An appraisal of ginger (*Zingiber officinale* Rosc.) production in Sikkim, India

PATIRAM, R C UPADHYAYA & L N SINGH

ICAR Research Complex for North Eastern Hills Region
Sikkim Centre
Gangtok - 737 102, India.

ABSTRACT

A general description of Sikkim and various aspects of cultivation and marketing of ginger (*Zingiber officinale*) in the state are discussed. The trend in production and major constraints in productivity are also dealt with.

Key words: cultivation, ginger, marketing, Sikkim, *Zingiber officinale*.

Introduction

Among the cash crops of Sikkim, ginger (*Zingiber officinale* Rosc.) has acquired an important place in the agrarian economy of the state. It is cultivated in about 3640 ha (1993-94) with a production of about 17,700 t of green ginger, which forms about 10 per cent of the total production of the country. The bulk of the ginger produced in Sikkim is exported to other parts of the country in the green form. In view of the importance of the crop in the economy of the state, a case study was taken to describe and assess ginger production systems in Sikkim.

General description

Sikkim lies between 27.04° to 28.07° North latitude and 88.01° to 88.58° East longitude in north eastern Himalayas. The state has an area of 7096 km^2 and two thirds of the area consists of mainly very high mountains perpetually covered with snow. The elevation of the state ranges from 300 to 8500 m above MSL with an undulating terrain. The climate varies from temperate and alpine in the north and north east to subtropical in the south. The mean annual rainfall varies from 2000 to 4000 mm and is characterised by drizzling showers in lower altitudes to torrential rain at higher altitudes.

Geology

Geologically Sikkim is located on the lesser Himalaya zone and the important groups of rocks include Daling, Darjeeling and Gondwana groups. The Daling group is found in the central part of Sikkim and has a very complex character being composed of phyllites, schists, slates and quartzites. The Darjeeling group comprises chiefly of

high grade gneisses containing quartz and feldspar with streaks of biotite. The younger Gondwana group contains sandstone, shale and carbonaceous shale with occasional thin coal bands. The northern, eastern and western parts of the state are constituted of hard massive gneiss rocks which are resistant to denudation to a considerable extent. The gneiss of South Sikkim is highly micaceous and frequently passes into mica-schists. The northern central part of West Sikkim is chiefly made up of Darjeeling gneiss.

Soil

The National Bureau of Soil Survey and Land Use Planning, Regional Centre, Calcutta, conducted a soil survey of Sikkim during 1990-91 and established 3 soil orders, 7 sub orders, 12 greate groups, 25 groups and 70 families. The distribution of soils in the orders of Inceptisols, Entisols and Mollisols are 33.4, 43.0 and 23.6 per cent, respectively (NBSSLUP 1992). Ecological disturbances cause widespread washing down of soils from the upper reaches to foot hills and valleys. The depth of soil at different places varies considerably because of differences in physiographic position and slope. The soil in Tista and Rangit Valley has been formed by the decomposition of Daling rocks and the resulting soil is sandy loam with a higher proportion of sand.

Soil fertility

The organic matter content of soils are quite high, ranging from 0.06 to 19.63 per cent and the majority values lie between 2 and 5 per cent (Bhutia, Gupta & Biswas 1985). Available phosphorus and potassium are low to medium category of nutrient availability in 58 and 70 per cent soils, where response of crops to these nutrients can be expected from moderate to high levels. The humid climate of Sikkim has resulted in the development of acidic soils of widely diverse nature. Soil pH tends to decreased with rise in elevation with steady increase in organic matter and cation exchange capacity (Gangopadhyay *et al.* 1990). The soils of less steep areas and valleys are more fertile.

Land use pattern

Sikkim has 36.3 per cent of its area under forests, 11.8 per cent under various crops and 10.0 per cent under non-agricultural uses (DES 1986). Wasteland (including fallow) constitutes a little more than 14 per cent of the area. The barren and uncultivable wasteland (28.7 per cent) represents the snow covered mountains, barren high hills, glaciers, lakes etc. The availability of land per head has decreased from 0.31 ha in 1981 to 0.24 ha in 1991 due to increase in population from 3,16,385 to 4,06,457, respectively. The density of population per unit area has increased from 45 to 57. At present ginger occupies 3800 ha which is about 3.3 per cent of the agricultural land available. About 58 per cent of the total population depend upon agriculture for their livelihood.

Area, production and productivity

The data on this aspect were taken from Spices Statistics, Directorate of Horticulture, Government of Sikkim (1991). In order to examine the long term trend in area, production and productivity of ginger from 1980-81 to 1994-95 (Table 1), the compounded growth rates were worked out by fitting the following equation of exponential type:

Table 1. Area, production and productivity of ginger in Sikkim

Year	Area ('000 ha)	Production ('000 t)	Productivity (kg/ha)
1981-82	1.64	3.41	2079
1982-83	1.20	5.88	4900
1983-84	1.80	8.64	4800
1984-85	2.14	9.10	4250
1985-86	2.20	9.40	4272
1986-87	2.30	10.90	4782
1987-88	2.60	12.60	5040
1988-89	3.00	14.00	4666
1989-90	3.00	15.00	5000
1990-91	3.00	16.00	5333
1991-92	3.50	17.00	4857
1992-93	3.54	17.20	4857
1993-94	3.64	17.70	4862
1994-95*	3.80	18.30	4816

* Anticipated

$Y = ab^t$ or $\log Y = \log a^+ t \log b$

where, Y = area, production and productivity; t = time in years; b = regression coefficient; and a = constant. The compounded growth rate (CGR) was calculated by the formula CGR (antilog b - 1) × 100. The area, production and productivity of ginger increased as the periods increased. The CGR's were 7.97, 8.96 and 2.86 per cent for area, production and productivity, respectively. The comparatively lesser growth of productivity is mainly attributed to widespread incidence of soft rot disease.

The major ginger producing districts are South, West and East Sikkim (Table 2). The production in North Sikkim is negligible and the crop is only

Table 2. Area and production of ginger in various districts

District	1993-94		1994-95	
	Area ('000 ha)	Production ('000 t)	Area ('000 ha)	Production ('000 t)
North	0.05	0.243	0.052	0.250
East	1.15	5.589	1.206	5.810
South	1.34	6.522	1.396	6.728
West	1.10	5.346	1.146	5.512
Total	3.64	17.700	3.800	18.300

grown in Gortaryong, Gnonsagdang, Tingwong and Ringhim blocks. In West Sikkim it is mainly concentrated in a few localities. Almost 70 per cent of the holdings are less than 2 ha. The land ownership is relatively equal. The large farmers with holdings above 5 ha constitute about 2 per cent and own roughly 13 per cent of the total cultivated area with an average size of 14 ha (ACU 1981)

Climate

In Sikkim, ginger is grown in an elevation of 300 – 1500 m in humid agroclimate, where the temperature remains high for at least some part of the year. It is susceptible to sunburn particularly during hot dry climate. Semi-shade conditions are ideal for its growth; however, larger and better rhizomes are produced in open conditions.

Cultural practices

Soil

Ginger is grown on terraced or slopy lands light in texture and rich in organic matter. Such a type of soil not only produces a good crop, but also increases the size of rhizomes and its texture. Farmers do not prefer soils which are heavy in texture and poor in drainage. Soils rich in organic matter have more of pore space which enables rain water to percolate easily and does not create mechanical impedence to root development and shoot emergence. Ginger does not grow well in sandy soil.

Land preparation

Generally the soil is ploughed 2-4 times with a local plough or it is pulverized by spade digging and breaking of clods 2-3 times before preparation of beds for sowing. The field is divided into beds of 60-80 cm width and 15-20 cm high with a spacing of 30-40 cm between beds to drain rain water. The beds are made with a gentle outward slope to avoid water logging and to safeguard from soft rot disease.

Manuring

Farmers generally apply a high quantity of manures, often up to 200 t/ha (dry matter 27-40 per cent), but 40-60 t/ha is the most common rate. Almost half the amount is mixed in the plough layer during land preparation and the remaining in the raised beds. Very few farmers apply inorganic fertilizers to ginger.

Sowing

The seed rhizomes are planted in shallow pits in rows maintaining 30-45 cm between rows and 15-20 cm between seed rhizomes on raised beds. Maize seeds are sown either around the periphery of beds or in the space made for draining the water between two beds. However in South Sikkim maize and ginger are raised in alternate rows of 60-80 cm distance. Normally a seed rate of 40-60 q/ha or even more is adopted. Sometimes whole rhizomes are sown; however, few farmers sow smaller sized rhizomes, the seed rate being around 15 q/ha. Ginger is sown from the last week of February to March in most places; but it may continue up to the end of April.

Mulching

Mulching of ginger beds is a common practice in Sikkim. The beds are covered by leaves and twigs of various forest trees after sowing of seed rhizomes. Weeds and grasses available around the fields and surplus rice straw are also

used for mulching. The amount of mulch varies from 5 to 20 t/ha on dry basis. The mulch keeps the soil shaded and cool, prevents weed infestation, minimizes soil erosion and protects the young plant from heavy rains. After decomposition, it enriches soil nutrients and meets and need of growing plants.

Varieties

Among the ginger cultivars grown in Sikkim, 'Bhaise' is most common followed by 'Gorubathane' and 'Mazole' (local names for the cultivars Nadia and China). Though many good varieties have been introduced in the state, they are yet to become popular.

Interculture

Depending upon weed growth and availability of labour, 2-4 hand weedings are done. Earthing is done once or twice to cover the exposed rhizomes.

Harvesting

Ginger is harvested twice in Sikkim. In the first stage during May/June, the mother or seed rhizomes are harvested. This is known as 'mau' and is of inferior quality. According to farmers, the harvesting of mother rhizomes gives proper space to the developing rhizomes. They also get a good price for mother rhizomes during the off-season.

The second stage of harvesting done after 7-8 months of planting is decided by market demands. The crop is ready for harvesting when the green leafy stems turn yellow and wither. It is dug carefully with a spade taking care not to bruise or break the fingers. Harvesting continues up to December and January. Most of the farmers leave a portion of the crop unharvested for seed purpose and dig it at the time of sowing in February and March.

Yield

Farmers frequently get an yield of 3-5 times of seed rhizomes sown, which is around 120 to 250 q/ha, provided the crop is not affected by soft rot. Few farmers who adopt improved package of practices (organic manuring, fertilizers, fungicides and insecticides) get an yield of 7-10 times of seed rhizomes sown.

Insect pests and diseases

Stem borer (*Conogethes punctiferalis*), rhizome scale (*Aspidiella hartii*), rhizome fly (*Mimegralla coerulifrons*), white grub (*Holotrichia* spp.) and grass hoppers are important insect pests which damage ginger.

Soft rot caused by *Pythium* spp., bacterial wilt caused by *Pseudomonas solanacearum* and leaf spot caused by *Leptopheria gingiberi* are important diseases in the field. In storage, rhizome scale (*Aspidiella hartii*) is the most prevalent insect pest and yellowing of rhizomes is caused by *Fusarium* spp.

Storage

There is a gap of 4 to 5 months between harvesting and planting of ginger. For seed purpose, fully matured rhizomes are selected and generally stored in pits in a shady place. A thick layer of dry leaves is spread over the entire area and covered with soil to prevent the rhizomes from drying. The crop is also left unharvested some times after maturity for seed purpose. Growers also store ginger on raised platform made of bamboo or wood with frequent sorting of diseased rhizomes. Traders do not store fresh ginger for more than the periods required for its disposal. For storage, aeration is an important consideration.

Intercrops with ginger

Ginger is widely grown by small and marginal farmers as rainfed pure crop

Table 3. Fertility indices of soils cultivated with ginger and other crops

Indices	Ginger (n=17)	Other crops (n=15)
pH	5.70 ± 0.36	5.80 ± 0.26
Organic carbon (%)	2.56 ± 0.43	2.08 ± 0.47
Available P (Bray P_1) (ppm)	42.40 ± 33.08	33.40 ± 17.70
Exchangeable K (meq/100g)	0.53 ± 0.26	0.49 ± 0.31
Exchangeable Ca+Mg (meq/100g)	9.36 ± 3.83	8.12 ± 2.77
Cation exchange capacity (meq/100g)	20.04 ± 3.00	19.49 ± 4.57

or mixed with maize. It is also grown as an intercrop with mandrin orange *(Citrus reticulata* Blanco) mixed with maize. Most of the farmers believe that raising ginger with maize gives more yield than the sole crop. Partial shading of mandarin orange provides a favourable environment for growth of ginger and the intensity of disease is often less as compared to that of open cultivation. Maize also provides shade during the early period of growth. After harvesting of maize the plants get exposed to the open atmosphere which favours development of bolder rhizomes. The higher yield of maize intercropped with ginger could be due to application of higher quantities of nutrients through animal manures as compared to sole crop. Mixed cropping is regarded more efficient and productive than sole cropping because of higher combined (calories and proteins) yields and better energy use efficiency (Willey 1979).

Crop rotation

Farmers do not cultivate ginger continuously for more than 2-4 years on the same land depending on the size of holdings. By rotation of fields, the incidence of soft rot is reduced. After harvest of ginger, maize-ricebean, maize-ragi and vegetables are grown during the remaining periods.

Soil fertility

The organic carbon, available P, exchangeable Ca + Mg and K are greater in soils where ginger is raised compared to non-ginger fields (Table 3), probably due to addition of large quantities of organic manures.

Economic returns

If improved methods of cultivation are followed, farmers can get an average of Rs. 50,000/ha irrespective of expenditure, provided the plants are not damaged by soft rot disease.

Marketing

Farmers clean and wash the dug out ginger rhizomes to remove adhering soil particles before marketing. Sorting is done at the trade level to remove light, diseased and deformed ginger fingers. In this process about 8-10 per cent of produce is discarded. Sorting charges are Rs 5-10/gunny bag of ginger. About 30 per cent of the produce is sold in the village itself to the local merchants or commission agents. The remaining produce is taken to markets for sale to commission agents/wholesalers. The markets in various districts are : i) East District: Gangtok, Pakyong, Singtam

and Ranpo ii) West District : Gyalsing, Rishi and Legshib iii) South District: Namchi, Jorethang and Malli iv) North District : Mangan.

The principal assembling markets are Jorethang, Singtam and Rangpo. From these markets, it is transported by road to Siliguri transit market from where it is taken to terminal markets like Calcutta, Patna and Delhi. The agents charge 5 per cent sorting losses (maximum 10 per cent) at the collection centres from the farmers. The wastage and losses range between 3 and 6 per cent during transporatation. It is reported that 83 per cent of the total produce is marketed and about 14 per cent is retained by producers for seed purpose (DMI 1991). Of the remaining 3 per cent, a little is utilized for domestic consumption and the rest goes as wastage at producer's level.

Major constraints for ginger production

The major constraints that limit ginger production are rhizome rot and bacterial wilt casused by *Pythium* spp. and *P. solanacearum,* respectively. In a few pockets of Sikkim, diseases are so prevalent that farmers have abandonded cultivation of ginger. The infected rhizomes are often the primary source of inoculum and hence use of disease - free planting material is a prerequisite for checking the spread of diseases.

Ginger trade in Sikkim is mostly controlled by private traders and cooperative societies play an insignificant role. The Denzong Cooperative Society, Gangtok purchases green ginger directly from growers which is nearly 10 per cent of the total market arrival. Ginger is a perishable produce and storage facilities are not available even in the capital city Gangtok. In villages the producers usually get a low price in the absence of market information. Hence, traders operate on high profit margins. The gap between wholesale and retail prices varies from 100 to 150 per cent.

System dynamics and assessment

The prevailing farming system of ginger production is Sikkim is ecologically well balanced because of recycling of nutrients through organic manures and a very limited use of externally procured chemicals. This system is a major source of income to small and marginal farmers. However, it is in a period of transition towards intensification, expansion and commercialization. The yield of ginger can be increased considerably by adopting good cultural practices and control of soft rot disease. Sikkim can emerge as a main supplier of green ginger for export to middle east countries, U K, U S A, Canada, Japan and Singapore who buy fresh ginger from India.

Ginger is considered as an exhaustive crop and would certainly pay best if grown in a rotation system with other crops. In Sikkim, nurients and organic matter are transferred to fields of ginger *via* livestock and other plant sources. This not only replenishes the nutrients removed by ginger, but also has a positive effect on soil quality. There is much scope for expansion of area under ginger and also bringing about improvement in its cultivation to get higher yields.

References

Agriculture Census Unit (ACU) 1981 State Report on Agriculture Census 1980-81. Agriculture Census Unit, Government of Sikkim, Gangtok.

Bhutia D T, Gupta R K & Biswas A K 1985 Soil Bulletin 'Fertility Status of the Soils of Sikkim'. Department of Agriculture, Government of Sikkim, Gangtok.

Directorate of Economics and Statistics (DES) 1986 Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.

Directorate of Marketing & Inspection (DMI) 1991 A report on the post harvest problems of ginger in Sikkim. Government of India, Ministry of Rural Development, Directorate of Marketing and Inspection, Market Planning and Design Centre, Nagpur.

Gangopadhyay S K, Das R K, Mukhopadhyaya S, Nath S & Banerjee S K 1990 Attitudinal pattern of soil characteristics under forest vegetation in eastern Himalayan region. J. Indian Soc. Soil Sci. 38 : 93-99.

National Bureau of Soil Survey and Land use Planning (NBSSLUP) 1992 Soils of Sikkim for land use planning. National Bureau of Soil Survey and Land Use Planning (ICAR), Regional Centre, Calcutta.

Willey R W 1979 Intercropping - its importance and research needs. Part 2. Agronomy and research approaches. Field Crop Abst. 32 : 73-85.