fills up within four to five months and then continues pilling up above the surface. It was not protected from direct expose to the sun, rainwater and run-off water. Livestock beds comprising waste fodder trees leaves and crop weeds are cleared twice a day to keep the pen clean. Bedding

materials mixed with dung decomposed and become part of FYM. But it is not protected from direct sun light, rain and drained water and thus quality of such manure is said not so good.

(ii) Compost

It is one of the best way for making manure by the use of locally available biomasses. Traditionally, no farmers were practiced it but few people are practicing compost making since few years. It is found that this trend is significantly increased after the implementation of this project. Mainly, people who are involving in commercial vegetable farming, have a little bit knowledge about how to make compost, and who do not have more animals are using this means to supply organic manure in their farm.

(iii) Chemical fertilizers

The application of chemical fertilizer was virtually non-existent in the study are until the mid-1980s. Confronted with declining FYM supply, a considerable proportion of farmers in the study area, started using chemical fertilizer to wheat, and seedbeds of millet and paddy then they use in maize and paddy. Most of them are known about the negative consequence of chemical fertilizer and pesticide but they are forced to use because animal population is decreased and no more family members are stay in home as earlier. Gradually they know regular uses of chemical fertilizer accelerate soil acidity. Now the proportion of farmers using chemical fertilizer is gradually decreasing over the years.

(iv) Use of green manure

Using green manure species namely a*shuro* (Adhatoda vasica), siplikan (Euphorbia roylena), *titepat*i (Artemisooa vulgaris), *dhursul* (Aibizia spp), *ankhitare* (Trichila connoroides), and *khirro* (Stirum insigne) in farm is one of the traditional practices. These wild plant species have more than double NPK content as compared to FYM (Sharma, 2001). Some of these species are useful for controlling weeds and pests. Normally green manure is applied in seedbeds. Despite their awareness of the nutritional value of green manure species, farmers cannot apply it to other field crops, owing to scarcity.

In response to diminishing supply of green manure, farmers are applying leaves of *chilaune* (schima wallichi) and *kaktus* (Castanopsis spp) specifically into the paddy field. According to farmers, these materials have low nutrient contents, but help to prevent soils from being acidic. Weeds grow in the field are also being utilized as green manure, specifically for millet

(v) Goth system

Keeping livestock for a few to several weeks under shed built on a parcel of land relatively distance from the home is locally known as the *goth* system. As practiced in other mountain areas of Nepal, farmers have adopted this system ever since the 1950s to cope with labor shortage. Carrying FYM to distant farm plots in a highly labor intensive task. Therefore, farmers build a makeshift livestock shed on

a farm plot and one of their household members stays there with livestock during December to April livestock are fed on crop residues stocked on the shed. During the daytime livestock graze on the farm plot and one kept under the shed at night.

The manure mixed with bedding materials is dumped in front of the shed and applied to *khet* during rice transplantation. Farmers demolish the shed and bring the livestock back to the farmhouse when the stock of crop residues is finished. The *goth* system is gradually declining as some of the *khet* are being utilized for winter crops and farmers are increasingly confronting the problem of labor shortage.

(vi) Inundating farmlands by first flood water

The first flood, which occurs immediately after the first monsoon shower, brings dung dropped by livestock on grazing lands, fallen leaves, decomposed organic materials and other fine and coarse materials from the catchments area. Farmers are well aware that those materials contain high amounts of plant nutrient. Therefore, they channel the first flood water throughout the farm plot they make water ways by cutting bunds and terrace risers, and keep on monitoring the flow of the nutrient containing water. This type of practice is common in *khet* land before 10-15 years but nowadays the trend is also gradually slow down. Because of open grazing is almost stopped and all households have toilet and open defecation is also stopped and farmers believe that firs flood will not have more nutrition to crops as it was rich earlier.

(vii) Legume cultivation

The need for increasing cropping intensity coupled with maintaining land fertility has increasing farmer's attraction in both areas to legume cultivation, which was not a typical practice until recently. Major legumes being cultivated are cowpea, pea, black gram, bean, broad bean, pole bean, rice bean, winter beans soybean, and peanut. Legumes are consumed, as side dishes with meals and their residues are palatable to livestock. People of hilly areas are planting legume with the aim increasing nutritional level not only to people but also to animals and soil itself. People of the study area are also using legume in cropping system.

(viii) Household ash

In addition to trash burning, household ash produced during cooking of food and burning of roughage is used in vegetable and crops seedbeds as pest controller and fertilizer. Though the amount of ash produced at home is relatively small but it is used to fertilizer farmlands. It is the traditional beliefs of farmers and they still heavily rely to this method.

(ix) Oilseed cake

Use of oilseed cake, as organic manure is a traditional practice before chemical fertilizer come into practice. Farmers recognized its nutritional value and used it in fertilizing farmlands. They used it in rice and millet seedbeds, vegetables and fruit plants, which fastest

growth need in short time period. However, the use of oilseed cake is gradually diminishing. The cropped area under oilseed is competing with winter wheat and farmers are gradually curtailing its cultivation. Secondly chemical fertilizer replaces it, and it is diverted to livestock feed. Still limited number of farmers especially who have no ability to purchase high amount of chemical fertilizer are continuing its use. They mix it with goat and sheep dung and apply evenly in newly germinated seedbeds.

CHAPTER 5

ANALYSIS AND DISCUSSION

Maintaining productivity or improving soil fertility is one of the major alternatives for minimizing the risk of food shortage. No people were aware in this study area before this project about what are the differences in production and productivity of land. They have no more concern in enhancing productivity only enjoying in increasing production. Some people were found serious about the nutrients available in organic manure that is important for increasing agricultural production and majority of them are not aware about this. The result of this study after the successful implementation of this project "organic matter management for sustainable agriculture" is presented hereunder in different points:

5.1 Organic manure production methods

Traditionally, people of study area were dependent mainly to farm yard manure that is produced in their own cattle shed. They were producing and using FYM since very long time but not manage it duly or protecting nutrients available in cattle dung and urine as they have no more technical knowledge about it. Various changes in manure management and productivity are seen after the implementation of this project in project VDC. During the field survey, respondents were asked what types of method do you adopted after this project. Among them, more than ninety-two (92.5 per cent) were said they are adopted both FYM and compost; only 7.5 per cent said FYM. No respondents found they only rely compost. All most all rural people have at least one animal and they make FYM as they know. People of Shankarpokhari VDC are using other litter and crops residual along with animal dung and urine while making FYM and compost. According to them urine supports to decompose biomass very soon and improve the quality of FYM and compost. The level of sanitation of cattle shed and home also is clean while they are making manure in improved way, they claim.

Table 3 : Organic matter management technology adopted

Ward number	OM technology adopted		
	FYM	Compost	Both
1	1	0	8
	11.1	0.0	88.9
2	1	0	4
	20.0	0.0	80.0
3	0	0	4
	0.0	0.0	100.0
4	1	0	10
	9.1	0.0	90.9
5	0	0	7
	0.0	0.0	100.0
6	0	0	5
	0.0	0.0	100.0
7	1	0	7
	12.5	0.0	87.5
9	0	0	4
	0.0	0.0	100.0
Total	**4**	**0**	**49**
Per cent	**7.5**	**0.0**	**92.5**

Source : Field survey, 2015

5.2 Use of chemical fertilizer and agricultural production

In the last few years of last decade, people all over the nation are heavily depended in chemical fertilizers. The major cause for this is decreasing animal population due to lowering attraction to agriculture among young generation. Children's school enrollment and school staying period is increasing and thus they cannot support more in household chore. But people are forced to grow more to feed growing population by using chemical fertilizers and pesticides. Due to their heavy dependence to chemical fertilizer, all most all people's soil samples are found acidic in this project VDC. People of study area were asked about the state of chemical fertilizer use in their farm after implementing this project. More than ninety-two (92.5 per cent) people were claimed that it is lowering and 7.5 per cent people said that the level of using chemical fertilizer is not reduced yet but it is constant in these last two years. Mainly all respondents from four ward (1, 2, 6 and 7) are said that the use of chemical fertilizer using is lowering. But only 75 per cent of ward 3 and 9 are said their level of using chemical fertilizer is lowering down.

Table 4 : Status of chemical fertilizer use in farm

Ward number	lowering down	Constant
1	9	0
	100.0	0.0
2	5	0
	100.0	0.0
3	3	1
	75.0	25.0
4	10	1
	90.9	9.1
5	6	1
	85.7	14.3
6	5	0
	100.0	0.0
7	8	0
	100.0	0.0
9	3	1
	75.0	25.0
Total	**49**	**4**
Per cent	**92.5**	**7.5**

Source : Field survey, 2015

5.3 Changes in agricultural production

It is considered that increasing agricultural production is not easy by the use of only organic manure in the first one or two years by stopping chemical fertilizer. During the study it is observed that no farmers are solely dependent to chemical fertilizer and they are now using chemical fertilizer as additional support to organic manure. Nominal numbers of farmers are found using chemical pesticide who are producing vegetable in large scale. While discussing on about production level just over ninety (90.6 per cent) respondent claimed that their agricultural production is increasing slightly, in overall. But respondent's views are different in different wards. Just 50 per cent respondents of ward number 3 agreed about increasing the production level of their farm. Similarly, 75 per cent respondents of ward number 9 were observed that agricultural

Table 5 : Increase in agricultural production

Ward number	Slightly increased	Not increased
1	9	0
	100.0	0.0
2	5	0
	100.0	0.0
3	2	2
	50.0	50.0
4	10	1
	90.9	9.1
5	6	1
	85.7	14.3
6	5	0
	100.0	0.0
7	8	0
	100.0	0.0
9	3	1
	75.0	25.0
Total	**48**	**5**
Per cent	**90.6**	**9.4**

Source : Field survey, 2015

production is increasing that is followed by ward number 5 with 85.7 per cent. During the study period majority of the respondents proudly claimed that it is not impossible to totally stop the use of chemical fertilizer, but we have to well manage animal dung and urine as well as crops residual. Similarly, they give importance to compost as they have no more animal but biomasses are available easily around their farm land and home or cattle shed.

5.4 Use of animal urine and physical condition of manure

Various studies shows that animal urine have more than double worth than that of dung but no people are aware enough about the importance of animal urine. Majority of farmers in Nepal are still not use animal urine in agricultural land. It is found that in Shankarpokhari VDC of Parbat district, people are realized the importance of urine and they are now started to better use of urine mainly in vegetable farm directly. Different five questions were raised during the study about quality and quantity of manure and use of urine as well. Around two (1.9 per cent) farmers said that their FYM quantity is improved in this year, just over fifteen (15.1 per cent claimed quality is found increased. It is light to carry, not sticky in hand and tools or easy in use, problems of insects and diseases is also reduced in some extend.

Table 6 : Changes in quality and quantity of OM and application practice

Ward number	FYM quantity improve	FYM quality increase	Best use of urine	Both urine and FYM use	Not left open long time
1	1	5	1	1	1
	11.1	55.6	11.1	11.1	11.1
2	0	2	0	3	0
	0.0	40.0	0.0	60.0	0.0
3	0	0	2	2	0
	0.0	0.0	50.0	50.0	0.0
4	0	1	10	0	0
	0.0	9.1	90.9	0.0	0.0
5	0	0	4	3	0
	0.0	0.0	57.1	42.9	0.0
6	0	0	5	0	0
	0.0	0.0	100.0	0.0	0.0
7	0	0	8	0	0
	0.0	0.0	100.0	0.0	0.0
9	0	0	3	0	1
	0.0	0.0	75.0	0.0	25.0
Total	**1**	**8**	**33**	**9**	**2**
Per cent	**1.9**	**15.1**	**62.3**	**17.0**	**3.8**

Source : Field survey, 2015

Significant number or more than sixty two (62.3 per cent) farmers were claimed that they know about the importance of urine and started to better use of it. Just seventeen (17 per cent respondents said that they are collecting urine in separate tank or in drum then pour it to

the dung pit. They said that it is easy to decompose biomasses within short duration if mixing urine. Just before two years, people of this VDC were carrying manure after making it dry by scatter it in direct sunlight for more than one week. It is totally stopped now, similarly, manure is usually left for more than two weeks in farm land but they now mixed it up within two days. During the discussion just around four (3.8 per cent) farmers claimed that manure is left open after carrying into the farm.

Another positive changes in this regard is seen while stay and moving around the field is about making natural pesticide by the use of animal urine which is left useless two years ago. All beneficiaries (200) were got drum from project executing agency and they use drum for collecting urine. Some of them are now making natural pesticide mixing various other biomass with urine. This picture shows such practice for instance. According to the farmers involving in such practice it is not difficult to prepare, it has no risk in use and more effective to control pests and diseases in vegetable. It takes around four weeks in winter and three weeks in summer to be ready for use.

While talking on about the use of animal urine, just over seventy-nine (79.2 per cent) people in overall, said they mix urine and cattle dung in pit, 17 per cent said they are making natural pesticide by the use of animal urine by mixing local herbs and biomasses. Similarly, just around four (3.8 per cent) people said that they are directly use urine in vegetable farming. They said it plays significant role to grow seedlings by supplying necessary nutrients and water also. Farmers observed that if it is possible to use urine regularly in vegetable farm it seen fruitful to control pest and disease.

Table 8 : Use of animal urine

Ward number	Direct used in vegetable	Mixed in FYM	Used to make pesticide
1	0	6	3
	0.0	66.7	33.3
2	1	4	0
	20.0	80.0	0.0
3	1	3	0
	25.0	75.0	0.0
4	0	8	3
	0.0	72.7	27.3
5	0	7	0
	0.0	100.0	0.0
6	0	5	0
	0.0	100.0	0.0
7	0	5	3
	0.0	62.5	37.5
9	0	4	0
	0.0	100.0	0.0
Total	**2**	**42**	**9**
Per cent	**3.8**	**79.2**	**17.0**

Source : Field survey, 2015

5.5 Status of nursery and fodder plants

People of Parbat district are seen beautiful plantation of fodder plants in Lumle area of Kaski as they are moving to and from Pokhara city. Significant numbers of farmers are now planted fodder plant mainly *Raikhaniyo* and many adult plant can be seen in Shankarpokhari also. But various farmers are not using it as they have no more idea and access to the seedlings of fodder plants. Shankarpokhari VDC has two shape half is face to northern part and another half part is face to southern part. Northern part has seen fodder plants but it is poor in southern part. Nursery is found established previously in ward number six of the VDC but not success as project expected and now it shifted to next ward (ward number 9) of same VDC.

However, beneficiaries (farmers) are planting seedlings of various types of fodder in around eight ward. Total 2205 fodder plants are found recorded and those are seen in the field also. Farmers are now protected such plants from animal and most of them are now seen taller than man. It is believed that the newly established nursery will may supply seedling of locally appropriate fodder plants. Farmers are increasingly planted legumes in their cropping system. Farmers are seen benefited from leguminous crops by integrating it as mix crop in maize and millet. Likewise, farmers are found now well known about the importance of leguminous crops as nitrogen is fixing in the root of such crops with the help of bacteria called ryjobia. It is one of the better idea of collecting nitrogen which is easily available in atmosphere with free of cost. During the discussion about the status of leguminous crops more than ninety-four (94.3 per cent) people said that the level of production is increasing in this year. Just around six (5.7 per cent) said it is constant.

Table 9 : Production of leguminous crops

Ward number	Increased	Constant
1	9	0
	100.0	0.0
2	5	0
	100.0	0.0
3	4	0
	100.0	0.0
4	9	2
	81.8	18.2
5	7	0
	100.0	0.0
6	5	0
	100.0	0.0
7	7	1
	87.5	12.5
9	4	0
	100.0	0.0
Total	**50**	**3**
Per cent	**94.3**	**5.7**

Source : Field survey, 2015

5.6 Means of income generation adopted by women

People of Shankarpokhari VDC are adopted various additional income generation measures in these last two years with the support of this project. Some parts are near to district headquarter and people of those villages are associated to vegetable farming and people residing a little bit far from market center are adopted goat keeping and poultry farming. During the discussion in overall 83 per cent people are adopted commercial vegetable farming. 7.5 per cent are involved in vegetable collection and goat keeping and just around two (1.9 per cent) involved in poultry farming. While talking about ward wise income generation measures only people of ward number one are involving in poultry farming as it is belongs to local market center or VDC headquarter. 25 per cent beneficiaries of ward 7 are

Table 10 : Income generating activities adopted

Ward number	Vegetable farming	Vegetable collection	Goat keeping	Poultry farming
1	7	0	1	1
	77.8	0.0	11.1	11.1
2	5	0	0	0
	100.0	0.0	0.0	0.0
3	4	0	0	0
	100.0	0.0	0.0	0.0
4	8	1	2	0
	72.7	9.1	18.2	0.0
5	6	1	0	0
	85.7	14.3	0.0	0.0
6	4	0	1	0
	80.0	0.0	20.0	0.0
7	6	2	0	0
	75.0	25.0	0.0	0.0
9	4	0	0	0
	100.0	0.0	0.0	0.0
Total	**44**	**4**	**4**	**1**
Per cent	**83.0**	**7.5**	**7.5**	**1.9**

Source : Field survey, 2015

involving in collection of locally produced vegetable and sent to the other nearest market. Similarly, 20 per cent beneficiaries of ward number 6 are involving goat keeping as it is accessible to forest base resources. It can be seen that majority of people in this project VDC are nowadays involving in small scale commercial vegetable farming.

While talking about how much money they are able to earn from the income generating means, four options were provided to respondents: first one is less than 10,000; 10,000 to 20,000; 20,000 to 30,000; and 30,000 to 40,000. In total, around forty (39.6 per cent) farmers said that they are able to earn around ten thousand from additional income which was supported by this project. More than twenty eight (28.3 per cent) people are able to earn ten to twenty thousand additional money as they were earning last year. Similarly, around twenty-three (22.6 per cent) farmers are able to earn NRs 30,000 to 40,000 from income generation schemes and rest around 9 per cent are able to earn NRs 20,000 to 30,000 money annually.

5.7 Level of empowering women

All project activities more or less hamper the beneficiary's daily life or they have to allocate additional time to the project activities. But it is important in what extend project support to enhance their capacity. This project mainly focus to women as targeted beneficiaries and few gender related activities were also found integrated in the project. Significant numbers of women are engaging in income generating activities and thus it is seen women's capacity is increased. Around eighty-five (84.9 per cent) people are agreed that women's capacity is enhanced as per their work burden is increasing. They were asked in what area their capacity is increasing? Around seventy-four (73.6 per cent) respondents observed that women's public speaking capacity is increasing significantly. They can talk in meeting and conference at local level and claim their rights. Just above eleven (11.3 per cent) people argued that women technical capacity in the area of organic matter management is increased. They believe that it may support to increase the agricultural production. About four (3.8 per cent) people agreed that women's facilitation skill is also increased after the implementation of this project. They can facilitated meetings and keeping record duly. The detail about sector of capacity enhancement is presented in following tables.

Table 13 : Sector of capacity enhancement

Ward number	Public speaking	Facilitation in meeting	Om mgmt. capacity increase	All above
1	5	1	1	2
	55.6	11.1	11.1	22.2
2	2	0	2	1
	40.0	0.0	40.0	20.0
3	3	1	0	0
	75.0	25.0	0.0	0.0
4	10	0	1	0
	90.9	0.0	9.1	0.0
5	4	0	0	3
	57.1	0.0	0.0	42.9
6	5	0	0	0
	100.0	0.0	0.0	0.0
7	7	0	1	0
	87.5	0.0	12.5	0.0
9	3	0	1	0
	75.0	0.0	25.0	0.0
Total	**39**	**2**	**6**	**6**
Per cent	**73.6**	**3.8**	**11.3**	**11.3**

Source : Field survey, 2015

Table : 12 Women's additional work burden vs increasing capacity

Ward number	best use of time	Enhanced capacity	Increased productivity
1	3	5	1
	33.3	55.6	11.1
2	0	4	1
	0.0	80.0	20.0
3	0	4	0
	0.0	100.0	0.0
4	0	11	0
	0.0	100.0	0.0
5	0	4	3
	0.0	57.1	42.9
6	0	5	0
	0.0	100.0	0.0
7	0	8	0
	0.0	100.0	0.0
9	0	4	0
	0.0	100.0	0.0
Total	**3**	**45**	**5**
Per cent	**5.7**	**84.9**	**9.4**

Source : Field survey, 2015

With the analysis of the table 12 and 13, the level of socio-economic empowerment of women is increasing significantly. As their capacity is increasing they are able to force VDC to allocate targeted group development budget as per Local Bodies Resource Mobilization Guidelines 2069 and make expenses accordingly.

5.8 Nutrition in soil

Soil testing campaign was organized by the project in its inception period in February 2014 with the technical support of Regional Soil Testing Service Section, Pokhara. 200 samples were tested in this phase. Most of the samples were seen more acidic and level of NPK was also very low. After 2 years same type of campaign was found organized and 50 sample were tested. The comparative status of pH and NPK is mentioned in annex 2. According to that annex, pH was 4.9 in February, 2014 February and it is 6.4 in February, 2016. It seems, acidity of soil is improved significantly in this short period. The comparative analysis of nitrogen, Phosphorus, and potash is described following points, below.

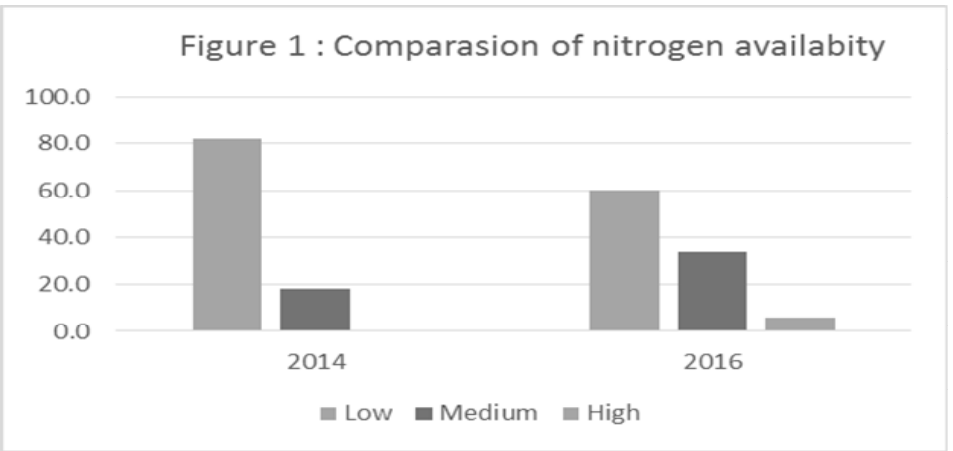
A. Nitrogen

Table 14: Comparative study of phosphorus within 2 years

2014 February			2016 February		
Status	**Number**	**Per cent**	**Status**	**Number**	**Per cent**
Low	32	64.0	Low	13	26.0
Medium	13	26.0	Medium	18	36.0
High	5	10.0	High	19	38.0
Total	**50**	**100.0**	**Total**	**50**	**100.0**

Source: STSS, Regional Office, Pokhara, (2014 and 2016)

Nitrogen is one of the primary nutrients for the plants for grow and give production to the farmers. While this project was organized soil testing camp in February 2014, larger of sample have low status of nitrogen. 82 per cent samples were in low status, 18 per cent were medium and none of the sample is in high status of nitrogen. In 2016, the status is seems changed dramatically. 60 per cent in low, 34 per cent in medium and 6 per cent in high status.



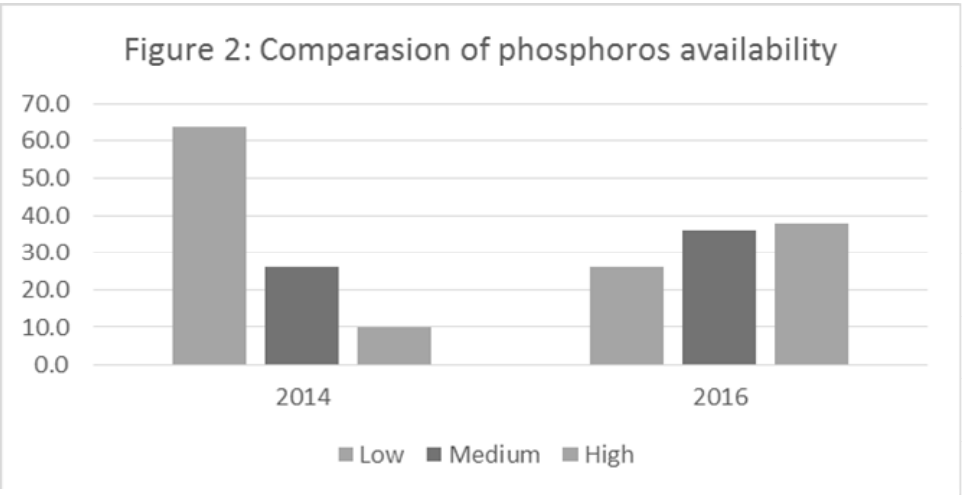
Source: STSS, Regional Office, Pokhara (2014 and 2016)

According to the figure 1 above, vast majority of samples have low nitrogen availability and there is vast difference in three types (low, medium, and high) in 2014. But it is improved after this project and there is few gap between three categories in 2016.

B. Phosphorous

State of phosphorous is also improved in the sampled soil while testing soil in 2016. Among 50 sample 32, 13, and 5 sample were found low, medium and high status respectively in 2014. The state of phosphorous availability of same plots are improved significantly in second test.

According to the table 14, the final test shows that there are 13, 18, and 19 sample are in low, medium, and high position. Low are decreased from 32 to 13, medium are increased from 13 to 18, high are also increased from 5 to 19.



Source: STSS, Regional Office, Pokhara (2014 and 2016)

Figure 2 above, presents the clear picture what is the changing scenario of phosphorous in two different tests. Situation is seen reverse, in first test 64 per cent sample were low, which is slow down remain 26 per cent in next test. Just 5 per cent samples were found high in first test which is increased sharply in next test with 38 per cent.

C. Potash

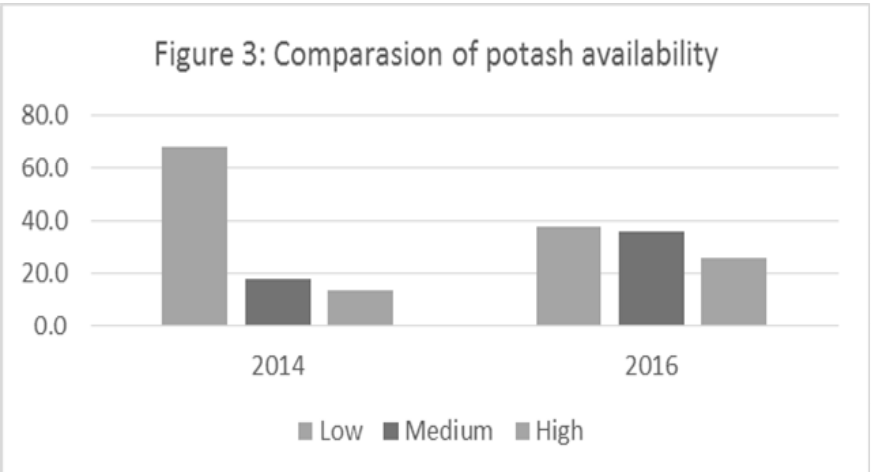
With other two major nutrients (nitrogen and phosphorous) the state of potash is also improved in tested 50 samples. According to this table the state of potash in sampled soil is different in two tests.

Table 15: Comparative study of potash within 2 years

2014 February			2016 February		
Status	**Number**	**Per cent**	**Status**	**Number**	**Per cent**
Low	34	68.0	Low	19	38.0
Medium	9	18.0	Medium	18	36.0
High	7	14.0	High	13	26.0
Total	**50**	**100.0**	**Total**	**50**	**100.0**

Source: STSS, Regional Office, Pokhara, (2014 and 2016)

In 2014, 34 samples were in low status which reduced and remain 19 in 2016. There were 9 samples in medium status in 2014 and were double now. Similarly, there were just 7 samples in high level but it is increased up to 13 in 2016.



Source: STSS, Regional Office, Pokhara (2014 and 2016)

Figure 3 presents per cent of low level samples are reduced from 68 to 38, medium level is increased from 18 to 36, and high level samples are also increased from 14 per cent to 26. It means the level of improvement in potash is also significant.

Above results shows, the overall status of soil of beneficiary's farmers is increasing day by day. If the farmers are continuously practicing this organic matter management technology then it will be increased and will keep sustainability in productivity not only production.

CHAPTER 6

MAJOR FINDINGS AND CONCLUSION

Various difference have been seen after the implementation of this project in Shankarpokhari VDC. Farmer's activities in managing FYM and crops residual is changed and thus positive effects have been seen and observed in production and productivity while conducting this study. Major findings of the study are explain in following sections.

6.1 Major findings

The impact study of the project “organic matter management for sustainable agriculture” has shown that farmers are responded positively organic matter management methods and realized the negative consequences of chemical means. Agricultural activities in project VDC is now moving slightly into new dimension with the adoption and integrating of new improved technology, attracting to cash crops, has led to significant changes in the traditional agricultural system and enhancing gradually the farm base income. Once, mainly in the period of 2050 to 2070 huge quantity of chemical fertilizer was consumed but now farmers are realizing its negative effects and back to natural or traditional means of fertilizer and organic pest management.

In remote villages of Parbat district, farmers are limited only to food grains cultivation and livestock rearing. But in the Shankarpokhari VDC farmers are found exposed to multiple cropping system- food grains, cash crops, and fruits production with livestock rearing. The development process mainly in agricultural farming system was accelerated by credits and other support service of the project. Major findings are discussed below in following points:

A. Quality and quantity of organic manure increased

People of this VDC are observing the negative consequences of heavy use of chemical fertilizer and pesticides as they feeling soil is tougher, production is reducing and quality also decreased as they found earlier in same field. All targeted people are now adopted organic matter management practice. The first step of organic matter management is cattle shed management and thus all people who are targeted to this project are completely make cattle shed. They are now claiming that it is easy to maintain animal clean and urine is not lost from shed. Cow dung is protected by making roof in dung pit, urine is collected in drum and directly using in vegetable farm and in dung pit. Animal residual is protected from sun light and water and thus nutrients are preserved.

Similarly, farmers are found making compost manure specifically near to the farms. They use locally available biomasses, crop residuals, urine collected in cattle shed, and other liters produce in farm. Soil status is improved significantly during this period. Level of soil acidity is increasing to neutral level and availability of NPK is also found increased sharply during this two years period (see please annex 2 for detail).

Some farmers are now using black plastic to make compost within short period. Farmers are now proudly claim that compost is more fruitful in vegetable farming rather

than cow dung. Urine also supported to control diseases, pest and also supply nutrients to plants and crops.

B. P*roduction and productivity of soil increased*

While talking to beneficiaries about the impact of the project, most of them observed that agricultural production is increased than that of last year. In the inception of the project 200 soil sample were tested and most of them are found acidic. Then they use *Kirshi chun* to balance the P^H level. Second round test was also conducted in February of 2016 of same plot. During final test only 50 samples were tested and test result was found more satisfactory. P^H and NPK level is improved now. So, there may be two causes of increasing the production: first one is soil acidic condition is improved after treatment; second one is farmer are using improved organic manure instead of chemical fertilizer. It is believed that the level of production increased will be maintained in the year coming as they are improving Farm Yard Manure (FYM) and compost.

A. Physical condition of manure and soil improved

Up to before two years, farmers of Shankarpokhari were used to carrying FYM to the farm after making it dry by keeping it on open sun at yard of the house or shed for up to seven days. They have no idea about the nutrients will be loosed while it keeping in direct sun light in several days. Now they are protected FYM from direct sun light by making shadow in dung pit. Similarly, they are not left FYM openly in farm after carrying it for long time. Now the physical condition of manure is fine, it is easy to carry and use to farm as it is dry and dusty. They also observed that chemical fertilizer using trend is reducing but production is not reduced, and they are claim that quality of food grain is also slightly improved. According to them soil is felt easier for digging and preparing.

B. Fodder plant extended

Major parts of this VDC is faced to north and seen dry than that of other parts. Rural local road network is extended in almost all settlement, landslide and soil erosion is increasing. Open grazing is practiced there since very long time due to that fodder plants were could not increase. After this project open grazing is totally banned and fodder seedlings are now protecting. One nursery was found established in ward no 6 of this VDC but it is found poor and they now shifted to other place (ward no 9 of same VDC) and planting seed of *Rai Khaniyo*. However, more than 6000 seedlings were planted with the support of District Forest Office and District Livestock Support Office. Those plants are growing faster hopefully it will support to control soil erosion and to increase nutrition level of cattle as well.

C. Level of empowerment of women increased

Women, the targeted beneficiaries are now able to earn additional money with the help of farm base income generating activities supported by this project. Access and control over their own earning is found remaining with them. It is one of the most important achievement of the project as women's voices were not heard or not addressed by local authority. Supporting to gender responsive village development plan was one of the components of this project and gender issues were discussed in community level. VDC started make gender responsive Annual Village Development Plan since fiscal year 072/073. Women are now able speak in in VDC level meeting and in other public places to claim their rights. Similarly, man were also found supportive to women to involve in various social activities. And thus, women's level of social and economic empowerment is now improving significantly.

6.2 Conclusion

Use of organic matter management technique is strongly supported to the adoption of organic and commercial farming. This technology has been supported to adopter households for producing more food and enhancing income. Non adopters are seemed to be benefited by seeing such changes in neighbor's farm. The analysis of linkages among the different components of farming system are strong. To increase awareness among formers regarding the adoption of vegetable production, fruit production and livestock rearing (with stall feeding system) to supplement and substitute the inorganic fertilizers has been an important factor contributing towards imposing the sustainability of the production system in the long-term. It was found that the consumption of inorganic fertilizer was reduce by 50 percent and they were attracted towards organic matter management technology, without damaging its long-term production potential and to meet increasing levels of demand. It has been found that there is significant correlation between organic matter management and agriculture production.

According to farmers there was various positive impacts: reducing the use of inorganic inputs/fertilizer and pesticide by 50 percent, soil is easier to work, comparatively, increasing food and other cash crop production, less pressure on forest by stall feeding and promotion of agro forestry, increased income by increasing agricultural production and vegetable, reducing women's workload through discussing about gender and discrimination to women in various aspect, encouraged to keep clean cattle shed. It can be believed that cattle's health status will also be naturally increased as they are feed nutritional fodder plants and keeping in healthier shed.

Despite this positive impact, replication of achievements to another places and remaining people of this VDC; farmer's involvement and continuing of organic matter management and use of organic pest in high value crops; marketing and processing of local products; involvement of landless people and gender equity in the traditional families have still some problems.

CHAPTER 7

SOME CONSIDERATIONS

In the last two decades, majority of working age people are temporarily migrating in gulf and other industrial countries for searching better job. Some remaining young temporarily sifted to larger city and staying in foot path with as salesperson. Large area of arable lands are left barren and only few elderly people who cannot do more in agriculture are left in villages. Local bodies (VDCs, municipalities and DDCs are not paid more attention towards agriculture related programme and large segment of their budget is allocating repeatedly in road sector. Farmers in these days are relies on chemical fertilizer as they could not kept more animal. People nowadays are choosing easy way for increasing production and no more attention is given in increasing productivity. Few people are engaging in commercial farming as road network is increasing and they are doing this by seeing such activities in another semi urban areas.

Shankarpokhari VDC is one of such VDCs where some people are engaging in small scale commercial farming and benefited in some extend. More than 200 families are directly benefited from this project and around same number of households are also started to adapt organic matter management technologies. So, following points are suggested for this VDC and these points may also important to other entity who are responsible to the people:

1. DDC should paid more attention towards agriculture development policies and programmes to attract young people in agriculture;
2. VDCs should mention agriculture development programmes in its annual plan. Without producing agricultural commodities in rural area, increasing road network is meaningless to local people;
3. It would be better to make integrated agricultural development schemes and animal farming with the close collaboration of District Agriculture Development Office (DADO) and District Livestock Support Office (DLSO). Increasing productivity of land is only possible by improving cattle shed, because the only source of organic manure in our farming system is animal dung which is not properly protected and utilized;
4. Integration of leguminous crops is another better way of increasing productivity of agricultural land. If farmers are increasing such crops nitrogen would be collected in their own root and ultimately contribute to soil;
5. Another problem in development in Nepali society is gender base discrimination to women. Few positive symptoms can be seen in changing roles of men and women in this VDC with the contribution of this project. It would be better if such campaign are continuing in the days coming;
6. Open grazing should be bane by the local body. It may support to preserve little seedlings of fodder plants and it may support to protect cow dung and its better use.

BIBLIOGRAPHY

Bryan Davies, David Eagles and Caney (1982), *Soil Management*, 4th Edition, Farming Press Limited, U.K.

CBS, (2004) *Statistical Pocket Book Nepal 2004*, Kathmandu,

Dahal, K.R, (2000) *Sustainable of Nepalese Agriculture: A challenges of our time;* Environment & agriculture, Ecological society, Kathmandu, Nepal.

Devkota, FR (2004) *Agriculture and Sustainable Development Conceptual Approach:* Vol 1No. 2 Central Department of R.D. TU Kirtipur.

Devkota, F.R., (2005) "Anthropological knowledge in solving plural problems", *Nepalese Journal of Development and Rural Studies*, vol1.2no./Jan.Jun, central Department of Rural Development. Tribhuvan University, Kirtipur (Kathmandu) P.P1-7

Devkota, F.R.2004, "Agriculture and sustainable development conceptual Approach.," *Nepalese Journal of Development and Rural Study*, vol.1 No.2 (July-Dec2004), central Department of Rural development, Tribhuvan University, Kirtipur, Kathmandu P.P.8-14

FSD (2003) *Sustainability The Lasting Fuel:* Forum for Sustainable Development, Nepal.

Jaisy, S.N., (1997) *Soil Fertility Management Activities, Future Strategy, constraints and Recommendation*, DOA,/CDD/STSSICA/, Kathmandu.

Jha, P.K, (2000) *Environment and Agriculture: Trend and perspective, Environment and Agriculture, at the crossroad of the nemillennium;* Ecological society, Kathmandu Nepal.

Lekhak H.D, Lekhak Binod (2003) *Natural Resource Conservation and Sustainable Development in Nepal:* Kshitiz Publication, Kathmandu.

NPC (2004) *Nepal Living Standard Survey:* NLSS Volume 1, 2 National Planning Commision, Nepal.

NPC (2003) *Statistical Year Book 2003,* National Planning Commission, Kathmandu.

Ojha, E.R, (1999) *Dynamics and Development of Highland Ecosystem*., Waldon books house Kathmandu

Ojha, E.R.(2001b) *Sustaining Mountain Agro ecosystems through sustance of Agricultural Terrace System:* Botanica Orientalis: Journal of Plant Science. Annual issue 2001, Central Department of Botany, TU KTM.

Regmi, Kosh Raj (2004) "*Agriculture Resource and sustainability*",. *Nepalese Journal of Development and Rural Study*. vol.1 No.1 (Jan-Jun2004), Central Department of Rural Development, Tribhuvan University, Kirtipur (Kathmandu) P.P. 46-52

SSMP (1999) *Tools for Reflection on soil Management:* Sustainable Soil Management Programme, Lalitpur, Nepal.

UNDP (2004) *Nepal Human Development Report:* United Nation Development Program, Kathmandu.

UNDP, (2004) Nepal Human Development Report Kathmandu, Nepal.

Upadhaya, B.P.,(2004) Problem and prospect of Sustainable Agriculture Development in Nepal, Forum for Sustainable Development, Kathamandu.

Upadhaya, Shyam K, (2003) "*Sustainable Agriculture Development in Nepal; "Sustainability the lasting Fuel, Forum for sustainable Development-Nepal*. P.P 189-192.

Annex 1

General Questionnaire

Namaste, this is me ..... I am here with you for studying the impact of the project **"Organic matter management for sustainable livelihood improvement"** as an external evaluator. Now, I am here to obtain information to examine impact of the project into productivity of land and level of women empowerment. You are the one who is directly or indirectly involved in project activities at local level and getting service from project executing agency. So, I hereby, kindly request you to provide your response and experiences in the following issues. All the information provided by you will be used solely for this above stated purpose, despite this all the information will be kept secret.

Name: Ward Number:

Cast: (Dalit, Ethnic group, Brahimin Chhetri) Sex: (a) Man (b) Women

1. What type of organic matter management method you adopted after this project?
   (a) Farm Yard Manure Management (FYM)
   (b) FYM and compost management (both)
2. What is position of using chemical fertilizer?
   (a) Lowering the use of chemical fertilizer
   (b) Not increasing chemical fertilizer but maintaining production as usual
3. What is the production level in your observation?
   (a) Increasing slightly
   (b) Not increasing but decreasing expenditure that is use in chemical fertilizer
4. What types of changes you observe after completion of the project?
   (a) Increase in quantity of FYM
   (b) Increase in quality of FYM
   (c) Collection of animal urine
   (d) Best use of FYM and animal urine collected
   (e) Not left manure more time in open light at farm land
5. What type of differences you observe in new method of OM management as compare to traditional method?
   (a) Light to carry and dry
   (b) Easy to use in farm land as it is dust
   (c) Not sticky in hand and leg while using it
   (d) All above
6. How do you use animal urine, after this project?
   (a) Direct use to vegetable
   (b) Mix it to FYM pit by picking it from collection tank
   (c) Make natural pesticide
7. How many fodder plants do you have after this project? ……
8. What is the production level of leguminous crops, after this project?
   (a) increased slightly
   (b) not increased or constant in production

9. What type of income generating means you adopted during this period?
   (a) Small scale vegetable farming
   (b) Collection of locally produced vegetable
   (c) Goat rearing
   (d) Poultry farming
10. what is your additional income by this project?
   (a) > NRs 10,000
   (b) NRs 10,000 to 20,000
   (c) NRs 20,000 to 30,000
   (d) NRs 30,000 to 40,000
11. Whether there is women's work burden is increased by this project?
   (a) Seen work load increased but we satisfied, because of the best use of time
   (b) Capacity enhanced by fulfilling additional responsibility
   (c) Satisfied from increasing the productivity of farm land
12. In what sectors women's capacity is increased?
   (a) Public speaking without hesitation
   (b) Meeting minuting and keeping record
   (c) Technical knowhow in producing and best use of organic manure
   (d) All above

Annex 2: Comparative analysis of P^H and NPK

Group	SN	Name of Farmers	P^H		N		P		K	
			2070	2072	2070	2072	2070	2072	2070	2072
Sewa Mukhi Group (1)	1	Ratna Bdr.Thapa	4.6	6.1	M	M	L	M	L	L
	2	Saraswati Karki	4.7	6	L	L	L	M	L	H
	3	Khem Kumari Paudel Chhetri	4.5	5.4	L	M	L	H	L	M
	4	Gita Tiwari	4.5	5.7	L	L	L	L	L	L
	5	Devi Adhikari	4.5	6.6	L	M	L	H	L	M
	6	Puspa Tiwari	4.9	6.8	L	M	H	H	L	M
	7	Pabitra Tiwari	4.5	7.1	M	L	M	M	M	H
	8	Chakra Pani Gautam	6.3	6.6	M	M	L	L	L	H
	9	Dharma Datta Adhikari	4.5	7.9	L	L	L	M	M	M
	10	Tilsi Bhusal	4.5	6	L	L	L	L	L	L
	11	Daya Bhusal	4.5	5.8	L	M	M	H	H	H
	12	Dotnaraj Bhusal	4.5	7	M	H	M	M	H	H
	13	Radhika Kumari Bhusal	4.5	7	M	M	M	M	M	H
	14	Maya Bhusal	4.5	6.1	L	H	H	L	M	H
	15	Diwakar Sapkota	4.7	5.8	L	L	H	H	H	L
Hariyali Farmers Group (3)	1	Ganga Prasad Adhikari	4.5	6.9	L	L	L	M	L	L
	2	Prem Prasad Adhiukari	5.1	6.8	L	L	L	H	L	M
	3	Kalpana Adhikari	5	6.7	L	M	L	M	L	M
	4	Homnath Adhikari	5.7	6.1	L	L	L	H	L	L
	5	Santi Adhikari	4.5	5.6	L	M	L	H	L	M
	6	Santi Gautam	5	5.6	L	L	L	M	L	L
Jagriti Farmers Group (4)	1	Rita Kumari Tiwari	4.9	6.4	L	M	M	M	L	H
	2	Nirmala Adhikari	5.3	6.2	M	M	M	M	L	L
	3	Guma Tiwari	5.7	5.8	L	L	L	H	M	L
	4	Devi Kafle	4.5	6.2	L	L	L	L	L	M
	5	Bhagawati Tiwari	4.5	6.6	L	M	L	L	L	L
	6	Mayadevi Rijal	4.5	5.3	L	M	L	M	L	M
Bhume Farmers Group (5)	1	Purna Bahadur Darji	5	5.9	L	L	M	M	L	M
	2	Sarita Regmi	4.5	5.9	L	L	M	M	L	M
	3	BhimKumari Regmi	4.5	6	L	L	L	L	L	M

	4	Tara Khatri	5.3	5.7	L	L	L	L	H	H
	5	Dal Bdr. Darji	6.2	6.8	L	L	L	M	L	M
	6	Sobhakhar Pariyar	6.3	7	L	H	L	L	H	H
	7	Rekha Rijal Paudel	4.5	6.9	L	L	H	H	L	L
	8	Sita Khatri	4.5	8.1	L	L	H	H	L	M
	9	Rupa Sharma	4.5	5.9	L	L	L	H	L	L
	10	Devi Khatri	5.3	6.4	L	L	M	H	M	M
	11	Sarada Devi Paudel	4.5	6.1	L	M	L	L	L	M
Suryodaya Farmers Group (6)	1	Dayaram Pangali	4.5	6	L	M	M	M	L	M
	2	Surya Prasad Lamichhane	5.7	6.6	L	L	L	H	L	H
	3	Durga Rijal	4.7	6.9	L	L	L	H	H	H
	4	Him Prasad Adhikari	4.9	5.8	M	L	M	H	H	L
	5	Shanti Bhusal	5.9	6.6	M	L	L	H	M	L
	6	Jalandhar Bhusal	4.5	6.9	L	L	L	L	L	H
	7	Narayan Rijal	4.5	5.7	L	L	M	M	L	L
Unnitshil Farmers Group (9)	1	Shiva Prasad Bhusal	4.6	7.3	M	M	L	M	M	L
	2	Purna Prasad Lamichhane	6	7	L	L	L	H	L	L
	3	Tilak Prasad Bhusal	4.7	6.4	L	L	M	L	M	L
	4	Mina Tiwari	4.8	5.8	L	M	L	H	L	L
	5	Laxmi Datta Bhusal	4.5	5.9	L	L	L	L	L	M
			4.9	6.4						

Note: N= Nitrogen, P= Phosphorus, K= Potash; L= Low, M= Medium, and H= High

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