PRODUCTIVITY AND PROFITABILITY OF GINGER IN DIFFERENT AGRO-CLIMATIC ZONES OF SIKKIM

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DECLARATION

I, **Yograj Sharma**, hereby declare that the issues and matters raised in this dissertation entitled "**Productivity and Profitability of Ginger in Different Agro-Climatic Zones of Sikkim**" are records of my own effort, that the contents of this dissertation did not appear for the award of any previous degree to me as well as to anybody else to my best knowledge, and no part of this dissertation has been submitted by me for any degree in any other educational institutions.

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

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CERTIFICATE

This is certified that the dissertation entitled **"Productivity and Profitability of Ginger in Different Agro-Climatic Zones of Sikkim"** submitted to Sikkim University in partial fulfillment of requirement for degree of **Master of Philosophy in Economics** is the result of research work that is carried out by **Mr. Yograj Sharma** under my supervision. No part of this dissertation has been submitted for any other degree.

He acknowledges assistance and helps those he received during the course of this research.

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Abbreviations

ADO	Agricultural Development Officer
AGMARK	Agricultural Marketing
CACP	Commission for Agricultural Costs and Prices
CAGR	Compound Annual Growth Rate
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FBI	Farm Business Income
FL	Family Labour
GSDP	Gross State Domestic Product
HYV	High Yielding Variety
ICAR	Indian Council for Agricultural Research
ISPS	Indo-Swiss Project Sikkim
NE	North Eastern States
OBC	Other Backward Class
PFP	Partial Factor Productivity
R&D	Research and Development
SC	Scheduled Caste
SFAC	Small Farmers' Agribusiness Consortium Report
ST	Scheduled Tribe
TFP	Total Factor Productivity

Chapter 1

Introduction

1.1 Introduction

Despite the advancement of industry and service sector, agriculture has continued to occupy important position in developing country like India where a significant section of the total population is directly or indirectly dependent on it for their livelihood. In Indian agriculture, majority of the farmers are small and marginal depending on subsistence farming for another set of farmers, agriculture is also main source of earning. Indian agriculture varies significantly across regions; where Western states of India primarily concentrate in cultivation of oilseeds, rapeseeds, mustards, sugarcane while Eastern states of India are famous in production of rice, vegetables, fruits etc. Southern states of India are largely cultivating plantation crops (such as banana, coffee, tea) and also famous for production of coarse cereals, spices; while fruits such as apple, orange are primarily cultivated in the Northern states of India; across the Central Indian states wheat, maize, soybean are major crops of cultivation. Beside such regional differences in crops of cultivation; significant difference in agriculture can be noticed between plain land farming and agriculture in hilly regions of India. Given the difference of soil condition, climatic condition, rainfall the seasonality and productivity of uniform crops differ significantly between hilly states and plain land sates of India. Majority of agricultural land being located in hills slopes again given the agro climate condition the hilly agriculture is more suitable for cultivation of horticultural crops rather than field crops. List of horticultural crops such as ginger, turmeric, and cardamom, fruits like: apple, oranges, grapes, vegetable crops like tomato, reddish, carrot etc., grows in significant quantity in the hilly sates of India.

One of the important horticultural cash crop is ginger have wider consumers market and a source of livelihood for many who are directly or indirectly engaged in the cultivation and business of it. Ginger is grown suitably in humid and warm climate at the elevation of 300-1500 meter above the sea level. It grows well in sandy loam soil with temperature required for ginger cultivation ranges from 28^{o} C to 30^{o} C. Ginger plants was

first discovered in South-Eastern Asia then after spread over the different nations of the world (Singh and Dhillion, 2015). India, China, Nepal, Nigeria, Bangladesh, Thailand, Indonesia, Japan, Philippines and Cameroon are the major ginger producing Nations in the world. Amongst the major ginger producing nations, India has continued to be the largest producer with largest area under cultivation with figure 136 thousand hectares; however, the country was suffering from low productivity (ranked 18th position in the world) during 2013 (FAOSTAT Database, 2010-2015). Ginger is produced almost all states in India, however, the states such as Karnataka, Orissa, Assam, Meghalaya, Arunachal Pradesh and Gujarat together contribute 65 percent to the country's total production (Indian Council of Agricultural Research, Kerala 2014). Amongst the different states of India, Assam was leading producer of ginger with figure of 1,22,307 tons during 2013 followed by Gujarat, Meghalaya, Arunachal Pradesh and Sikkim with figures 70,646; 62,994; 57,000; and 52,110 tons respectively during 2013-2014 (State Agriculture /Horticulture Departments, DASD CALICUT, 2015). As per the SFAC (Small Farmers' Agribusiness Consortium Report, 2015) the North Eastern (NE) States of India accounts for 24.6 percent area under ginger cultivation and 24.1 percent of India's ginger production having higher oil and oleoresin content, making it one of the best qualities.

Unlike other hilly states of India the hilly states of NE India also grows significant quantity of horticultural and cash crops. One of the NE states of India, Sikkim envies in cultivation of various horticultural and cash crops such as ginger, cardamom, turmeric etc., besides fruits and vegetable crops. Agriculture continued to remain as primary occupation for many in Sikkim, it accounts for 16.3 percent of the total Gross State Domestic Product (GSDP) during 2009-2010, meanwhile commercial horticulture has slowly replacing the subsistence farming system in Sikkim (Sikkim Annual Progress Report, 2009-2010). Agriculture land use in Sikkim being strongly influenced by elevation, climate and mountain terrain with nearly 11 percent (7,09,600 Hectare) area was devoted for agriculture where more than 60 percent of population dependent on it (Handbook on Organic Production in Sikkim, 2014). Being a hilly state Sikkim grows diverse horticultural and cash crops amongst which ginger is one of the important crops grown in the state. Sikkim is an important producer of ginger amongst the North Eastern

states, contributing 5 percent to the country's production during 2010-2011 and it is grown in terrace structured on hill slopes of Sikkim using tree leaves as mulch and Bhaaise, Gorubathane and Majhauley are the main varieties of it (Yadev et al., 2014). Ginger cultivation practices is prevalent in all districts of Sikkim with South district being leading[1] in terms of area, output and yield while North district of Sikkim was at the bottom in all three respect during 2001 to 2014. The ginger growers in the state are primarily small and marginal farmers[2] whose livelihood is primarily dependent on it (Biswa and Majumdar, 2013). During last two decade or so the non-traditional area being brought under ginger resulting from higher returns fetched by farmers (Kumar et al., 2012).

Healthy productivity of a crop is important for the fate of farmer to retain remunerative earnings out of the cultivation of the crop. The productivity of any agricultural crop may be influenced by number of agricultural inputs, extension services, research and development (R&D). Productivity analysis in agriculture has been attempted in the works of several researchers such as (Dayal, 1984; Kumar and Rosegrant 1994; Pujari, 2005; Janaiah et al., 2006; Kumar and Mittal, 2006; Hamid and Ahmad 2009) while Singh and Dhillion (2015) have examined the productivity of ginger in Himachal Pradesh. While examining the productivity gap between advanced and less developed countries Hayami (1969) claimed inputs made factors were the main determinant of the difference in agricultural productivity than differences in natural factors and added that education, research were also responsible for agricultural productivity difference. The cross- country productivity differences are large in agriculture than other sectors (Lagakos and Waugh, 2013). Durate and Restuccia (2010) argued that labour

[1] During 2001-2014 the average area under ginger cultivation in South Sikkim was 3.08 thousand hectares followed by East, West and North Sikkim 2.93, 2.72 and 0.38 thousand hectares. The average production of ginger was highest (17.12 million tons) in South district followed by East, West and North districts of Sikkim 15.69, 14.94 and 1.97 million tons respectively during the mentioned period. Again the productivity of ginger recorded to be highest in South district and it was lowest in North district of Sikkim during the fourteen years period of study (Database of Horticulture & Cash Crops Development Department, Government of Sikkim, 2016).

[2] Marginal farmers are those who cultivate in less than 1 hectare of land, small size farmers are those who cultivate between 1- 2 hectare of land, medium farmers are those who cultivate between 2-10 hectare of land and large farmers are those who cultivate above 10 hectares of land (Hand Book on Agriculture in Sikkim, 2014-2015)

productivity differences between rich and poor countries are large in agriculture and services sectors and smaller in manufacturing while Ponti de et al., (2002) argued that organic productivity gap was significantly differ between crop groups and regions, and there was huge difference in conventional and organic agriculture system.

Earning remunerative profit is also important for the farmer's initiating cultivation at commercial basis for their livelihood. The profitability of any crop may be influenced by factors which are external and internal to agriculture. Externally the marketing condition, price, cost of production including transportation cost, public support price policy can be important determinant of profitability while internally area under cultivation, output quality and quantity can also be important predictor of profitability. Studies like Masuku and Xaba, (2013); Wabbi et al., (2013); Begho et al., (2013); Mbata and Arene, (2008); Adinya, (2009); Ajah and Ohem, (2015); Reddy, (2015) made an attempt to examine profitability of agriculture while Singh Dhillion (2015); Nmdu and Marcus (2013); Islam et al., (2011) on ginger.

An important determinant of higher return for farmer is price of the crop. However, price variability of ginger is most prominent in Sikkim as the price of ginger continued to be lower during the harvesting season (November to January) whereas the price remains high during the off season (March to October). Thus, farmers in Sikkim have been experiencing obscurity of ginger farming with increasing price variability and low returns from sell. The limited availability of cold storage facilities in different locations insisted the farmers to sell their output immediately after harvesting yielding them to fetch low price.

1.2 Rationale of the Study

Attaining high productivity in agriculture is prime concern of farmers as well as the policy makers to meet the rising demand for food and raw materials for increasing population and to meet the industrial needs. Earning remunerative profit is important for the fate of farmers who took agriculture as the primary source of livelihood. Ginger is an

important cash crop of Sikkim on which a significant section of marginal[3] farmers are engaged in its cultivation and dependent on it for their livelihood. However, ginger farming in Sikkim observed to suffer low productivity compared with national average for some time. Factors such as high incidence of disease, unfavorable agro-climatic conditions to some extent traced responsible. The possibility of productivity difference is predictable for natural and climatic condition difference across agro-climatic hill slopes. In addition insufficient farming knowledge, gradually declining interest of farmers and youths and move toward cultivation of other crops, price fluctuations, increasing labour scarcity in agriculture in the wake of alternative employment opportunities such as MGNREGA[4] resulting soaring wage rate may be to some extent responsible for low profitability amongst the ginger farmers of Sikkim. Hence an investigation is necessary for understanding if natural or agro-climatic factors being responsible for difference in productivity whereas agricultural and socio-economic factors being responsible for farm level profitability variation in different hill slops of Sikkim; thereby identifying the disadvantageous regions for cultivation of specific crop.

1.3 Theoretical Background

The concept of productivity has received considerable attention of academician and policy makers since last five to six decades or so and literature has appeared to be productivity at different levels such as at the level of economy, abroad sectoral level, agriculture, industry and service, individual level, farm levels and plant level (Kathuria et al., 2014). Productivity in economics is of two types: total factor productivity (TFP) and partial factor productivity (PFP). TFP is defined as the ratio of an index of aggregate output to an index of aggregate input. Solow 1957 was the first to propose a growth accounting framework, which attributes the growth in TFP to that part of growth in output which cannot be explained by growth in factor inputs like land, labour and capital.

[3] Amongst the total farming households in Sikkim, the shares of marginal farming households was highest with figure of 54.01 percent followed by Small, medium and large farmers with total shares of 22.60 percent, 22.33 percent and 1.06 percent respectively (Hand Book on Agriculture in Sikkim, 2014-2015).

[4] Mahatma Gandhi National Rural Employment Guarantee Act (It was initiated as NREGA in 2005 later on renamed as MGNREGA)

Economists have developed productivity measures which are based on the relationship between one or more outputs relation to a single key input named as PFP. The PFP and TFP can be defined as follows;

$$PFP = \frac{Q}{x}$$

Where, Q stands for total output for a particular crop

x stands for unit of particular input used

While, $$TFP = \frac{Q}{p_1x_1+p_2x_2+\cdots\cdots+p_nx_n} = \frac{Q}{\sum p_jx_j}$$

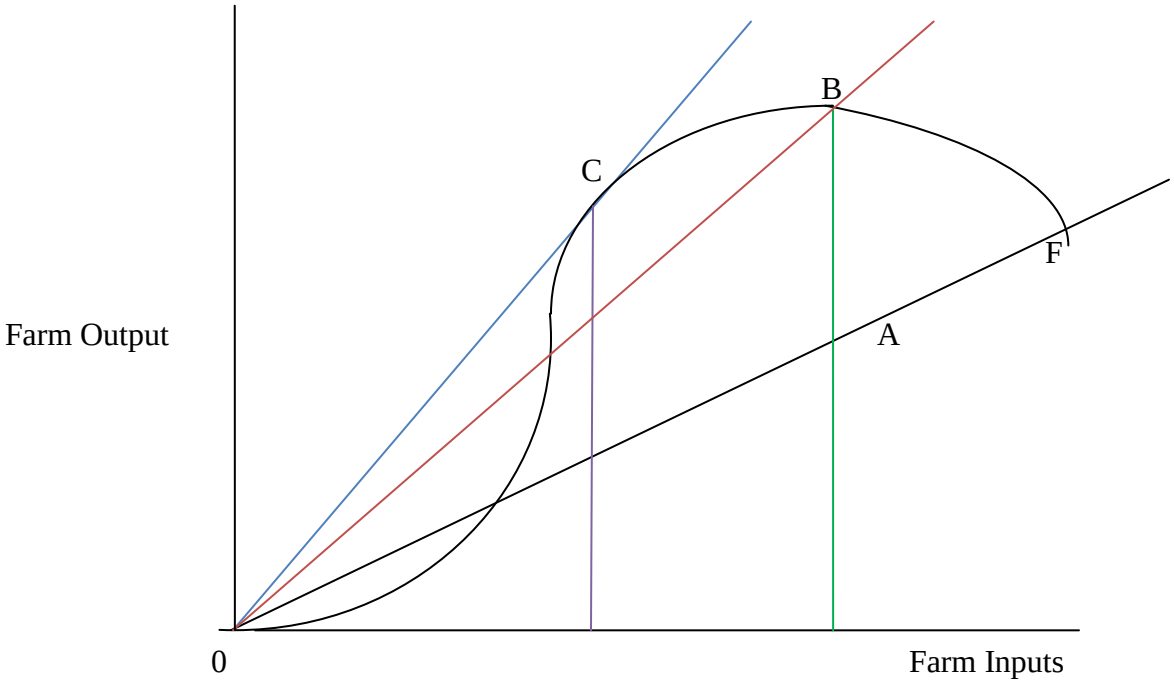
Where, Q stands for value of total output

p_j stands for price of j^{th} inputs

x_j stands for quantity of j^{th} inputs

Graphically productivity may be expressed as in Figure 1.1

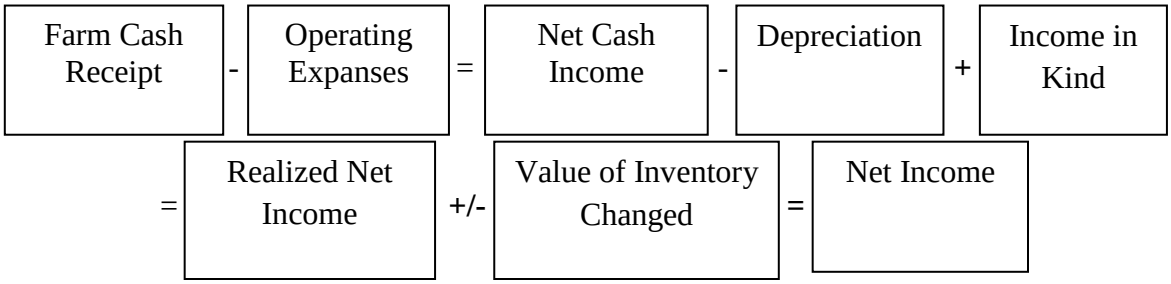
Figure: 1.1 Graphical Representation of Productivity



Often the term productivity and efficiency are interchangeably used. However, they are different from each other. Normally, all points on the frontier line are efficient but there is only one point that is productive. Refer to figure 1.1 as per definition of efficiency; point A is inefficient compared with C and B. The movement from A to B will result rise in productivity as well as efficiency. Point B is the maximum possible output producible from given inputs combinations. Movement from B to C will result in improvement in productivity but not add to efficiency level. Point C is the point of maximum possible productivity.

Productivity measurement in agricultural sectors has been initiated in several studies such as Tripathi (2008) examined the performance of agricultural productivity in India for the period of (1969-2005) while Saika (2009) made an attempt to evaluate the determinants of TFP growth and its trend in Indian agriculture. Whereas Rosegrant and Evinson (1995); Chand et al., (2012) studied the foundation of productivity growth in Indian agriculture taking into consideration of public and private investment and returns from public investments in agriculture. While examining productivity and efficiency of Indian agriculture Bhushan (2005) claimed agriculture a most successful sectors of the national economy in terms of productivity growth which had more than remunerated for the rapid growth in demand from the past few decades while Kumar and Mitthal (2006) argued that an increase in research and development would be helpful to stimulate the TFP in Indian agriculture.

By profitability we understand the net gain (return) of an enterprise or a farmer. The net return is the difference between total value product and total factor cost which includes all kinds of variable and fixed costs associated with the production process. The various steps to calculate profitability or income generated from agriculture are as follows;



Source: *Agriculture and Agri-Food Canada and Statistics Canada*, 2000

One of the various techniques of evaluating profitability in agriculture is estimation of farm business income (FBI). FBI as a measure of profitability initiated in the works of Singh and Dhillion (2015). FBI found as a major source of income across different farm size in Bihar (Pandey, 2015). FBI was used as a measure of profitability across different farm size in Assam (Goswami, 2016) while in order to determine profitability of major Kharif crops in Madhya Pradesh FBI was estimated in a study of (Sharma et al., 2015).

1.4 Review of Literature

The practices of ginger cultivation constrained by various exogenous as well as endogenous factors were found in the works of various researchers. Exogenously poor drained soil, plain areas, undulating topography, very high rainfall and drought prone conditions being responsible for low ginger output in Maharashtra (Salunkhe et al., 2014). Price fluctuations, lack of fertile land, lack of extension services were identified as threat for ginger cultivation in Kerala (Geroge, 1996) while Yadav et al., (2004) observed shifting cultivation, land tenure system, small land holdings, lack of inputs, high rainfall, low use of fertilizer, use of pesticides were primary problem for ginger cultivation for NE states of India in general. In another study by Mody et al., (2012) remarked limited government assistance and technical supports, lack of scientific guidance, involvement of middlemen, lack of cheap labour, hostile climate; low market rate has constrained ginger cultivation in Arunachal Pradesh.

Insufficient access to finance has constrained ginger cultivation found in the works of (Geroge, 1996; Yadav et al., 2004; Mody et al., 2012; Singh and Dhillion, 2015). The marketing of ginger and its oscillatory price behavior causing serious problems for the ginger growers were identified in many studies. Geta and Kifle (2011) argued absence of external support and management, the marketing of ginger product being challenged by market volatility and price fluctuations in Southern Ethiopia while the ginger grower of Mizoram being confronted by market imperfection, asymmetric information, high degree of market instability and lack of integration in terms of price (Vanrammawia, 2015). Improper processing and marketing facilities has challenged

ginger cultivation in NE states and in Himachal Pradesh (Yadav et al., 2004; Singh and Dhillion, 2015).

Hegde and Hegde (2014) expressed lack of innovative technology, problem of storage and packaging, farm management, weak business linkage, limited role of private investors and absence of market promotion has restricted ginger cultivation in Ethiopia while small land size, high altitude, market distance and inefficient market structure was identified as major impediments of the ginger growing farmers in Tanzania (Saverine et al., 2014).

Endogenously plant disease such as rhizome rot disease has been found to be a major threat for ginger cultivation (Geroge, 1996; Rahman et al., 2009). The rot caused by bacteria, fungi and grubs of insects resulted in ginger crop failure in all districts of Sikkim (ISPS, 2005) while nematodes being threatening ginger cultivation in Madhya Pradesh (Vadhera et al., 1998). As a remedy of rhizome disease the effectiveness of combined application of fungal and bacterial bio-control treatment was mentioned in (Dohroo and Gupta, 2014) while seed treatment found to be more effective to control the ginger diseases (Singh, 2011).The NPK uptake by shoot and rhizome of ginger was significantly higher comparing other different production parameters in Maharashtra (Shaikh et al., 2005). While studying the association of plant spacing with incidence of disease Tabin et al., (2014) found decreasing plant spacing increase the disease incidence which gives less productivity of rhizome. The earthling up ginger at 4 month after planting using flat bed fetch the higher productivity of rhizome in Pune mentioned in (Shaikh et al., 2006). The lack of technical guidance, farmers' ignorance and high cost of inputs were major hindrance of adoption of new technique among the ginger farmers of Koraput district of Orissa (Mohapatra and Acharya, 2006).

The ginger planting under tree canopy and under the forest could reduce the production cost helping employment generation and income of rural population adjoining forest estates of Nigeria (Oladela and Papoola, 2013) while Tabin et al., (2014) mentioned tree canopy has positive role in enhancing the productivity of ginger in humid tropical region of Arunachal Pradesh. Despite its cost ineffectiveness the drip irrigation

technique being preferred by the ginger cultivators against conventional method for its productivity benefit (Kalkyankar et al., 2011).

The association of non-chemical method of production higher yield ginger in NE states of India found in (Dohroo et al., 2012). For enrichment of soil carbon, reduce crop diseases, raising productivity, and generation of production the organic mulching practices being important (Kumar et al., 2012; Yadav et al., 2014; Singh et al., 2014). While examining the importance of mulch and tillage practices on productivity and growth of ginger Zaman et al., (2002) claimed that zero tillage with mulch found as best production technique in Bangladesh. Bisht et al., (2000) mentioned the importance of fodder tree in attaining maximum net returns of ginger and turmeric. Kumar (2012) expressed the benefit of acquirement new technique of production and its adoption for enhancing the income of ginger cultivators of Sikkim while the use of new technology seems to be directly linked with the productivity and income of Malaysian ginger grower (Suhalmi et al., 2014). Kumar et al., (2012) recommended implementation of technology with fertilizer could be helpful in attaining higher productivity in Sikkim while positive association of productivity and quality of ginger with the increased use of fertilizer observed in (Seyie et al., 2013) similar observation was made for ginger grower of Meghalaya (Majumdar et al., 2005) for the combined application of farmyard manure and potassium (K). Rana and Karlo (2010) argued organic manure in combination with inorganic fertilizers enhances the quality and yield of ginger in Nauni Solan. The organic manures[5] being indifferent in improvement of growth and productivity of ginger plant and fresh weight of ginger in Central Java felt in (Samanhudi et al., 2014). The positive association of R&D on ginger with the rate of returns in Bangladesh was found in (Hasan and Islam, 2014).

Karthick et al., (2015) observed that India's ginger export has registered negative growth under multilateral trade regime post WTO owing to stiff competition from other exporting nations. The worry about serious environmental pollution sourced from application of chemical for increasing ginger yield in Nagaland felt in (Khasto and Ao, 2014). Amongst many 'Meghalaya Local' ginger will be suitable for commercial

[5] chicken manure, goat manure and cow manure

products with potential applicable in both flavor and pharmaceutical industries in Meghalaya found in (Sanwal et al., 2010). Nepali (2013) claimed that even after facing the problems of marketing, low productivity, and rhizome rot problem of ginger in Nepal, the farmers was been found to depend themselves on ginger cultivation for its importance of employment generation.

1.5 Research Gap

Measurement of productivity and profitability in agriculture being initiated in the works of several researchers, but efforts to examine the productivity and profitability differences specifically for ginger across different agro-climatic zones of Sikkim are rare. Present study is an attempt in that direction. In addition the study seeks to examine the factors determining profitability of ginger farmer across different agro-climatic zones of the study area.

1.6 Research Question

1. Does there any significant difference in productivity of ginger exist in different agro-climatic zones of Sikkim?
2. Whether the profitability of ginger different significantly across different agro-climatic zones of Sikkim and what are its major determinants?

1.7 Objectives of the Study

1. To understand the status of ginger cultivation in Sikkim.
2. To examine the difference in productivity of ginger in different agro-climatic zones of Sikkim.
3. To evaluate the profitability differences of ginger in different agro-climatic zones of Sikkim and the factors determining profitability.

1.8 Research Methodology

1.8.1 Data Source

Present study is based on secondary as well as primary data. The secondary data for the study was collected from various published sources. In order to examine the

global status of ginger cultivation time series data on area, production and productivity of ginger were collected between the period of 2005-2013 from Food and Agriculture Organization Corporate Statistical Database (FAOSTAT, 2010-2015); time series data for the period 2008-2014 on area and production and productivity of ginger across major ginger cultivating states of India was collected from Ministry of Agriculture and Commerce, Government of India and National Horticultural Board of India (various issues). Annual data on area and production covering the period 2001-2014 on area and production of ginger and district-wise area and production of ginger in Sikkim for the period 2010-2014 has been obtained from Horticulture and Cash Crop Development Department, Government of Sikkim, (2016). Also data on price of ginger and turmeric[6] between the periods from 2002-2015 was collected from Agricultural Marketing (AGMARK), Government of India, (various issues).

As the present study seeks to examine if any difference in productivity and profitability exist in different agro-climatic zones of Sikkim. An understanding of different agro-climatic zones is important prior construction of sample design and selection of sample. The official report of sikkimforest.gov.in/Biodiversity-of-Sikkim.htm has specified agro-climatic zones according to different agro eco-system as in Table 1.

Agro-climatic zone is a classification of climatic regions keeping in view the suitability to agriculture. According to Meteorological Department Government of India the climate types may be classified on the basis of rainfall, temperature and these two characteristics are again influenced by altitude. Although, ginger is cultivated in almost all districts of Sikkim but it is only suitable to cultivate among three agro-climatic zones of Sikkim (see Table 1.1) such as in lower hills (tropical and sub-tropical zones) and mid hills (temperate zone). Following are the classifications of Agro-climatic zones of Sikkim;

[6] Turmeric being selected as the closest competing crop

Table: 1.1 Agro Ecosystem of Sikkim

Area	Climate	Altitude (in Meter)	Crops
Lower Hills	Tropical	300-500	rice, maize, finger millet, wheat, sarson, urd, rice bean, soybean, vegetables, potato guava, lime, lemon, ginger, mandarin, etc.
	Sub-tropical	500-1500	
Mid Hills	Temperate	1500-2000	maize, rice, finger, millet, wheat, pulses like rice, bean, rajmah, sarson, soybean, vegetables, potato, mandarin, plum, peach, pear, large cardamom, ginger
High Hills	Temperate	2000-2700	maize, barley, vegetables, potato, apple, plum, peach, peas, off-season vegetables and large cardamom
	Sub-alpine	2700-4000	seed potato and vegetables are grown in few places
	Alpine	4000-5000	apple, potato and other horticultural crops
Very High Hills	Alpine	Above 5000	vegetation is mainly herbs and medicinal plants

Source*: sikkimforest.gov.in/Biodiversity-of-Sikkim.htm*

The primary data for present study was collected via field visit by conducting personal interview with head of household of farmer. The universe of the present study was all the ginger cultivator of Sikkim. Given the vastness of the universe of the study and time and resource constraints on the part of individual researcher present study was concentrated only in two districts (East and South) of Sikkim for undertaking the field survey. The reasons for selection of these two districts were being their importance of ginger cultivation in terms of area, and output. The multi-staged random sampling method was used for selection of villages where the survey has been administered. The sampled design for selected villages has been given in the Figure 1.2.

Three agro-climatic zones were selected for present study. However, the altitude range of one village does not lie on same heights because of hilly slopes and terrain, the altitude of a village varies from place to place. Hence, for research convenience and also to nullify such variations the present study has rearranged the agro-climatic zones by classifying the zones as tropical (100meter $< Z_3 <$ 700meter), sub-tropical (700meter $< Z_2 <$ 1400meter) and temperate (1400meter $< Z_1 <$ 2100meter) zones as in Table 1.2.

With the classification of agro-climatic zones the selection of the farming household has been done as in Table 1.2.

Table: 1.2 Classification of Agro-climatic Zones

Districts	Agricultural Development Officer (ADO) Circle	Village Name	Altitude (Meter)	Sampled Households	Classification of Agro-climatic Zone (Z) (Meter)	Z
East	Pakyong	Pakyong	1404	34	$1400 < Z_1 < 2100$	Z_1
South	Namchi	Maniram	1771	33		
East	Pakyong	Pacheykhani	890	33	$700 < Z_2 < 1400$	Z_2
South	Timi Tarku	Tarku	798	33		
East	Rhenock	Rorathang	100	33	$0 < Z_3 < 700$	Z_3
South	Jorethang	Salghari	375	34		

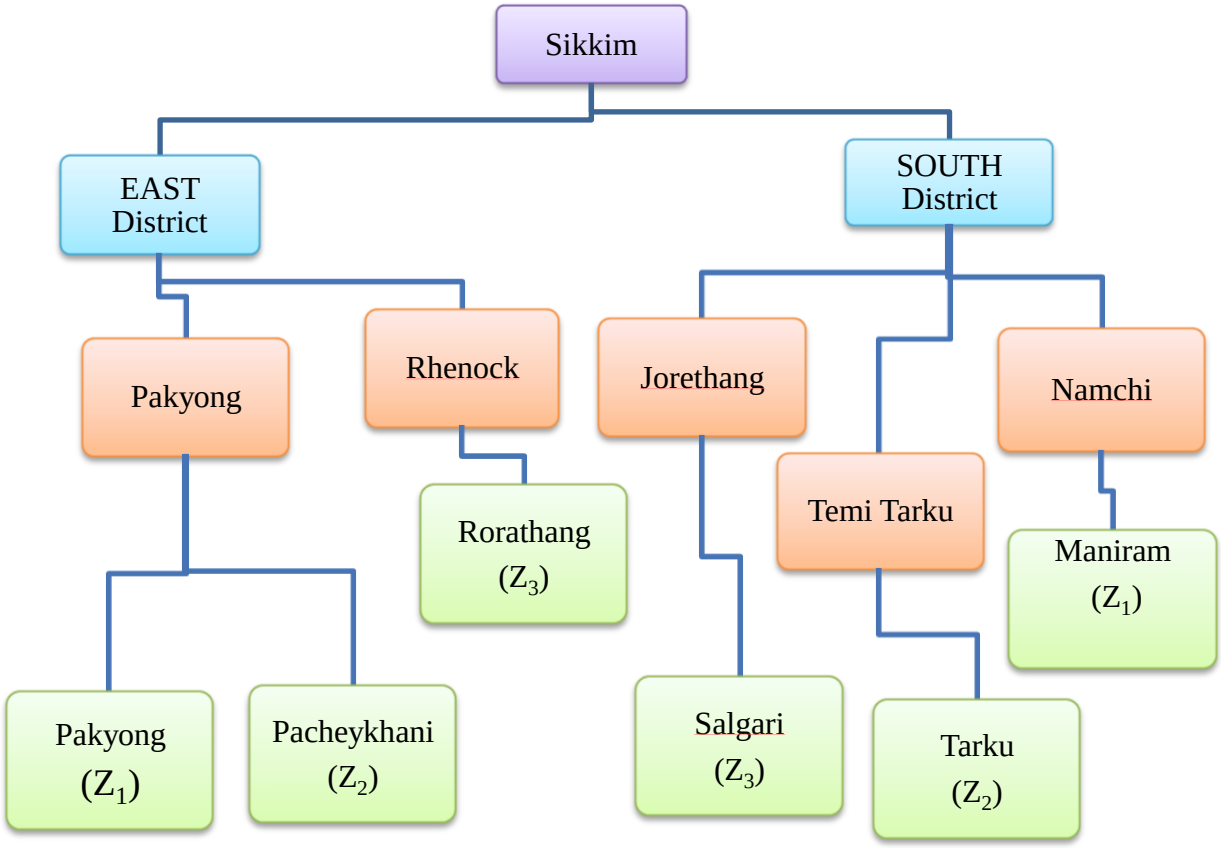
Stage A

Initially two districts (East and South) were selected for the present study for their importance in ginger cultivation in Sikkim. Then two blocks were selected from East district and three blocks were being selected from South district for having importance in terms of coverage of areas under cultivation in different agro-climatic zones. For East district, Rorathang (100 meter), Pakyong (1404meter) and Pacheykhani (890 meter) were being selected and Salghari (375 meter), Maniram (1771 meter), and Tarku (798 meter) were being selected from South district by maintaining the variation in altitude in different Agriculture Development Officer (ADO) circle.

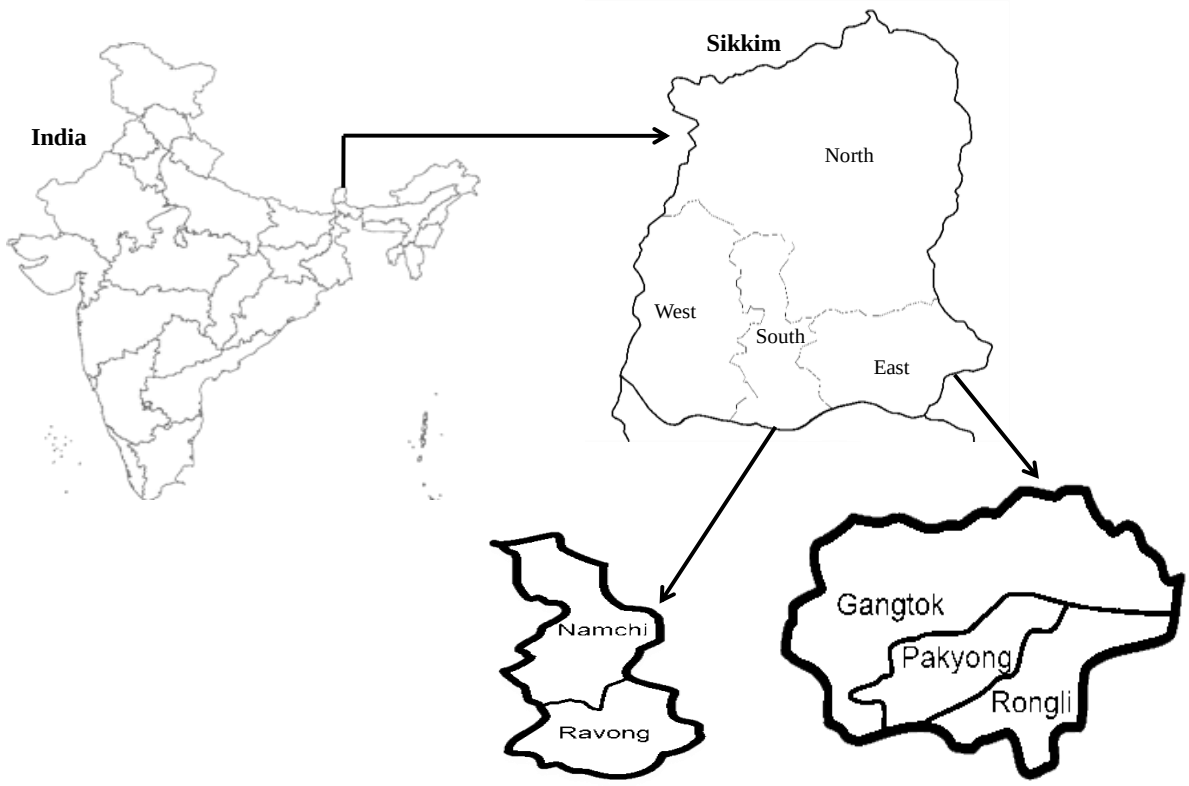
Stage B

A representative percentage of the existing ginger farming households were selected for collection of primary data. Present study has covered only marginal farmers because in the sampled districts of study small, medium and large farmers were insignificant in number initiating ginger farming. Primary data was collected with a scheduled questionnaire (close ended) by conducting personal interview with the head of ginger farming household. Primary data were generated on various aspects such as of agriculture of ginger cultivation, the socio-demographic and economic profile of the sampled ginger farming households during June 2016 till September 2016 through field survey.

Figure: 1.2 Sampled villages in different Agro-climatic Zones of Sikkim



Map 1.1 Sampled Sub-divisions of the Two Districts of Sikkim



Source: *www.mapsofindia.com/maps/sikkim*

1.8.2 Line of Analysis

Descriptive statistics, quantitative technique and econometric techniques were applied for analysis of the data. While analyzing the secondary data, the status of ginger cultivation in different levels (global, national and state level) were examined using descriptive statistics and Compound Annual Growth Rate (CAGR) also estimating the value of acceleration and deceleration in growth rate. The acceleration and deceleration of growth (G_t) has been estimated through ordinary least square estimate (OLS) of equation (i). Consider the following log-linear equation as;

$$lnY_t = \pi_0 + \pi_1 t + \pi_2 t^2 \qquad \text{(i)}$$

Taking partial derivative of equation (i) with respect to time as follows;

$$\frac{\partial lnY_t}{\partial t} = \pi_1 + 2\pi_2\, t \qquad \text{(ii)}$$

So the fitted model would be

$$G_t = \pi_1 + 2\pi_2\, t + U_t \qquad \text{(iii)}$$

Where, π_0 is constant intercept, π_1 is growth coefficient and π_2 is acceleration and deceleration of growth coefficient

The relative productivity gap was estimated to understand the status of the country, state or district in question. Price variability and relative price taking turmeric as the competing crop were measured in order for understanding farmer's business status in ginger cultivation in Sikkim.

In order for understanding if any difference in productivity (total factor productivity: TFP) and also for difference in profitability (in terms of FBI) exist or not across different classified agro-climatic zones of the study area simultaneously present study used one way ANOVA test, an attempt was also made to examine if the agro-climatic zones are significantly different between sub-groups taking two zones at one point of time with the help of independent sample t test. Multiple linear regression models were estimated in order for understanding the factors determining the profitability in the study area.

Relative Productivity Gap:

The relative productivity gap of ginger has been calculated as follows. The relative productivity gap(R_{it}) has been defined as

$$R_{it} = \frac{P_{it}}{\sum_{i=1}^{N} P_{it}} \qquad \text{(iv)}$$

Where,

R_{it} stands for relative productivity gap of the ith unit (country or state or district) at time t.

P_{it} stands for productivity gap of ith unit at time t. The Productivity gap has been estimated with following differencing method

$$P_{it} = [Q_t - q_{it}] \qquad \text{(v)}$$

Where, Q_t Stands for overall productivity of the entire individual ith unit at time t

q_{it} Stands for the productivity of a particular ith unit at time t

$\sum_{i=1}^{N} P_{it}$ Stands for aggregate of overall productivity of all the individual ith unit at time t

An increase in R_{it} of agriculture is a negative indicator for the farming unit.

Price Variability of Ginger:

The price variability is the ratio of difference between maximum and minimum price of a particular crop to that of the mean price of the same crop. The increase in price variability of a crop may lower the confidence of the farmer for future cultivation of that crop. As the price variability of ginger increases over time then it is a warning for the farmers as the farmer will lose confidence on the particular crop. The additional increasing price variability indicates instability in the price of the crop. The price variability of ginger has been calculated in following way,

$$Price\ Variability\ of\ Ginger = \frac{Max\ Price\ of a\ particular\ \ year - Min\ Price\ of\ a\ particular\ \ year}{Mean\ Price\ of\ a\ particular\ \ year} \quad \text{(vi)}$$

Relative Price of Ginger:

The relative prices can be obtained by taking the ratio of prices of nearest competing crops. In the present case the relative price of ginger was obtained by dividing the price of ginger by the price of turmeric. The rise in relative price of ginger over time may impetus farmers to increase the cultivation of particular crop as the farmer gain a confidence to get higher returns from such crops because if the relative price of particular crops increases (decrease) the expectation of higher returns from that crop will increase (decrease). The relative price of ginger has been obtained as;

$$Relaive\ Price\ of\ Ginger = \frac{Price\ of\ Ginger}{Price\ of\ Turmeric} \quad \text{(vii)}$$

An increase in relative price of ginger is good indicator for ginger farming.

Productivity Analysis:

The literature of productivity suggests two ways for measurement: PFP and TFP. Given the biasness and problem of underestimation associated with PFP many studies in agriculture attempted TFP, some studies attempting TFP in agriculture such as (Shaw, 1967; Dayal, 1984; Kumar, 1994; Kumar and Rosegrant 1994; Pujari, 2005; Janaiah et al., 2006; Kumar and Mittal, 2006; Hamid and Ahmad, 2009). Following Rao (2005); the TFP has been calculated as in equation (viii);

$$\text{TFP} = \frac{V_g}{p_1x_1+p_2x_2+\cdots\cdots+p_nx_n} = \frac{V_g}{\sum p_j x_j} \qquad \text{(viii)}$$

Or, $$\text{TFP} = \frac{V_g}{\sum_{j=1}^{n} p_j x_j}$$

Where, V_g stands for value of ginger output (in Rs.)

p_j stands for price of j^{th} inputs

x_j stand for quantity of j^{th} inputs

Profitability Analysis:

Profitability measurement of ginger farming has been attempted in the works of Nmdu and Marcus (2013), Islam et al., (2011) while agriculture in general has been applied in the works of (Mbata and Arene, 2008; Adinya, 2009; Masuku and Xaba , 2013; Begho et al., 2013; Wabbi et al., 2013). Following Singh and Dhillion (2015) profitability of ginger cultivation in the study area has been captured using estimation of FBI. The FBI can be defined as the disposal income out of the enterprise. The existing literature on FBI has defined it in two ways; either FBI as the difference of Cost A2 from gross income or the difference of Cost A2 and family labourer from gross income.

Cost concepts:

The guidelines of CACP (Commission for Agricultural Costs and Prices) have specified nine different types of cost concepts as used in agriculture. With the regional differences in agriculture the CACP cost concepts were used in the studies of

Narayanmoorthy, (2013); Sigh and Dhillion, (2015) and specific cost function in Goswami (2016). The cost functions specified by CACP are as follows:

Cost A1= Includes all actual expanses in cash and kind incurred in production by owners which includes (i) value of hired human labour, (ii) value of hired bullock labour, (iii) value of owned bullock labour, (iv) value of owned machinery, (v) hired machinery charges, (vi) value of seed/ seedlings, (vii) value of manures, (viii) value of fertilizers, (ix) value of plant protection chemicals, (x) irrigation charges, (xi) depreciation on farm buildings and implements, (xii) interest on working capital, (xiii) insurance premium, (xiv) land revenue, and (xv) miscellaneous expenses.

Cost A2 = Cost A1+ rent paid for leased in land

Cost A2+FL = Cost A2+ imputed value of family labour

Cost B1 = Cost A1+interest on value of owned capital asset (excluding land)

Cost B2 = Cost B1+ rental value of own land (net of land revenue) and rent paid for leased-in land

Cost C1 = Cost B1+ imputed value of family labour

Cost C2 = Cost B2+ imputed value of family labour

Cost C2* = Cost C2 estimated by taking into account statutory minimum or actual wage whichever is higher

Cost C3 = Cost C2*+ 10% of cost of C2* on account of managerial functions performed by farmers

Given the limitation of data as farmers were not able to provide the costs information on interest value of owned capital assets (excluding land) and also because being marginal farmer and disadvantage geographical specification, farmers in the study area were not using the capital like tillers, tractors etc., and were found using only simple tools such as sickle, trowel, plough axe, hoes, rake, etc. Therefore, reporting interest on such tools being not viable for farmers and estimation for the researcher. Thus with the

constraints of capturing the information on depreciation of capital goods the present research used only three cost concepts: A1, A2 and A2+FL while measuring FBI.

In the present study A1 includes all kinds of expenditure such as value of paid labour, value of animal labour, value of manures, value of rent for leased-in land, value of seeds, and miscellaneous expenses incurred by sampled farming household of the study area of Sikkim.

A2 = A1 + Rent on land

Having defined the various forms of cost concepts as per the existing literature the estimation of FBI needs differencing the figures of revenue from cost. The revenue figures of each ginger farming households were arrived by taking the product of average price of the price reported by the sampled household of present study with the total ginger output generated by each farming household. It was done because it will be unrealistic to assume perfect competition for agricultural products. There were variations in price across different agro-climatic zones of present study. However, those variations were not so high to substantially overstate or understate the value of the crop (ginger). Also, the regions where the price of ginger was slightly higher, the wage rate of labour per day, price of seeds and cost of manure were also moderately higher. This actually cancels out the price effect. Nevertheless, present study considered average prices at the village level in order to minimize the effects of variations in prices on profitability, if not to eliminate it completely.

Taking FBI as a measure of profitability the present study estimated the two variants of farm business income namely FBI1 and FBI2 following (Singh and Dhillion, 2015; Goswami, 2016).Where, FBI1 denotes returns over variables costs of ginger farming households without considering imputed value of family labour and FBI2 denotes returns over variable cost of ginger farming households plus imputed value of family labour.

FBI1 = Gross Income – Cost A2

FBI2 = Gross Income – Cost A2 + FL

Where, FL stands for imputed value of family labour

The description of the explanatory variables and their likely impact on FBI is specified in following Table 1.3

Table: 1.3 Descriptions of Explanatory variables and Hypothesized Relation with FBI

Variables	Description	Hypothesized Relation
Exp	Experience of farmer (in years)	+
Edu	= 1 if the farmer is literate, = 0 if illiterate	+
PL	Labour cost per day hours (in Rs.)	+/-
FL	Imputed Family Labour per day hours (in Rs.)	+
AL	Animal labour cost per day (in Rs.)	+/-
Mnr	Manure cost per kg (in Rs.)	+/-
Seed	Seed cost per kg (in Rs.)	+/-
RL	Rent for leased in land (in Rs.)	+/-
Dis	Loss from disease (in Rs.)	-
Msl	Miscellaneous cost (in Rs.)	-/+
Temperate zone (D_1)	=1 if the Zone is falling in the range (1400meter $< Z_1 <$ 2100meter) =0 otherwise	+/-
Sub- tropical zone (D_2)	=1 if the Zone is falling in the range, (700meter $< Z_2 <$ 1400meter) = 0 otherwise	+/-

Note: Z_3 has been considered as base zone

It was assumed that farmers were rational and given his experience in farming, he would use inputs till the level where contribution of the inputs to income is positive. The explanatory variables used in the studies are farmer's characteristics, cost of cultivation, disease and locational dummies. The farmer's characteristics include experience (Exp) and education (Edu) and land tenure system (leased in land). The age of the farmers and education can be expected to be contributing positively to FBI of ginger farmers and land tenure system like rent for leased in land (RL) may have negative impact on FBI. Cost of production such as value of paid labour (PL), value of seeds (Seed), Value of manure (Mnr), value of animal labour (AL) and miscellaneous expenses (Mscl) can be expected to be negatively as well as positively influencing FBI except imputed value of family labour (FL). The disease caused from rhizome rot (Dis) also can be expected to have negative relation with FBI of ginger. Since, study has been carried out in three location on the basis on agro-climatic zones (i.e. tropical, sub-tropical and temperate agro-climatic

zones) of Sikkim, hence two locational dummies were used in order for understanding whether the FBI changes as we move to temperate or tropical agro-climatic zones of study area. It was considered that D_1 =1 if the zone was falling in the range (1400meter < Z_1 < 2100meter) that is temperate agro-climatic zones and D_2 =1 if the zone was falling in the range (700meter < Z_2 < 1400meter) that is sub-tropical agro-climatic zones. The tropical zone was assumed as the base zone for comparison in the study. It is less predictable to know the sign the coefficient of these locational dummies were anticipated to be sign indifferent. Having considering the listed variables two multivariable linear regression model were estimated by dropping FL in one model and incorporating it in another model.

Since the data used in this exercise came from a cross-section of farmers, before estimating the model, the Breusch-Pagan/Cook-Weisberg test was applied to check the presence of heteroskedasticity in the data set.

1.9 Chapter Plan

The chapter plan for the study was as follows;

Chapter 1: *Introduction*: This chapter has covered introduction, rationale of study, literature review, research questions, objectives, data sources and methodology.

Chapter 2: *Status of Ginger Cultivation in Sikkim*: Besides obtaining global and national status, this chapter has examined the Sikkim's stand as a ginger producing state amongst the major ginger producing states of the country.

Chapter 3: *Productivity and Profitability of Ginger in different Agro-climatic Zones of Sikkim*: This chapter has examined the productivity differences in ginger in different agro-climatic zones of Sikkim. An attempt also being made to explore the factors determining profitability of ginger in the study area.

Chapter 4: *Observations and Policy Implications*: This chapter made an attempt to provide the overview of observations of present study and has outlined the policy implication.

Chapter 2

Status of Ginger Cultivation in Sikkim

Present chapter has made an attempt to examine the status of Ginger cultivation with special reference to Sikkim, India and major cultivating nations of the world in general. The chapter has been divided into following sub-sections. The first section will examine the status of ginger cultivation in the major ginger producing nations, the second section will examine the status of ginger cultivation in the major producing states of India and the final section will examine the state level status amongst major cash crops[7] in Sikkim and district level status of ginger cultivation in Sikkim.

2.1 Global Status of Ginger Cultivation

Being commonly cultivated across nations of the world India, China, Nigeria, Nepal are some of the major ginger cultivating countries of the world (FAOSTAT, 2010-2015). Despite having low productivity India ranks top in terms of area under cultivation and output of ginger, during 2005-2013 (Table 2.1; Appendix B). Amongst the major ginger producing nations the average area under ginger cultivation was largest with an area of 119.2 thousand hectares under cultivation in India followed by Nigeria, China, and Nepal on an average 76.59, 33.65 and 16.03 hectares respectively with Cameroon standing at the bottom (1.92 thousand hectares on an average) during 2005-2013. Philippines found to be most consistent in terms of area under cultivation and production while Nigeria was inconsistent in both respect during the reference year amongst the ten major gingers producing nations in the world. Countries like China and Nepal registered highest growth in area under ginger cultivation followed by India 5.2 percent during the study period. However, the growth of production was highest (24 percent per annum) in Cameroon followed by India, China, and Nepal with 9.4 percent, 6.2 percent and 6 percent respectively during 2005-2013. The productivity of ginger was recorded to be largest in Japan with an average value of 25.34 kg per hectares while the productivity was least 0.21 kg per hectares in Indonesia during the reference period (as in Table 2.1; Appendix B). Thus, although the area under cultivation and production of ginger was

[7] Cash crops such as ginger, cardamom and turmeric

largest in India amongst the major producing nations, but India suffered low productivity during the nine years study period (2005-2013). The productivity of ginger was maximum in Japan while the growth of production in Cameroon remarked to be highest during the period under study

Table: 2.1 Area and Productivity of Major Ginger Producing Nations (2005-2013)

Countries	Variables	Mean	CV	CAGR (%)
India	Area (%)	38.4	21.63	6.97
	Productivity	4.04	15.27	4.1
China	Area (%)	10.91	26.65	8.85
	Productivity	11.35	4.02	0.05
Nepal	Area (%)	5.21	25.11	8.86
	Productivity	11.94	4.58	-0.32
Indonesia	Area (%)	10.4	41.6	3.74
	Productivity	0.21	21.4	0.38
Nigeria	Area (%)	22.71	67	-21.97
	Productivity	3.02	89.54	10
Thailand	Area (%)	3.03	20	4.12
	Productivity	16.01	9.61	-0.5
Bangladesh	Area (%)	2.84	18.74	3.47
	Productivity	7.7	8.39	2.1
Japan	Area (%)	0.63	15.16	3.17
	Productivity	25.34	10.94	3.7
Cameroon	Area (%)	0.62	15.49	2.84
	Productivity	14.08	56.57	23
Philippines	Area (%)	1.27	13.86	1.95
	Productivity	6.9	3.27	0.6
World	Area	315.99	15.14	-1.75
	Productivity	5.69	22.46	7.79

Source: Self estimated based on figure FAOSTAT (2010-2015)
Note: % Area in thousand hectares; Productivity in kg per hectares

2.1.1 Relative Productivity Gap of Major Ginger Producing Nations

Maintaining a higher productivity in agriculture is paramount importance for all farmers to get higher returns and profit. Normally, a fall in productivity gap is a good sign for a nation initiating cultivation of a crop. Refer to Table 2.2; the yearly average

relative productivity gap was 96.13 kg per hectares in Indonesia followed by Nigeria and India with an average figure 50.87 kg per hectares and 26.45 kg per hectares respectively during 2005-2013 while relative productivity gap was -359.26 kg per hectares in Japan. The growth rate of relative productivity gap was highest with a figure of 99 percent annually in Thailand followed by Nepal and China whereas in case of Indonesia the growth of relative productivity gap recorded to be least -2 percent per annum during the reference period. Except India, there has been no acceleration in the growth of productivity gap in case of all nine major ginger producing nations. As per FAOSTAT report (2010-2015) though India ranks first in production and area under ginger but rank 18th in world on its productivity. Thus productivity of ginger has considerably worsened in Thailand whereas made recovery in Japan during the nine years period under consideration. Amongst the major ginger producing nations, India was only country experiencing acceleration in relative productivity growth during the reference period.

Table: 2.2 Relative Productivity Gap of Major Ginger Producing Nations (2005-2015)

Unit = kg per Hectares

Countries	CAGR (%)	β_2	Mean
India	46	2	26.45
China	85	0	-111.65
Nepal	87	0	-122.99
Indonesia	-2	0	96.13
Nigeria	0	0	50.87
Thailand	99	0	-195.86
Bangladesh	59	0	-40.76
Japan	84	0	-359.26
Cameroon	0	0	-134.42
Philippines	65	0	-27.68

Source: Self estimated based on figure FAOSTAT Database (2010-2015)
Note: β_2 stands for acceleration and deceleration coefficient

2.2 Status of Ginger Cultivation in India

Ginger occupies an important position among the major cultivated cash crop in India and is next only to black pepper and cardamom (Khasto and Ao, 2013). Ginger is produced in several states of India like Orissa, Kerala, Karnataka, Arunachal Pradesh,

Assam, West Bengal, Sikkim and Madhya Pradesh. Amongst different cash crops ginger occupies fourth in terms of production and sixth as export earnings in India (Singh and Dhillion, 2015). The growth of area under cultivation was largest in Karnataka 28.61 thousand hectares followed by Assam, Orissa, Meghalaya and Sikkim while the growth of Gujarat was low during 2008-2014 annually. Except Mizoram and Gujarat, the percentage share of area under ginger has registered a negative growth in all other major producing states during 2008-2014 (as in Table 2.3; Appendix C).

Table: 2.3 Area and Productivity of Selected Ginger Producing States in India (2008-2014)

States	Variables	Mean	CV	CAGR (%)
Assam	Area (%)	12.65	12.28	-1.52
	Productivity	7.52	8.88	3.78
Arunachal Pradesh	Area (%)	5.15	12.12	-1.92
	Productivity	7.79	7.44	2.74
Gujarat	Area (%)	3.24	16.75	4.44
	Productivity	16.22	11.05	4
Kerala	Area (%)	4.91	25.92	-4.53
	Productivity	4.48	29.4	-6.32
Karnataka	Area (%)	22.14	58.95	-28.59
	Productivity	3.22	26.49	5.02
Meghalaya	Area (%)	6.78	24.53	-7.4
	Productivity	6.4	7.58	3.39
Mizoram	Area (%)	6.46	40.31	1.39
	Productivity	4.25	27.67	-5.74
Orissa	Area (%)	12.47	16.71	-4.91
	Productivity	2.05	9.95	3.93
Sikkim	Area (%)	6.61	9.87	-0.2
	Productivity	5.51	2.23	0.97
India	Area	132.79	13.92	3.74
	Productivity	4.5	14.72	6.14

Source: Self estimated based on figure Spice Board of India (Various issues), Cash Crops& Horticulture Development Department, Govt. of Sikkim (2016)
Note: % Area in thousand hectares; Productivity in kg per hectares

During 2008-2014 the area under ginger cultivation registered highest growth in Gujarat with a figure of 8.18 percent per annum followed by Mizoram and Sikkim at 5.12 and 3.53 percent annually, however the growth rate of Karnataka was negative during the

same period. The growth of production was maximum in Gujarat while that of Karnataka was negative during the reference period. The average productivity of ginger found to be maximum in Gujarat with a figure of 16.22 kg per hectares and was least in Orissa with a figure of 2.05 kg per hectares for the period under consideration. During the study period the productivity of ginger has been found to be most consistent in Sikkim and was least consistent in Kerala. Amongst the major ginger producing states of India, Gujarat was observed to be leading in terms average area under cultivation, production, whereas, the productivity of ginger was most consistent in Sikkim during seven years period of study.

2.2.1 Relative Productivity Gap of Major Ginger Producing States in India

Despite being a leading producer of ginger in the world India is facing a huge challenge in terms of its productivity and there is also wide variation in productivity of ginger across the states of India. Refer to Table 2.4; the average relative productivity gap of ginger was highest in Orissa with a figure of 53.95 kg per hectare during 2008-2014. Whereas the productivity gap of Assam was least with a figure of -483.09 kg per hectare during the reference period. The average productivity gap of Sikkim was 27.77 kg per hectare during the study period. Yadev et al., (2014) claimed that Sikkim is among major ginger producer contributing 5 percent to the country's production during 2011 and also its productivity improved, however, it has not kept pace with the all India average. The acceleration of growth in relative productivity gap was recorded to be highest in Kerala amongst the major ginger producing states followed by Mizoram while only Karnataka could able to achieved deceleration of relative productivity gap by narrowing down the productivity gap in all India average. There has been deterioration in the productivity of ginger in Orissa while there has been an improvement in its productivity in Assam in contrast with national productivity during the seven years period under consideration. Karnataka was observed to be only states experiencing deceleration in the growth of relative productivity gap in all India average.

Table: 2.4 Relative Productivity Gaps of Major Ginger Producing States in India (2008-2014)

			Unit = kg per Hectares
States	CAGR (%)	β_2	Mean
Assam	60	0	-483.09
Arunachal Pradesh	66	0	-75.32
Gujarat	45	0	-264.56
Kerala	67	27	-2.15
Karnataka	70	-1	27.79
Meghalaya	66	0	-35.99
Mizoram	67	4	3.30
Orissa	42	0	53.95
Sikkim	84	0	24.77

Source: Self estimated based on figure from Govt. of India, Ministry of Agriculture & Commerce (2016)
Note: β_2 stands for acceleration and deceleration coefficient

2.3 Status of Ginger cultivation in Sikkim

Popular as a major horticultural cash crop for more than two decade of Sikkim with high returns resulted in non-traditional areas being brought under ginger (Kumar et al., 2012). Ginger is an important cash crop particularly for small and marginal farmers largely cultivated in the tropical and sub-tropical belts of Sikkim (Biswa and Majumdar, 2013). It is cultivated almost in all districts of Sikkim, although its productivity is low when compared with all India average (Yadav et al, 2014). It has been observed that in Sikkim the average area under large cardamom was highest with a figure of 17.57 thousand hectares yearly followed by ginger and turmeric in second and third positions during 2001-2014. Amongst the different spices, the ginger has been observed to be most consistent in terms of area under cultivation with turmeric being least consistent for the 14 years study period. In terms of percentage share of area under cultivation amongst major spice cash crops, there has been an increase in the percentage share of ginger by 14.37 percent with a CAGR of 5.27 percent during 2001 till 2014 while in case of turmeric the growth rate was 11.44 percent annually. However, the percentage share of area under large cardamom registered a negative growth 2.51 percent annually during the same period (as in Table 2.5; Appendix D).

Amongst the three major cash crops the average production of ginger was largest with a figure of 40.05 million tons yearly followed by large cardamom and turmeric with an average figure of 3.78 and 2.79 million tons respectively during 2001-2014. During the reference period the production growth recorded maximum in case of turmeric with ginger taking second position amongst different cash crops the production growth was highest in case with ginger in second position while the large cardamom has experienced a negative growth during the reference period. During 2001-2014 the productivity of ginger recorded as highest while that of large cardamom was least in Sikkim. Thus, ginger was the most consistent in terms of area under cultivation, productivity and also recorded largest average production amongst major cash crops of Sikkim during fourteen years period under observation.

Table: 2.5 Area and Productivity of Major Spices Produced in Sikkim (2001-2014)

Spices	Variables	Mean	CV	CAGR (%)
Ginger	Area (%)	29.29	23.4	5.27
	Productivity	5.33	5.36	1.16
Large Cardamom	Area (%)	67.36	12.13	-2.51
	Productivity	0.21	13.68	1.3
Turmeric	Area (%)	3.35	47.43	11.44
	Productivity	3.28	6.92	0.1
Total	Area	25.9	13.14	-0.4
	Productivity	1.83	24.95	5.9

Source: Self estimated based on figure of Cash Crops, & Horticulture Development Department, Govt. of Sikkim (2016)
Note: % Area in thousand hectares; Productivity in kg per hectares

Ginger cultivation practices are prevalent almost in all districts of Sikkim; however, the production of ginger in North Sikkim has been found to be low due to less favorable area for its cultivation. Refer to (Table 2.6; Appendix E) reveals that on an average the growth of area under ginger cultivation during 2010-2014 was recorded highest in South district with a figure of 3.08 thousand hectares annually followed by East, West and North district with an average area of 2.93, 2.72 and 0.38 thousand hectares respectively. The average production and productivity as well as area under ginger cultivation were recorded highest in South district during five years period under consideration (2010-2014). East district registered second position in average production

of ginger while West district took the second position in terms of productivity. The production and productivity of ginger recorded as lowest in North district of Sikkim during the reference period.

Table: 2.6 District-wise Area and Productivity of Ginger Cultivation in Sikkim (2010-2014)

Districts	Variables	Mean	CV	CAGR (%)
North	Area (%)	4.12	10.59	4.4
	Productivity	5.28	9.29	-3.9
East	Area (%)	32.15	0.45	0.2
	Productivity	5.36	1-.73	0.81
South	Area (%)	33.82	1.66	-0.75
	Productivity	5.75	1.91	1.1
West	Area (%)	29.9	0.07	-0.04
	Productivity	5.49	1.56	0.41
Sikkim	Area	9.91	4.17	2.8
	Productivity	5.52	1.57	0.38

Source: Self estimated based on figure Cash Crops & Horticulture Development Department, Govt. of Sikkim (2016)
Note: % Area in thousand hectares; Productivity in kg per hectares

The yearly average production of ginger was registered highest with a figure of 17.17 million tons in South district followed by East district with average figure 15.69 million tons while least average production of 1.97 million tons in North district as observed in the study. The production of ginger was most consistent in South and West districts during 5 years of study while the least consistent in North district of Sikkim. The growth rate of production was largest in North district of Sikkim with CAGR of 3.3 percent per annum with the least growth in South and West district at 3.1 percent per annum during the period under consideration. The productivity of ginger has been found to be highest in South district with figure 5.75 kg per hectares while North district recorded to have least productivity with average figure 5.28 kg per hectares during the reference period.

Area under ginger cultivation in Sikkim has undergone significant change during the phases of time (2001-2006) and (2007-2014). Referring to Table 2.7, it can be observed that during 2001-2006 the CAGR of area under ginger was 6 percent per annum which declined to 4 percent per annum during 2007-2014. The time dummy variable

being significant implies that area harvested under ginger have undergone significant change during the period of study. Thus despite the area under ginger cultivation in Sikkim is increasing over the years but it has experienced a slow growth rate during 2007-2014. Report of Indo-Swiss Project Sikkim (2005) reveals that farmers in Sikkim are leaving the ginger cultivation as they are facing huge loss due to rot caused by bacteria, fungi and grubs of insects resulted ginger crop failure in all districts of Sikkim. Despite a continuous growth in expansion of area under ginger cultivation in Sikkim over the year it has been experiencing slow growth in the recent years.

Table: 2.7 CAGR of before and after the Structural Break in Area under Ginger Harvested in Sikkim

Variables	CAGR (%)		Constant	Time dummy	R^2
	2001-2006	2007-2014			
Area Harvested (in thousand hectares)	6**	4***	6.08*** (0.35)	2.4** (0.46)	0.69

Source: Self estimated based on figure Cash Crops & Horticulture Development Department, Govt. of Sikkim (2016)
Note: *** significant at 0.01 percent level, ** significant at 0.05 percent level

2.3.1 Inter-district Relative Productivity Gap of Ginger Cultivation in Sikkim

Due to difference in land slopes, undulating topography, variation in agro-climatic conditions across hills there exist a variation in productivity of ginger across district of Sikkim. Refer to Table 2.8; an average relative productivity gap of ginger in North district of Sikkim was highest 5.08 kg per hectare during 2010-2014 with registering a positive CAGR of 112 percent accelerating at 3 percent per annum. Observation of Avasthe et al., (2012) reveals that due to improper adoption of practices of cultivation in North Sikkim the productivity of ginger is far below the average productivity of the state. Whereas, the average relative productivity gap in South district recorded to be negative during the time under consideration. The west district of Sikkim was remarked to be 3rd position in average relative productivity gap amongst other districts of Sikkim. During the five years period of study there has been considerable decline in productivity of ginger has been observed in North district of Sikkim while productivity of ginger has improved in South district of Sikkim.

Table: 2.8 Relative Productivity Gap of District-wise Ginger Production in Sikkim (2010-2014)

		Unit = kg per Hectares	
District	CAGR (%)	β_2	Mean
North	112	3	5.08
East	44	3	3.69
South	0	0	-3.34
West	35	7	1.3

Source: Self estimated based on figure Cash Crops & Horticulture Development Department, Govt. of Sikkim (2016)
Note: β_2 stands for acceleration and deceleration coefficient

2.3.2 Price Variability of Ginger and Turmeric

The price variability is the ratio of difference between maximum and minimum price of a particular crop to that of the mean price of the same crop. The increase in price variability of a crop may lower the confidence of the farmer on future cultivation of that crop. As the price variability of ginger increases over time then it is a warning for the farmers as the farmer will lose confidence on the particular crop. The additional increasing price variability indicates instability in the price of the crop.

Table: 2.9 Price Variability of Ginger, Turmeric (2002-2015)

Variables	Mean	CV	CAGR (%)	Min	Max
Price variability of ginger (in Rs.)	57.57	26.00	-2	42.33	90.20
Price variability of turmeric (in Rs.)	49.06	79.00	-1	17.60	167.77

Source: Self estimated based on Published Statistics of Agmark (Various Issues) Govt. of India, 2016

The incessant increase (decrease) in price variability of agricultural crops influence by many factors such as crop failure, drought, high rainfall, differences in agro-climatic conditions, natural disasters, excess production (excess supply), and inflation and deflation in the economy. Refer to Table 2.9 the average price variability of ginger was higher with a value of Rs.57.57 per kg than turmeric whose price variability recorded as Rs. 49.06 per kg during the 2002-2015. The price variability of ginger found to be highly consistent than the price variability of turmeric. In case of annual growth rate of price variability, both ginger and turmeric found to be negative growth with figure of - 2

and -1 percent per annum respectively over the time period under consideration. Hence the ginger farmer in Sikkim must be facing challenges in keeping confidence in ginger farming under realm of increasing price variability of ginger during the last fourteen years period under consideration.

2.3.3 Relative Price of Ginger in Sikkim

The rise in relative price of ginger over time may impetus farmers to increase the cultivation of particular crop as the farmer gain a confidence to obtain higher returns from such crops because if the relative price of particular crops increases (decrease) the expectation of higher returns from that crop will increase (decrease). Refers to Table 2.10 the average relative price of ginger in Sikkim was observed at Rs. 60.02, registering a positive growth rate with figure 1 percent per annum during 2002-2015. The maximum price of relative price of ginger was recorded at Rs. 99.55 per kg while minimum price was Rs. 23.53 per kg during the reference period. Although, ginger farmers in Sikkim are losing confidence in continuing the cultivation of the crop under the realm of increasing price variability of the crop but only hope of ray for the farmer is the increasing relative price of ginger.

Table: 2.10 Relative Price of Ginger (2002-2015)

Descriptive Statistics	Relative price of ginger (in Rs)
Mean	60.02
Std. Deviation	22.65
CAGR (%)	1
Min	23.53
Max	99.55

Source: Self estimated based on Published Figures of Agmark (Various Issues); Govt. of India (2016)

2.4 Conclusion

Despite having dominance in area under cultivation amongst major ginger cultivating nations of the world, India suffered low productivity during 2005-2013. Importantly, there has been some acceleration in the growth of relative productivity of ginger during the study period. The average area under ginger cultivation and production has been observed to be largest in Gujarat while productivity of Sikkim remarked to be

most consistent amongst the major ginger cultivating states of India during 2008-2014. States like Orissa experienced fall in productivity of ginger while Assam has regained productivity of ginger during the seven years period under observation. The relative productivity gap of ginger farming has decelerated in Karnataka compared with all India average. Amongst the major cash crop cultivated in Sikkim, the productivity and average production of ginger recorded to be highest during 2001-2014. The productivity of ginger recorded a decline in North district of Sikkim while it has made a recovery in South district of the state. Although, ginger farmers in Sikkim are losing confidence in continuing the cultivation of the crop under the realm of increasing price variability during last fourteen years period of study, only hope of ray for the farmer is the increasing relative price of ginger.

Chapter 3

Productivity and Profitability of Ginger in Different Agro-Climatic Zones of Sikkim

The analysis of productivity and profitability from crops cultivation has important implications. The knowledge about differential levels of productivity and profitability from cultivation of a crop at different agro-climatic zones may help the farmers to utilize their resources more efficiently and help them to identify the potential location for initiating the cultivation of the crop. This in turns contribute to increase in income level and uplifting the living standard of farmer. Moreover, understanding of the factors that contribute to variation in profit level across farm household may helps the policy makers to design policies on improving the economic condition of farmers in an effective manner. Against the backdrops, the present chapter made an attempt to examine the productivity and profitability of ginger based on data generated through a primary survey in different agro-climatic zones of two concentrated districts of Sikkim. The chapter identified whether any significant difference in productivity level of ginger exist or not for farmers initiating its cultivation in different agro-climatic zones of the state. An attempt also has been made to capture the agro-climatic zonal level profitability differences of the ginger farming household in the study area and the factors responsible for variation in profitability across the farm households. The chapter has been divided into following sub-sections. The first section will examine the socio-economic profile of the ginger farming households in the study area; the next section will examine if any differences in productivity of ginger exist across different agro-climatic zones in the area under consideration and the final section will evaluate if any profitability differences in terms of farm business income (FBI) of ginger farming household exist or not across the different agro-climatic zones of study area. An attempt has also been initiated in the final section to understand the factors influencing FBI across the ginger farming household of Sikkim.

3.1 Socio-Demographic Profile of Ginger Farming Household

Understanding the socio-economic profile of the farming household is important in order to understand their level of living. Various indicators such as age, experience and literacy rate of ginger farmers, social profile such as gender, religion, castes and land tenures system of sample households has been used to capture the level of living of the farming household.

Refer to Table 3.1 the average age of ginger farming respondent in the study area of Sikkim was observed as 45 year. The farmers of South district were found to be older by age compared with farmers in East district. Each farmer was having 17 years of ginger farming experience on an average among the sampled farming household of study area with the farmers in East district found to have higher experience compared with farmers in the South district of Sikkim.

Table: 3.1 Age and Experience of Farmer

State/ District	Number of Observation	Age (Years)		Experience (Years)	
		Mean	Std. Deviation	Mean	Std. Deviation
Sikkim	200	44.48	12.92	17.1	10.9
East	100	44.42	12.34	17.38	10.14
South	100	45.55	13.5	16.85	11.64

Source: Self estimates based on Primary field survey during June-September, 2016

The social status of farmers such as religion, caste, gender and literacy may have certain influence on the pattern and urge for farming, based on the response of farmers it was noted that as some sections of the farmers responded that their hereditary and hierarchical attachment urge them to initiate ginger framing. Refer to Table 3.2 reveals that majority of respondent in the study area were Hindu by religion and were mostly general caste. The ginger farming practices were mostly initiated by male farmers in the study area. Nearly 82 percent of farmers in the study area were literate with literacy level was high among the farmers of East district compared with South. The general category farmers were observed to be maximum and the concentration of male farmers was found to be highest in the study area. Maximum sections of ginger farmers were found to be literate in the study area.

Table: 3.2 Religion, Caste, Gender and Literacy rate of Farmer

State/ District	Religion (%)			Caste (%)				Gender (%)		Literacy Rate (%)
	Hindu	Buddhist	Christian	General	OBC	ST	SC	Male	Female	
Sikkim	77	19	4	52	19.5	22	6.5	85	12	82
East	87	13	0	66	7	16	11	92	8	87
South	67	25	8	38	32	28	2	84	16	77

Source: Self estimated based on Primary field survey during June-September, 2016

Institutional transformation in agriculture by improvising the land holding system, providing irrigation facilities, access to credit and extension activities are helpful for farmers. Refers to Table 3.3, it has been found that around 10.5 percent farming households in the study area initiated cultivation in leased in land while remaining were cultivating in their own land. The farmers with own land holding were less in South district compared with East district farmers. There was absence of any external help towards the farming households in the two districts from the government in terms of providing irrigation facilities, access to credit and extension activities.

Table: 3.3 Land Holding, Irrigation, Access to Credit and Extension Activities of Farmer

State/ District	Lased in land (%)	Own Land (%)	Irrigation (%)	Access to Credit (%)	Extension Activities (%)
Sikkim	10.5	89.5	0	0	0
East	9	91	0	0	0
South	12	88	0	0	0

Source: Self estimates based on Primary field survey during June-September, 2016

3.2 Productivity of Ginger in different Agro-Climatic Zones

In an attempt to examine if the productivity of ginger differs significantly among the ginger farming household in the study area the total factor productivity (TFP) were estimated. The independent sample t test results reveals that productivity of ginger differs significantly across the farming household cultivating in different agro-climatic zones of the study area. Significant difference in TFP of farmer being found between temperate and sub-tropical agro-climatic zones and also between temperate and tropical agro-

climatic zones in study area (as in Table 3.4). The mean TFP value among the ginger farming household in temperate agro-climatic zones has been found as Rs.1.11 where as in sub-tropical agro-climatic zones it was Rs.1.21 whereas it was Rs.1.27 in tropical zones.

In the present study it was observed that TFP was not significantly different when we compare the three locations simultaneously in terms of one way ANOVA results. However, the difference was observed when we attempted to compare the productivity of ginger by taking two locations at a point of time (as in Table 3.4).

Table: 3.4 TPF of Ginger in different Agro-Climatic Zones of Sikkim

Descriptive Statistics	Z_1	Z_2	Z_3	One way ANOVA between Z_1, Z_2 and Z_3
Mean	1.11	1.21	1.27	
Std. Deviation	0.23	0.22	0.28	
Number of Observation	67	66	67	
Zones	Z_1 with Z_2	Z_1 with Z_3	Z_2 with Z_3	
Independent Sample t-test	2.51** (0.03)	3.59*** (0.04)	1.38 (0.04)	0.994 [0.372]

Source: Self estimates based on field survey during June-September, 2016
Note: *** significant at 0.01 percent level, ** significant at 0.05 percent level
Figures in the parenthesis are standard error; Figures in [ ] stands for significance level

The productivity of ginger has been found to be high amongst the farming households in tropical agro-climatic zones when compared with other zones in the study area with low productivity being recorded in temperate zones. Such behavior in ginger productivity indicates that productivity will decline as the farmer moves to high agro-climatic zones. Some of the reasons for low or declining TFP in temperate agro-climatic zones may be climatic conditions, animal[8] attacks as reported by farmers. Apart from such problem faced by ginger cultivators in temperate agro-climatic zones, the rhizome rot disease and nematode (roundworm) are found to be a primary cause for falling TFP in that area. There has been a significance difference in TFP of ginger across different agro-climatic zones of Sikkim. The temperate agro-climatic zone was found to be less productive where as the productivity recorded was high in the tropical agro-climatic zones of the study area.

[8] Animals like monkey, rabbit, peacock etc.

The loss of crop from rhizome rot disease found to be threatful for the farmers initiating cultivation in different agro-climatic zones of the study area. Refer to Table 3.5, taking the three different agro-climatic zones together, significant difference in the value of loss from ginger farming was observed in the present study as per the results of one way ANOVA, in addition the loss incurred for diseases was significantly different between temperate and tropical agro-climatic zones as per the results of independent sample t-test. The average value of loss from rhizome rot found to be highest with a value of Rs.5,112.03 across the farming households in temperate zone followed by sub-tropical and tropical zones as Rs. 3,675.32 and Rs. 2,480.72 respectively.

Table: 3.5 Loss (Rs.) in Ginger Farming Due To Disease In Different Agro-Climatic Zones of Sikkim

Descriptive Statistics	Z_1	Z_2	Z_3	One way ANOVA between Z_1, Z_2 and Z_3
Mean	5112.03	3675.32	2480.72	
Std. Deviation	7504.41	6094.43	3875.65	
Number of Observation	67	66	67	
Zones	$Z_1$with Z_2	Z_1 with Z_3	Z_2 with Z_3	
Independent Sample t-test	1.21 (1186.45)	2.55** (1031.86)	-1.29 (885.97)	3.21** [0.04]

Source: Self estimates based on field survey during June-September, 2016
Note: ** significant at 0.05 percent level
Figures in the parenthesis are standard error; Figures in [ ] stands for significance level

Thus loss of crop from disease may be one of the reasons for low productivity of ginger in temperate zone of the study area. The temperate zones found to be unfriendly in enhancing higher productivity of ginger as the zone was faced with the threat of rhizome rot disease; however the threat of rhizome rot seemed to be minimal in tropical agro-climatic zone in the study area.

3.3 Profitability of Ginger

Profitability measurement of ginger farming has been attempted in the works of Nmdu and Marcus (2013) and Islam et al., (2011) while agriculture in general has been applied in the works of (Mbata and Arene, 2008; Adinya, 2009; Masuku and Xaba , 2013; Begho et al., 2013; Wabbi et al., 2013). Following Singh and Dhillion (2015)

profitability of ginger cultivation in the study areas has been captured using estimation of Farm business income (FBI). The FBI can be defined as the disposable income after incurring the production cost. The existing literature on FBI has defined it in two ways either FBI as the difference of Cost A2 from gross income or the difference of CostA2 and family labourer from gross income.

Cost concepts:

The guidelines of CACP (Commission for Agricultural Costs and Prices) have specified nine different types of cost concepts as used in agriculture. With the regional differences in agriculture the CACP cost concepts were used in the studies of Narayanmoorthy, (2013); Sigh and Dhillion, (2015) and specific cost concepts in Goswami (2016). The cost functions specified by CACP are as follows:

Cost A1= Includes all actual expanses in cash and kind incurred in production by owners which includes (i) value of hired human labour, (ii) value of hired bullock labour, (iii) value of owned bullock labour, (iv) value of owned machinery, (v) hired machinery charges, (vi) value of seed/ seedlings, (vii) value of manures, (viii) value of fertilizers, (ix) value of plant protection chemicals, (x) irrigation charges, (xi) depreciation on farm buildings and implements, (xii) interest on working capital, (xiii) insurance premium, (xiv) land revenue, and (xv) miscellaneous expenses.

Cost A2 = Cost A1+ rent paid for leased in land

Cost A2+FL = Cost A2+ imputed value of family labour

Cost B1 = Cost A1+interest on value of owned capital asset (excluding land)

Cost B2 = Cost B1+ rental value of own land (net of land revenue) and rent paid for leased-in land

Cost C1 = Cost B1+ imputed value of family labour

Cost C2 = Cost B2+ imputed value of family labour

Cost C2* = Cost C2 estimated by taking into account statutory minimum or actual wage whichever is higher

Cost C3 = Cost C2*+ 10% of cost of C2* on account of managerial functions performed by farmers

Given the limitation of data as farmers were not able to provide the costs information on interest value of owned capital assets (excluding land) and also because being marginal farmer and disadvantage geographical specification, farmers in the study area were not using the capital like tillers, tractors etc., and were found using only simple tools such as sickle, trowel, plough axe, hoes, rake, etc. Therefore, reporting interest on such tools being not viable for farmers and estimation for the researcher. Thus with the constraints of capturing the information on depreciation of capital goods the present research used only three cost concepts: A1, A2 and A2+FL while measuring FBI.

In the present study A1 includes all kinds of expenditure such as value of paid labour, value of animal labour, value of manures, value of rent for leased-in land, value of seeds, and miscellaneous expenses incurred by sampled faring household of the study area of Sikkim.

A2 = A1 + Rent on land

Having defined the various forms of cost concepts as per the existing literature the estimation of FBI needs differencing the figures of revenue from cost. The revenue figures of each ginger farming households were arrived by taking the product of average price of the price reported by the sampled household of present study with the total ginger output generated by each farming household. It was done because it will be unrealistic to assume perfect competition for agricultural products. There were variations in price across different agro-climatic zones of present study. However, those variations were not so high to substantially overstate or understate the value of the crop (ginger). Also, the regions where the price of ginger was slightly higher, the wage rate of labour per day, price of seeds and cost of manure were also moderately higher. This actually cancels out the price effect. Nevertheless, present study considered average prices at the village level in order to minimize the effects of variations in prices and rental rates on profitability, if not to eliminate it completely.

Taking FBI as a measure of profitability the present study estimated the two variants of farm business income namely FBI1 and FBI2 following Singh and Dhillion, (2015); Goswami, (2016). Where, FBI1 denotes returns over variables costs of ginger farming households without considering imputed value of family labour and FBI2 denotes returns over variable cost of ginger farming households plus imputed value of family labour.

FBI1 = Gross Income – Cost A2

FBI2 = Gross Income – Cost A2 + FL

Where, FL stands for imputed value of family labour

3.3.1 Differences of Profitability of Ginger in different Agro-climatic Zones of Sikkim

Refer to Table 3.6 the FBI1 was not significantly different when we compare the three locations simultaneously in terms of one way ANOVA results. However, significant difference in FBI1 was observed when we attempted to compare sub-tropical agro-climatic zones with tropical zones in the study area. The average value of FBI1 was maximum (Rs. 6,303.16) in tropical agro-climatic zones of the study area where as it was lowest (Rs. 4,437.47) in sub-tropical zones of the study area.

Table: 3.6 Differences in FBI1 across different Agro-climatic Zones of Sikkim

Descriptive Statistics	FBI1			One way ANOVA between Z_1, Z_2 and Z_3
	Z_1	Z_2	Z_3	
Mean	5286.24	4437.47	6303.16	
Std. Deviation	4371.83	3598.71	5400.21	
Number of Observation	67	66	67	
Zones	$Z_1$with Z_2	$Z_1$with Z_3	$Z_2$with Z_3	
Independent Sample t-test	0.84 (1008.77)	0.85 (1192.68)	2.07** (902.21)	0.09 [0.91]

Source: Self estimates based on field survey during April-August, 2016
Note: ** significant at 0.05 percent level,* significant at 0.10 percent level
Figures in the parenthesis are standard error; Figures in [ ] stands for significance level

Similarly the FBI2 was not significantly different when we compare the three locations simultaneously in terms of one way ANOVA results. However, the difference in FBI2 was significant when we attempted to compare the FBI2 between temperate and sub-tropical zone and also between sub-tropical and tropical agro-climatic zones of the study area. The average value of FBI2 was found to be highest with a value of Rs. 3,655.4 in tropical zones and was lowest in temperate zones of the study area (as in Table 3.7).

Table: 3.7 Differences in FBI2 across different Agro-climatic Zones of Sikkim

Descriptive Statistics	FBI2			One way ANOVA between Z_1, Z_2 and Z_3
	Z_1	Z_2	Z_3	
Mean	1614.60	2120.05	3655.40	
Std. Deviation	1497.20	1353.02	3033.20	
Number of Observation	67	66	67	
Zones	$Z_1$with Z_2	$Z_1$with Z_3	$Z_2$with Z_3	
Independent Sample t-test	0.62 (821.80)	1.98* (1030.70)	1.84* (836.62)	0.82 [0.44]

Source: Self estimates based on field survey during June-September, 2016
Note: * significant at 0.10 percent level; Figures in the parenthesis are standard error, Figures in [ ] stands for significance level

3.3.2 Factors determining Profitability

It was assumed that farmers were rational and given his experience in farming, he would use inputs till the level where contribution of the inputs to income is positive. The explanatory variables used in the studies are farmer's characteristics, cost of cultivation, disease and locational dummies. The farmer's characteristics include experience (Exp) and education (Edu) and land tenure system (leased in land). The age of the farmers and education can be expected to be contributing positively to FBI of ginger farmers and land tenure system like rent for leased in land (RL) may have negative impact on FBI. Cost of production such as value of paid labour (PL), value of seeds (Seed), Value of manure (Mnr), value of animal labour (AL) and miscellaneous expenses (Mscl) can be expected to be negatively as well as positively influencing FBI except imputed value of family labour (FL). The disease caused from rhizome rot (Dis) also can be expected to have negative relation with FBI of ginger. Since, study has been carried out in three location

on the basis on agro-climatic zones (i.e. tropical, sub-tropical and temperate agro-climatic zones) of Sikkim, hence two locational dummies were used in order for understanding whether the FBI changes as we move to temperate or tropical agro-climatic zones of study area. It was considered that D_1 =1 if the zone was falling in the range (1400meter < Z_1 < 2100meter) that is temperate agro-climatic zones and D_2 =1 if the zone was falling in the range (700meter < Z_2 < 1400meter) that is sub-tropical agro-climatic zones. The tropical zone was assumed as the base zone for comparison in the study. It is less predictable to know the sign the coefficient of these locational dummies were anticipated to be sign indifferent.

Having considered the listed variables the following two linear multiple regression equations were fitted for understanding the factors determining the FBI of ginger farmers in the two sampled districts of Sikkim.

$$FBI1_i = \beta_0 + \beta_1 Exp_i + \beta_2 Edu_i + \beta_3 PL_i + \beta_4 AL_i + \beta_5 Mnr_i + \beta_6 Seed_i + \beta_7 RL_i + \beta_8 Dis_i + \beta_9 Mscl_i + \beta_{10} D_{1i} + \beta_{11} D_{2i} + U_i \quad \text{(i)}$$

$$FBI2_i = \beta_0 + \beta_1 Exp_i + \beta_2 Edu_i + \beta_3 PL_i + \beta_4 FL_i + \beta_5 AL_i + \beta_6 Mnr_i + \beta_7 Seed_i + \beta_8 RL_i + \beta_9 Dis_i + \beta_{10} Mscl_i + \beta_{11} D_{1i} + \beta_{12} D_{2i} + U_i \quad \text{(ii)}$$

Where, i= 1,2,3,……, 200th sampled ginger farming households

$U_i \sim IIND\ (0, \sigma^2)$

β_0 is the positive intercept of the regression model

$\beta_1, \beta_2, \beta_3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots, \beta_{12}$ are the positive slope coefficients

Since the data used in this exercise came from a cross-section of farmers, before estimating the model, the Breusch-Pagan/Cook-Weisberg test was applied to check the presence of heteroskedasticity in the data set. The result of the test showed the presence of heteroskedasticity and consequently, heteroskedasticity robust standard error was estimated.

To enquire the factors determining the FBI1 and FBI2 of ginger in three different agro-climatic zones of Sikkim the regression analysis was carried out. Refer to Table 3.8; it can be observed that out of eleven control variables five were found to be statistically significant when we account for FBI1 where as in case of FBI2 only four control variables were found to be significant out of twelve control variables.

It has been found that the coefficients of paid labour, manure, disease, miscellaneous expenditure and the locational dummy (D_1) are negative and significant in regression equation of FBI1. Whereas, the coefficients of imputed family labour has been found to be positively significant in regression equation of FBI2. In addition, coefficient of manure, disease and locational dummy (D_1) found to be negatively significant in regression equation of FBI2. Thus, these results imply that if the paid labour increased by a unit the household would have relatively lower farm business income (FBI1). The result for lower income on paid labour may be the increasing wage rate consuming a substantial payment as factor price to the hired labour in the wake of increasing labour scarcity in agriculture. The other variables such as manure also found to be significant at 1 percent level indicating a unit increased in the expenditure of manure has significantly reduced the FBI1 by 1.26 units in the study area. Interesting to observe that the coefficient of disease was negatively significant, implying a unit increase in disease would have lowered the FBI in the study area by 0.17 units in FBI1. Likewise, the coefficient of miscellaneous expenditure has also been remarked to be negatively significant implying higher miscellaneous expenditure were responsible for lower FBI1 in the study area. Important to note that the coefficient of locational dummy (D_1) has been found to be negatively significant at 5 percent level, however, the locational dummy (D_2) has not been observed to be significant. Since the intercept (constant) being positively significant at 5 percent level implies the minimum FBI1 in the tropical agro-climatic zones was Rs. 2,410.14. Again, locational dummy (D_1) being negatively significant implies the minimum FBI1 in the temperate agro-climatic zone is negative taking a value of Rs. 40.22. The overall significance for regression equation of FBI1 found to be highly significant and is established.

Table: 3.8 Renaults of Regression Analysis for FBI1 and FBI2

Test of Heteroskedasticity	BP/CW test $Chi^2(11)=163.31$ Prob=0.000	BP/CW test $Chi^2(12)=190.11$ Prob=0.000
Dependent Variables	FBI1	FBI2
Independent variables/constant	Estimates of coefficients/values	Estimates of coefficients/values
Experience	10.58 (39.57)	32.45 (36.64)
Education	1201.64 (1248.37)	1659.17 (1178.42)
Paid labour	-1.15** (0.47)	0.61 (0.43)
Imputed family labour	-	1.11*** (0.42)
Animal labour	-0.64 (1.09)	-0.73 (0.92)
Manure	-1.26*** (0.41)	-1.27*** (0.42)
Seeds	0.22 (0.18)	0.17 (0.18
Rent in leased in land	1.53 (1.99)	0.32 (1.54)
Disease	-0.17* (0.09)	-0.21** (0.09)
Miscellaneous	-0.89** (0.35)	-0.44 (0.51)
D_1	-2450.36** (947.07)	-2712.20*** (860.60)
D_2	-788.81 (761.75)	-396.05 (693.33)
Constant	2410.14** (1422.25)	-159.93 (1311.76)
R^2	0.34	0.23
F	4.00*** [11,188]	3.10*** [12, 187]
N	200	200

Source: Self estimates based on field survey during June-September, 2016
Note: *** significant at 0.01 percent level, ** significant at 0.05 percent level
* significant at 0.10 percent level
Figures in the parenthesis are the heteroskedasticity consistent Robust Standard Error of the respective estimates
Figures in [ ] are numerator and denominator degree of freedom of F statistic

Again taking into account the regression equation of FBI2 reveals that the coefficient of imputed family labour being highly positively significant. Thus, a unit increase in imputed family labour in the study area would have helped to increase the FBI2 by 1.11 units. However, the coefficient of manure being negatively highly significant implies that a unit increased in the expenditure on manure would have reduced the FBI2 amongst the farming households by 1.27 units. The threat of disease found to be negatively significant at 5 percent level indicating a unit increased in disease in the study area would have reduced the FBI2 by 0.21 units. The coefficient of locational dummy (D_1) has been found to be negatively highly significant which implies the farmers in the temperate agro-climatic zones must be the victim of low and negative FBI2. However, the coefficient of locational dummy of sub-tropical zones and intercepts representing tropical zones were not found to be statistically significant.

Any increased expenditure on hired labour, manure, miscellaneous expenditure and loss due to disease seemed to be responsible for lower FBI1 the farming household in the study area. Interesting that the farmer's initiating cultivation with self effort and self labour (imputed value of family labour) found to help in raising FBI2 in the study area. Locational advantage and disadvantage seemed to be prominent as the FBI1 and well as FBI2 were lower as we move to temperate zones of the study area. Factors such as loss incurred by the farmer from rhizome rot disease, occurrence of nematode and high expenditure on paid labour in wake of labour scarcity in agriculture in recent years may be the reason for lower values of FBI1 and FBI2 in the temperate zones of the study area. Interestingly, significant section of farmer reported externality in the form of threat of animal attack (such as monkey, rabbit etc.) was another serious problem in temperate ago-climatic zone of the study area.

3.4 Conclusion

From the present study it was observed that there is considerable difference in TFP of ginger across different agro-climatic zones of the study area. The temperate agro-climatic zone found to be subject of low productivity whereas the productivity of ginger was high in the tropical agro-climatic zones in the area under consideration. The loss incurred in the wake of rhizome rot disease, occurrence of nematode and less favorable

climatic condition may be responsible for low productivity of ginger in temperate zone. Noticeable difference in farm business income from ginger was observed in the different agro-climatic zones of present study with highest average farm business income, both for FBI1 and FBI2 was recorded in tropical zone while it was lowest amongst the farming households in temperate zone of the study area. Amongst the various factors such as expenditure on hired labour, manure cost, miscellaneous expenditure; and loss incurred on account of rot disease seemed to be responsible for lower FBI1 of the farming household in the study area. Increased use of imputed labour seemed to be helpful in raising FBI2, however it was found to decline with increased expenditure on manure, disease, and miscellaneous expenditure in the area under consideration. Locational advantage and disadvantage seemed to be prominent in influencing the farm business income of the study area, as the minimum farm business income was recorded when we head towards temperate zone instead of other two agro-climatic zones of the study area.

Factors such as loss incurred by the farmer were rhizome rot disease, occurrence of nematode, gratuitously use of manure in ginger cultivation, raising expenditure on wage payment. The raising expenditure on wage payment in wake of labour scarcity in agriculture in recent years may be because of alternative engagement opportunities such as MGNREGA[9] and other construction works in the remote areas besides declining interest of young youth to initiate cultivation, low mobility with lack of interest of labourer particularly to move to temperate agro-climatic regions in search of employment. Interestingly, significant section of farmer reported externality in the form of threat of animal attack was another serious threat in temperate zone of the study area. It was observed that farmers were not beneficiaries of any kind of assistance such as extension activities, access to credit, irrigation, High Yielding Varieties (HYV) seeds, organic pesticides etc., which could have helped in attaining higher productivity and profitability of the farmers. Hence, public initiative in the form of extension services, credit facilities, irrigation, HYV seeds, organic pesticides and research and development (R&D) for the farmers may be helpful in improving the challenges of productivity and profitability in the different agro-climatic zones of Sikkim.

[9] Mahatma Gandhi National Rural Employment Guarantee Act (It was initiated as NREGA in 2005 later on renamed as MGNREGA)

Chapter 4

Observations and Policy Implications

For the proposed objective of the study that was to understand the status of ginger cultivation in Sikkim at macro level while at micro level to examine if any difference in productivity and profitability of ginger exist or not across different agro-climatic zones of Sikkim and the factors determining profitability. The present chapter outlines the major findings of the study in following sub sections. The first section makes an attempt to summarize the macro status of ginger farming in Sikkim. The findings of the primary data being divided into two sub sections by summarizing the productivity differences in different agro-climatic regions in one section while the profitability differences in different agro-climatic zones and factors determining profitability in another sub section. Some policy implications being added in the final section of the present chapter.

4.1 Status of Ginger Farming

India, China, Nepal, Indonesia, Nigeria, Thailand, Bangladesh, Japan, Cameroon and Philippines are some of the major ginger producing nations of the world. Amongst these listed nations India stands as a largest in terms of area under cultivation and production of ginger; however the country has been subject of low productivity during the nine years period of study (2005-2013). During the nine year time period Japan ranked top in terms of productivity while the productivity has considerably worsened in Thailand. The acceleration in growth of productivity gap during (2005-2013) was an alarming signal for India. Amongst the different states of India extensive cultivation of ginger is practiced in Assam, Arunachal Pradesh, Gujarat, Kerala, Karnataka, Meghalaya, Mizoram, Orissa and Sikkim. The average area under cultivation and production of ginger was largest in Gujarat during (2008-2014) whereas the productivity of ginger was most consistent in Sikkim during that time period.

Ginger cultivation practices have prevalent in almost all districts of Sikkim. Amongst major cash crops of Sikkim the production and productivity of ginger recorded as largest during fourteen year period (2001-2014) of study. During the five years time

period (2010-2014) the production, productivity as well as area under ginger harvested was observed to be highest in South districts of Sikkim while North district was lagging behind the rest of the districts in both the respect. Despite growth in expansion of area under ginger cultivation in Sikkim there has been a slowdown in its growth recent years. Another threat of ginger farming of Sikkim in recent years is its increasing price variability. The increasing price variability of ginger has imposed challenges for the farmers of the state holding confidence in its cultivation perpetually. Under the realm of increasing price variability of ginger the only hope of ray for the ginger farmers of Sikkim being the increasing relative price of ginger compared with nearest competing crop such as turmeric.

4.2 Productivity of Ginger in different Agro-climatic Zones

The total factor productivity (TFP) of ginger has been observed to be considerably different across the different agro-climatic zones of Sikkim. The TFP has been found to be significantly different between temperate and sub-temperate zones, and also between temperate and tropical zones. The temperate zone has been found to be subject of lowest productivity while it was recorded highest in the tropical zone of the study area. The loss incurred in the wake of rhizome rot disease, occurrence of nematode and less favorable climatic condition for ginger cultivation may be to some extent responsible for low productivity in temperate zones.

4.3 Profitability of Ginger in different Agro-climatic Zones

The profitability analysis in the study has revealed presence of significant difference in farm business income (FBI) of ginger in both FBI1 and FBI2 across different agro-climatic zones of the study area of Sikkim. The average FBI was found to be largest amongst the framers in tropical zones while it was lowest amongst the ginger farming households in temperate zone of the study area. Any increased expenditure on hired labour, manure, miscellaneous expenditure and disease observed to be responsible for lower FBI of the farming household in the study area. It was interesting to observe that the farmers initiating cultivation with self effort and self labour (imputed labour) enjoying an increased farm business income while increased cost of paid labour in

cultivation attributed to lower farm business income in the study area. Locational advantage and disadvantage seemed to be prominent in the present study as the farm business income recorded low as we move to temperate zones. Factors such as loss incurred because of rhizome rot disease, occurrence of nematode and high expenditure on paid labour in wake of labour scarcity in agriculture in recent years may be the reason for lower values of farm business income in the temperate zones of the study area. Interestingly, significant section of farmer reported eco-system externality in the form of threat of animal attack (rabbit, monkey, and peacock) was another serious problem in temperate ago-climatic zone of the study area of Sikkim.

4.4 Policy Implication

Public and private initiative on extension activities through training and ancillary activities in the form measures for disease control and initiating preventive measures for the threat of eco-system externalities may help the ginger farmers to reduce the problem of low productivity especially in the temperate agro-climatic zone of the study area.

References

Accessed from Food and Agriculture Organization Corporate Statistical Database (FAOSTAT, 2010-2015), visited on 2nd March 2016.

Accessed from Indian Council of Agricultural Research, Kerala (2014), Ginger Extension pamphlets), Visited on 25 August 2016.

Accessed from sikkimforest.gov.in/Biodiversity-of-Sikkim.htm, visited on 28th October 2016.

Accessed from http://works.bepress.com/amarnath_tripathi/2/ Amrawathi Tripathi, visited on 30th October 2016.

Accessed from State Agriculture /Horticulture Departments, DASD CALICUT (2015), visited on 6th November 2016.

Accessed from Agriculture and Agri-Food Canada and Statistics Canada, (2060/B), Understanding Measurement of Farm Income (2000), visited on 17 November 2016.

Accessed from www.mapsofindia.com/maps/sikkim, visited on 28 November 2016.

Adinya, I.B. (2009), Analysis Of Costs-Returns Profitability in Groundnut Marketing in Bekwarra Local Government Area Cross River State, Nigeria, *The Journal Of Animal & Plant Sciences* 19(4): 212-216.

Arene, C.J. and Mbata, G.I.O. (2008), An analysis of the profitability and choice of metropolitan waste-use in urban agriculture of the Federal Capital Territory, Abuja, Nigeria, *Agriculture Economics Czech*, 54(6): 269-275.

Ayodela, T.J. and Sambo, B.E. (2014), Ginger (Zingiber Officinale Roscoe) Producton Efficiency and Constraints among Small Scale Farmers in Southern Kaduna, *Nigeria, Journal of Agriculture Science*, 16(8): 141-148.

Begho, T., Ogisis, O.D. and Alimeke, B.O. (2013), Productivity and Profitability of Cassava (Manihot Esculenta) In South and Ika North East Local Government Areas of Delta State, Nigeria, *Journal of Agriculture and Veterinary Science*,6(1): 52-56.

Bhusan, B. (2005), Total Factor Productivity Growth of Wheat in India: A Malmquist Approach, *Indian Journal Of Agricultural Economic*, 60(1): 32-48.

Bisht, J.K., Chandra, S., Chauhan, V.S. and Singh, R.D. (2000) Performance of Ginger (Zingiber Officinale) and Turmeric (Curcuna Longa) with Fodder Tree Based on Silvi-Horti System in Hills, *Indian Journal of Agricultural Sciences*, 70(7): 431-433.

Biswa, R.K. and Majumdar, D. (2013), Baseline Data on Area, Production and Productivity of Horticulture Crops in Sikkim, Agro-Economic Research Centre Visva-Bharati Santiniketan, (174).

Chand, R., Kumar P. and Kumar, S. (2012), Total Factor Productivity and Returns to Public Investment on Agricultural Research in India, *Agricultural Economics Research Review*, 25(2): 181-194.

Dayal, E. (1984), Agricultural Productivity in India: A Spatial Analysis, *Annals of the Association of American Geographers*, 74(1): 98-123.

Dholakhia, K.H. and Dholakia, B.H. (1993), Growth of Total Factor Productivity in Indian Agriculture, *Indian Economic Review*, 28(1):25-40.

Dohroo, N.P., Kansal, S. and Ahluwalia, N. (2012), Status of Soft Rot of Ginger (Zingiber Officinale Roscoe), Project submitted to Department of Vegetable Science, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni Solan, Himachal Pradesh.

Dohroo, N.P. and Gupta, M. (2014), Effect of Biogents on Management of Rhizome Diseases, Plant Growth Parameters and Nematode Population in Ginger, *Agricultural Science Digest*, 34(1): 41-44.

Duarte, M. and Restuccia, D. (2010), The Role of the Structural Transformation in Aggregate Productivity, *The Quarterly Journal of Economics*, 125(1): 129-173.

George, L. (1996), Problem of Ginger Cultivation, The Ginger Economy of Kerala, Thesis Submitted to Cochin University of Science and Technology for the PhD degree: 212-222.

Geta, E. and Kifle, A. (2011), Production, processing and Marketing of ginger in Southern Ethiopia, *Journal of Horticulture and Forestry*, 3(7): 207-213.

Goswami, B. (2016), Farm Business Income across Land-size Classes and Land Tenure Status: A Field Study in Assam Plains, *Agricultural Economics Research Review*, 29(1):1-14.

Government of Sikkim (2009-10), Annual Progress Report, Horticulture and Cash Crops Development Department.

Government of Sikkim (2014), Handbook on Organic Crop Production in Sikkim, ICAR Research Complex for NER, Sikkim.

Government of Sikkim (2014-15), Handbook on Agriculture in Sikkim, Agriculture Census & EARAS Unit, FS&ADD.

Government of Sikkim (2016), Database of Horticulture and Cash Crops Development Department, Sikkim.

Hamid, A. and Ahmad, R.K. (2009), Growth and Productivity in Purview of Traditional Dynamics in Pakistan Agriculture Sector, *Pakistan Economic and Social Review*, 47(1), 49-78.

Hasan, M.K. and Islam, M.S. (2014), Ex-post Analysis of Ginger (Zingiber Officinale) Research and Extension Investment in Bangladesh, *A Scientific Journal of Krishi Foundation*,12(2):103-115.

Hayami, Y. (1969), Sources of Agricultural Productivity Gap among selected Countries, *American Journal of Agricultural Economics*, 51(3): 564-575.

Hegde, V. and Hegde, S. (2014), An Economic Overview of Ginger Production in Ethiopia, *International Journal of Science and Research*, 3(12): 2052-2054.

Indo-Swiss Project Sikkim (2005), Experiences in Collaboration-Ginger Pests and Diseases, In cooperation India Programme Series (1).

Islam, Q.M.S., Matin, M.A. and Hossan, S. (2012), Economic Performance of Ginger (Zingiber Officinle Rosc) Cultivation in Some Selected Location of Bangladesh, *Bangladesh Journal of Agricultural Research*, 37(1): 109-120.

Islam, M.S., Rahman, K.M.M. and Hasan, M.K. (2011), Profitability and Resource Use Efficiency of Producing Major Spices in Bangladesh, *Bangladesh Journal of Agricultural Economics*, 34(1&2): 1-13.

Janaiah, A., Outsuka, K. and Hossain, M. (2006), Is the Productivity Impact of Green Revolution in Rice Vanishing? Empirical Evidence from TFP Analysis, *Economic and Political Weekly*, 40(53): 5596-5600.

Kalyankar, P.P., Takle, S.R. and Bhaise, V.B. (2011), Drip Irrigation Technique and Productivity of Ginger, *International Journal of Management Research and Technology*, 5(2): 359-370.

Karthick, V., Alagumani, T. and Anbarassan, A. (2015), Growth and Export Performance of ginger in India-An Economic Analysis, *Economic Affairs*, 60(2): 207-214.

Kathuria, V., Raj, R.S.N. and Sen, K. (2014), Productivity in Indian Manufacturing, in Kathuria, V., Raj, R.S.N. and Sen, K. (Eds), Routledge publication: 1-19.

Khasto, K. and Ao, N.T. (2013), Biocontrol of Rhizome Rot Diseases of Ginger (Zingiber Officinale Rosc), *International Journal of Bio-resource and Stress Management*, 4(2): 317-321.

Kumar, A. (2012), Ginger Seed Production- A Profitable Venture at Dzongu, North Sikkim, Farming System Options for Rural Livelihood, *NAIP Bulletin*, (2): 12-14.

Kumar, A., Avesthe, R.K., Lepcha, B., Mohanty, A.K.and Sukla, G. (2012), Impact of Frontline Demonstration on Yield Enhancement of Ginger (Var. Majuley) in the Tribal Resource Biosphere of Sikkim, *Himalayan Journal of Agriculture Science* 3(2): 121-123.

Kumar, A., Avasthe, R.K., Borah, T.R., Lepcha, B. and Pandey, B. (2012), Organic Mulches Affecting Yield, Quality and Diseases of Ginger in Mid-Hills of North Eastern Himalayas, *Indian Journal of Horticulture*, 69(3): 439-442.

Kumar, P. and Mittal, S. (2006), Agricultural Productivity Trends in India: Sustainability Issues, *Agricultural Economic Research Review*, 19: 71-88.

Kumar, P. and Rosegrant, M.W. (1994), Productivity and Sources of Growth for Rice in India, *Economic and Political Weekly*, 29(53): A183-A188.

Lagakos, D. and Waugh, M.E. (2013), Selection, Agriculture, and Cross-country Productivity differences, *The American Economic Review*, 103(2): 198-980.

Majumdar, B., Vankatesh, M.S., Kumar, K. and Patiram. (2005), Effect of Potassium and Farmyard manure on Yield, Nutrient Uptake and Quality of Ginger (Zingiber Officinale) in a Typic Hapludalf of Meghalaya, *Indian Journal of Agriculture Sciences*, 75(12): 809-811.

Mody, P., Mihu, R., Tada, B. and Taggu, A. (2012), Impact of Commercial Ginger Cultivation on Economic Variables: A Case Study on Lohit and Lower Dibang Valley District of Arunachal Pradesh, *Asian Journal of Multidimensional Research*, 1(4): 58-72.

Mohapatra, S.C. and Acharya, P. (2006), Adoption of Recommended Cultivation Practices in Ginger (Zingiber Officinale Rosc) at Koraput District, Orissa, *Journal of Spices and Aromatic Crops*, 15(2): 130-132.

Narayanamoorthy, A. (2013), Profitability in Crops Cultivation in India: Some Evidence from Cost of Cultivation Survey Data, *Indian Journal of Agriculture Economics*, 68(1):107-120.

Nepali, M.N. (2013), Promotion of Ginger Production Micro-enterprise, *Development Programme Ministry of India, United Nation Development Programme (UNDP),* (2): 99-104.

Nmadu, J.N. and Marcus, P.L. (2013), Efficiency of Ginger production in Selected Local Government Areas of Kaduna State, Nigeria, *International Journal of Food and Agricultural Economics*, 1(2): 39-52.

Ohen, S.B. and Ajah, E.A. (2015), Cost and Return Analysis in Small Scale Rice production in Cross River State, Nigeria, *International Research Journal of Agricultural Science and Soil Science,* 5(1): 22-27.

Oladela, A.T. and Papoola, L. (2013), Economic Analysis of Growing Ginger (Zingiber Officinale) Under Teak (Tectona Grandis) Canopy is South West Nigeria, *Journal of Forest Science,* 29(2): 147-156.

Pandey, G.K. (2015), An Inter-District Analysis of Income and Inequality among Farmers in Rural Bihar, *Agricultural Situation in India,* 72(9): 90-110.

Ponti de, T., Rijk, B., and Ittrersum Van, M.K. (2002), The Crop Yield Gap between Organic and Conventional Agriculture, *Agricultural System,* (108):1-9.

Pujari, A.K. (2005), Efficiency and Productivity in Indian Agriculture: A Stochastic Frontier Approach, Indira Gandhi Institute of Development Research (IGIDR), January: 1-35.

Rana, N. and Karlo, B.N. (2010), integrated Farming with Organic Fertilizers on Yield and Quality of Ginger (Zingiber Officinale Rosc), *Agricultural Science Digest,* 30(4): 250-253.

Rao, D.S. Prasad. (2005), Lecture on Efficiency and Productivity Measurement: Basic Concept, School of Economics, University of Queensland Australia: 36-36.

Reddy, A.A. (2015), Regional Disparity in Profitability of Rice Production: Where Small Farmers Stand?, *Indian journal of Agricultural Economics,* 70(3): 259-271.

Rehman, R., Karuppayan, R., Kishore, K. and Denzongpa, R. (2009), Traditional Practices of Ginger Cultivation in North-Eastern India, *Journal of Traditional Knowledge*, 8(1): 20-28.

Rosegrant, M.W. and Evision, R.E. (1995), Total Factor Productivity and Sources of Long-Term Growth in Indian Agriculture, International Food Policy Research Institute Washington, D.C., (7): 1-27.

Samanhudi, Y.A., Pujiamanto, B. and Rahayu, M. (2014), Effect of Organic Manure and Arbuscular Mycorrhizal Fungi on Growth and Yield of Young Ginger (Zingiber Officinale Rosc), *Journal of Agricultural and Vatenary Science*, 7(5):1-5.

Saika, D. (2009), Total Factor Productivity in Indian Agriculture: Some Conceptual and Methodological Issues, *Munich Personal RePEc Archive (MPRA)*, (20578): 1-22.

Sanawal, S.K., Yadav, R.K., Singh, P.K., Buragohain, J. and Verma, M.R. (2010), Gingerol content of Different Genotype of Ginger (Zingiber Officinale), *Indian Journal of Agricultural Sciences*, 80(3): 258-260.

Salunkhe, P.P., Pawar, C.T. and Gharpure, V.T. (2014), Ginger Cultivation in Satara District: A Geographical Analysis, *International Journal of Advance and Applied Research*, 1(3): 17-24.

Severine, D., Lazaro, E., Khledal, P., Karantininis, K., Sibuga, K. and Mbapila, S. (2014), Why Transaction Cost Impede Smallholder Farmer' Participation into Export organic Markets, in Rahman, G. and Aksoy, U. (Eds.), 4th ISOFAR Scientific Conference at the Organic World Congress, Istanbul, Turkey, October, (23644): 1077-1080.

Seyie, A., Naruka, I.S., Singh, P.P. and Khushwah, S.S. (2013), Nutrient Management and its Effect on Growth, Yield and Quality of Ginger Cultivars, *Indian Journal of Horticulture*, 70(1): 65-70.

Shaikh, A.A., Khumbhar, S.G. and Jawale, S.M. (2005), Effect of Production Parameter on Uptake Pattern in Ginger (Zingiber Officinale) , *Indian Journal of Agricultural Sciences*, 75(4): 216-217.

Shaikh, A.A., Ghandage, H.L. and Jawale, S.M. (2006), Influences of Planting Methods and Time of Earthing Up on Yield, Nutrient Uptake and Balance in Ginger (Zingiber Officinale), *Indian Journal of Agricultural Sciences*, 76(4): 246-248.

Sharma, P., Patel, R.M., and Dupare, B. (2015), Profitability of Soybean vis-à-vis Major Kharif Crops in Madhya Pradesh, *Soybean Research*, 13(2):65-77.

Shaw, H.L. (1967), Alternative of Aggregate Inputs and Productivity in Agriculture, *Journal of Farm Economics*, 49(3): 670-683.

Singh, A.K., Singh, R.K., Singh, A.K., Rawat, S.S., Mehta, K.S. and Kumar, A. (2014), Bio-mulching for Ginger Crop Management: Traditional Ecological Knowledge Led Adaption Under Rain-feed Agro-ecosystem, *Indian Journal of Traditional Knowledge*, 13(1): 111-122.

Singh, S. and Dhillion, S.S. (2015), Socio-Economic of Ginger Crop in Himachal Pradesh, *Indian Journal of Hill Farming*, 28(1): 35-42.

Singh, A.K. (2011), Management of Rhizome Rot Caused by Pythium, Fusarium and Ralstonia spp in Ginger (Zingiber Officinale) Under Natural Field Conditions, *Indian Journal of Agricultural Sciences*, 81(3): 268-270.

Singh, O.P., Singh, R. and Singh, M.K. (2014), Impact of Farm Sector Electricity Subsidy on Water Use Efficiency and Water Productivity in India, *Indian Journal of Agricultural Economics*, 69(3): 404-413.

Solow, R.M. (1957), Technical Change and the Aggregate Production Function, *Review of Economics and Statistics*, 39: 312-320.

Suhami, M.Y., Mohamad, A.M. and Hani, M.N.F. (2014), Potential and Viability Analysis for Ginger Cultivation Using Fertigation Technology in Malaysia, *International journal of Innovational and Applied Studies*, 9(1): 421-427.

Tabin, T., Balasubramiun, D. and Arunachalam, A. (2014), Influence of Plant Spacing in Seed Rhizome Size and Tree Canopy on the Incidence of Rhizome Rot in Ginger, *Indian Journal of Hill Farming*, 27(2): 49-51.

Vadhera, I., Tiwari, S.P. and Dave, G.S. (1998), Plant Parasitic Nematodes Associated with Ginger (Zingiber Officinale) in Madhya Pradesh and Denematization of Rhizome by Thermotherapy for Management, *Indian Journal of Agricultural sciences*, 68(7): 367-370.

Value Chain Analysis of Selected Crops in North Eastern States (2012), Report of Small Farmers'Agribusiness Consortium (SFAC), New Delhi.

Vanrammawia, K. (2015), Agricultural Marketing Efficiency in Mizoram, *Social Change and Development*, 12(1): 97-108.

Wabbi, J.B., Mugonola, B., Ajibo, S., Kirinya, J., Kato, E., Kalibwani, R., Kasenge, V., Nyamwaro, S., Tumwesigye, S., Chiuri, W., Mugabo., J., Fungo, B. And Tenywa, M. (2013), Agricultural Profitability and Technical Efficiency: The Case of Pineapple and Potato in SW Uganda, *African Journal of Agricultural and Resource Economics*, 8(3): 145-159.

Xaba, B.G. and Musuku, M.B. (2013), Factors Affecting the Productivity and Profitability of Vegetables Production in Swaziland, *Journal of Agricultural Studies*, 1(2): 37-52.

Yadav, R.K., Yadav, D.S., Rai, N., Sanawal, S.K. and Sharma, P. (2004), Commercial Prospect of Ginger Cultivation in North-Eastern Region, *ENVIS Bulletin, Himalayan Ecology*, 2(12): 1-5.

Yadav, A., Kumar, A., Gopi, R., Kalita, H. and Lepcha, B. (2014), Ginger *(Zingiber Officinale L), Handbook of Organic Crop Production in Sikkim*, in Avasthe, R.K., Pradhan, Y. and Bhutia, K. (Edt.), ICAR, India: 129-138.

Zaman, M.M., Hasum, A.S.M.H., Ahmed, N.U., Salam, M.A. and Rahman, M.H. (2002), Effect of Tillage and Mulch on the Growth and Yield of Ginger in the Hill Area, *Journal of Biological Sciences*, 2(2): 121-123.

Appendix

Appendix A

Village Scheduled

Items	Pakyong	Pacheykhani	Rorathang	Maniram	Tarku	Salghari
Pucca road (distance in Km)	2	0	3	0	2	4
State/National Highway (distance in Km)	27	25	15	35	9	30
Public Bus stand (distance in Km)	7	5	9	6	9	10
Weekly Haat (distance in Km)	7	5	3	6	9	10
District Head Quarter or Major town (distance in Km)	7	5	20	6	25	10
Commercial Bank Branch (distance in Km)	7	5	9	9	9	10
Retail Outlet for Fertilizers, pesticides etc. (distance in Km)	Na	Na	Na	Na	Na	Na
Retail Outlet for Farm fuel (distance in Km)	Na	Na	Na	Na	Na	Na
Cold Storage (distance in Km)	Na	Na	Na	Na	Na	Na
PHC (distance in Km)	7	5	3	6	9	2
Wages rate of agricultural workers (in Rs per day)	250	250	200	250	200	200
Any organization to support or train the farmers in the village	Na	Na	Na	Na	Na	Na
Prevailing System of agricultural land holding	Sharecropping and rent in leased and leased out system					

Source: Field Survey, June -September 2016

Appendix B

Area and Production of Major Ginger Producing Nation in World (2005-2013)

Variables		Mean	CV	CAGR (%)
India	Area	119.20	18.12	5.20
	Production	492.23	33.46	9.40
China	Area	33.65	21.16	7.10
	Production	379.84	18.40	6.20
Nepal	Area	16.03	19.89	7.10
	Production	191.64	20.09	6.00
Indonesia	Area	32.27	39.89	1.90
	Production	155.47	44.86	1.40
Nigeria	Area	76.59	83.06	-23.00
	Production	172.40	69.64	-12.00
Thailand	Area	9.38	9.17	2.00
	Production	150.86	13.18	1.80
Bangladesh	Area	8.76	7.50	1.70
	Production	67.74	13.77	0.04
Japan	Area	1.93	4.54	1.50
	Production	49.29	14.83	5.20
Cameroon	Area	1.92	3.74	1.20
	Production	27.60	58.66	24.00
Philippines	Area	3.95	1.24	0.20
	Production	27.28	3.77	0.90
World	Area	315.99	15.14	-1.75
	Production	1762.05	18.71	6.03

Source: Self estimated based on figure FAOSTAT (2010-2015)
Note: Area in thousand hectares; Production in million tons

Appendix C

Area and Production of Major Ginger Producing States in India (2008-2014)

Variables		Mean	CV	CAGR (%)
Assam	Area	16.57	6.87	2.22
	Production	125.13	15.09	6.00
Arunachal Pradesh	Area	6.74	4.10	1.81
	Production	52.64	10.50	4.56
Gujarat	Area	4.30	20.41	8.18
	Production	71.01	32.70	12.19
Kerala	Area	6.41	21.85	-0.82
	Production	27.36	23.42	-7.15
Karnataka	Area	28.61	55.95	-24.84
	Production	83.90	52.34	-19.84
Meghalaya	Area	8.81	17.63	-3.68
	Production	52.81	15.86	-0.28
Mizoram	Area	8.44	40.68	5.12
	Production	32.77	8.81	-0.63
Orissa	Area	16.23	3.43	-1.17
	Production	33.20	6.76	2.73
Sikkim	Area	8.68	7.90	3.53
	Production	47.93	9.89	4.51
All India	Area	132.79	13.92	3.74
	Production	606.99	25.73	9.87

Source: Self estimated based on figure Spice Board of India (Various issues), Cash Crops& Horticulture Development Department, Govt. of Sikkim (2016)
Note: Area in thousand hectares; Production in million tons

Appendix D

Area and Production of Major Cash Crops Produced in Sikkim (2001-2014)

Variables		Mean	CV	CAGR (%)
Ginger	Area	7.45	19.82	4.80
	Production	40.05	24.10	5.90
Large Cardamom	Area	17.59	22.77	-29.00
	Production	3.78	21.88	-1.60
Turmeric	Area	0.85	51.11	10.90
	Production	2.79	46.76	11.00
Total	Area	25.90	13.14	-0.40
	Production	46.62	22.74	5.40

Source: Self estimated based on figure of Cash Crops, & Horticulture Development Department, Govt. of Sikkim (2016)
Note: Area in thousand hectares; Production in million tons

Appendix E

Inter-districts Area and Production of Ginger in Sikkim (2010-2014)

Variables		Mean	CV	CAGR (%)
North district	Area	0.38	14.14	7.60
	Production	1.97	5.99	3.30
East district	Area	2.93	4.84	3.00
	Production	15.69	5.43	3.20
South district	Area	3.08	3.70	2.10
	Production	17.71	5.41	3.10
West district	Area	2.72	4.49	2.70
	Production	14.96	5.41	3.10
Total	Area	9.91	4.17	2.80
	Production	50.33	5.42	3.10

Source: Self estimated based on figure of Cash Crops, & Horticulture Development Department, Govt. of Sikkim (2016)
Note: Area in thousand hectares; Production in million tons