# A Boon for Mountain Populations

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# A Boon for Mountain Populations

## Large Cardamom Farming in the Sikkim Himalaya



*Farming and tourism are the primary livelihood options for mountain people in the Hindu Kush–Himalayan region. Tourism in Sikkim, a small Indian state in the eastern Himalaya, has become popular only since 1990; the main focus is on ecotourism. Only a small segment of the population is engaged in this sector, however. More than 80% of the population depends on agriculture. The developmental measures of the "green revolution" implemented in other Indian states were not successful in the Himalayan region because adequate fertilizers were never available on time, irrigation could not be developed, and soils are very fragile. Population growth and consequent fragmentation of farmland in Sikkim have caused a reduction in per capita holdings. This has forced farmers to cultivate cash crops such as potatoes* (Solanum tuberosum)*, ginger* (Zingiber officinale)*, and mandarin oranges* (Citrus reticulata)*. The latter two have caused rapid nutrient depletion of the soil. Production of another cash crop, large cardamom* (Amomum subulatum)*, a plant native to the Sikkim Himalaya, has been a boon to the mountain people of the area. Large cardamom is a perennial cash crop grown beneath the forest cover on marginal lands. Its cultivation is an example of how a local mountain niche can be exploited sustainably.*

**FIGURE 1** Agroforestry system showing large cardamom growing under the cover of $N_2$-fixing *Alnus nepalensis*. (Photo by E. Sharma, 1993)

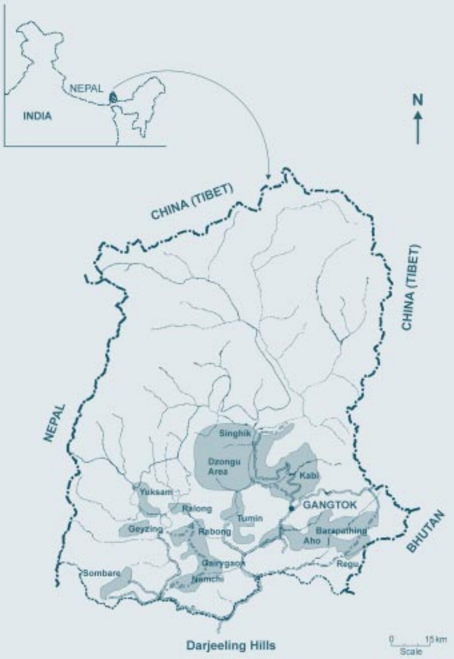
### A cash crop and its well-adapted agroforestry system

Cardamom is probably one of the oldest spices known to mankind. In India, it was used as early as the 6th century BC in Ayurvedic preparations, as mentioned by Susruta. The spice was known to the Greeks and Romans as *Amomum* and was recorded by the Greek philosopher Theophrastus in the 4th century BC. Its capsule (fruit) contains about 3% of essential oil rich in cineole. The first inhabitants of Sikkim, the Lepchas, collected capsules of large cardamom from natural forests, but these forests eventually passed into village ownership and the crop was domesticated. However, 1316 ha of reserved forest in Sikkim are still being used for under-canopy large cardamom cultivation (Figures 1 and 7). Farmers lease the land but have no rights to cut trees.

The cultivated species is *Amomum subulatum* Roxb. belonging to the family *Zingiberaceae*; 7 wild species can still be found in the region. The cultivated species has 6 varieties suitable for cultivation at different elevations and adapted to various other environmental factors such as water deficit and frost. Cardamom is also cultivated in the Darjeeling hills, Nepal, and Bhutan, but Sikkim contributes about 53% of the world's production. Large cardamom is predominantly farmed in the southern half of Sikkim (Figure 2) between 600 and 2000 m, that is, from the subtropical to the cool temperate zones. The plant is a shrub by habit and has several tillers consisting of pseudostems with leaves on the upper part. The inflorescence (spike) appears on the rhizome from the point where the pseudostem shoots up (Figure 3). It is essentially a cross-pollinated crop, although it is capable of self-fertilization. The harvested capsules are cured in traditional kilns.

A total of 16,949 cardamom holdings have been recorded in Sikkim State, most of which are smaller than 1 ha. About 30% of the total area under cultivation is 1–3 hectares in size. In some areas, the shade tree used in new plantations and large

FIGURE 2 Location map showing large cardamom growing areas in Sikkim.




patches of existing cardamom agroforestry systems is the $N_2$-fixing Himalayan alder (*Alnus nepalensis* D. Don) (Figure 1). Other common shade trees are *Schima wallichii, Engelhardtia acerifolia, Eurya acuminata, Leucosceptrum canum, Maesa chisia, Symplocos theifolia, Ficus nemoralis, Ficus hookeri, Nyssa sessiliflora, Osbeckia paniculata, Viburnum cordifolium, Litsaea polyantha, Macaranga pustulata,* etc. Large cardamom agroforestry practice thus supports conservation of tree biodiversity in the region, though use of the *Alnus*-cardamom system has recently proved more profitable.

## The economic value of cardamom

Only 12.3% of the land in Sikkim is available for cultivation, including currently used and fallow land. Forested areas account for 41.9%, while a large portion of the land—25.4%—is barren and uninhabited. Climatic conditions in Sikkim, ranging from subtropical to alpine, are diverse enough to be conducive to cultivation of a large number of crops. The cropping pattern changed radically after Sikkim's merger with India in 1975. Cereal-dominated subsistence agriculture was slowly transformed into high-value cash crop-based commercial agriculture, with increased production of pulses, oil seeds, fruit, and vegetables, and cultivation of cash crops such as ginger and mandarin oranges (Figure 4). The actual changes in area under different crops between 1975–1976 and 1995–1996 are presented in Table 1. The total cropped area increased by 106%, while land under large cardamom increased by 135% in 20 years. Many new large cardamom plantations are on terraced fields that were previously used for cultivation of paddy and other crops.

The greatest percentage increase of cultivated land was recorded for cereals, followed by large cardamom, oil seeds, vegetables, oranges, pulses, ginger, and potatoes (Table 1). Percentage increases in state production in the past 20 years clearly show that crops such as cereals, vegetables, ginger, and potatoes performed very well. The percentage contribution of large cardamom production was proportionally small, as it is a low-volume crop that nevertheless has high economic value. Large cardamom's share in the state's gross income from all crops was proportionally very high: 16.58% in 1995–1996, which was second to the 31.14% contribution of cereals.

The gross income from large cardamom cultivation in Sikkim increased from US$1.9 million in 1975–1976 to 5.7 million in 1985–1986 and 6.4 million in 1995–1996 (conversion at a fixed rate of US$1 = Rs 42). Gross income from different cash crops at 10-year intervals is presented in Figure 5. In 1975–1976, large cardamom contributed more than 80%; this decreased to about 58% in 1985–1986 and to about 38% in 1995–1996. In recent years, the contribution of ginger has increased tremendously, but the net income from large cardamom is still much higher. A study that compared two systems, one dominated by large cardamom and the other by maize and potatoes, showed that household income and per person per day income were almost double in the large cardamom system (Table 2).

## Ecological sustainability under different systems

Apart from its high income value and the fact that it is not labor intensive, large cardamom is also a low-volume, nonperishable crop; this is a great advantage in an area

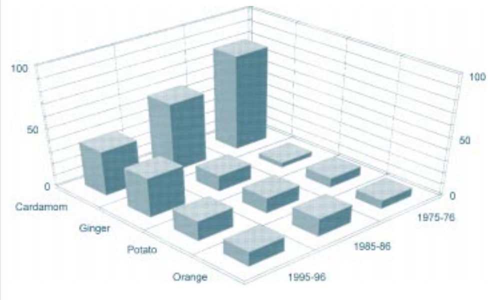
FIGURE 3 Large cardamom bush showing pseudostems and spikes with flowers. (Photo by E. Sharma, 1994)

FIGURE 4 Subsistence farming system in the mountains. (Photo by E. Sharma, 1996)

**TABLE 1** Changes in the size of areas ($\times 10^3$ ha) under different crop cultivation in Sikkim (source: Department of Agriculture, Government of Sikkim).

| Crops | 1975–1976 (area $\times 10^3$ ha) | 1985–1986 (area $\times 10^3$ ha) | 1995–1996 (area $\times 10^3$ ha) |
|---|---|---|---|
| **Common crops** | | | |
| Cereals | 47.25 | 69.70 | 72.57 |
| Pulses | 1.70 | 5.50 | 6.73 |
| Oil Seeds | 1.50 | 6.70 | 9.73 |
| Vegetables/fruits/tubers | 2.60 | 8.67 | 10.00 |
| **Cash crops** | | | |
| Mandarin oranges | 1.40 | 4.60 | 6.60 |
| Potatoes | 2.40 | 5.00 | 5.50 |
| Ginger | 0.50 | 2.30 | 4.50 |
| Large cardamom | 10.00 | 20.90 | 23.50 |
| Total cash crops | 14.30 | 32.80 | 40.10 |
| **Total cropped area** | 67.35 | 123.37 | 139.13 |

**FIGURE 5** Temporal changes in percentage of contribution to gross income by different cash crops in Sikkim. Calculation of gross income from cash crops was based on state production and actual prices in the year of estimation.




where accessibility and transportation are restricted. Furthermore, cardamom agroforestry is almost a closed system that does not depend on external inputs. 800 to 1000 kg/ha of fuelwood are required for curing the capsules; the shade trees actually produce from 4500 to 5500 kg/ha, thus offering a welcome surplus for other uses.

Cardamom is also well adapted to the local soil conditions. Various data were collected for large cardamom and other crops based on 6 rainfall events. Soil loss (30 kg/ha), overland flow (2.17% of precipitation), and nutrient loss (nitrogen 0.41 kg/ha, organic carbon 1.86 kg/ha, and total phosphorus 0.02 kg/ha) were low in large cardamom agroforestry. By comparison, soil loss (477 kg/ha), overland flow (9.55%), and nutrient loss (nitrogen 2.35 kg/ha, organic carbon 11.86 kg/ha, and total phosphorus 1.49 kg/ha) were much higher in other cropped areas. Ecological sustainability is even greater with cardamom when the Himalayan alder (*Alnus nepalensis)* is used as a shade tree, as this tree regenerates naturally on sites affected by landslides and grows within the same agroclimatic range as *Amomum.* Dry-matter production is also higher under $N_2$-fixing alder, and nutrient cycling is faster. The total biomass, number of tillers, basal area, and biomass of the cardamom crop are also much higher under the influence of *Alnus.* The annual net primary productivity of alders is slightly higher than the productivity of mixed tree species despite a low density; moreover, the productivity of large cardamom more than doubles under the influence of *Alnus* (see Table 3).

The agroforestry system under the influence of *A. nepalensis* is more productive because of higher nutrient cycling rates. The poor nutrient conservation and low nutrient use efficiency of the alder, together with the malleability of nutrient cycling under its influence, make it an excellent associate for cardamom. By comparison with other cash crops, large cardamom is thus a low-input crop, and nutrient exit through agronomic yield is also very minimal, making it an excellent crop for this fragile ecosystem.

## The future of cardamom farming

Large cardamom-based agroforestry is almost a self-sufficient system. The postharvest technology continues to be largely traditional. Farmers have devised indigenous ways of processing cardamom. The capsules are dried in traditional kilns (Figure 6). Fuelwood is consumed in the ratio of 4:1 for cured cardamom; about 800 kg/ha of wood are required to cure 200 kg/ha of the finished product. Recent-

**TABLE 2** Gross income (US $) generated at the levels of the household and the individual from different livelihood options by farmers in two major production systems, based on sample sites in Sikkim (source: Sharma et al 1997).

| Livelihood options | Cardamom-dominated system | | Maize–potato-dominated system | |
|---|---|---|---|---|
| | Household (income US $) | Worker/day (income US $) | Household (income US $) | Worker/day (income US $) |
| Crop production | 144 | 1.97 | 158 | 3.00 |
| Large cardamom | 872 | 11.94 | 162 | 5.23 |
| Livestock | 207 | 1.69 | 106 | 0.69 |
| Agricultural labor | 36 | 1.11 | 145 | 1.14 |
| Nonagricultural labor | 41 | 1.11 | 31 | 1.14 |
| Service sector | 447 | 3.31 | 239 | 2.23 |
| Business/shop | 24 | 1.17 | 58 | 1.60 |
| All options | 1771 | 3.60 | 899 | 1.83 |

**TABLE 3** Productivity and yield of large cardamom agroforestry under *Alnus* and mixed tree species as shade trees (source: Sharma et al 1994).

| Parameters | *Alnus*–cardamom | Forest–cardamom |
|---|---|---|
| Biomass (kg/ha) | 28,422 | 22,237 |
| Net primary production (kg/ha/year) | 10,843 | 7501 |
| Agronomic yield (kg/ha/year) | 454 | 205 |

ly, some institutions have developed improved kilns and gasifiers for curing as well as capsule tail cutting and polishing machines for added value; but farmers have not been adopting these technologies. Nor has any cardamom hybrid been developed by Research and Development institutions. The Spices Board is now trying to popularize seed-raised planting materials as opposed to the popular split rhizome suckers in order to maintain genetic variability and control the spreading of viral diseases.

The most worrying factor in large cardamom farming is the decrease in yield per hectare recorded in recent years by Sikkim's Department of Agriculture. Our sample survey of yield from various fields does not confirm the government's data, thus raising questions about the validity of its projections. Yet it is true that yield depends on the plant's age and that most of the cardamom plantations (about 10,000 ha) that existed before 1975 are very old and have actually not been producing more than 100 kg/ha. But the majority of new plantations (about 13,500 ha) are well maintained and produce from 250 to 350 kg/ha. New plantations should replace the older ones, however. Large cardamom starts producing from the 3rd year after planting, and yield declines considerably after the 20th year. Filling the gaps created by withering cardamom bushes and carrying out selective felling of old trees is not enough. Management of cardamom agroforestry, with a rotational cycle of 20 years for both shade trees and cardamom, is therefore suggested to maintain and increase yield.

Another cause of decline in large cardamom yield has been infestation mainly by two viral diseases, 'Chirkey' and 'Foorkey.' Uprooting and burning of all the infected plants makes it possible to control these viral diseases. The Dzongu-Golsey variety has been found to be resistant to these viral diseases. Other common diseases are leaf streak caused by *Pestatotiopsis royenae* and anthracnose caused by *Glomerella cingulata*. These two fungal diseases can be controlled by fungicides. Finally, by planting several wild relatives of large cardamom in each plantation, one can ensure that resistance to diseases will improve and genetic variability will be maintained through crossbreeding.

**FIGURE 6** Large cardamom curing after harvest in a traditional kiln. (Photo by E. Sharma, 1994)

**FIGURE 7** Natural forest used for undercanopy large cardamom cultivation. (Photo by E. Sharma, 1997)

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