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# Summary and Conclusions

Farmers from the state of Sikkim, located in the eastern Himalayas, are a good example of harnessing a local mountain niche through adoption of cardamom farming, a practice compatible with mountain specificities. The per capita income, again at constant prices, is around one hundred US dollars, compared to the national average of US \$ 63. Among the different states, Sikkim ranks fifth in terms of per capita income. Nearly half of its population is now literate, compared to nearly one-fifth about two decades ago; the female literacy rate has undergone tremendous progress, from less than one-tenth to around two-fifths.

Farming in Sikkim is fast changing towards high-value cash crops, such as vegetables, ginger, fruits, oilseeds, and pulses, for which the state possesses a comparative advantage. This is evident from a significant decline in the percentage of area under cereals, from nearly three-fourths to one-half. The yields of various crops have increased by varying degrees and compare somewhat favourably with other mountainous states and also with national averages. The yield of large cardamoms has, however, declined continuously. The most striking feature of state agriculture is very low use of external inputs, e.g., chemical fertilizers. The consumption of fertilizers is as low as eight kilogrammes per hectare, compared to the national average of 72kg and 32kg in Himachal Pradesh.

Broadly, agriculture in Sikkim is dominated by three major farming systems. While in the north it is dominated by large cardamoms, in the east, west, and south maize and potatoes dominate the farming system at higher elevations and paddy, ginger, mandarin oranges, and wheat at lower elevations. The two farming systems, namely, the large cardamom-dominated and the maize-potato dominated, account for nearly sixty per cent of the total cultivated land in the state. The present study was undertaken to analyse the diverse economic and ecological features of these two farming systems and, more importantly, to examine how these features impinge upon the sustainability of mountain agriculture. More precisely, the study aimed to document the range and quality of livelihood options of households under the two farming systems and to assess the sustainability of the cardamom farming option.

A multi-stage, stratified sampling technique was followed to select the sample households in the study sites. To begin with, two *panchayat*(s) — one representing the cardamom-dominated farming system (Kabi, in northern Sikkim) and the other the maize-potato dominated farming system (Damthang, in southern Sikkim) — were selected purposively.

The selection of the two *panchayat*(s) was proceeded by reconnaissance field visits to all four districts of the state, and detailed discussions and dialogues with concerned state government officials, scientists, and other informed people were carried out. Households were classified into two categories: those who owned up to two hectares were listed as small farmers and the others were designated as large farmers. Finally, a sample of 90 households was selected for detailed study to be conducted on the basis of the proportional allocation method; there were 40 from the cardamom-dominated area and 50 from the maize-potato dominated area. A conceptual framework was developed to operationalise the concept of sustainability. For example, the different livelihood options adopted by households were studied in relation to socioeconomic features and basic infrastructural facilities in the two farming systems selected. Thereafter, implications of different options for sustainability were analysed in terms of their impact on quality of life, equity, and the natural resource base. Some ecological and economic indicators were constructed to quantify different dimensions of sustainability .

The micro-evidence shows that the yields of cereal crops were low except for those of paddy. The low yields of cereal crops are attributed to negligible use of external inputs. Crops in both farming systems are largely market-oriented. For example, despite the fact that the maize-potato farming system operates at a near subsistence level, maize is no longer the staple diet of the people, although it is an important crop. Because of the traditional market institution, called *haat* in local parlance, the Sikkimese farmer is very well acquainted with market behaviour. The important constraints that hinder farmers from switching over to high-value cash crops include the lack of institutional backup and other basic inputs.

The evidence also indicates that mainly three to four livelihood options are common. While there is a positive relationship between the number of options adopted and the household and per capita incomes in the maize-potato farming system, no such relationship can be established in the large cardamom farming system. The per capita and household income in the cardamom farming system were nearly double those of the maize-potato farming system. The micro-evidence, therefore, lends credence to the hypothesis that the adoption of a higher number of livelihood options is motivated by survival considerations and tends to be distress-driven.

Among the various indicators measuring the quality of a livelihood option, per worker per day earnings were used as the best gauge; in that, such a gauge takes cognizance of both income and employment. Going by this yardstick, the qualities of different livelihood options, particularly of cardamoms, livestock, and the service sector, were far superior in the cardamom-dominated system than in the maize-potato dominated farming system. Crop production as an option yielded higher per worker per day earnings in the maize-potato dominated system. As regards the contribution of different options towards total household income, large cardamoms accounted for nearly half of the income in the cardamom-dominated farming system. In comparison, more than 50 per cent of the household income was contributed by off-farm livelihood options, such as agricultural labour and service, in the maize-potato dominated farming system.

Livelihood options were screened for their implications on sustainability. Some quantitative indicators, both economic and ecological, were constructed for three major production options, namely, crop production, livestock, and large cardamom farming, in order to assess their sustainability. In this respect, the evidence at our disposal suggests that crop production as an option has some positive features such as sufficient area of support land and low cropping intensity. However, very low productivity (net returns per hectare vary from US \$ 137 to US \$ 247) makes this option unsustainable. Similarly, the livestock option is sustainable but at low rates of productivity, particularly in the cardamom-dominated area.

The large cardamom, being a high-value cash crop perfectly compatible with mountain specificities is, however, the most important farming option. The evidence, both ecological and economic, - indicates positive sustainability implications due to its special characteristics such as low-volume, high-value, non-perishable cash crop (net returns per hectare vary from US \$ 741 to US \$ 857), less infrastructure-intensive (e.g., roads) and, thereby, it is compatible with the inaccessibility attribute of the mountains, with no dependence on external inputs. On ecological accounts, the large cardamom fares extremely well; it helps to conserve soil and maintain soil fertility, forests, and biodiversity. For example, the nitrogen exit from the production system through agronomic yield is as low as 2.91 kilogrammes per hectare per year in comparison to as high as 43.36 kilogrammes from the maize-potato dominated farming system. The phosphorus exit is also much lower, 0.52 kilogramme per hectare compared to 5.70 kilogrammes in the maize-potato dominated system. The tree diversity index is 4.10 in the cardamom-dominated farming system compared to 2.81 in the maize-potato farming system.

In the ultimate analysis, different livelihood options impact on the quality of life of the people. In this context, various indicators, such as expenditure on superior grains, education, clothing, health, and incidence of poverty, suggest a high quality of life for large cardamom farmers compared to that of the maize-potato farming families. The low quality of life in the latter case is the direct manifestation of low crop yields; crops being the dominant livelihood option. Insofar as equity aspects are concerned, the evidence is not so conclusive. Nevertheless, some aspects of equity do suggest sustainability of the large cardamom farming system.

### **Farming Prospects for Cardamoms**

The large cardamom, from all angles, is an excellent crop suitable to the mountain ecology and environment. For a majority of farmers in Sikkim, the sustainability of this crop as a livelihood option is extremely important. Apart from economic considerations, the crop also needs to be protected as a valuable genetic resource. If the crop fails, not only will a valuable genetic resource be lost but the survival of the entire agroforestry system would be threatened. The crop is a native plant of the state and possesses some special attributes, and it did not require much institutional support from the government in the past. This is in variance with the spread of high-value cash crops, such as apples in Himachal Pradesh and sericulture in Ningnan County, China, where

ample state support in the form of subsidies and infrastructure had to be provided. But this crop, if it is to be sustained, can no longer be marginalised and neglected.

A number of problems, such as diseases, traditional technology, and marketing, besets the crop. Its sustainability is being increasingly endangered by the spread of viral diseases. The two diseases, *phurkey* and *chirkey*, have already inflicted substantial damage. The plantations are highly susceptible to these diseases, being overage, and due to the practice of propagation through rhizomes. To recall, many of the plantations, particularly in the cardamom-dominated area, are more than 50 years of age. Despite being the most important environmentally friendly crop, the crop has been neglected and not much attention has been given to evolving disease-resistant varieties in the existing R & D set-up. In fact, the crop until recently, has been the victim of interdepartmental rivalries. While both the agriculture and forest departments claim ownership of the crop, neither of them have taken measures to protect it from diseases and provide other supporting facilities. The only institution which is rendering some service to check diseases and educate farmers about the market is the Spices' Board of India. The Board is providing nursery plants and subsidies to replace the aged and disease-affected plantations. Therefore, measures are needed, first to evolve disease-resistant varieties and second to educate farmers about the available technical know-how to combat the diseases, this can be achieved by strengthening the extension facilities.

As seen earlier, the yield levels of crops in both areas are very low. The low yields are primarily due to the fact that practically no modern inputs, such as high-yielding varieties and chemical fertilizers, are used. However, while not advocating indiscriminate use of chemical fertilizers, farmers need to be educated about balanced use of chemical fertilizers and bio-composts. Farmers complained about inputs, particularly seeds, not being made available in time and in adequate quantities. They also complained about lack of packing materials.

The whole issue of subsidies needs a fresh look. Some subsidies may be essential for a mountainous state like Sikkim. Resources should be invested to create basic infrastructural facilities—physical, institutional, and social. Since sustainable development is a dynamic process, the availability of these facilities will make the system more resilient to unforeseen shocks and stresses.