ECONOMICS OF ORGANIC CASH CROPS AND FOOD CROPS IN SIKKIM: A COMPARATIVE STUDY

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DECLARATION

I, Bishnu Kumar Portel hereby, declare that the issues and matters raised in this thesis entitled **"Economics of Organic Cash Crops and Food Crops in Sikkim: A Comparative Study"** are records of my own effort and the contents of this thesis or part of it has not been submitted anywhere for the award of any degree or diploma, or for any other academic purposes.

This is being submitted in partial fulfillment of the requirement of the degree of **Master of Philosophy** in the Department of Economics, School of Social Sciences.

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This is certified that the dissertation entitled **"Economics of Organic Cash Crops and Food Crops in Sikkim: A Comparative Study"** submitted to Sikkim University in partial fulfillment of the requirement for the degree of Master of Philosophy in Economics is the result of research work carried out by Mr. Bishnu Kumar Portel under my direct supervision. The contents of the thesis or part of it has not been submitted anywhere for any degree, diploma or for any other academic purposes.

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CONTENTS

Declaration *i*

Certificate *ii*

Acknowledgement *iii*

Chapter 1: Introduction **1-18**

1.1 Introduction 1

1.2 Importance of Organic Farming 3

1.3 Importance of Organic Agriculture to Sikkim's Economy. 6

1.4 Problems and Prospects of Organic Farming. 10

1.5 Rationale of the Study 15

1.6 Research Questions 15

1.7 Objectives of the Study 16

1.8 Hypotheses 16

1.9 Data Source 17

1.9.1 Source of data 17

1.9.2 Types of data 18

1.9.3 Sources of secondary data 18

1.10 Technique of Analysis 18

Chapter 2: Review of Literature: Economics of Organic Farming **19-27**

2.1 Introduction 19

2.2 Organic Farming (traditional) Verses Conventional Farming 20

2.3 Food Security, Employment and Sustainability Aspects of Organic Farming 22

2.4 Survey of Methods of Analysis 25

2.5 The Research Gap 27

Chapter 3: Agriculture Profile of Sikkim **28-48**

3.1 Agriculture in Sikkim 28

3.2 Sectoral Composition 29

3.3 Land Use Classification 31

3.4 Cropping Pattern 33

3.5 District Wise Land holding Pattern in Sikkim 34

3.6 Area, Production and Productivity of Major Food Crops of Sikkim 35

3.6.1 Paddy 35

3.6.2 Maize 39

3.7 Area, Production and Productivity of Major Cash crops of Sikkim 41

3.7.1 Potato 42

3.7.2 Ginger 43

3.8 The Government Policy and Initiatives 45

3.9 Major Agricultural Issues 46

Chapter 4: Analysis and Interpretation of the Results **49-87**

4.1 Results on Paddy Production 49

4.1.1 Independent t-test *51*

*4.1.2 ANOVA- Test: 2*2 ANOVA* *52*

4.1.3 Regression Analysis *59*

4.2 Results on Maize Production 61

4.2.1 One way ANOVA (maize) *63*

4.2.2 Two-way ANOVA (Maize) *64*

4.2.3 Regression Analysis *66*

4.3 Results on Ginger Production 68

4.3.1 One way ANOVA (ginger) *69*

4.3.2 Regression Analysis *74*

4.4 Results on Potato Production 76

4.4.1 Tukey Test *78*

4.4.2 ANOVA test: *78*

4.4.3 Regression Analysis *81*

4.5 Profit Analysis 84

Chapter 5: Conclusions and Policy Suggestions **88-91**

5.1 Conclusions 88

5.1 Policy Suggestions 91

5.3 Limitations of the Study 93

BIBLIOGRAPHY **94-100**

APPENDIX **101-107**

List of figures

Fig: 3.1 Trend line of Productivity of Paddy 37

Fig: 3.2 Trend line of Area under Maize Cultivation and Production of Maize 40

Fig: 3.3 Trend line of productivity of Maize 41

Fig: 3.4 Trend line of potato and ginger production 44

List of tables

Table: 3.1 Composition of Gross State Domestic Product (Constant Prices) (in Percent) 31

Table: 3.2 Land Use Classifications in Sikkim as on 2007. 32

Table: 3.3 District Wise Land Holding 35

Table: 3.4 Area, Production and Productivity of Paddy in Sikkim. 37

Table: 3.5 District wise area, production and productivity of paddy (2011-12) 38

Table: 3.6 Area, Production and Productivity of Maize in Sikkim. 39

Table: 3.7 Area, Production and Productivity of Two Major Cash Crops 42

Table: 4.1 Descriptive Statistics: Paddy Production 50

Table: 4.2 Group Statistics 51

Table: 4.3 Independent Samples Test 52

Table: 4.4 Between-Subjects Factors 53

Table: 4.5 ANOVA Results - Tests of Between-Subjects Effects 55

Table: 4.6 Descriptive Statistics 57

Table: 4.7 ANOVA Test - Tests of Between-Subjects Effects 58

Table: 4.8 OLS estimates of the parameters of C-D paddy production function 60

Table: 4.9 Descriptive Statistics: maize 62

Table: 4.10 ANOVA test 63

Table: 4.11 Tukey Test of Homogeneity of the groups 63

Table: 4.12 Descriptive Statistics Maize 65

Table: 4.13 Tests of Between-Subjects Effects 65

Table: 4.14 OLS Regression estimates of maize production 67

Table: 4.15 Descriptive Statistics- ginger 69

Table: 4.16 One way ANOVA Descriptive (Area Wise) 69

Table: 4.17 Tukey Test of Homogeneity of the groups 70

Table: 4.18 Two factor ANOVA test 71

Table: 4.19 Descriptive Statistics: ginger 72

Table: 4.20 Tests of Between-Subjects Effects 73

Table: 4.21 OLS estimates of the parameters of C-D paddy production function 75

Table: 4.22 Descriptive statistics 77

Table: 4.23 Tukey Test of Homogeneity of the groups 78

Table: 4.24 Descriptive Statistics 79

Table: 4.25 Tests of Between-Subjects Effects 80

Table: 4.26 Regression Results 82

Table: 4.27 Revenue, Cost and Profit Analysis of the sample 84

Table: 4.28 Profit and Loss Making Farmers in Specified Crops out of Total Sample 85

Table: 4.29 Profit and Loss making farmers-District wise 86

Abbreviation

APEDA	Agriculture Product Export Development Authority
DAC	Development of Agriculture Cooperation
DAP	Diammonium Phosphate
FAO	Food and Agricultural Organization
FOAM	International Federation of Organic Agriculture Movements
FSADD	Food Supply and Agriculture Development Department
GDP	Gross Domestic Product
GOI	Government of India
GOS	Government of Sikkim
HCCDD	Horticulture and Cash Crops Development Department
HYV	High Yielding Variety
Ha	Hectare
ICS	Internal Control System
IFOAM	International Federation of Organic Agriculture Movements
ILO	International Labour organization
Kms	Kilometers
KVK	Krishi Vigyan Kendra
Kg	kilogram
NA	Not Applicable
NAAS	National Academy of Agricultural Sciences
NGO	Non Government Organization
PPP	Public Private Partnership
SGDP	State Gross Domestic Product
SIMFED	Sikkim Marketing Federation
Tha	Thousand hectare
Tt	Thousand tonnes

Chapter 1

INTRODUCTION

Chapter 1

Introduction

1.1 Introduction

Agriculture has a pioneering role of in the industrial growth. The industrial growth in England in the mid-18th century, Japan in the late-19th century and much of Asia in the late 20th century are all the result of strong agricultural base in those countries (Diao et al., 2005). Agriculture-led growth played an important role in reducing poverty and transforming the economies of many of the Asian, Latin American and some African countries (Diao and Sarpong, 2007). The theories of economic development, the cross country empirical studies and the success of the green revolution in Asia, confirm that agriculture can play a crucial role in the development process (Diao et al, 2005). As of 2011, the International Labour Organization (ILO) states that approximately one billion people, or over one third of the available work force, are employed in the global agricultural sector (The World Fact Book, 2013). An estimated 2.5 billion persons are dependent on agricultural activity for their livelihood (Byerlee et al., 2010). The contribution of agriculture to the World GDP is 6 percent to the total GDP (The World Fact Book, 2013).

India accounts for only about 2.4 percent of the world's geographical area and 4 percent of its water resources but has to support about 17 percent of world's human population and 15 percent of the livestock. Agriculture accounts 14 percent of the nation's GDP; about 11 percent of its total export; principal source of income of about half of the population and a source of raw material for large number of industries (State of Indian Agriculture 2012-13). Accelerating the growth of agricultural production is therefore, necessary not only to achieve overall GDP growth of 8 percent during the 12^{th} Plan (2012-17)

and meet the rising demand for food but also to increase income of those dependent on agriculture to ensure inclusiveness.

Increased population and consequent rising demand for food led to introduction of new technologies and use of chemical inputs which increased production as well as the productivity of the limited available agricultural land. But the new form of agricultural practices deteriorated the soil quality and environment and, therefore, productivity decreased in the long run (Munda et al., 2010). Modern innovations and technology diffusion in agriculture coupled with massive demand for food grains by burgeoning human population transformed the agriculture from a circular causation mode to a linear flow model with complete dependence on external inputs of synthetic fertilizers and pesticides. With the Green Revolution initiatives, the production as well as the productivity of the agricultural land increased and India became self-sufficient in food grain production. The surplus of the produces exported and the earnings helped in improving economic strength of the country. However, the intensive use of synthetic fertilizers in non-organic method of agriculture in India eroded soil fertility and soil health which has threatened the sustainability of agriculture sector in the long run. The negative effects of the chemical inputs in agriculture were realised both at the farmers' level as well as at the planning level. Thus, the existing non-organic farming system gradually moved towards the organic method of cultivation (Munda et al., 2010).

Organic farming is the form of agriculture in which techniques, such as crop rotation, green manure, compost and biological pest control are followed. Organic farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include chemical herbicides, insecticides and fungicides), plant growth-regulators such as hormones, livestock antibiotics, food additives, genetically

modified organisms, human sewage sludge and nanomaterials (Cardelli et.al., 2004 and Willer et. al., 2008). In fact, the organic farming methods combine scientific knowledge and modern technology with traditional farming practices based on thousands of years of agriculture. Crop diversity is a distinctive characteristic of organic farming. The Latin American countries, the countries of Oceania, USA, Canada, Australia, some Asian countries like India, China are some of the leading countries in the organic farming.

1.2 Importance of Organic Farming

The importance of organic farming has been realised world over. The studies on the organic farming have shown that the Organic farming techniques improve the soil health in the long run and the fertility of the soil remains for longer time once it is restored. The conventional, chemical-intensive methods deplete soil, organic principles add life to the soil and healthy soil produces healthy food (Adhikari et.al 2013; Sankaram, 2001; Kautama et. al, 2013).

The other importance of the organic farming is that the organic food is not irradiated. Irradiation damages the quality of food and a diet high in irradiated foods has not been proven safe over the long term.

As far as the biodiversity of the said organic farming is concerned, the organic farming technique also improves the biodiversity. Diverse systems are more resilient as they are less prone to disease and infestations. Organic farming does not use synthetic pesticides. Synthetic pesticides are not only a danger to personal health, but are a threat to farm workers, local ecosystems, waterways and the surrounding communities. A recent study reporting on a meta-analysis of 776 scientific papers concluded that organic farming produces more biodiversity than other farming systems (Das, 2007).

The organic practice of agriculture aims at producing food while establishing an ecological balance to prevent soil fertility or pest problems. Organic agriculture takes a proactive approach as opposed to treating problems after they emerge which is also one of the objective of the sustainable approach. Soil building practices such as crop rotations, inter-cropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices.

In many agriculture areas, pollution of groundwater courses with synthetic fertilizers and pesticides is a major problem. As the use of these is prohibited in organic agriculture, these are replaced by organic fertilizers like compost, animal manure, green manure and through the use of greater biodiversity (in terms of species cultivated and permanent vegetation), enhancing soil structure and water infiltration. Well managed organic systems with better nutrient retentive abilities, greatly reduce the risk of groundwater pollution (Narayanan, 2005). In some areas where pollution is a real problem, conversion to organic agriculture is highly encouraged as a restorative measure for example done by the Governments of France and Germany (Dhama, 2009).

So far the response to climate change and the mitigation potential of agriculture is concerned, a number of studies conducted have revealed that soil organic carbon contents under organic farming are considerably higher in organic farming (Thapa, 2010). The more organic carbon is retained in the soil; the mitigation potential of agriculture against climate change is higher.

Many developed countries like the members of European Union and the USA do provide financial help for the conversion to organic agriculture, as do a few developing countries like Tunisia (Hurley, et al, 2009).This can be very important for the farm economy as the period of conversion often leads to falling yields as it takes time for full biological activity of the agro-ecosystem to be restored. Intervention may come in the form like

compensation for losses (as during conversion, products cannot be sold as organic), integration of extra costs such as certification or support for infrastructure developments. This can be in the form of investment in research, rural extension and training for farmers, and organic market development. The premium prices paid by the consumer for the organic produce also form an economic incentive for the individual farmer.

As far as the food security in relation to organic farming is concerned organic farms grow a variety of crops and livestock in order to optimize competition for nutrients and space between species: this results in less chance of low production or yield failure in all of these simultaneously (Das, 2007). This can have an important impact on local food security and resilience. Further in rain-fed systems, like of Sikkim, organic agriculture has demonstrated to outperform conventional agricultural systems under environmental stress conditions (Dhama, 2009). Under the favourable circumstances, the market returns from organic agriculture can potentially contribute to local food security by increasing family incomes. The farmers of Sikkim are small land holders and hence the organic practices in the farming systems of the state can become a viable option to improve food security of smallholding farmers by increasing income, decreasing input cost, producing more for both household consumption as well as for market, and adopting ecologically sustainable practices with locally available resources. It can be also assumed that the difference in production gap due to adoption of organic agriculture would be negligible; rather there is scope for enhancing productivity with good organic management. The organic premiums would boost earning of the local farmers.

1.3 Importance of Organic Agriculture to Sikkim's Economy.

The advent of green revolution in the country and its success story in the state like Punjab, Andhra Pradesh and Utter Pradesh encouraged using the chemical fertilizers and pesticides to increase agricultural production in the state of Sikkim also, since the agriculture in the state was also pegging with low level of production as well as low productivity of the limited available agricultural land. Though the per capita use of chemical fertilizers was meagre as against the national average, the severe consequences of utilization of these chemical fertilizers and pesticides on agriculture such as erosion of soil fertility and related consequences were realised by the state government in the early phase of conventional agricultural development and hence the policy makers and the government decided to switch over to organic farming from the practices of existing conventional agricultural system. Here the term conventional farming is used to denote the farming using post Green Revolution technology- use of chemical fertilizers, pesticides, tractors, harvesters, etc. It was also realised that the increasing use of chemical fertilizers in the agriculture was causing severe impacts to the ecology and the environment of the tiny state of Himalaya.

The commercialization of agriculture in Punjab through the Green Revolution led to the effects, which were far reaching and irreversible. The Green Revolution replaced indigenous agriculture with modern agriculture led to the use of high yielding seed varieties of various crops; the contamination of soils and water systems from the use of pesticides, chemical fertilizers, modern irrigation systems and dependency on modern machinery and technology (Kutama et. al, 2010).

Considering these aspects, the state government of Sikkim took decision to adopt organic system of farming in the entire state. The state government felt the drastic impacts of the green revolution techniques of agricultural production and since the eco-system of Himalayan region is quite delicate, the state government considered better to go for organic system of agriculture. On the other hand, since the use of chemical fertilizers and pesticides was very less in the state, the state government found it easy for the process of transformation of the existing conventional farming practices to the organic farming system. The cultivation practices in the Himalayan state of Sikkim was largely traditional, hence it became easy for the state government as well to the farmers to adopt the newly implemented organic farming techniques. Here the word traditional farming is used synonymously with organic farming because the individual farm households do not adopt organic farming in the strict sense of the term. But they are banned to use chemical fertilizer, pesticides and other chemical manures. Hence, organic farming means traditional cultivation with no chemical fertilizers and pesticides etc.

In the process of agricultural mechanisation, the issue of achieving sustainable agricultural production becomes the central focus of planning both at academic and planning level. In prospect of organic farming in Sikkim, initiatives at the state level have been taken and the implementing agencies are already engaged in the process. The lack of academic research related to it is a constraint for effective policy on making Sikkim a fully organic state. The work at the academic level facilitates policy makers for making effective and appropriate policy for organic farming practices in attaining greater efficiency. With this aim, an effort is made to carry out a micro level study within Sikkim particularly relating to the economic prospects of the organic farming.

Sikkim, the 22nd state in India has attempted to make the state fully organic. The state adopted organic farming policy in 2003. Since, the use of Green Revolution technologies was limited in the state and the farmers were adopting mixed strategies (both traditional and in-organic techniques) in agricultural practices, it became easy for the farmers to amalgamate with the newly implemented organic farming methods. Synthetic inputs in agriculture was meagre (12 kg per ha against national average of 90 kg per ha) (FS&ADD and H&CCDD, GOS, 2011).

The state of Sikkim has 62,000 farming families who own an average of 1.9 ha of farm land and do the farming in the traditional way. Taking this as an advantage, the State Government initiated to promote the organic farming in the state. Sikkim also has some advantage of continuing traditional farming since the farmers of the state are cultivating with knowledge and skills based on organic farming. The possession of variety of agro-climatic conditions and an emerging new class of educated farmers wanting to make agriculture a professionally viable vocation, there is a good potential of making the organic farming a success (SIKKIM towards Fully Organic State by 2015, 2012, FS&ADD and H&CCDD, Government of Sikkim). For Sikkim, this generates hope of improving soil health of largely marginal hill farmland, reducing the cost of inputs and developing cash crops and agro-enterprises with an aim to offer opportunities of employment. The vibrating tourism industry gets better boost with the success of the organic farming as the organic farming can become a matter of greater interest for the visitors on the aspects like having organic food and to see the organic activities involved there in the agriculture practices. The State has the enormous opportunities to develop niche based organic agriculture business enterprises providing self employment to educated youth and improving states' economy. The farmers of Sikkim can avail the benefit of increasing both in terms of income generation as well as employment generation since the international market for organic product is growing at the rate of 30

percent and World organic food sales jumped from US$23 billion in 2002 to over US$62 billion in 2010 (SIKKIM Towards Fully Organic State by 2015, 2012, FS&ADD and H&CCDD, Government of Sikkim). Production of organic product in large scale for the purpose of export can help the economy of the state to boost towards greater height of development. Owing to unique agro climatic conditions and farming practices, there are larger opportunities for high-value products such as cardamom, ginger, orange, tea, kiwi fruits, passion fruit and many types of mountain vegetables and food-grains. The cultivation of these crops through organic method has more potential for national and international markets (SIKKIM towards Fully Organic State by 2015, ed. 2012, published by FS&ADD and H&CCDD, Government of Sikkim). The government has targeted to transform the state to fully organic by 2015 and the work is going on in the entire state.

The fertile land, the topography and the climatic condition of the state largely support agriculture. The cropping pattern of the State has over the years transformed from cereal dominated subsistence agriculture to high value, cash crop dominated commercial agriculture. However, the cultivation of the food crops has not lost significance as the topography and the climatic conditions largely support the cultivation of these crops in the state. Agriculture, horticulture and animal husbandry constitute a mainstay of the largest segment of Sikkim's population. Maize, paddy, wheat, barley and buck wheat are the main cereals and potato, ginger, cardamom and mandarin are the major commercial/horticultural crops grown in the state. Since all these crops are being growing organically, there is huge potential of capturing the local, domestic and international market for the organic produces by the state.

1.4 Problems and Prospects of Organic Farming.

Despite having several advantages of the organic farming, there is laxity in the adoption of organic farming practices in the agriculture. Developing countries are already producing a wide range of organic products and many are thriving well, however, most of them are often faced by a number of constraints, such as lack of technical know-how, ignorance of production method, and lack of market information, for example which crop to grow, which markets and distribution channels to choose, competition, market access, etc. Producers face certification problem which posses not only a technical problem but also adds considerable costs to the product, which have to be borne by the consumer in one way or another. Since importers, food manufacturers, retail organizations and consumers need a guarantee of organic origin, the farmers ultimately fail to fetch good price (Bello, 2008).

Another discouraging aspect of the organic farming is that, organic agricultural products are expensive due to higher costs requirement in growing, harvesting, transportation and storage. Along with this, certification and intensive management cost, problem of higher labour input in its Operation lead to do the farming on a smaller scale. This is why Pandel and Lampkin (1994), stated that the labour input measured in terms of either hours of work or full –time job is usually greater on organic than on equivalent conventional farms. Organic research tends to be more diffused, farm-base participatory, drawing on local knowledge and tradition. It also focuses on public goods, resources and tools that are not readily patentable. This explains why organic farming attracts little investment from private sources compare to conventional and biotechnological approaches (Parrot and Marsden, 2002).

The major problem areas for the growth of organic farming in India are lesser content of nutrient in the organic manure than that of chemical fertilizers, lack of awareness relating to knowledge based of organic farming techniques, marketing problems of organic input and

outputs. It was found that the farmers of organic wheat in Rajasthan got lower prices than those of the conventional wheat (Rao, 2003) which shows the lack of awareness on the farmers' part or the failure in the marketing of the organic products. The shortage of organic biomass, poorly supporting infrastructure coupled with high input costs are also the major constraints the sector is facing. Such problems of lack of infrastructure; lack of organic fertilizers and lack of awareness programmes at the farmers' level are the similar problems that the state of Sikkim is also facing. During the survey, it was found that the vermi compost shed, the rural compost shed, and other necessary requirements were very scarcely available and even if available, they are in the idle stage. The farmers in the survey area were found to be using traditional technique in the cultivation of their crops. This shows either laxity on the part of farmers and the management or the scarcity of the resources relating to the organic farming in the state. Though the farmers are using the imported High Yielding Varieties of seeds but at the time when the crops are harvested, the volume of output collected is quite marginal. The output is even not sufficient for the subsistence level of consumption. Many of the farmers further reported that many a times the farm outputs produced organically face severe competition with the inorganically produced farm outputs. When the farmers offer their products for sale, they do not receive good price. This is also attributed to the involvement of middle men as they bargain with the farmers.

In 2011, during the kharif season the state government introduced baby corn and sweet corn with the model of Public Private Partnership and forward and backward linkages and was successfully demonstrated. The farmers were provided with free seeds and were assured to give good price. Eventually, farmers harvested good volume of baby corn and sweet corn and R □ 60 per kg for both the corn was provided to them at the farm gate itself. The crops were procured by the Sikkim Marketing Federation (SIMFED). The poor farmers earned good amount of cash out of the crops. However, in the next year, though the farmers

harvested good volume of the crops but at the time of procurement of their crops, the agency gave half the price that it had given the last time. The agency made the statement that the quality of the product is not good enough as per the market requirement; the size of the baby corn was not perfect (some are large, not suitable). During the third year, the seeds were not distributed to the farmers and again the farmers started cultivating the local variety. So far the failure in regard to the termination of the cultivation of the baby corn and the sweet corn in the state is concerned, it is observed that the constant monitoring and providing technical knowledge to the farmers lacked and due to which the marketing of the product failed in the subsequent years as a result the production of the crops stopped despite having better performance of the crops. The HYV of maize seed yield the better output but are prone to the attack of pests and the durability of the crop is also very less.

India is also lacking in suitable agriculture policy promotion of organic agriculture both for export and domestic consumption, the requirements of food security for millions of the poor, national self-sufficiency in food production, product and input supplies, etc. are vital issues which will have to be dealt within an appropriate agriculture policy of India. Lack of financial support and the resultant low yield during conversion period and the complex certification procedure are the common factor why many of the farmers sometimes do not comply with the guidelines of the organic farming practices.

Organic agriculture is now being practiced in more than 130 countries with a total area of 30.4 million hectare, about 0.65 percent of total agricultural land of the world. With respect to the area under organic agriculture, Australia occupies the prime position followed by China, Argentina, USA, Italy and many other countries. India, although comes at second place with respect to total number of certified organic farms (44,926), occupies 13th position as far as the area under organic agriculture concerns. In India, about 528,171 hectare area is under organic agriculture (including certified and area under organic conversion) accounting

for about 0.3% of total agricultural land (Pandey and Singh, 2012). As per the Handbook of Sikkim towards Fully Organic State by 2015, 2012, out of total agricultural land of 79,000 ha 4,607 ha has already achieved the certified status, 42,000 ha is under various stages of conversion.

Organic farming is environment friendly and provides energy for microbial activity and this has been suggested as an indicator of change for soil properties (Agren and Bosta, 1998) because the size and activity of the microbial quotient is directly related to the amount and quality of carbon available (Breland and Eltun, 1999). Increasing soil organic matter by organic farming has the added benefit of improving soil quality and thereby enhancing the long-term sustainability of agriculture (Laird et al.; 2001). Organic agriculture also help to conserve and improve precious resource- the topsoil, compaction, nutrient loss and erosion, organic farmers use trees, shrubs, leguminous plants to stabilize and feed soil, dung and compost to provide nutrients, and terracing which prevent erosion and conserve ground water (Parrot and Marsden, 2002). In Sikkim, though not in consonance, but farmers use the techniques like multi cropping, minimum tillage, and plantation of leguminous plants and follow the guidelines given by the monitoring agency in order to conserve topsoil, compaction, nutrient loss and erosion, dung and compost to provide nutrients, and terracing to prevent soil erosion and to conserve ground water. These practices ensure the sustainability of the agriculture in the state if followed continuously in the long run.

The State Government of Sikkim is taking initiatives to make the organic farming a viable activity, however, several challenges in the adoption as well as in other related aspects have been realised and the difficulties are being faced by the implementing agencies and the farmers. Lack of effective organic plant protection alternatives; unavailability of organic seeds and planting materials; lack of value addition/processing facilities; lack of marketing linkages and lack of research support on organic farming system are the major setbacks

relating to organic farming in the state. The major cash crop of Sikkim- Cardamom, its yield has steadily gone down over the years. This used to be 250 kg per hectare in 1975-76 which came down to as low as 153 kg per hectare in 1996-97 (Economic Survey of Sikkim 2006-07) and during the survey of the study it was reported by almost all the cardamom growers that the production of cardamom has come down to around 25 percent of the production that used to be 10-15 years back. This is mainly attributed to very old age of cardamom bushes and is also being destroyed by diseases called chirkey, foorkey and some other unidentified diseases. Other problems like drying up of whole bushes, drying up of flowers, not maturing of the seed are common.

The production and the productivity of many of the corps are going down. During the survey of the study, many of the respondents reported that the production of both the major food crops as well as of cash crops has gone down significantly. They have further reported that they are doing cultivation just not to keep their land barren. Marketing hassles is another big problem that the agriculture of the state is facing. Processing of the state products in other parts of the state leads to loses out of employment-generating opportunities, income and revenue, both directly from agro-processing as well as from allied activities such as packaging, labelling, and so on. Hence, a robust study highlighting the problems and potential prospects of organic farming in the state, analysing the crop-wise detailed economic analysis as well as detecting the factors responsible for marketing failure and providing suitable policies for future sustainability and viability of the organic farming generating investment opportunities for the sector in the state is crucial. Accelerating the production of both the food crops and the cash crops using the existing techniques of agriculture is necessary not only to meet the local demand but also producing for the purpose of export. State should establish itself as a major player of the organic product in the organic product market both at domestic as well as at international level. In doing so, income of the farmers

and others involved can increase along with economic boost of the state. The study analyses all the major economic problems and prospects and provide suitable policy implications for the growth of the sector.

1.5 Rationale of the Study

1. Organic farming encourages management of the agro-eco system as autonomous based on the capacity of the soil in the given local climatic conditions.
2. Crop-wise detailed economic analysis will give a clear in depth picture of the comparative advantages of different crops.
3. Research at micro level will entail suitable policy framework for understanding the factors that help promoting organic farming.
4. Suitable feasible crop rotation policy can be adopted to enhance the productivity of the land as well as other inputs.
5. The study will provide input to the government policy on providing various input subsidies to the farmers.
6. The study will help in an effective price policy to be adopted by the state to make the farmers price efficient.

1.6 Research Questions

1. Does production process differ crop-wise and district-wise?
2. Does farm-size influence the productivity of organic food crops and organic cash crops?

3. Does the social profile of the farmers such as education of the farmers, education of the family and experience of the farmers influence the farm output, profit, cost, etc?

1.7 Objectives of the Study

1. To study the importance, prospects and scope of organic farming in the state of Sikkim.
2. To study the crop-wise value of production, productivity, inputs used, profit and cost of all the crops under the study.
3. To study the factors of variability of productivity among the crops consideration.
4. To estimate the farm size and productivity relation for the crops under consideration.

1.8 Hypotheses

1. Ho: Farm size has no statistically significant relationship on output productivity.

   Ha: Farm size has statistically significant relationship on output productivity.
2. Ho: The non-economic factors have no statistically significant impact on adopting organic farming.
3. Ha: On the adoption of the organic farming, the non –economic factors have statistical significant.
4. Ho: There are no significant differences of profitability per acre between food crops and cash crops.

   Ha: There are significant differences of profitability per acre between food crops and cash crops.

1.9 Data Source

Present study is based on both primary as well as secondary data.

1.9.1 ***Sources of Data***

The entire research work is primarily based on primary data collected from the farm households of four districts of Sikkim. In each districts two villages have been selected on the basis of concentration of crop growing areas. For each crops separate samples have been taken since all the farmers in the sampled area do not grow all crops (food crops and cash crops) simultaneously. The sample household taken for each crop is different, even though the sample area remains same for some crop. The crops are paddy maize potato and ginger. These crops are selected because of their greater concentration in Sikkim. For paddy 42 samples have been collected from two districts- east and west (21 each from the two areas - Ranka and Syari of East district and another 21 sample farm households from Daramdin area of West district). Similarly for maize all the districts have been considered. A total of 160 sample households have been selected (In East district, 40 from- Ranka and Syari villages, 40 from Daramdin and Soreng villages of West Sikkim, 40 from Hee Gyathang and Lingdong Berphuk areas of North district and Kabrey and Paleytam villages of Namthang block of South district). The total number of samples collected for potato is 120 (30 from each district- Ranka and Syari villages of East district, Daramdin and Soreng villages of West Sikkim, Hee Gyathang and Lingdong Berphuk of North district and Kabrey and Paleytam villages of South district) and a total of 75 farm households have been sampled consisting of 25 samples each from three districts (Ranka and Syari villages of East district, Hee Gyathang and Lingdong Berphuk of North district and Kabrey and Paleytam villages of south district).

1.9.2 Types of data

A detailed schedule of questionnaire had been framed both in Nepali and English languages. The questions are related to the socioeconomic profile of the farm household, types of crop grown, area under the crop, production, productivity, inputs used, cost of the inputs, price of output, revenue obtained from the crop, extension information, experience of the farmers, etc. The information were collected through conducting interview with farmers and the experience members with respect to farming during the period of June to Aug 2014. The schedule questionnaire has been attached in the appendix.

1.9.3 Source of secondary data:

The secondary data have been collected from the different sources like the State Profile of Sikkim, 2010-2011, Annual Report 2012-13, MSME-Development Institute Ministry of MSME, Govt. of India, Gangtok, FAO Statistics, 2010, Economic Survey of Sikkim 2006-07, Handbook of SIKKIM towards Fully Organic State by 2015, 2012, FS&ADD and H&CCDD, Government of Sikkim.

1.10 Technique of Analysis

The statistical and econometric tools that have been employed are independent t-test, ANOVA test, tukey test and Cob-Douglas Production Function. The independent t-test has been conducted to test the null hypothesis of there is no differences in the mean output per farmer between the two districts. One way ANOVA test and Tukey Test have been conducted to test the null hypothesis that the differences in the land size and level of education of the farmers have no significant impact on the level of output. Lastly C-D production function has been run to test the significance of the inputs individually and collectively on the output of all the crops. It also enables us to know the returns to scale.

Chapter 2

REVIEW OF LITERATURE:

ECONOMICS OF ORGANIC FARMING

Chapter 2

Review of Literature

2.1 Introduction

Organic farming has been defined in several ways by several organizations. According to International Federation of Organic Agriculture Movements (IFOAM), (2009), organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

The relevance, benefits, problems, constraint and economic viability of the organic farming practices have been reviewed and tested by several studies and have shown a mixed results. Some studies on comparison between the non-organic farming and organic farming show that organic farming is not a better alternative than the existing non-organic farming techniques (modern agriculture) (Dubgaard,1994; NAAS Report, 2005). As per Dubgaard (1994), Denmark, yield differences for intensive crops (wheat and potato) with organic yields is around half the conventional (non-organic) averages. Organic farms use as much as two times more labour per hectare as the non-organic farms use. Substantial price premiums on output and public support are essential for economic viability. According to National Academy of Agricultural Sciences (NAAS) Report 2005, India, cultivation area required to maintain the present level of food grain production without using synthetic fertilizers, reaches more than the total geographical area in India.

2.2 Organic Farming (traditional) Verses Conventional Farming[1]

It has been the remarks of some sections of the farmers and policy makers that the organic farming yields lesser output than that of non-organic farming. This perception and the observations are may be owing to the fact that the yield under the conventional farming technique of agriculture is more as the farming technique uses the chemical fertilizers and pesticides and the historical evidences of success of the Green Revolution has revealed that the yield rate is greater in the conventional farming practices than the agriculture during the post revolution period. However, some of the studies found no significant differences in the yield rate between organic method of cultivation and conventional method of cultivation (John, 1994; Wynen, 1994). In a study conducted in UK, (Jenkinson, 1994), found that wheat yields are shown to be on average slightly higher in the organically fertilized plots (3.45 tonnes/hectare) than the plots receiving chemical fertilizers (3.40 tonnes /hectare). More importantly though, soil fertility, measured as soil organic matter and nitrogen levels, increased by 120% over 150 years in the organic plots, compared with only 20% increase in chemically fertilized plots. The studies have further shown that the performance of organic agriculture on production depends on the previous agricultural management system. In generalization of the impact of conversion to organic agriculture on yields indicates that in industrial countries, the organic systems decrease yield but the range depends on the intensity of external input use before conversion. In case of the so-called Green Revolution areas, conversion to organic agriculture on the whole leads to almost identical yields whereas in traditional rain-fed agriculture, organic agriculture has the potential to increase yields.

[1] Conventional farming is also known as non-organic farming.

John, (1994), Canada, reviewed various field experiments conducted on organic farming in Canada. Many sample farms recorded yields equal or slightly below the conventional farms. Similarly, Wynen, (1994), Australia, found that wheat yields were almost similar between organic and conventional farms. The study also claimed that variability of wheat yields is lower in organic farms than in conventional farms. Financial results of two groups of farmers per hectare were also remarkably similar.

As far as the relative profitability of the organic farming in comparison to the conventional farming is concerned, Welsh, (1999), found that organic cropping systems were always more profitable than the most common conventional cropping systems if the higher premiums that organic crops enjoy were considered. Similarly the study made by John, (1994) in Canada concluded that the prices of organic products were 30 percent higher than the prices of conventional products. When the higher premiums were not factored in, the organic systems were still more productive and profitable in three of the six studies. This was attributed to lower production costs and the ability of organic systems to outperform the non-organic practices in drier areas, or during drier periods.

In respect to the cost aspect, Anderson, (1994), examined different research studies conducted on organic farming in USA and found that the lower yields on organic farms contrasted with conventional farms were balanced by lower production costs and concluded that the differences between economic performances of organic and other farms may be due to farm size rather than farming system.

Similarly, study in India carried out by Kshirsagar, (2008) in Maharashtra found that the organic sugarcane cultivation enhances human labour employment by 16.9 per cent and its cost of cultivation is also lower by 14.2 per cent than conventional sugarcane farming. Although, the yield from organic sugarcane was 6.79 per cent lower than the conventional crop, it is more than compensated by the price premium received and yield stability observed

on organic sugarcane farms. Overall, the organic sugarcane farming gave 15.63 per cent higher profits than conventional sugarcane farms.

As per the study of Charyulu and Biswas, **(**2010) in four Indian states viz. Gujarat, Maharashtra, Punjab and U.P., the unit cost of production is lower in organic farming in case of Cotton (both Gujarat and Punjab) and Sugarcane (both in U.P and Maharashtra) crops whereas the same is lower in conventional farming for Paddy and Wheat (both in Punjab and U.P) crops. It confirms the findings of Lampkin and Padel, (1994). The study has further observed that the efficiency levels are lower in organic farming when compared to conventional farming; however, the organic farming has ample scope for increasing the efficiency in the long run.

The study of Chouichom and Yamao, (2007), measured the attitude of the farmers towards organic and conventional farming on four aspects: organic farming knowledge, environment, marketing, and costs and benefits, and found that there was a correlation of attitudes among the respondents for both organic and conventional interviewees in the four aspects examined. Additionally, educational level, farm holding and extension worker contact affected opinions and attitudes of organic farming interviewees. Among conventional farming interviewees, their farming experiences affected their attitude towards organic farming.

2.3 Food Security, Employment and Sustainability Aspects of Organic Farming

There are lot of issues relating to the supply of agriculture products. The major question is whether the organic farming can meet the food security issues of the world. Rajalakshmy, (2005), in his study found the economic and environmental superiority of

organic farming over conventional farming, which enables sustainable agricultural growth, since these agricultural practices promote environmental and ecological balance. The study also found that there is tremendous scope for increasing the area under organic farming and earnings from the export of organic products for a country like India where the average farm size is small and the farmers have the advantage of traditional knowledge and skill to practice organic farming. Large number of studies has been conducted to see the viability of the organic farming. The organic farming also boasts to produce sufficient amount of output in the same available land and hence can feed the world (Christos, 2000). In reviewing some of studies, Christos, (2008) found that the organic farming accomplishes many of the Food and Agriculture Organisation's (FAO's) sustainability aims, as well as showing promise in increasing food production ability. Similarly Johannsen et. al. (2005), in their study found that organic farming opens up the prospect of producing enough food in the long term without destroying natural resources; can boast a better energy and environmental balance and makes a substantial contribution to conserving biodiversity and agricultural diversity and avoids risks of agro-genetic engineering used in some other forms of agriculture that have not yet been sufficiently analyzed.

The study by Panneerselvam, (2008) found that the organic farming is a viable option to improve food security of smallholding farms by increasing income, decreasing input cost, producing more for home consumption, and adopting ecologically sustainable practices with locally available resources.

In analysing the ecosystem of north eastern states Munda et.al, (2010), found that this region has a better scope for organic agriculture. It is estimated that up to 30 percent of the rain fed farmers in many remote areas of the country do not use chemical fertilizers and pesticides. Thus, many resource poor farmers are practicing organic farming by default. The Government of India task force on organic farming and several other reviewers have

identified rain fed areas and regions in north east as more suitable for organic farming in view of the use (Department of Agriculture and Cooperation, Ministry of Agriculture, GOI, 2009-10; Dwivedi 2005; Ramesh et.al, 2005).

In fact, the north eastern region is neither favourable to use capital intensive techniques nor the size of the farm allows the use of modern farming instruments as well as irrigation facilities. The lack of industrialisation has reduced the mobility of the family and farm labour to other sectors, hence, the chance of employment will be more if there is more organic farming. The use of inorganic fertilizers and chemicals is meagre and the system of production in the hills remained low- input-low risk-low yield technology. It can be assumed that the difference in production gap due to adoption of organic agriculture is expected to be negligible; rather there is scope for enhancing productivity with good organic management. The organic premiums would boost earning of the hill farmers. Further, it is an added advantage that all the households are maintaining livestock (pig, poultry, cattle, goats, etc.) producing sufficient quantity of on-farm manures, which could be efficiently used for organic agriculture (Munda et.al, 2010).

Despite the advantages of the organic farming on the aspects like yield rate, low cost, high premium and positive attitude of the farmers toward organic farming, it suffers from the problems like long time certification procedures, high input costs in the initial stages, lack of awareness, marketing hassles, lack of policies to support such programmes, short-sightedness of existing Governmental schemes and paucity of pragmatic and proactive measures (Rajalakshmy, 2005).

As far as the review of the literature is concerned, it is found that studies have focused on the comparative cost, comparative market price, comparative profit, farm size and productivity and lastly the farmers' attitude towards organic and non-organic farming practices. Despite differences, majority of studies found that organic farming is more

profitable, viable and sustainable in the long run (Research Institute of Organic Agriculture (FiBL) and IFOAM, 2012; John, 1994; Kshirsagar, 2008; Wynen, 1994; Jenkinson et al., 1994; Anderson, 1994; Welsh, 1999; and Kshirsagar, 2008).

Looking at the prevailing deteriorating agricultural environment and soil health, resulted out of conventional farming practices in agriculture, the increasing importance and the advantages of the organic farming, and given the agro-climatic condition, the topographical characteristics and the farm size of Sikkim, Government of Sikkim saw comparative advantage in adopting the organic farming practices in the state. Sikkim has attempted to make the state fully organic and adopted organic farming policy in 2003. As per the (FSADD & HCCDD), Govt. of Sikkim, (2010), the plan document-"Vision for holistic and sustainable organic farming in Sikkim- the Future thrusts", State Government has set the vision for the organic farming and has also highlighted its various activities and initiatives that it is taking up to make organic farming a success in the terrain of Sikkim. The Government of Sikkim has already started large number of projects in the states and has put ban on the use of chemical fertilizers (Sikkim Organic Mission: Policy Vision and Mission, 2010). Despite resistance from some parts of the state, state government is continuously working and has set the target to make the state fully organic by 2015.

2.4 Survey of Methods of Analysis

The review of literature on organic farming reveals the fact that organic farming is practised in many countries of the world such as Latin American countries, the countries of Oceania, USA, Canada, Australia, some Asian countries like India and China. Studies related to the organic farming have also been conducted in these countries on the aspects like relevance, benefits, problems, prospects, marketing of the organic products, viability and sustainability of the practices. All those studies have specifically used both the primary data

(such as the area under the crop, output, inputs used etc.) and the secondary data (production, productivity, marketing data, etc.) of organic households of different crops like paddy, corn, potato, fruits, sugarcane, etc. All these studies on organic farming on different crops empirically tested different dimensions of crop production such as impact of different factor inputs on production, productivity, size and production, impact of social factors on production, profitability, cost efficiency, price premium of organic and non-organic crops etc. (John, 1994, Welsh, 1999, Charyulu and Bisas, 2010, Dubgaard, 1994). In collecting the primary information, the sampling techniques like simple random sampling method and purposive sampling technique have been used (Adhikari, 2011; Kshirsagar, 2008). In analysing the data, to measure the yield rate, the statistical and econometric tools like ANOVA, Student-Newman Keuls (SNK) test, t-test, etc. have been employed (Clark et al., 1999). The yield variability and yield stability in the crops considered have been assessed using the Coefficient of Variation (CV) technique. In measuring profits also, the Coefficient of Variance technique has been employed. Non-parametric techniques like Data Envelopment Analysis (DEA), parametric Stochastic Frontier Analysis have been used to analyse the different types of efficiency of the farm households. Cost benefit-analysis has been used to assess the economics of the organic farming practices. Output-input ratio has also been used in some studies to measure the cost efficiency of the organic farming. Contingent Valuation method has been used by Copper, (1997) to estimate the minimum incentive payments a farmer would require in order to adopt more environmentally friendly best management practices (BMPs). To measure the attitude of the farmers towards farming practices, methods like chi-square and t-test have been employed (Clark et al., 1999).

Overall review shows that the methods like ANOVA, Student-Newman Keuls (SNK) test, t-test, Coefficient of Variation (CV) technique, nonparametric Data Envelopment Analysis (DEA), parametric Stochastic Frontier Analysis, chi-square have been used.

2.5 The Research Gap

Many studies have made comparison between the organic farming and the non-organic farming on the aspects like production, market and the environment related issues. As far as the review of the literature is concerned, no such study has been found which has empirically examined the economics of organic farming in Sikkim. Further, no such study has made a comparative study on the economic aspects of food crops and cash crops. The existing review of literature does not find a study in Sikkim which compares the farm size productivity, profitability, etc.

Chapter 3

AGRICULTURE PROFILE OF SIKKIM

Chapter 3

Agriculture Profile of Sikkim

This chapter briefly presents the agricultural profile of Sikkim. It gives detail information on trends on various food and cash crops. This chapter will also provide sufficient information while analysing and interpreting the results.

3.1 Agriculture in Sikkim

Agriculture and allied sectors like forestry and fisheries accounted for 13.7% of the GDP (Gross Domestic Product) in 2013, and about 50% of the total workforce. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India.

As of 2011, India had a large and diverse agricultural sector, accounting, on average, for about 16% of GDP and 10% of export earnings. India's arable land area of 159.7 million hectares (394.6 million acres) is the second largest in the world, after the United States. Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world. India is among the top three global producers of many crops, including wheat, rice, pulses, cotton, peanuts, fruits and vegetables. Worldwide, as of 2011, India had the largest herds of buffalo and cattle, is the largest producer of milk and has one of the largest and fastest growing poultry industries (Livestock and Poultry: World Markets and Trade, United States Department of Agriculture, 2011).

Sikkim is the 22nd state of India, came into existence with effect from 16th May, 1975 has extended approximately 115 Kms from north to south and 65 Kms from east to west, surrounded by vast stretches of Tibetan Plateau in the North, Chumbi Valley of Tibet and the kingdom of Bhutan in the east, Darjeeling district of West Bengal in the south and Nepal in the west. The State is located at the foothills of Eastern Himalayas between latitude of 27 degree 49" and 28 degree 10" north and the longitudes of 88 degree 28" and 88 degree 55" East. The state being a part of inner ranges of the mountains of Himalayas has no open valley and no plains but carried elevations ranging from 300 to 8583 metres above mean sea level (MSL) consisting of lower hill, middle and higher hills, alpine zones and snow bound land, the highest elevation 8583 metres, being the top of the Mt. Kangchendzonga itself. Sikkim has been divided into four districts and each district has further been bifurcated into two sub-divisions for administrative purpose except the East district which has three sub-divisions. Out of elevation ranging from 300 to 8583 meters the habitable areas are only up to the altitude of 2100 metres constituting only 20 percent of the total area of the state. The highest portion of Sikkim lies in its North West direction (Sikkim Urban Dynamics, 2013).

3.2 Sectoral Composition

Sikkim is a land of villages. Agriculture, horticulture and animal husbandry constitute a mainstay of the largest segment of Sikkim's population. Agriculture is the main occupation of the people. By and large, Sikkim's wealth is derived from agriculture and forests. However the original inhabitants were not agriculturists. It was started as sedentary farming when Bhutia people migrated to Sikkim. Settled agriculture stepped into Sikkim only with the arrival of Nepali immigrants.

The nature of the terrain and varied micro climatic conditions influence agriculture in Sikkim. Maize, paddy, wheat, barley and buck wheat are the main cereals grown in Sikkim. Sikkim has the largest area and the highest production of large cardamom in India. Cardamom, ginger, potatoes and orange are important cash crops of Sikkim. A special kind of tea much valued by the connoisseur for its taste and quality is also produced in the state. A government Tea Estate is being developed in Kewzing in the western part of Sikkim. There is one more tea estate at Temi. Both these estates extend over an area of 400 acres. Under horticulture, large quantities of oranges and apple are raised. Vegetables, pineapple and banana are other cash crops of Sikkim.

The Gross State Domestic Product (GSDP) at current prices for the financial year 2012-13 is $1.83 billion (2013 Update). The growth rate of 7.62 per cent of GDP at constant price was recorded in 2012-13. The per capita income of the state, which was ` 30, 727 in 2004-05, has increased substantially to ` 1, 42,625 in 2012-13 at current prices (State Profile of Sikkim, 2010-11; 2013 Update). The major socio-economic indicators for the State show commendable improvement. The poverty ratio has declined to 17.8 per cent as compared to all India average of 29.5 per cent in 2011-12 as per the Rangarajan Committee's estimates. The literacy rate of the state stood at 81.40 per cent in 2011-12.

Two major trends are visible in the growth path of the Sikkim's economy since 2004-05. During the period of 2004-05 to 2008-09, the service sector was the dominant contributor as it accounted for more than half of the GSDP. Since 2009-10 the relative share of secondary sector has increased mostly driven by manufacturing, construction and power sectors. The inter-sectoral composition of GSDP since 2004-05 shows that the service sector, which accounted for half of the State GSDP till 2008-09, has declined to about 38 per cent in 2011-12. At the same time the relative share of the secondary sector has grown to about 54 per cent in 2011-12 (Table 3.1). The relative share of primary sector has been declining over

the years and the share of mining and quarrying activities remained very small. The data in Table: 3.1 also imply that the relative share of agriculture in primary sector is slowly reducing. Despite declining share of agriculture, it remains a major occupation of the rural people of Sikkim.

Table: 3.1 Composition of Gross State Domestic Product (Constant Prices) (in Percent)

Particulars	**2004-05**	**2005-06**	**2006-07**	**207-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Primary sector	18.71	17.79	16.76	16.18	14.56	8.74	8.44	10.56	10.09
Only Agriculture	18.59	17.65	16.65	16.07	14.40	8.65	8.34	10.42	9.89
Secondary sector	28.72	29.25	29.54	38.18	34.94	55.03	59.12	59.06	59.57
Tertiary sector	52.58	53.01	53.70	53.64	50.51	36.22	32.44	30.39	30.34
GSDP Growth rate		9.79	5.99	7.63	16.38	73.61	8.71	10.76	7.62

Source: State Income Unit, DESM&E, Government of Sikkim, 2013

3.3 Land Use Classification

Agriculture continues to be the backbone of the Sikkim's economy. More than 64 percent of the population depend upon agriculture and related activities for their livelihood. Prior to 1975, the uncertainties about land tenure rights, negligible public investment and over dependence on traditional technologies had made the cost of cultivation very high in Sikkim. Sikkim's agriculture thus remained highly subsistence-oriented. The economy was further plagued by low productivity, negligible marketable surplus and other institutional backwardness. However, in the post merger period in spite of limited area of cultivated land, smaller land holdings, difficult hilly terrain, diverse agro-climatic condition prevailing at short distances, low farm income and lack of adequate supportive infrastructures for

agriculture development, the State has achieved to indigenously sustain a larger portion of its food requirement.

Table: 3.2 Land Use Classifications in Sikkim as on 2007.

Land type	Percentage	Hectare
Total geographical area	100	709600
Cultivable area	14.91	109068
Permanent pastures	10.14	73947
Land put to non agricultural use	8.70	51200
Barren land	17.70	130230
Land under miscellaneous trees & groves	0.75	5450
Forests	47.3	335640

Source: Economic Survey of Sikkim 2006-07.

Agricultural holdings are well spread over from an elevation of 300 to 3000 meters. Most of the cultivable lands are terraced and farmers have settled on these holdings with established regular cropping system. Out of total geographical area (Table 3.2), marginal holdings and small holdings clubbed together comprise about 50% of all operational holdings and occupy 41% of the total cultivable area, 14.91 % are cultivable area.

Though the large chunk of population of the state depends on agriculture for the source of livelihood, only around 11 percent of the total geographical area is under agriculture. Agriculture is of the mixed type and is mostly done in subsistence level rather than for commercial purpose. However, it has been observed in the last decades that the farmers are driving towards the cultivation of cash crops which are mainly meant for commercial purposes. Cultivators account for the greater majority of the people in the state, their percentage is 57.84 percent (Medium Terms Fiscal Plan for Sikkim 2014-2015 to 2016-2017).

3.4 Cropping Pattern

The cropping pattern of the State has over the years transformed from cereal dominated subsistence agriculture to high value, cash crop dominated commercial agriculture. Eighty percent of the population lives in rural Sikkim. The total cultivable land in the state is around 79,000 hectares. Agriculture in the State of Sikkim is practiced under diverse conditions. The region is characterized by large variations in slopes (0-100%) altitudes (300-3000 m above MSL) and rainfall (200-400 cm). The soil of entire state is acidic in nature (State profile of Sikkim, 2010-11). The above mentioned agro climatic factors by and large affect the management and productivity of the crop either in multiple cropping or under mono-cropping system. Moreover, the choice of crop is mostly consumption oriented and system of cultivation has established in low input, low risk, low yield technology because the primitive forms of agriculture is still most dominant (State profile of Sikkim, 2010-11).

The principal crops of the state are maize, rice, large cardamom. Along with maize and rice, soya bean is raised as intercrops. Wheat, mustard, buck wheat are the important crops. Potato, radish, brinjal, tomato, ladies fingure, beans, cow peas, rai, pea, are the important vegetables crops grown in the State. Wide range of fruit crops are also grown successfully in the State. The important fruit grown in the state are mandarin orange, banana, guava, papaya, mango peach, plum pears, apple, etc. Presently mandarin orange is an important commercial fruit crop of Sikkim. Sikkim produces 80% of India's large cardamom which enjoys a high value export market in Pakistan, Singapore and Middle-East. The ginger of Sikkim is also of a good quality and has export prospects. The climate is also ideal for development of mulberry trees and hence the establishment of a sericulture industry (Economic Survey of Sikkim 2006-07).

The state agriculture is predominantly dependent upon rain fed cultivation and giving more priority to mixed cropping. Now, since 2003 onward Sikkim has been branded as state heading towards organic farming. The state is basically an agrarian where approx 65% of the population depended upon agriculture for their livelihood.

In spite of all these prospects, the absence of profitable marketing network and the lack of appropriate processing facilities for manufacturing quality finished products have resulted in most of the produce being sold at uncompetitive prices to other states as raw materials and their true potential has not been exploited.

3.5 District Wise Land holding Pattern in Sikkim

District wise analysis of food production shows that unlike its share in cash crops including vegetables, the contribution of North in the total food basket is much less than 10 percent whereas the West contributes over 35 percent closely followed by the East with over 30 percent and South over 25 percent. Similarly rice is predominantly produced in East (over 40 percent) and West (over 30 percent) and maize in all four districts of North, South, East and West. The increase in production is attributed to concurrent rise in crop area due to double cropping /mixed cropping and the cumulative effect of increased application of improved agricultural inputs. The HYV coverage has been as high as 98 percent in wheat, 41 percent in rice and 40 percent in maize (Economic Survey of Sikkim 2006-07).

Sikkim falls within high rainfall zone and especially in monsoon, the State receives a high precipitation and its annual rainfall exceeds 400mm. The culturable command area, suitable for practicing agriculture, is approximately 1,09,000.00 ha. Rain fed agriculture is a predominant feature and only about 15% area is under irrigation (Annual Report of Sikkim, 2011-12). In Sikkim only minor irrigation is feasible as the agriculture lands are available in small patches in between the rugged terrains and at the foothills.

The land holding, production and productivity of some major crops (rice, maize and potato, ginger and cardamom) grown in state are depicted in Table 3.3. East district has largest operated area of 34450 ha followed by south and west. However, the state has an average of 2.11 ha per economic holding.

Table: 3.3 District Wise Land Holding Pattern

Particulars	Unit	North	East	West	South	State
Operational holdings	Numbers	5124	20271	12854	14448	52697
Area operated	Hectares	15444	34450	29336	32072	111302
Average area per holding	Hectares	3.01	7.7	2.22	2.28	2.11

Source: 1) Sikkim-A Statistical Profile, 2006-07; 2) Deptt. of Commerce & Industries, of Sikkim.

2) Sikkim: A Statistical Profile 2011-12

3.6 Area, Production and Productivity of Major Food Crops of Sikkim

3.6.1 Paddy

Paddy is most important staple cereal crop of Sikkim grown in all places having warm and humid climate with shallow water. This crop is used for human consumption and there is large variety of its kind. The residual of the crop (Paraal in local language) is the main source of animal fodder.

The share of paddy as the main food item, in the total food production has been hardly 20 percent. The per capita availability of paddy in the state is 158 gms/ day which is far

below the National average of 417 gm during 2001-02 (Economic Survey of Sikkim, 2006-07). This shows that the State is deficit in paddy production which is the staple food of the State therefore the State is dependent on import of rice from outside the State. The low availability of paddy as a major crop in the state is also attributed to shrinking of the land under paddy cultivation due to several developmental activities (Economic Survey of Sikkim, 2006-07). The trend of area under the paddy production is declining slowly. But the trend of production and productivity has an increasing trend. The declining area under paddy is due to the relative increase in the substitution of cash crops farm for food crops. Table 3.4 shows the fact that even though area under paddy crop is declining from 14.74 thousand hectares in 2003-04 to 11.92 thousand hectares, the production has increased from 21.19 thousand tonnes to 23.44 thousand tonnes and the productivity has increased from 1437 kg per hectare to 1966.44 kg per hectare. Fig 3.1 shows the productivity trend for paddy.

Table: 3.4 Area, Production and Productivity of Paddy in Sikkim.

	Year	Area (000' hectares)	Production (000' tones)	Productivity (kg./ha)
1.	2003-2004	14.74	21.19	1437.00
2.	2004-2005	14.74	21.61	1466.00
3.	2005-2006	14.74	22.69	1539.35
4.	2006-2007	14.15	21.45	1515.90
5.	2007-2008	14.00	22.85	1632.14
6.	2008-2009	13.00	22.23	1709.23
7.	2009-2010	12.27	20.93	1705.79
8.	2010-2011	12.14	20.97	1727.63
9	2011-2012	12.03	21.18	1770.50
10	2012-2013	11.92	21.34	1790.27
11	2013-2014	11.92	23.44	1966.44

Source: Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim, 2013-2014.

Fig: 3.1 Trend Line of Productivity of Paddy

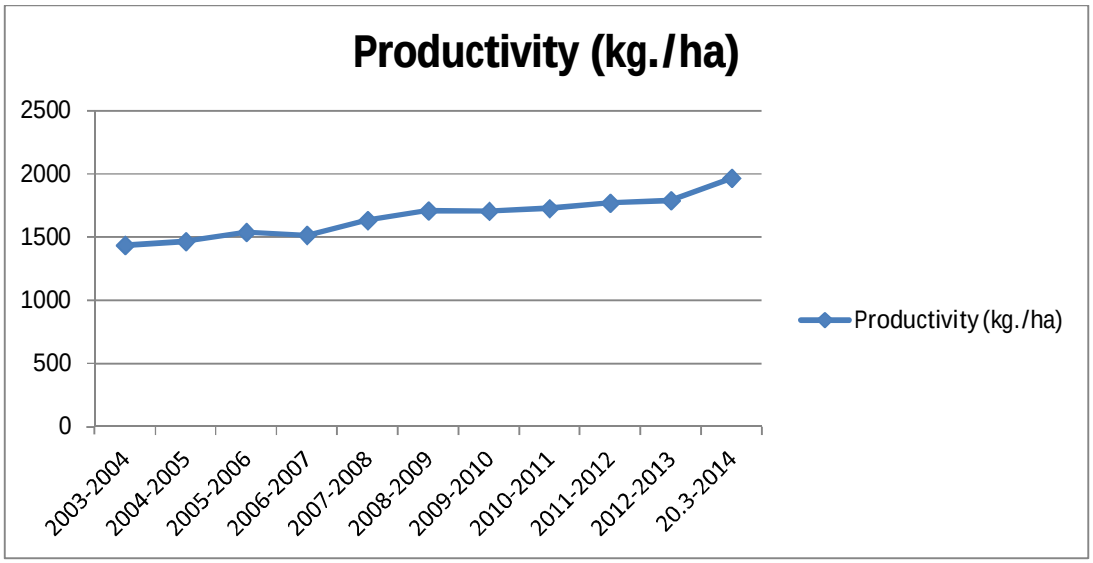


Table: 3.5 District wise area, production and productivity of paddy (2011-12) (figure in the brackets is percentage out of 100%)

Paddy	East	West	North	South	Total state
Area (000' ha)	4.95 (40.7)	3.97 (32.7)	1.00 (8.23)	2.22 (18.28)	12.14 (100)
Production ('000 tones)	8.67 (41.3)	7.21 (34.38)	1.14 (5.43)	3.94 (18.78)	20.97 (100)
Productivity (kg/ ha)	1752.0	1817.00	1140.00	1778.20	1723.00
Productivity (per acre)	709.01	735.31	461.53	719.61	697.27

Source: Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim, 2013-2014.

Table 3.5 shows the district wise area, production and productivity of paddy in Sikkim. Out of total area under paddy in Sikkim 12.14 Tha (Thousand hectares), 40.7 % i.e. 4.95 Tha belongs to East district followed by West 32.7 %. That is why the samples have been collected from East and West districts. Similarly out of total paddy production, 20.97 thousand tonnes, around 80% of paddy production is in East and West districts (41.3% and 34.38% respectively).

The State is in deficit of paddy production which is the main staple food crop of the people. To meet the demand of the population state has to depend on import of rice from outside the State. The less availability of paddy as a major crop and decrease in its total production in the state is in fact attributed to shrinking the land under paddy cultivation due to several developmental activities taking place in the state (Economic Survey of Sikkim, 2006-07). The area under the crop has decreased as well as the production has also not shown improvement during the period of last 10 years i.e. between 2003-4 to 2013-14. Though the productivity has been improved but since the land under the crop has shrink, the hope for the improvement in the quantity of the output is very less. Hence, rethinking and execution of

effective policy implication with regard to the restoration as well as improvement of the crop's production is urgently needed.

3.6.2 Maize

Maize is the most important cereal crops of Sikkim. It is grown over an area of about 36,000-40,000 hectare which is about 35-40% of total cultivable area (Economic Survey of Sikkim 2006-07). Maize is part of the staple food item in Sikkim; its production contributes over 50 percent of the total food grains production in the State. The crop is largely used as animal fodder.

Table: 3.6 Area, Production and Productivity of Maize in Sikkim.

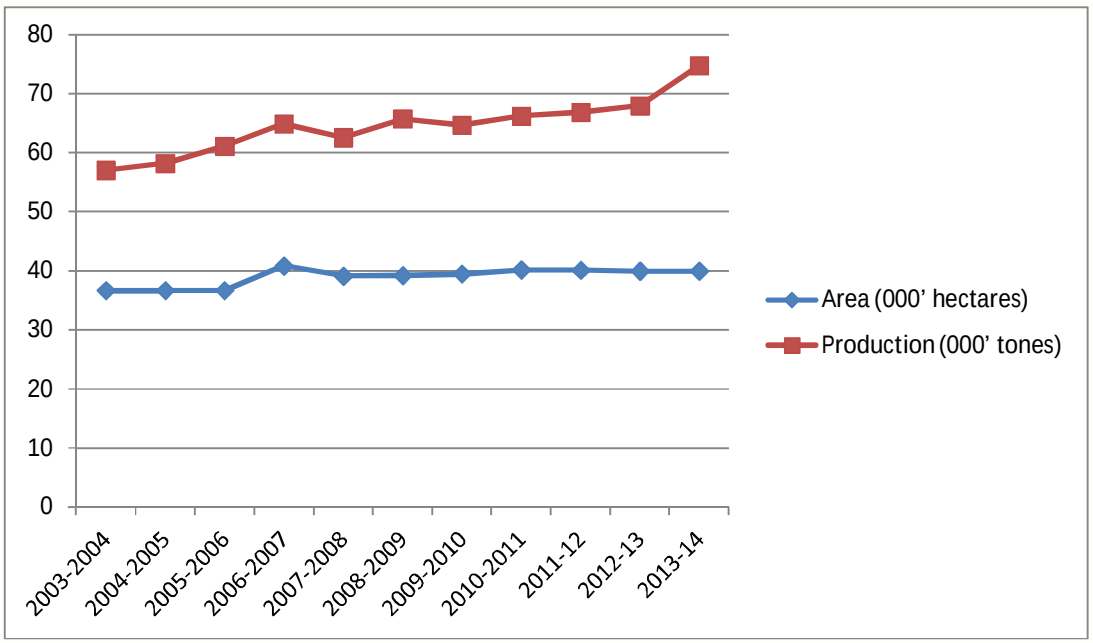
	Year	Area (000' hectares)	Production (000' tones)	Productivity (kg./ha)
1.	2003-2004	36.70	57.05	1554.50
2.	2004-2005	36.70	58.19	1585.00
3.	2005-2006	36.70	61.10	1664.85
4.	2006-2007	40.85	64.89	1588.49
5.	2007-2008	39.10	62.56	1600.00
6.	2008-2009	39.20	65.74	1677.04
7.	2009-2010	39.50	64.69	1637.72
8.	2010-2011	40.17	66.19	1647.82
9	2011-12	40.12	66.84	1680.44
10	2012-13	39.97	67.95	1700.03
11	2013-14	39.97	74.75	1870.15

Source: Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim, 2013-2014.

Table: 3.6 presents the detail information on area, production and productivity of maize crop in Sikkim. Area, production and productivity of maize have been shown an

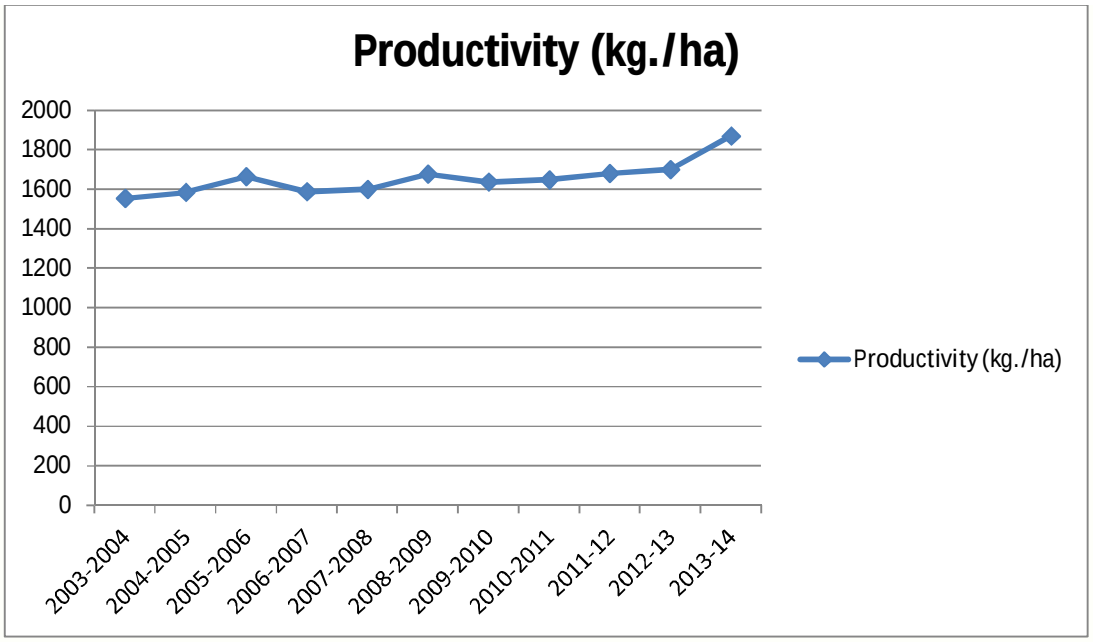
increment between 2003-04 and 2013-14. However, the production and productivity has increased at a higher rate. The Table: 3.5 and 3.6 show that the area under paddy in 2003-04 was 11.79 Tha and it was 36.70 Tha for maize, around four times the area of paddy. In 2013, the area was respectively 11.92 Tha and 39.97 Tha which is more than three times of paddy area. Similarly the productivity of maize is much higher than paddy productivity during the same period.

Fig: 3.2 Trend Line of Area under Maize Cultivation and Production of Maize



There has not been notable increase in the land under the crop since the crop is the most dominant cereal in the total agricultural products in Sikkim and the cultivation of which is the age old practices of the farmers of Sikkim. The crop can be grown in the entire range of agricultural zone of the state. The residual of the crop is used for animal fodder which is considered better for feeding the milching cows and buffalos.

Fig: 3.3 Trend Line of Productivity of Maize



As far as the production of the crop is concerned, the data source shows that it has increased in the last 10 years period. The productivity of the crop has also shown improvement during the period. Since the crop is rain fed and the cultivation does not necessarily require the terraced level land, it is cultivated by almost all the farmers in the state. An effective policy and the efficient measures of cultivation of the crop supported by HYV of seeds can help the state as well the farmers to gain larger economic gain from the crop.

3.7 Area, Production and Productivity of Major Cash crops of Sikkim

The major cash crops grown in the state are potato, large cardamom, ginger, turmeric, fruits, flowers which are mostly meant for commercial purposes. The area under the crop, production and productivity of some of the principal cash crops has been shown in the table below:

Table: 3.7 Area, Production and Productivity of Two Major Cash Crops

(Area in '000 Hectare; Production: in '000 Tonnes & Productivity: Kg/Hectare)

Crops		1975-76	1980-81	1985-86	1990-91	2000-01	2002-03	2005-06	2011-12
Potato	Area	NA	NA	NA	NA	6.20	NA	NA	9.76
	Production	5	6.64	16.40	18.00	25.50	23.71	33.14	47.09
	Productivity	NA	NA	NA	NA	4112.00	NA	NA	4821.00
Ginger	Area	NA	NA	NA	NA	5.10	NA	NA	8.9
	Production	2.00	3.20	10.90	16.00	24.00	23.00	36.00	49.50
	Productivity	NA	NA	NA	NA	4705.00	NA	NA	5561.00

Source: 1)Sikkim: A Statistical Profile 2002 & Sikkim Perspective for planning and development.

2) Economic Survey of Sikkim 2006-07

3) Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim, 2013-2014.

Note: NA- Not Available

3.7.1 Potato

Potato is one of the major cash crops of Sikkim. The crop has witnessed growth in terms of area, production as well as productivity. The area under the crop has increased from 6.20 thousand ha during 2000-01to 9.76 thousand ha during 2011-12 (Table 3.6). Production of the crop has also shown an improvement. During the year 1975-76 it was 5 thousand tonnes which increased to 23.71 thousand tonnes during 2002-03 and in 2011-12 it is 47.09 thousand tonnes. During the period of 1975-76 to 2002-03, the increase in production was due to the application of chemical fertilizers in the crop. The production has shown a significant improvement during this period. Though the use of chemical fertilizers was banned from 2003, the production of the crop still showed a significant growth. The total production increased from 23.71 thousand tonnes in 2002-03 to 49.50 thousand tonnes during

the year 2011-12. This improvement in the production was owing to the increase in the area under the crop. On the other hand the productivity of the crop too has shown an improvement. The productivity of the crop during the year 2000-01 was 4112.00 kg/ha which increased to 4821.00 kg/ha during 2011-12.

3.7.2 Ginger

Ginger is another cash crop grown in the state. It is locally called *Adhua*. Similar to that of the potato, the area under the crop has also increased from 5.10 thousand ha during 2000-01to 8.9 thousand ha during 2011-12. Production of the crop improved during the period between 1975-76 to 2002-03. It was 2.00 thousand tonnes during the year 1975-76 which increased to 24.00 thousand tonnes during 2002-03 and in 2011-12, it further increased to 49.50 thousand tonnes. The production has shown a significant improvement during this period. The production further increased to 49.50 thousand tonnes during the year 2011-12. This improvement in the production was owing to the increase in the area under the crop and application of the chemical fertilizers during the period of 1975-76 to 2002-03 and proper management of the crop with organic technique during the later period (SIKKIM towards Fully Organic State by 2015, ed. 2012, published by FS&ADD and H&CCDD, Government of Sikkim). On the other hand the productivity of the crop too has shown an improvement. The productivity of the crop during the year 2000-01 was 4705.00 kg/ha which increased to 5561.00 kg/ha during 2011-12.

Table: 3.7 shows that the production of potato has increased from 5 Tt (thousand tonnes) to 47.09 Tt but for ginger it has increased from 2 Tt to 49.50 Tt.

Fig: 3.4 Trend Line of potato and ginger production

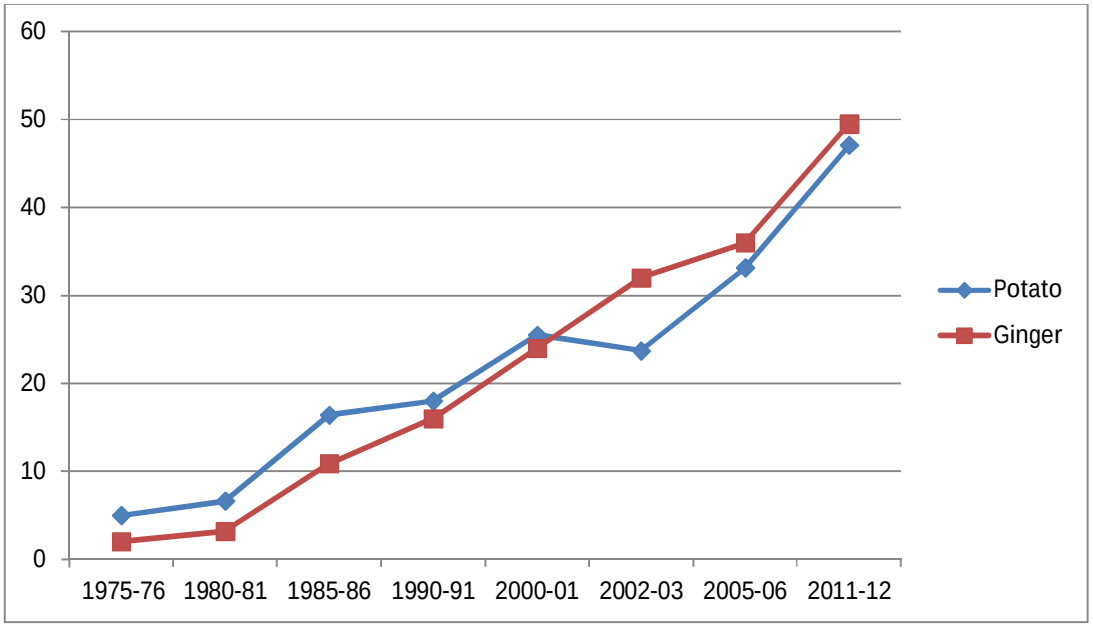


Figure 3.5 clearly depicts that the growth trend for the two major crops viz; potato and ginger shows a positive trend. The growth trend line of potato is somewhat fluctuating whereas the growth trend line of the ginger is literally smother. In relation to the ginger, the price of the ginger remains quite fluctuating. Sometimes the rise in the price is very high and sometimes it becomes very low also. However with an anticipation of the increase in the price, the farmers keep on cultivating the crop continuously. The durability of the crop is also longer which is further advantageous for hoarding the crop for longer time in the wait of price to rise. Farmers need not to depend on others for seed provided they themselves keep the seeds. Due to the longer life of the crop, the farmers can keep seed for longer time and can plant during the sowing season. On the other hand the price of potato remains somewhat stable, however, the crop cannot be hoarded for longer time especially for kharif season since the water content in the crop is relatively high than that of the rabi season. The farmers have to dispose off their crop at the existing market price. However, the increasing demands of the Sikkim's potato outside the state and the increasing domestic market of the crop, the production of the crop in increasing every year. The productivity of the crop has also

increased which shows the proper management of the farmland for the production for the crop.

3.8 The Government Policy and Initiatives

The Government of Sikkim adopted the strategy of organic farming in the state and has attempted to make the state fully organic. The state adopted organic farming policy in 2003. The farmers adopting mixed strategies (both traditional and non-organic techniques) in agricultural practices and the limited use of synthetic inputs in agriculture have helped both the farmers as well as the implementing agencies to adopt organic farming strategies more efficiently (SIKKIM Towards Fully Organic State by 2015, ed. 2012, published by FS&ADD and H&CCDD, Government of Sikkim).

To boost organic farming in state, initiatives at the state level have been taken and the implementing agencies are already engaged in the process. The state of Sikkim has 62,000 farming families who own an average of 1.9 ha of farm land and do the farming in the traditionally organic way. Taking this as an advantage, the State Government has taken the initiatives to promoting the organic farming in the state. “Sikkim State Organic Board” has been constituted in the state and State Government has adopted a seven year plan to wipe out the use of chemical fertilizers and to gradually replace them with organic sources of plant nutrient. Practices such as on-farm organic manure production like, rural compost, vermi-compost, EM compost, bio-dynamic compost etc have been promoted in the state. State soil testing laboratory has also been established in all four districts and the process of certification is also being carried on. There are in total 14 Service Providers (8 local NGO + 6 national NGO) and are involved in Internal Control System (ICS) management and training which

monitors the farming practices in their respective service areas; six APEDA accredited Certification Agencies are involved in certification in the state.

The State has already prepared the Horticulture Master Plan and related activities are Fruit development, Vegetable development, Floriculture development, Development of seed of potato, Development of spice crops. Extension services are provided to the farmers especially by Krishi Vigyan Kendra (KVK) whenever needed. There are instances where timely and appropriate extension services have made significant differences in both production and productivity. Organisations like SIMFED, DAC and some other marketing agencies are there in the state for marketing of agriculture-horticulture products. Government is providing premium subsidies to these organisations so that these organisations could provide premium prices to the farmers or the producers. Horticultural produce from Sikkim is usually exported in its raw state and, in many cases, processed in other parts of the country. Recently a few private initiatives, such as processing 'dalle khorsani'into chili paste and pickle, fruit processing into jams and squashes, and marketing of Sikkim Gouda cheese, have been started, but these are small in scale, and mainly marketed locally or in neighbouring areas.

3.9 Major Agricultural Issues

Despite several initiatives, the State Government as well as the farmers are facing challenges in the adoption as well as other related aspects of the organic farming. Lack of effective organic plant protection alternatives; unavailability of organic seeds and planting materials; lack of value addition/processing facilities; lack of marketing linkages and lack of research support on organic farming system are the major setbacks relating to organic farming in the state.

In fact, the investment in agriculture sector has not been commensurate to the importance it commands in the Sikkimese society and economy. It is partly because of this, the growth rate in the agriculture sector has tended to decline sharply over the years. The real agricultural growth rate has declined from 8.37 per cent between 1980-81 and 1992-93 to negative 0.2 per cent between 1993-94 and 1999-2000 (Economic Survey of Sikkim 2006-07). This is certainly not a good trend for an essentially agrarian state. Sikkim continues to remain a highly food deficit State. The deficits are seen more remarkably in paddy, oilseeds and pulses production. At the same time, there are many geographical locations where the extension services do not reach. The reasons attributed to these factors are inadequate institutional support and lack of wherewithal of services. There is a wide spread apprehension that the food production in Sikkim as reflected in both State and national level data is grossly overestimated. In fact, the state has to depend on importing a massive quantity of food grains under the Public Distribution System (PDS).

The major cash crop of Sikkim-Cardamom, its yield has steadily gone down over the years. Marketing hassles is another big problem that the agriculture of the state is facing. Processing of the state products in other parts of the state leads to loses out of employment-generating opportunities, income and revenue, both directly from agro-processing as well as from allied activities such as packaging, labelling, and so on. The marketable surplus of other products is mostly sold through rural markets, and typically involves the trading of small quantities of produce. There are 17 rural markets in Sikkim (6 each in the South and West districts, 4 in the East and only one in the North district). They are largely unorganised and not well frequented, given the low purchasing power of the rural populace. Most vital horticulture items like cardamom, orange and ginger are almost cent percent dependent on private traders, merchants and middle men for marketing. Therefore, the farmers are deprived both ways, as producers and as consumers. Though organisations like SIMFED, DAC some

other marketing agencies are there for marketing of agriculture-horticulture products, but these organisations are incurring losses and are not much active in the state hence most of the agriculture-horticulture products continue to be marketed by the middlemen.

Chapter 4

ANALYSIS AND INTERPRETATION

OF

THE RESULTS

Chapter 4

Analysis and Interpretation of the Results

This chapter critically analyses and interprets the results of the empirical analysis carried out for food crops (paddy and maize) and cash crops (potato and ginger).

4.1 Results on Paddy Production

With reference to the second objective of the study i.e. to study the crop wise value of production, productivity, input used, profit and cost, various statistical tools have been utilized. Independent t-test has been conducted to test the null hypothesis of there is no differences in the mean paddy output per acre between the two districts. One way ANOVA test has been conducted to test the null hypothesis that the differences in the land size and level of education of the farmers have no significant impact on the level of output. Further 3X2 factor ANOVA has been used to test the null hypothesis that the differences in the level of land size, level of experience and extension services have no impact on the level of paddy output. Lastly Cobb-Douglas production function for paddy output has been estimated to test the significance of the inputs individually and collectively. The descriptive statistics of paddy are presented in Table: 4.1.

A total number of 42 samples (21 from west district and 21 from east district) for paddy output were collected. Since the farming households were collected randomly, households cultivating paddy were very less in the remaining two districts of south and north, hence the two districts have been dropped and analysis has been done with the data of the two districts only. The average paddy output per acre of land is 959.52 kg. The average land used under the crop in the total sampled households for paddy is 1.302 acre. The crop is labour

intensive and the average number of famly labour (labour days) is 44.29 days while that of hired labour is 59.52 (labour days) per acre. In an average, about 105 labour (labour days) per acre is required from the beginning of sowing time to harvesting or threshing time of the crop. The average cost per acre incurred during the entire period of the cultivation of the crop is ` 17613.95. The average number of bullock labour days per acre is 8.48. This indicates that the paddy crop is cost intensive. The average year of schooling of the farmers cultivating paddy is 2 and the average year of experience of the farmers regarding the cultivation of the crop is 37.79 years. Though the education level of the farmers is low but so far the experience with regard to the cultivation of the paddy crop is concerned, it is reasonably high.

Table: 4.1 Descriptive Statistics: Paddy Production (per acre)

Variables	N	Range	Min	Max	Mean	S.D
Output (kg)	42	2050	150	3000	959.52	589.464
Land (acres)	42	2.7	0.3	3	1.302	0.5912
Famlab (labourdays)	42	140	10	150	44.29	28.468
Hiredlab (labourdays)	42	135	15	150	59.52	32.268
Cost (in rupees)	42	4000	14500	18500	17613.95	2626.011
Bull (labourdays)	42	19	2	21	8.48	3.522
Education (years of schooling)	42	3	1	4	1.71	1.019
Edufam (average years of schooling)	42	2	1	3	2.02	0.680
Experience (in years)	42	55	10	65	37.79	14.533

At the outset it was felt to test the significance of the mean paddy output per acre of the sample farm households. In order to do this, the mean paddy output per acre of the state has been computed from the secondary data and found to be 735.31 kg (the population

mean). The 't' test of mean significance has been employed to estimate the test of significance of difference between sample mean paddy output of 959.52 kg per acre and population mean output of 735.31 kg per acre. The 't' value is 3.150 and the significance level is 0.003. It implies that the null hypothesis of no difference between sample mean and population mean has been rejected.

Since the sample paddy farm households are from East and West, it is useful to know whether the mean paddy output per acre is statistically different between the two districts. Independent t-test has been employed to test the mean difference of two independent groups.

4.1.1 Independent t-test

Table: 4.2 Group Statistics

District	N	Mean	Std. Deviation	Std. Error Mean
Output 1 (west)	21	1078.57	446.814	97.503
2 (east)	21	840.48	694.913	151.643

As per the Table: 4.2 the mean paddy output of the sample of two groups (East and West) are 1078.57 kg and 840.48 kg per acre respectively.

Table: 4.3 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Output	Equal variances assumed	1.280	.265	-1.321	40	.194	-238.095	180.284
	Equal variances not assumed			-1.321	34.123	.195	-238.095	180.284

On the basis of Levene's test of equality of variances the null hypothesis of equal variance has been accepted. Hence the t-test for equality of means of two groups under equal variance hypothesis has been considered. On the basis of the 't' value the null hypothesis that there is no difference between the mean paddy output between East and west district has been accepted. This may be due to the fact that the production and productivity between the two districts do not differ much as shown in the Table 3.5 of chapter three. The area, production and productivity of paddy are more or less similar. Another reason that validates the null hypothesis of no difference in the mean paddy output is that the farmers of both the districts are using same technique of production. The crop is seasonal and both the districts have similar kind of irrigation facilities and other extension services. More or less same variety of the paddy is cultivated in both the districts.

4.1.2 ANOVA- Test: 2x2 ANOVA

In order to test whether differences in land size and differences in level of education of the farmers have any significant impact on the level of paddy output per acre, one way ANOVA test has been conducted. Land size is categorized into two groups: category 1 for the land less than or equal to 1.5 acre and category 2 for the land more than 1.5 acre. Similarly farmers have been categorized on the basis of their educational attainment. The farmers with schooling of less than or equal to one year is categorized as category 1 and those with more than one year of schooling are categorized as category 2.

Table: 4.4 Between-Subjects Factors

Landsizecat	**educat**	**Mean (paddy output)**	**Std. Deviation**	**N**
1	1	800.00	456.328	18
	2	792.86	478.321	14
	Total	796.88	458.423	32
2	1	1450.00	738.725	8
	2	1600.00	565.685	2
	Total	1480.00	681.175	10
Total	1	1000.00	622.896	26
	2	893.75	543.714	16
	Total	959.52	589.464	42

Descriptive statistics test of 2x2 ANOVA in the Table: 4.4 shows that the mean paddy output of farmers having land size less than 1.5 acre and education level of less than 1 year is 800 kg per acre. But the average decreases to 792.86 kg when the educational level increases. It was reported by the farmers that the people with higher level of education, particularly the youth, do not consider agricultural activities economically viable and as a result, are less involved in the agricultural activities and they are going out of the village in search of

secondary jobs leaving agriculture behind. This may be the cause of lower production of the crop with higher level of education. However, the mean paddy output increases with higher land size. The mean paddy output of the farmers with comparatively larger land size with category 1 of schooling is 1450kg and their number is 8 out of total 10 farmers of 2^{nd} category land size. But average paddy output per acre further increases in 2^{nd} category of land size with higher levels of schooling. This shows that the farmers with combination of higher education and higher land size have higher level of paddy output. But the number of farmers with combination of higher education and higher land size is only two. However, the implication is that there is scope of rising production and productivity of the crop in the larger land size with higher level of education.

Out of the total farmers (42) the mean output of 26 farmers with low level of education is 1000 kg with a standard deviation of 622.896 and mean output of 16 more educated farmers is 893.75kg. This indicates that the paddy output is more with the farmers having low education. The reason established for this result is that the less educated farmers are more involved in the agriculture than the farmers with higher educational attainment. The farmers with low education generally consider the agriculture as their main stay for livelihood earning and work regularly in the crop field while the case is relatively not alike with the farmers with higher level of education. Rather they use hired labour in the cultivation of the crop. But when the size of land increases to more than 1.5 acres, coupled with higher education level of farmers, the mean output of paddy increases to1600 kg per acre which is more than the mean output of the paddy crop with same category of land size but with lower level of education of farmers (1450 kg per acre).

The two factor ANOVA technique is employed to know the effect of land size, education and the interaction effect of land size and educational level of the farmer on the mean paddy output.

Table: 4.5 ANOVA Results - Tests of Between-Subjects Effects

(Dependent variable: output –paddy)

Variables	df	Mean Square	F	Sig.	Partial Eta Squared
landsizecat	1	2823550.697	10.071	.003	.209
educat	1	27139.088	.097	.757	.003
landsizecat*educat	1	32838.296	.117	.734	.003
Total	42				

The hypotheses set are:

Ho: The land size has no significant effect on the level of output.

Ho: education category has no significant effect on the level of output.

Ho: The interaction effect of land size and education on paddy output is zero.

The result in Table 4.5 shows that the land size has significant effect on the paddy output. The partial eta square value shows that the size of land has 20.9 % effect on the paddy output while the effect of the education is not significant and the combined effect of both land size and education is also not significant.

3X2 factor ANOVA has been used to test the null hypothesis that the differences in the level of land size, level of experience and extension services have no impact on the level of paddy output. Hence the land size has been categorised into two categories- category 1 (less than or equal to 1.5 acre) and category 2 (more than 1.5 acres). Secondly the experience of the farmers has been divided into two categories- 1st category (farmers with $\leq$ 30 years of experience) and 2nd category (farmers with > 30 years of experienc). The majority of the

farmers have the experience of more than 30 years. It shows that more than half of the farmers have long time engagement in the paddy cultivation. This implies that many farmers of the sampled area have little education (as before 50 years there was rare opportunity in Sikkim to have school education) and were traditionally engaged in the agricultural activities. Lastly, the farmers have been grouped on the basis of extension services they receive. Those who do not have availed the extension service are categorized as group-1 and those who have access to extension service are categorized as group -2. A majority of farmers have not benefited of extension services.

Table: 4.6 shows subject group classification for example, the mean paddy output of farmers with less than 1.5 acres of land with less than 30 years of experience but have no extension help is 500 kg., their number is 5. But there are 8 farmers who have availed extension services with the same land size and experience category, the mean output is very large i.e. 831.25 kg per acre. The mean output of 1st category land size with 30 years of experience is 689.29 kg and the number is 14. Similarly there are 18 farmers with land size of less than 1.5 acres and more than 30 years of experience and the mean output is 880.56 kg. That means the mean output increases when experience increases land size remaining constant.

The number of farmers with more than 1.5 acres of land and less than 30 years of experience is only 2. But the farmers' number with more than 1.5 acres of land and more than 30 years of experience is 8 and the mean output is 1450. Even though the mean output is more in 2x1xTotal, the aggregate effect on total is less because of only two farmers.

Table: 4.6 Descriptive Statistics

(Dependent Variable: output-paddy)

landsizecat	Expcat	extensioncat	Mean	Std. Deviation	N
1 (≤ 1.5 acre)	1 (≤ 30 years)	1 (no extension service)	500.00	384.708	6
		2 (access extension service)	831.25	400.836	8
		Total	689.29	415.182	14
	2 (> 30 years)	1	930.77	449.786	13
		2	750.00	600.000	5
		Total	880.56	484.203	18
	Total	1	794.74	467.230	19
		2	800.00	464.130	13
		Total	796.88	458.423	32
2 (> 1.5 acre)	1 (≤ 30 years)	1	2000.00	.	1
		2	1200.00	.	1
		Total	1600.00	565.685	2
	2 (> 30 years)	1	1400.00	1104.536	4
		2	1500.00	216.025	4
		Total	1450.00	738.725	8
	Total	1	1520.00	993.479	5
		2	1440.00	230.217	5
		Total	1480.00	681.175	10
Total	1 ≤ 30 years)	1	714.29	666.905	7
		2	872.22	394.581	9
		Total	803.13	517.194	16
	2 (>30 years)	1	1041.18	650.057	17
		2	1083.33	594.769	9
		Total	1055.77	619.730	26
	Total	1	945.83	658.047	24
		2	977.78	501.534	18
		Total	959.52	589.464	42

Table: 4.7 ANOVA Test - Tests of Between-Subjects Effects

(Dependent Variable: output-paddy)

Variables	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1	2.706E7	96.509	.000	.739
Land size	1	3107494.331	11.084	.002	.246
experience	1	799.114	.003	.958	.000
extension	1	98407.220	.351	.557	.010
Land size * experience	1	137481.797	.490	.489	.014
land size * extension	1	235716.599	.841	.366	.024
experience * extension	1	49054.807	.175	.678	.005
land size*experience* extension	1	649744.174	2.318	.137	.064
N	42				

The 3x2 factor ANOVA analysis is made to know the effect of land size, experience and extension service individually and the interaction effect of land size, experience and the extension on the mean paddy output. The result in Table 4.7 above shows that the land size has significant effect on the paddy output. The partial eta square value shows that the size of land has 24.6 percent effect on the paddy output per acre while the effect of the experience and extension service is not significant. The effect of land size is positive because that the farmers with relatively higher cultivable land are more concentrated on the agricultural activities, invest more which enhance the output. The combined effect of the land size and experience; land size and extension service and experience and extension service have no significant impact of the paddy output. This is because the farmers with higher education are mostly involved in the activities other than agriculture and use hired labour for agriculture which may not enhance output of the crop. The farmers practice traditional methods in cultivation and they are acquainted with the practice hence do not easily adapt with the

modern technique and since the extension services presently provided to the farmers are not so extensive to amalgamate farmers with the modern technique of cultivation. This is because the impact of experience and extension service has been less significant. The combined effect of land size and experience, land size and extension service, experience and extension service and the interaction effect of all the factors (land size, experience and extension service) on the mean paddy output are also not significant.

4.1.3 Regression Analysis

For paddy, regression analysis has been conducted to know the significance of each input in the production of paddy. The empirical model of Cobb-Douglas Production function is fitted in the equation:

$$\text{Log (Paddyoutput)} = \beta_0 + \beta_1 \ln \text{famlab} + \beta_3 \ln \text{hirlab} + \beta_4 \ln \text{cap} + \beta_5 \ln \text{bullab} + \beta_6 \ln \text{seed} + \beta_7 \ln \text{famedu} + \beta_8 \ln \text{exp} + \beta_9 D_1(\text{landsize}) + \beta_{10} D_2(\text{edufarmer}) + \beta_{11} D3(\text{extn}) + ui \text{----------} (1)$$

The descriptive statistics of table: 4.1 shows the mean and standard deviations of the variables used. In the regression, land area under the crop has been used as a dummy (D1), if the area is less than or equal to 1.5 acres, the value is zero and if it is more than 1.5 acre the value is 1. Similarly the education of the sampled paddy farmers is used as a dummy (D3), if it is less than or equal to 2 years of schooling it is zero and above two years is 1. In case of experience, the dummy (D2) has been used, less than 20 years of experience is considered as zero and more than 20 years is taken as 1.

Table: 4.8 OLS estimates of the parameters of C-D paddy production function

variables	Coefficients	t	Sig.
(Constant)	2.437** (.938)	2.598	.014
D1 (landsize) (≤ 1.5 acre=0; .1.5 acre= 1)	.020 (.123)	.272	.788
Log famlab	.428*** (.117)	4.270	.000
Log hiredlab	.132 (.151)	1.103	.279
Log capital	-.092 (.066)	-1.245	.222
Log bulllab	-.126 (.197)	-1.038	.307
Log seed	.577** (.087)	3.802	.001
Log edufam	-.067 (.125)	-1.041	.306
Log manure	.009 (.187)	2.746	.230**
D3 (education) ((≤ 2 years of schooling=0; > 2 years =1	.006 (.190)	.050	.961
Log exp	.028 (.182)	.254	.801
D2 (experience) (≤ 30 years=0; >30 years=1)	.076 (.147)	.771	.047
R^2	.909		
F	30.910 (0.000)		
N	42		

Note : ** 5 % level of significance *** 1 % level of significance. (Value in the brackets is the standard error)

From the regression result it is evident that land size dummy has no significant impact on the production of paddy. Since the mean area under the crop is very small (1.302) actual value) with a minimum of 0.3 acre. The productivity does not differ significantly. However, family labour, seed and experience of the family has positive and significant influence on paddy production per acre. One percent increase in experience leads to 4 percent increase in the level of paddy production. In case of labour power, family labour has significant impact on paddy production. One day family labour raises production by 50 percent. This shows that the more and more involvement of family labour in the production will yield more output. Of

all the factors, 90 percent of the total variation in the level of output is explained by all the explanatory variables. The result has an important implication that using good quality certified seed will definitely increase productivity. Secondly those farmers who are engaged in agriculture must be given more education and extension training so that they can improve their efficiency. Since family labour is comparatively more productive, inclusiveness should be given at farmers level by the government to make them attracted towards agriculture.

4.2 Results on Maize Production

In case of maize, Tukey Test has been conducted to test the Homogeneity of means between the groups (East &West and North & South). 3X2 factor ANOVA has been used to test the null hypothesis that the differences in the level of land size, level of experience and education have no impact on the level of maize output. At last C-D production function for maize output has been estimated to test the significance of the inputs individually and collectively.

A total number of 160 samples (40 from each district) were collected for maize. All the farming households cultivate maize since it is the crop that is grown in all agriculture zones of the state. Maize output is analyzed for all districts and Tukey Test has been conducted to test the Homogeneity of means between the groups (East &West and North & South).

Descriptive statistics of variables of maize:

Table 4.9 Descriptive Statistics: maize

variables	**N**	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Output	160	570	30	600	175.50	90.114
Landsize	160	2.8	.2	3.0	1.164	.5577
Famlab	160	38	2	40	17.76	7.347
Hirlab	160	30	0	30	15.36	7.205
Capital	160	5630	500	5130	2321.63	1832.402
Bullab	160	20	0	20	3.76	3.013
Seed	160	38	2	40	13.87	6.560
Manure(bhari=40kg)	160	200	0	200	66.29	38.800
Education	160	7	1	8	1.89	1.058
Famedu	160	3	1	4	2.03	.720
Experience	160	55	10	65	35.19	13.597
N	160					

Table: 4.9 presents the descriptive statistics of maize output and inputs used for the crop. The average maize output per acre of land is 175.50 kg. On an average 33 number of labour days per acre is required for the cultivation of the maize crop and the average cost incurred during cultivation per unit of acre is ` 2321.63. Local manure is used for the crop as the main input. The average experience of the farmers relating to the cultivation of the maize crop is 35.19 years. This indicates that the farmers have long time experience in relation to the cultivation of the maize crop. In fact maize is the main crop that all the farmers cultivate though the scale of production largely varies.

4.2.1 One way ANOVA (maize)

Table: 4.10 ANOVA test

Output	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	86685.000	3	28895.000	3.742	.012 **
Within Groups	1204475.000	157	7720.994		
Total	1291160.000	160			

Table: 4.11 Tukey Test of Homogeniety of the groups

		Subset for alpha = 0.05	
District	**N**	**1**	**2**
1 (East)	40	154.00	
3 (West)	40	160.00	
4 (North)	40	174.25	174.25
2 (South)	40		213.75

Here the null hypothesis is that there is no difference in the mean output of maize district-wise. And another is that the mean output of east and west is not different from the mean output north and south.

The null hypothesis of no difference in the mean output of maize is rejected at 5 percent level of significance. Table: 4.11 shows that there is difference in mean output of maize between the districts. Further, the null hypothesis of no difference in the mean output of east and west and north and south is also rejected at 5 percent level of significance. The mean output of east and west is different from north and south. This implies that the level of output in different districts of the state are different in respect of maize output and this may be attributed to different variety of seeds used, different quantity of manure used and the different level of irrigation facilities.

4.2.2 Two-way ANOVA (Maize)

On the basis of size of land acres used for maize, the farmers have been classified into two groups. First group with less than or equal to 1.5 acre, a total of 106 farmers and second group with more than 1.5 acres, a total of 54 farmers adding to 160. Experience of less than or equal to 30 years is categorized as group 1 and more than 30 years of experience is categorized as group 2 and similarly education with less than or equal to one year of schooling is classified into category 1 and more than one year of schooling is classified into category 2.

The next table (4.12) shows the mean output of the different subjects groups and the standard deviation. The mean maize output with less than 1.5 acres of land, the education with category 1 and with less than 30 years of experience, is 156.36 kg., and their number is 22. But there are 49 farmers whose mean output decreases to 131.65 kg. with higher experience level which means the experience does not have significant effect on the mean output because the method of cultivation of maize is mostly traditional. The same land size with higher education and experience of both categories also do not have significant effect on the level of mean output of maize.

But when land size increases the mean output of the maize increases. The maize crop is used both as staple crop and fodder for animals. The output with small land size is less because the crop is consumed in its raw state itself. Land size is the main factor which significantly influence the mean output of the maize

Table: 4.12 Descriptive Statistics Maize

Landsize	education	Experience	Mean	Std. Deviation	N
1 (≤ 1.5 acre)	1 (≤ 1 year)	1 (≤ 30 years)	156.36	52.149	22
		2 (>30 years)	132.65	53.181	49
		Total	140.00	53.639	71
	2 (> 1 year)	1	118.75	53.033	8
		2	131.11	42.547	27
		Total	128.29	44.622	35
	Total	1	146.33	54.170	30
		2	132.11	49.378	76
		Total	136.13	50.926	106
2 (>1.5 acre)	1	1	230.00	109.870	15
		2	264.81	99.822	27
		Total	252.38	103.566	42
	2	1	233.33	57.735	3
		2	261.11	102.402	9
		Total	254.17	91.598	12
	Total	1	230.56	101.661	18
		2	263.89	99.003	36
		Total	252.78	100.196	54
	1	2	179.61	96.532	76
		Total	181.77	93.276	113
	2	1	150.00	74.162	11
		2	163.61	83.671	36
		Total	160.43	80.971	47
	Total	1	177.92	85.127	48
		2	174.46	92.521	112
		Total	175.50	90.114	160

Table: 4.13 Tests of Between-Subjects Effects

Variables	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1	3009096.367	587.708	.000	.795
Landsize	1	261380.068	51.050	.000	.251
Education	1	2013.151	.393	.532	.003
Experience	1	3383.629	.661	.418	.004
landsize * education	1	1938.402	.379	.539	.002
landsize * experience	1	7045.219	1.376	.243	.009
education * experience	1	1086.287	.212	.646	.001
landsize*education* experience	1	2394.649	.468	.495	.003
N	160				

The 3x2 factor ANOVA analysis is made to know the effect of land size, education and experience and the interaction effect of land size, educational level and the experience of the farmers. The result shows that the land size has significant effect on the maize output. The partial eta square value shows that the size of land has 25.1 percent effect on the maize output per farmer while the effect of education and experience of the farmers is not significant and the combined effect of land size and education, land size and experience, education and experience and the interaction effect of all the factors-land size, education and experience is also not significant.

4.2.3 Regression Analysis

The empirical model is-

$$\textbf{Log (output)} = \beta_0 + \beta_1\textbf{(landsize)} + \beta_2\textbf{ln famlab} + \beta_3\textbf{ ln hirlab} + \beta_4\textbf{ ln bullab} + \beta_5\textbf{ ln seed} + \beta_6\textbf{ ln manure} + \beta_7\textbf{ D}_1\textbf{ (edufarmer)} + \beta_8\textbf{ D}_2\textbf{(ext)} + u_i \text{----------(2)}$$

The regression results presented in Table: 4.14 shows that the education of the farmer has been used as a dummy (D1), if the education is less than or equal to 2 years, it is zero and above two it is 1. In case of extension service, the dummy (D2) has been used for the farmers on the basis of extension services they receive. Those who do not have availed the extension service are zero and 1 for those who have access to extension service.

Table: 4.14 OLS Regression estimates of maize production

(Dependent variable: output- maize)

Variables	Coefficients	t	Sig.
(Constant)	3.011*** (.232)	12.987	.000
Land size	.112 * (.063)	1.842	.067
Log famlab	.212 ** (.067)	3.040	.003
Log hiredlab	.099 * (.067)	1.651	.101
Log bulllab	.541*** (.064)	6.734	.000
Log seed	.046 (.075)	.607	.545
Log manure	.220 *** (.033)	3.823	.000
Education (D1)	.065 (.053)	1.326	.187
Extension (D2)	.077 * (.045)	1.687	.094
R^2	0.727		
F	47.504		0.000
N	160		

Note : * 10 % level of significance, ** 5 % level of significance, *** 1 % level of significance. (Value in the brackets is the standard error)

From the regression result it is evident that education dummy and seed have no significant impact on the production of maize but the extension dummy has significant impact on the production of the maize crop at 10 percent level of significance. Land size, family labour, hired labour, bullock labour and manure have positive and significant influence on maize production per acre at 10 %, 5 %, 10 %, 1 % and 1 % level of significance respectively. One percent increase in land size leads to 11 percent increase in the level of maize production. In case of labour power, family labour has significant impact on maize production and the impact of hired labour is also reasonably good as one percent increase in it may lead to 9 percent increase in maize production. But the impact of family labour is more.

One percent increase in family labour can increase the maize production by 21 percent. This implies that the family labour contributes more in increasing yield of the crop. The bullock labour and the manure have significant impact on the maize output. One percent increase in both the bullock labour and the manure can lead to 54 percent and 22 percent increase in the maize yield. This shows that more and more use of bullock labour, (as to make the land suitable for cultivation mainly depends on the bullock labour) leads to increase in the yield of the maize. More and suitable diffusion of manure in the farmland results in the better yield of the crop. 72 percent of the total variation in the maize output is explained by all the explanatory variables.

4.3 Results on Ginger Production

To test the Homogeneity of means between the groups (East &West and North & South), Tukey Test has been conducted. The 4X2 factor ANOVA has been used to test the null hypothesis that the differences in the level of land size, level of education and extension services have no impact on the level of ginger output. Here in case of ginger also C-D production function has been estimated to test the significance of the inputs individually and collectively on the level of ginger output.

A total number of 75 samples (25 each from east, south and north districts) have been collected. From west district the sample could not be collected because only few farmers cultivate ginger in the sampled area, hence, the west district has been declined in case of ginger. Ginger output is analyzed for all the three districts and Tukey Test has been conducted to test the Homogeneity of means between the groups.

Table: 4.15 Descriptive Statistics- ginger

Variables	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
manure	75	290	10	300	115.73	60.206	3.625E3
Famlab	75	38	2	40	16.52	7.448	55.469
Experience	75	25	5	30	15.23	5.933	35.205
Hirelab	75	26	4	30	14.56	7.266	52.790
Output(in mon=40kg)	75	6	34	40	38.74	6.599	43.548
Seed (in kg)	75	14.75	.25	15.00	3.8833	2.95127	8.710
Education	75	7	1	8	1.85	1.216	1.478
Bulllab	75	3	1	4	1.47	.704	.495
Landsize	75	.9	.1	1.0	.349	.2049	.042
N	75						

Table: 4.15 shows the descriptive statistics on ginger. The average ginger output per acre is 38.74 mon (1 mon= 40 kg). On an average about 15 mon (=600 kg) of ginger can be cultivated on an acre of land and since the crop involves high risk of price fluctuation, the farmers of Sikkim do not cultivate the crop in large scale, despite being the major cash crop of Sikkim.

4.3.1 One way ANOVA (ginger)

Whether the production of the ginger crop is statistically different among farmers in different districts. With the null hypothesis of there is no significant differences among the districts, the ANOVA test has been conducted. The result shown in the table: 4.17 shows that

Table: 4.16 One way ANOVA Descriptive (Area Wise)

Output	N	Mean	SD
1 (East)	25	31.54	4.96
2 (South)	25	34.28	7.226
3 (North)	25	34.23	7.033

Table: 4.17 Tukey Test of Homogeneity of the groups

District	N	Subset alpha= 0.05
1 (East)	25	31.54
3 (North)	25	34.28
2 (South)	25	34.23

the null hypothesis of no difference in the mean output of ginger is rejected at 5 percent level of significance. There is difference in mean output of ginger between the districts which implies that the level of ginger output is different in the different districts. During the survey the farmers were asked to share their experience regarding the output variation in different places, a massive 95 percent of farmers reported that the production of ginger differs in different types of soil and altitudes. The variety of seed is another factor that also lead to differences in the level of output. Table: 4.16 shows the mean and standard deviation of each districts' ginger output.

On the basis of size of land acres used for ginger cultivation, two groups have been made which is presented in table: 4.18. The land with less than or equal to 0.5 acre is grouped as group 1 which totals 53 and another group with more than 0.5 acre totals 22, adding to 75 in total. Regarding extension service, the farmers who have not accessed to extension service is categorized as group-1 and who have accessed are classified as group-2. In respect of educational attainment of the farmers, two categories have been made. The level of education with less than or equal to one year of schooling is grouped as category-1 and the farmers with the education level of more than 1 year of schooling is clubbed to group -2.

Two factor ANOVA Analysis: Between subjects factor

Table: 4.18 Two factor ANOVA test

Variables	**Category**	**N**
District cat	1 (East)	25
	2 (South)	25
	3 (North)	25
Edu cat	1 (≤1 year)	53
	2 (>1 year)	22
Land size cat	1 (≤ 0.5 acre)	53
	2 (> 0.5 acre)	22
Exp cat	1 (no extension service)	47
	2 (access to extension service)	28

The hypotheses are:

Ho: The land size has no significant effect on the level of output.

Ho: education category has no significant effect on the level of output.

Ho: extension service category has no significant effect on the level of output.

Ho: The interaction effect of land size, education and experience on the output of ginger is zero.

Table: 4.19 Descriptive Statistics: ginger

(Dependent Variable: output – ginger)

Districtcat	landsizecat	Educat	extcat	Mean	Std. Deviation	N
1 (East)	1 (≤0.5 acre)					
			Total	16.86	3.482	22
	2 (> 0.5 acre)		Total	27.67	2.517	3
			Total	18.16	4.896	25
2 (South)	1	Total	Total	9.06	14.165	18
	2	Total	Total	17.00	20.328	7
	Total			11.28	17.226	25
3 (North)	1		Total	5.77	13.468	13
	2	Total	Total	17.08	15.160	12
	Total			11.20	17.176	25
Total	1	Total	Total	7.34	13.883	53
	2	Total	Total	17.14	16.714	22
	Total			10.21	16.599	75

The table: 4.19 shows subject group classification of the mean ginger output of farmers with district categories and with both the categories of land size, education and extension service. The district category 1(east) with the land size, education and extension service of category 1, the mean output of ginger is 16.44 mon and with category 2 of land size, it increases to 25.00 (1000 kg) mon. Similarly the mean output of ginger in the second category of district (south) with the lower land size and lower education level with no extension service is 18 mon and with extension service is 18.11 while the mean output of the ginger increases with the category 2 land size, education and extension service, the mean output increases to 27 mon (1080 kg) per acre. The mean output of ginger increases with the category 2 of land size, education and extension service in all the district categories. So far the increase in output of the crop is concerned it increases with the higher level of land size. The extension service and the education do not matter a lot in increasing the output of the

crop because the farmers do the cultivation in the traditional manner and are experienced with the practice that has been adopted so far.

The crop is not free from the diseases and the crop yield variability is there among the farmers. However, the farmers who do the cultivation in large scale take more care of the crop. In the absence of which they may have to bear a loss of the crop which causes higher economic loss for the farmers.

Table: 4.20 Tests of Between-Subjects Effects

Dependent Variable: output ginger

variables	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1	5680.717	363.830	.000	.254
Districtcat	2	7.202	.461	.633	.629
Landsize	1	687.727	44.047	.000	.044
Edu cat	1	88.200	5.649	.021	.106
Extcat	1	103.383	6.621	.013	.213
districtcat * landsize	2	30.200	1.934	.154	.060
districtcat * educat	2	58.201	3.728	.030	.014
districtcat * extcat	2	73.675	4.719	.013	.014
landsize * educat	1	307.559	19.698	.000	.076
landsize * extcat	1	36.442	2.334	.132	.029
educat * extcat	1	90.043	5.767	.020	.074
districtcat * landsize * educat	1	.010	.001	.980	.038
dsitrictcat * landsize * extcat	1	187.240	11.992	.001	.003
districtcat * educat * extcat	1	.013	.001	.977	.024
landsize * educat * extcat	1	164.479	10.534	.002	.002
districtcat * landsize * educat * extcat	0	.	.	.	.001
N	75				

The 4x2 factor ANOVA analysis is made to know the variability in the level of output in the different districts. The different districts and the differences in the level of output with different categories of land size, education and extension service have been analyzed. The interaction effect of district category, land size, educational level and the extension service of the farmers have also been examined. The result in Table 4.20 shows that the level of output of ginger changes in different districts category. The partial eta square value shows that when the district changes there will be 62.9 percent effect on the ginger output per acre. This implies that the level of output differs in different districts. The effect of the land size is 4 percent, education is 10 percent and that of the extension service is 21 percent which is significant. However, the combined effect of district category and land size, land size and education, district category and extension service, land size and education, land size and extension service, education and extension service is not significant. The interaction effect of all the factors - district category, land size, education and extension is also not significant.

4.3.2 Regression Analysis

The fitted empirical model is-

$$\text{Log (output)} = \beta_0 + \beta_1 \ln \text{famlab} + \beta_2 \ln \text{hirlab} + \beta_3 \ln \text{bullab} + \beta_4 \ln \text{seed} + \beta_5 \ln \text{manure} + \beta_6 D_1 \text{(land size)} + \beta_7 D_2 \text{(Experience)} + \beta_8 D_3 \text{(extension)} + ui \text{----------(3)}$$

In the regression, the land size, experience of the farmers and extension service has been used as a dummy. (D1) for land size, if the land size is less than or equal to 0.5 acre it is zero and above 0.5 acre is 1. In case of experience, (D2), less than 20 years of experience is considered as zero and more than 20 years is taken as 1. Lastly, the dummy (D3) has been

used for the farmers on the basis of extension services they receive. Those who do not have access to extension service are zero and 1 for those who have access to extension service.

Table: 4.21 OLS estimates of the parameters of C-D paddy production function

(Dependent variable: output- ginger)

Variables	**Coefficients**	**t**	**Sig.**
(Constant)	-.645 (.579)	-1.114	.269
Log famlab	.119 (.579)	.238	.012**
Log hirlab	.030 (.098)	.397	.693
Log bullab	.073 (.096)	.731	.467
Log seed	.555*** (.163)	3.688	.000 ***
Log manure	.361** (.146)	2.761	.007 ***
D1 (land size) (≤0.5 acre=0; > 0.5 acre=1)	-.160 (.156)	-.770	.o44 **
D2 (Experience) (< 20 years=0; > 20 years= 1)	-.004 (.135)	-.080	.936
Dum3 (extension service)(No =0; Yes=1 >)	.026 (.066)	.544	.588
R^2	0.882		
F	61.436		0.000
N	75		

Note : ** 5 % level of significance *** 1 % level of significance. (Value in the brackets is the standard error)

The regression result of table: 4.21 shows that the land size has significant impact on the level of output of ginger. One percent increase in the land size lead to 16 percent increase in the level of output. Family labour has also significant impact on the level of ginger output. A percentage change in the number of family labour lead to about 12 percent increase in the level of ginger output. But the experience and extension service dummies have no significant impact on the production of ginger and this is because that the extension service is not

extensively provided to the farmers. Similarly, the, hired labour and bullock labour also do not have significant impact on the production of ginger. But the seed and manure have the significant impact on the production of the ginger both at 99 percent level of significance. During the survey, it was reported by the farmers that the output of ginger mainly depends on the quality of seed and the quantity of manure used for. However, the crop is also affected by the diseases like *pahelay* (local name) etc. The disease once appeared fully destroys the plant of ginger and the root decays, resulting to complete collapse of the crop.

However, eighty eight (88) percent of the total variation in the output is explained by all the explanatory variables. The result has an important implication that the crop with good quality seed, good amount of manure with higher involvement of the family labours has potential for further increase in the production as well as of productivity. But the problems of diseases and price fluctuation have serious impact on the amount of ginger cultivation as well as on the level of production and productivity. Education and extension training to the farmers relating to modern technique of cultivation and farm management is highly important to increase the output of the crop. This may help the crop to boast to be one of the major cash generating crops for the farmers of Sikkim like that of cardamom. Market management is also equally important for the success of the crop. The fluctuating price of the crop discourages the cultivation of the crop in a large scale which debars the farmers from earning the good amount of profit.

4.4 Results on Potato Production

In case of potato also, the homogeneity of the means of output between the groups (East &West and North & South) have been tested conducting the Tukey Test. One way ANOVA test has been conducted to test the null hypothesis that the differences in the land size and different districts have no significant impact on the level of output. Further (4X2)

factor ANOVA has been used to test the null hypothesis that the differences in the level of land size, level of experience and extension services have no impact on the level of potato output. Cobb-Douglas production function for potato output has been estimated to test individual and collective significance of the inputs on output.

A total number of 120 samples (30 from each district) have been collected. Most of the farming households cultivate potato since it is the crop that can be grown in all altitudes of agriculture zones of sikkim. It is the most important vegetable crop which also serves as the main cash crop for the farmers of Sikkim. Descriptive statistics of variables in potato are given below in table: 4.22

Table: **4.22 Descriptive statistics**

(Dependent variable: output- potato)

Variables	N	Range	Minimum	Maximum	Mean	Std. Deviation
Output (kg)	120	400	1200	1600	1400	207.341
Landsize	120	.9	.1	1.0	.255	.1269
Totallab (labour days)	120	10	60	70	23.18	9.624
Capital	120	500	3500	4000	3750	2166.165
Seed (kg)	120	100	400	500	450	56.336
Manure (bhari)	120	50	250	300	275	39.387
Edufarmer	120	7	1	8	1.94	1.125
Edufam	120	3	1	4	2.03	.709
Experience	120	50	10	60	23.29	10.837
N	120					

The farmers of the sampled area cultivate potato in small scale. The land under the crop ranges from 0.1 acre to 2 acre in the sampled area. A very few farmers cultivate the crop in area of more than one acre. The average potato output per acre of land is 1400 kg. The homogeneity of mean potato output has been tested using Tukey Test and the result is presented in the table: 4.23 below.

4.4.1 Tukey Test

Table: 4.23 Tukey Test of Homogeneity of the groups

(Dependent variable: output- potato)

Subset for alpha = 0.05				
		Subset		
Districts	N	1	2	3
4 (South)	30	1132.67		
1 (East)	30	1378.43		
3 (North)	30		1276.67	
2 (West)	30			1360.33

The null hypothesis of no difference in the mean output of potato is rejected at 5 percent level of significance. Some farmers cultivate the crop in the dry lands using irrigation through pipe water while canal irrigation is used in the land wherever it is suitable and some cultivate without irrigation also. Thus, there is valid reason for the rejection of null hypothesis of there is no difference in mean output of potato between the districts. There are differences in the mean output of the potato between the districts. Again the null hypothesis of no difference in the mean output of east and west and north and south is rejected. The mean output of east and west is different from north and south.

4.4.2 ANOVA test:

Here, in case of potato, the land size under the crop has been categorized into three different groups on the basis of size of land acres used for the crop. The land with less than or equal to 0.5 acre is grouped as category-1 which totals 76 farmers and another group (category 2) with 0.5 acre to 1 acre totals 31 farmers and the third group of farmers (category 3) with land size of more than 1 acre totals 13 farmers adding to 120. The education of the

farmers has been categorised into two groups. The farmers with education of less than or equal to one year of schooling is categorised as group-1 and the education higher than one year of schooling is categorised as group-2. With regard to experience of the farmers, the farmers with the experience of up to 10 years is categorised as group-1, up to 20 years of experience is classified as group-2 and the farmers with more than 20 years of experience are categorised as group-3. The majority of framers have experience of up to 20 years.

The null hypotheses set here are that the land size has no significant effect on the level of output; education category too has no significant effect on the level of output; the effect of extension service on the output is zero and the interaction effect of district category, land size, education and experience also do not have significant effect on the output of potato.

Table: 4.24 Descriptive Statistics

(Dependent Variable: output potato)

District	Landsize	Educat	Expcat	Mean	Std. Deviation	N
1 (East)	1 (<0.5 acre)		Total	1127.94	45.706	18
	2 (0.5 to 1 acre)		Total	1206.25	86.344	8
	3 (> 1 acre)		Total	1350.00	129.099	4
	Total		Total	1178.43	102.976	30
2(West)	1		Total	1171.67	88.916	12
	2		Total	1345.83	191.238	12
	3		Total	1766.67	136.626	6
	Total		Total	1360.33	262.803	30
3(North)	1		Total	1169.47	70.196	19
	2		Total	1297.50	167.054	8
	3		Total	1900.00	100.000	3
	Total		Total	1276.67	241.509	30
4(South)	1		Total	1115.93	60.017	27
	2		Total	1283.33	76.376	3
	Total		Total	1132.67	78.999	30
Total	1		Total	1140.96	68.465	76
	2		Total	1291.29	158.698	31
	3		Total	1669.23	256.205	13
	Total			1219.49	197.070	120

The subject group classification of the mean potato output of farmers with district categories and with both the categories of land size, education and experience is shown in Table: 4.29. East district with the land size, education and experience of category 1, the mean output of potato is 1127.94 kg. and increases to 1206.25 kg with the land size of category 2. The mean output further increases to 1350.00kg with land size of more than one acre. The mean output of potato increases with the category 2 and category 3 of land size, education and extension service in all the district categories**.**

Table: 4.25 Tests of Between-Subjects Effects

(Dependent Variable: output- potato)

Variables	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Intercept	1	5983438.335	594.507	.000	.883
District	3	90180.907	8.960	.000	.254
Landsize	2	1067637.961	106.079	.000	.729
Educat	1	3272.118	.325	.570	.004
Expcat	2	47174.379	4.687	.012	.106
dist rict* landsize	5	42563.741	4.229	.002	.211
district * educat	3	16917.547	1.681	.178	.060
dist rict* expcat	4	4828.505	.480	.750	.024
landsize * educat	2	5633.945	.560	.574	.014
landsize * expcat	4	16305.834	1.620	.177	.076
educat * expcat	2	11720.146	1.164	.317	.029
district * landsize * educat	2	31836.002	3.163	.048	.074
district * landsize * expcat	4	12225.877	1.215	.311	.058
district * educat * expcat	2	1175.647	.117	.890	.003
landsize * educat * expcat	2	13957.669	1.387	.256	.034
dist rict* landsize * educat * excat	0	.	.	.	.000
Total	120				

The 4x2 factor ANOVA analysis has been made to know the effect of district category, land size, education and experience and the interaction effect of district category, land size, educational level and the experience of the farmers. The result in Table: 4.25 shows that the district category has significant effect on the potato output. The partial eta square value shows that when the district changes there will be 25.4 percent effect on the potato output per acre. This indicates there are differences in the level of potato output in different districts. The effect of the land size is highly significant whose partial eta square value stands at 72.9 percent. There is no effect of education while the effect of experience is 10 percent which is significant. The combined effect of district category and land size is significant. When district category changes and land size increases the output of potato increases. But the combined effect of district category and education, land size and education, land size and experience, education and experience is not significant. Similarly the interaction effect of district category, land size, education and experience on the level of output is also found to be not significant.

4.4.3 Regression Analysis

To know the significance of the inputs used for the production of potato, the following empirical model is fitted as

$$\textbf{Log (output)} = \beta_0 + \beta_1 \textbf{ ln totallab} + \beta_2 \textbf{ ln seed} + \beta_3 \textbf{ ln manure} + \beta_4 D_1 \textbf{ (land size)} + \beta_5 D_2 \textbf{ (edufarmer)} + \beta_6 D_3 \textbf{ (Experience) +ui ----------(4)}$$

Dummy has been used for land size, education and experience of the farmers in the regression analysis. In the regression, land area under the crop has been used as a dummy (D1), if the area is less than or equal to 0.5 acre the value assigned is zero and if it is more than 0.5 acre the value is 1. Similarly the education of the sampled potato farmers is used as a

dummy (D2), if it is less than or equal to one year of schooling, it is zero and above one is 1. In case of experience, the dummy (D3) has been used. Less than 20 years of experience is considered as zero and more than 20 years is taken as 1.

The regression results in Table: 4.26 show that land size dummy, labour power and education have no significant impact on the production of potato. But seed and manure have significant impact on the output. The impact of variables is significant both at 5 percent level of significance. One percent increase in the quality of seed and one percent increase in both quality and quantity of manure can increase the output by 36 percent and 31 percent respectively.

Table: 4.26 Regression Results

(Dependent Variable: log output- potato)

Variables	**Coefficients**	**t**	**Sig.**
(Constant)	1.260 (.649)	1.942	.055**
D1 (landsize) (≤0.5 acre=0; □ 0.5 acre=1)	.049 (01.6)	.673	.502
Log totallab (labour days)	.156 (.208)	1.412	.161
Log capital	-.097 (.055)	-1.938	.055**
Log seed	.368 (.140)	2.969	.004**
Log manure	.319 (.187)	2.746	.007** *
D2 (education) (≤1= 0; >1= 1)	.073 (.076)	1.448	.150
D3 (experience) (≤ 20 years= 0; > 20 years= 1)	.091 (.081)	1.783	.077*
R^2	0..731		
F	43.373		0.000
N	120		

Note : * 10 % level of significance ** 5 % level of significance. (Value in the brackets is the standard error)

The potato growing farmers are using both local and non-local variety of seeds. The different varieties of seed with its different place of origin have different impact on the level

output of the crop. Of all the factors 73 percent of the total variation in the output of the potato crop is explained by all the explanatory variables. The result has an important implication that the crop with good quality of seed and good amount of manure used as well as with long time experience of the farmers, boost yield rate.

In order to know the existing position of all the crops considered in the study with respect to the production stage that the crops are passing in Sikkim, the coefficients of all the inputs (explanatory variables in the regression analysis for individual crop) have been added. The sum total of coefficients of inputs of the regression results shows returns to scale. The sum total value of coefficients has three implications. If the value is less than one, it is increasing returns, if it is equal to one, constant returns to scale and if it is more than one, indicates decreasing returns to scale. The results have important inference that the crops like paddy, ginger and potato are in the stage of increasing returns to scale. This implies that these crops with efficient utilization of the available land resource and other inputs have potential for further improvement in the level of production as well as productivity. But in case of maize, the sum total value of coefficients is 1.372, which is greater than one, indicates that the crop has already attained the third stage of production. Only 30.37 percent of farmers in the sampled area are making profit in the maize crop which also supports the findings of decreasing returns. Further expansion in the cultivation of the crop incurs higher cost which results declining returns out of the crop causing more loss to the farmers as well as to the economy of the state as a whole. However, this can be resolved by providing HYV of seeds and extension service to the farmers. This can further improve the productivity of the crop.

4.5 Profit Analysis

The study has analysed the profit for all the crops considered. The farmers are making profit on the crops like paddy, ginger and potato when the influence of fixed cost is not considered. But if the influence of the fixed cost is considered the farmers are making profit in paddy and ginger only. Profit in maize crop is negative.

Table: 4.27 Revenue, Cost and Profit Analysis of the sample

Crop	ACWFC (in Rs)	ACWOFC (in Rs)	AR (in Rs)	APWOFC (in Rs)	APWFC (in Rs)	No. of sample
Paddy	17613.95	16704.65	19201.16	2496	1587.21	43
Maize	5630.54	5092.08	3932.28	-1159.81	-1698.26	158
Ginger	18174.01	17535.21	29225	11689.99	11050.27	76
Potato	4152.85	3642.05	3993.02	350.97	-159.83	120

ACWFC (Average Cost With Fixed Cost); ACWOFC (Average Cost Without Fixed Cost); AR (Average Revenue); APWOFC (Average Profit Without Fixed Cost); APWFC (Average Profit With Fixed Cost)

The percentage of profit making farmers in the sample district, in all crops- paddy, maize, ginger and potato are 67 percent, 30 percent, 94 percent and 45 percent and the loss making farmers for the crops are 33 percent, 70 percent, 6 percent and 55 percent respectively. The farmers are making profit in paddy due to the fact that the farmers are being provided HYV seed (like VL 82, Pant Dhan 10 etc.) and since the involvement of the family labours in the crop is high and its influence was also seen positive in the regression analysis.

Table: 4.28 Profit and Loss Making Farmers in Specified Crops out of Total Sample

(in percent)

Particulars/crops	**Paddy**	**Maize**	**Ginger**	**Potato**
No. of farmers making profit	29 (67.44%)	48 (30.37%))	72 (94.37%)	54 (45.37%)
Avg. edu of profit making farmers (category wise)	2	2	2	2
Avg. years of exp of the profit making farmers (category wise)	2	1	1	1
Avg. land size of the profit making farmers (category wise)	1	1	1	1
No. of loss making farmers	14 (32.55%)	110 (69.62%)	4 (5.26%)	65 (54.62%)
Avg. edu of loss making farmers (category wise)	1	2	2	2
Avg. years of exp of the loss making farmers (category wise)	2	2	1	1
Avg. land size of the loss making farmers (category wise)	1	1	1	1

However, though the maize is the major crop of the state, the farmers are not making profit in it. The fact is that the maize is a Kharif crop and the crop is seldom irrigated and the market value of the crop is also less than the market value of other crops. During the survey many of the farmers reported that they are cultivating the maize crop just not to keep their land barren. In Ginger the farmers are found to be making profit due to the fact of prevailing higher price of the crop. However, the price of the product is highly fluctuating which sometimes results in huge profit for the farmers but in some occasions the farmers have to bear massive loss. In potato the farmers are not making much profit but there is scope of generating more profit by enhancing the production and productivity as the crop has high market demand. The crop is prone to diseases and the effect of the climatic changes, hence

extension services along with suitable farm management training should be provided to the farmers in order to make the farmers capable of abstaining greater loss of the crop. Besides, the crop also lacks the irrigation facility, hence steps can also be taken in that respect.

Table: 4.29 Profit and Loss making farmers-District wise

(Figures in the brackets are the percentage of total)

Crop/ Districts	**East**			**West**			**South**			**North**		
	P	**L**	**T**	**P**	**L**	**T**	**p**	**L**	**T**	**P**	**L**	**T**
Paddy	9 (40%)	12 (59 %)	**21**	20 (95 %)	1 (5%)	**21**						
Maize	6 (15%)	34 (85%)	**40**	14 (35%)	26 (65%)	**40**	16 (41 %)	24 (58 %)	**40**	13 (31 %)	27 (69 %)	**40**
Ginger	23 (92%)	2 (6%)	**25**				24 (96%)	1 (4%)	**25**	22 (88%)	3 (12%)	**25**
Potato	12 (40%)	18 (60%)	**30**	16 (54%)	14 (46 %)	**30**	13 (43 %)	17 (57%)	**30**	14 (46 %)	16 (54 %)	**30**

Note: P- Profit; L- Loss; T- Total Sample of the district.

As per Table: 4.29 the farmers of west district are making more profit in the paddy crop. The reason is that the productivity of paddy in west district (1817 kg/ha) is higher than the productivity in east district (1752 kg/ha) (State profile of Sikkim 2011-12) and the mean output of west district is also higher which indicates that there must be variability in the level of input used in the cultivation of the crop. During the survey it was found that the west district was having comparatively better irrigation facilities.

In case of maize, the percentage of profit making farmers is less than the loss making farmers in all the districts. But the constituent of loss making farmers in the east district is very large (85%). This was due to the fact that the farmers had reported that the crop is also largely damaged by the wild pests. The maize crop in the sampled area as per the result of the regression analysis has entered the stage of decreasing returns to scale.

The ginger and potato growers are making profit out of the crops. The percentage of profit making farmers of ginger crop is 94.37%. and that of potato is 45.37%. The sum total value of coefficients of the variables inputs of both the crops shows that the crop has potential for further improvement both in terms of production as well as of productivity.

Chapter 5

CONCLUSIONS AND POLICY SUGGESTIONS

Chapter 5

Conclusions and Policy Suggestions

5.1 Conclusions

The entire study is related to the comparative study of economics of organic food crops and cash crops. This study has collected sample on four crops- paddy and maize (food crops) and potato and ginger (cash crop) because of their relative importance in the agriculture of Sikkim. The study has attempted to find out productivity differences for each crop with reference to the district, farm size, education of the farmer, experience and family education. Further crop-wise and district-wise profitability comparison has been made.

As far as the paddy is concerned, there is not much variability in the level of production and productivity of the crop in the total samples. The difference in the level of output in the different districts is also less. The output of the crop increases with the increase in the land size. The studies reviewed have also shown that the output increases with the increase in land size (Dubgaard, 1994). About 68 percent of the farmers, out of total sampled farmers, are making profit. The crop has prospective for further expansion and hence the cultivation of the crop can be increased bringing the waste land under cultivation and providing better irrigation facilities. Maize is the crop which is cultivated by almost all the farmers of the sampled area and the area under the crop is also highest in the state i.e. about 40 percent of the total agricultural land. But the farmers are not making profit out of the crop.

So far the cash crops i.e. ginger and potato is concerned, the land size has the positive relation with the level of output of the crops. There are differences in the level of output per acre of the cash crops in the different districts. Farmers are making more profit in cash crops. Though only about 45 percent of the farmers are making profit in potato crop but they are

receiving good amount of cash when the market situation is favourable. The demand of the crop remains high throughout the agricultural year.

The results have shown that the existing land holdings pattern is not suitable for increasing output for all crops considered. Many of the farmers of Sikkim have small land holdings and as a result there is no significant growth in the level of output of the crops considered. The education and the experience of the farmers have not shown much impact on the level of output of the crops considered, but when these are combined with the larger category of land size, the impact on the level of output is significant. It is due to the fact that education of the farmers is not agriculture based, and experience gained therewith is of traditional farming practices only. The impact of extension service has not been observed significant, since the extension services are not extensive. The extension services that are presently provided to the farmers are like providing direction to the farmers, providing seeds and explaining technique of cultivation, etc. in a casual manner mostly outside the farmlands. The contribution of seed has been observed significant in all crops except in maize. The impact of manure has also been found significant.

Larger chunk of crop output is consumed by the farm households themselves and very less amount of the crop is marketed which is also done within the households' level. It was pointed out during the survey that even though the farmers are producing the crops with commercial objective, their products are not procured by the marketing agencies and ultimately they sell to the local traders at lower prices. This has discouraged the farmers to grow the crops in large scale.

Farmers are cultivating both the crops in a traditional manner and the farming technique is traditionally organic. Initially the farmers used chemical fertilizers and pesticides but for about last ten years they are doing the farming using local manure and some other

organic manure provided by the agriculture and horticulture department. The inputs used in all the crops are similar while the technique of use is different. The farmers use both the hired labour and family labour for the cultivation of the crops. The hilly terrain land and the traditional technique of cultivation have resulted in higher cost for the production. The hired labour and bullock labour constitute highest share of cost of about 80 percent. The revenue generated from the crops like paddy and maize is reasonably low since both the crops are labour intensive in the case of Sikkim. The profit out of the food crops is quite low and the number of farmers making profit is less than the farmers making loss in case of maize. Though the percentage of profit making farmers in case of paddy is comparatively more than that of maize but the amount of profit is low. The crop residuals of both the crops are the major source of animal fodder. The large number of famers has livestock in their houses and the crops are also the major source of the fodder for animals, and this is the reason why the farmers are doing food crop cultivation despite having low return of the crops.

As far as the land size and productivity relation is concerned, though the output of all the crops under consideration increase with the higher land size, the available land is more suitable in case of cash crops. The farmers are making more profit in cash crops. In case of cash crops the potentiality of further increase in production by increasing inputs is immense as shown by the results of the regression analysis of the study. The sum total value of coefficients of variables of both the cash crops is less than one which implies that there is a scope for further increase in the production of the crops. While, in the case of the food crops, the value is more than one in case of maize and it is less than one only in case of paddy. The inference is that the excess land under the maize crop can be better substituted for the cultivation of crop like ginger and potato. However, the state has better scope for increasing both food crops and cash crops. The farmers do the agriculture (both food crops and cash crops) in a traditionally organic way. The provisions and execution of extension service

activities need further intensification for making the agriculture economically viable vocation.

5.2 Policy Suggestions

The absence of the practices like cluster farming are the major setback in the Sikkim's agriculture. Therefore, the Government needs to implement a policy to bring the land of the farmers together and the technique like cluster farming may be followed declaring some particular village as belt (eg. Ginger belt) may be initiated. This may facilitate fuller utilization of the limited available land and higher level of agricultural output may be realised. Cooperative farming may also be initiated. Since the landholdings in Sikkim are of small type, the system of cluster farming or cooperative farming may be more economically practicable particularly for cash crops. This will also be more effective system of farming from the view point of procurement for marketing of the agricultural products.

Technical training is to be provided to the farmers mainly for the cultivation of cash crops. Opening of krishi vidhalaya at the local level can serve the purpose. More Extension services are to be provided to the farmers at the farm level continuously. HYV seeds need to be provided to the farmers to increase production of the crops. This will increase the revenue and profit from the crops. Though there is deficit in the food crop production in the state, however, the farmers can make higher profit if the State Government take initiative to be a "Brand of Organic seed producing state", since the state is doing organic farming. This will encourage the farmers to cultivate the crops technically and due to the higher price of the seed, the economic benefits will also be higher.

The crops like ginger, potato are disease prone, hence regular provision of extension services is important. Marketing is the major problem in the state for the agricultural

products; emphasis is to be laid on providing better market for the organic crops of the state. Agriculture Processing are to be opened within the state level. The agriculture and Horticulture Department should make investment in the agriculture sector and credit facilities at low interest rate should also be provided to the farmers. This will definitely encourage the educated youth to the agriculture sector making the sector economically viable. Cool storage facilities should also be provided in all districts of the state. Investment should be increased in the agriculture sector. The Public Private Partnership (PPP) model of investment can be encouraged.

Lack of irrigation is the major problem that the farmers of Sikkim are facing. The agriculture in the state is mostly rain fed. The farmers do the farming in the small scale. Vegetables have huge market demand but the farmers are not being able to produce much for the market. The farmers in the study area were asked to share their views about their laxity in the production of surplus vegetables. A massive 90 percent of the farmers reported that the cultivation of vegetables largely depends on irrigation and even if the surplus is produced, marketing becomes a major problem. The rising industrial and tertiary sector of the state has led to increase in urbanisation in the state and has also triggered the demand for vegetables. But as far as the marketing of the local vegetables is concerned, it is surpassed by the vegetables products coming from outside the state in all seasons. The farmers do not have control over the price rather they are the price taker in the vegetables market. In order to create higher demand for the local vegetables, there must be reduction in the volume of import of the vegetables from outside the state and a massive revolution need to be initiated in the agriculture sector by way of organic technique itself. The Government should intensively focus on the marketing and distribution of organic produce.

5.3 Limitations of the Study

1. During the research work it is realised that he study could not use the Parametric Frontier technique such as Stochastic Frontier Analysis to analyse different types of efficiency.

2. Secondly Non- Parametric Frontier technique (a distribution free method) is also not utilised. It will be considered in further studies.

3. Not using cost function to see whether the farms are minimising the cost is a limitation of the study and it will be used in the higher research level.

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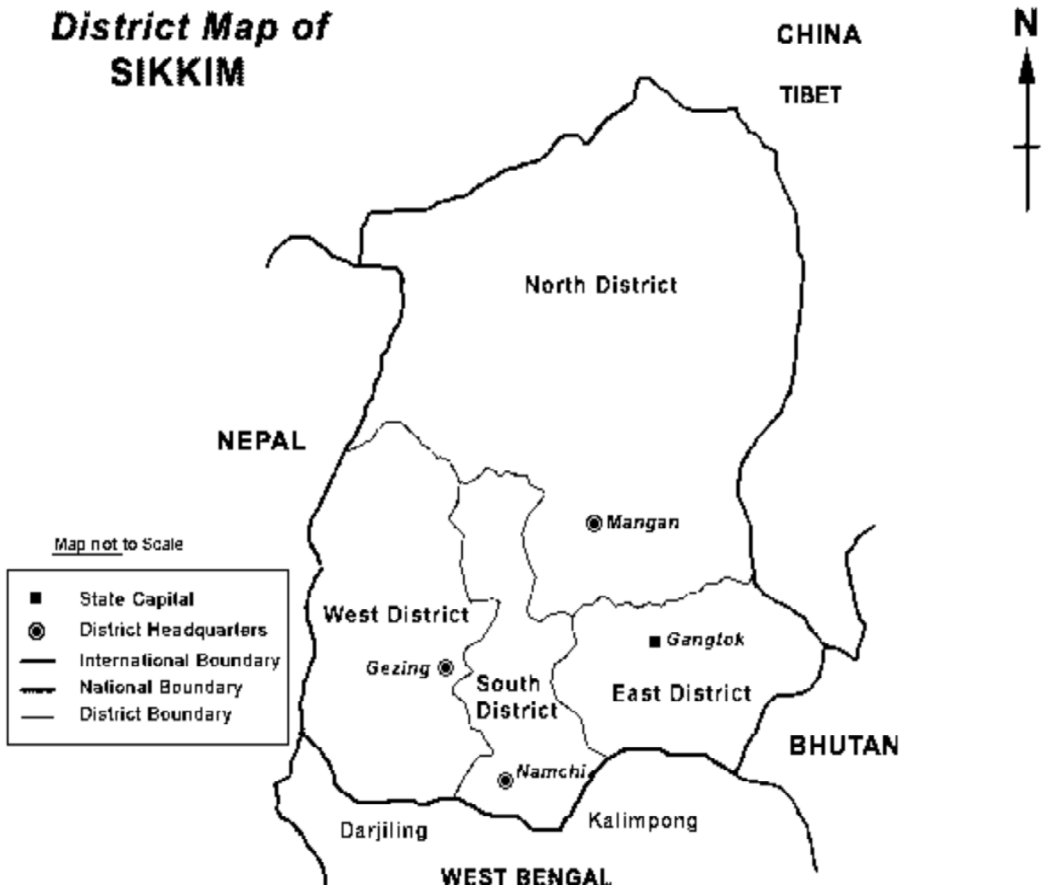
APPENDIX I

Map 1.1: Map of Sikkim



APPENDIX II

SIKKIM UNIVERSITY

QUESTIONNAIRE FOR THE SURVEY OF THE OPERATIONAL HOLDINGS IN SIKKIM, 2014-15

1. Name and Address of the Cultivator:

(a). Name: (b). Village Name:

(c). Post Office: (d). Police Station:

2. The cultivator and his family as on the date of the survey: Size, Composition and Occupational Pattern of the Farmer.

No of family members engaged in different activities

category	Total members in family	Crop production	Allied activities	Industry business	service
Children*					
Adult male					
Adult female					
Total					

3. Details of the Effective* head of the household and other family members (Educational status, age).

category	Age	primary	Higher primary	Higher secondary	college	Any other
Effective Head household						
House wife						
Children 1. 2.						
Adult male 1. 2.						
Adult female 1. 2.						

4. (A) Area of agricultural holdings as on date of the survey (area in acres)

Sl.No.	Self cultivated	Leased in	Un cultivated	Leased out	Irrigated (y/n)
1					
2					
3					
4					
Total					

(B) Description of Land:

Land Type	Acre(s)
Dry land	
Water land	
Forest	

5. (A) Cultivation taking place (organically):

Since last 10 years 8 years 5 years 3 years

(B) How many years of experience do you have in agriculture?

6. Crops you are growing:-

(a)Paddy (b)pulses (c)maize (d) buckwheat (e)wheat (f)vegetables (g)ginger (h)potato (i)mustard (j) Cardamom (k)Baby corn (l)Sweet corn (m) Banana (n)Turmeric

7. Sources and mode of irrigation:-

(a) Pipe water (b) canal water (c) rain water (d) Tank water

8. (i) Any panchayat level and block level extension services regarding farm management:

Yes / No.

9. Are you getting any govt. support? For example: free seed, free fertilizers, agriculture loan with subsidy, price premium for agriculture product etc.

10. Has the agriculture pattern changed after implementation of organic farming technique in the agriculture? Yes/ No

If yes, what are the changes you have observed in the agriculture pattern?

11. Cost of Factor inputs:

Factor Inputs	Quantity	Cost per unit
Tractor hours		
Pair of bullock		
Seeds: 1. paddy 2. maize 3. ginger 4. potato		
Manuers (local)		
Fertilizers (orgnic)		
Pesticides/herbicides (organic)		
Irrigation		
Family Labour: Male		
Female		
Children		
Hired Labour: Male		
Female		

12. Crop wise area (acre), production (qtls), (qtl/acre)

Name of crops	Area (in acre)	Type of fertilizers	Mode of irrigation	Production (in Kg/	Value
Maize					
Paddy					
Potato					
Ginger					

13. Rate of rent (amount) paid and received in (Rs or Amount of crop/Acres)

(i). Rent on leased land: paid/ received

(a) Amount of crop (per year): (b) Amount of cash (per year):

(ii). Rent on own cultivation paid to the government.

14. Is your land organically certified one? Or is in the process of certification?

Is your land tested regularly? If yes do you take personal initiative or any state agency or the state government does the same?

15. Do you have any storage facility in your village or block or district level? Yes/ No

16. Stock of the capital equipments and draught animals.

category	No	Construc-tion cost/ purchase	Year of construction/ purchase	Book value (Rs)	Depreciation	*appreciation
i) compost shed ii-cattle shed						
Irrigation equipment 1. Tank 2. Pipe						
Machinary i-tractor ii- plough iii-others						
Livestock						
i. draught ii.milch iii-calves and heifers iv-others						

17. Particulars of live-stock as in the year of survey.

(a)Dung produced by the type of cattle

Variety	Numbers	Dung produced	Value
Draught, milch, Calves (TOTAL)			
Others			

18. (a) Expenses on the draught animals for feed.

category	Quantity(Qtls)	Value(Rs)
Green fodder		
Dry fodder		
Concentrates		
Total		

(b). Cost of medicine for draught animals

(c). Man days required for the maintenance of the draught animals only and the corresponding charges. SELF/OR WORKER EMPLOYED.

19. Employment of owned draught animals and farm machinery and attached farm servant during the year.

Category	Given ED	HO and C &PD	Crop PD	Tending cattle	Other FWD	Non FWD
Pair of Draught animal						
Machine						
Farm servant						

Note: HO- hired out, ED- exchange days, CPD- crop production days, FWD- Farm work days

20. Running and Maintenance expenses on farm machinery during the survey years.

Category	Repairs Major	Value (Rs)	Repair minor	Value (Rs)	Total Expenses
1. tractor					
2. wooden plough					
3. Spade and others					

21. Consumption and marketing of crops during the survey year.

Item	Quantity consumed (qtls)	Marketed surplus (qtls)	Value (Rs)
Paddy			
Maize			
potato			
ginger			

22. How do you sell your product?

- Personally in the market
- Given to middleman
- Directly given to agencies like SIMPHED.

Which among these is the best way to dispose your product?

Reason:

23. Is your product being sold as per your desired price? Yes/ No

24. Are you considering your agriculture farming a sustainable source of income?

Date:

Signature of the investigator Signature of the effective farmer.

Remarks (if any)