Large Cardamom in Nepal: Production practice and economics, Processing and Marketing

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Government of Nepal
Nepal Agricultural Research Council
National Commercial Agriculture Research Program
Pakhribas, Dhankuta, Nepal
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<table>
<thead>
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<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS</td>
<td>Agriculture Development Strategy</td>
</tr>
<tr>
<td>BIS</td>
<td>Bureau of Indian Standards</td>
</tr>
<tr>
<td>BCR</td>
<td>Benefit Cost Ratio</td>
</tr>
<tr>
<td>DFTQC</td>
<td>Department of food technology and quality control</td>
</tr>
<tr>
<td>ICIMOD</td>
<td>International Centre for Integrated Mountain Development</td>
</tr>
<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
</tr>
<tr>
<td>MoAC</td>
<td>Ministry of Agriculture and Cooperatives</td>
</tr>
<tr>
<td>MoAD</td>
<td>Ministry of Agricultural Development</td>
</tr>
<tr>
<td>MoC</td>
<td>The Ministry of Commerce</td>
</tr>
<tr>
<td>PBP</td>
<td>Payback Period</td>
</tr>
<tr>
<td>NAF</td>
<td>Nepal Agro-forestry Foundation</td>
</tr>
<tr>
<td>NERAMAC</td>
<td>North Eastern Regional Agricultural Marketing Corporation</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>NSCDP</td>
<td>National Spice Crop Development Programme</td>
</tr>
<tr>
<td>NTIS</td>
<td>Nepal Trade Integration Strategy</td>
</tr>
<tr>
<td>SFAC</td>
<td>Small Farmers’ Agribusiness Consortium</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment</td>
</tr>
<tr>
<td>TEPC</td>
<td>Trade and export promotion center</td>
</tr>
<tr>
<td>VDC</td>
<td>Village Development Committee</td>
</tr>
</tbody>
</table>
1. Large cardamom plant

The large cardamom grown in Nepal, known as Alaichi, is one of Nepal's largest export crops. It is one of the highest commercial product among all Nepal's export products. It was first introduced in the Ilam district in 1865, but commercial cultivation began in the late 1950. Currently, it is grown in 51 (Figure 1) districts, mainly in the eastern hill and mountain areas and gradually expanding to the western parts (Shrestha, 2018).

Large cardamom is one of the popular spices found in the Zingiberaceae family. It is a tall, perennial, evergreen, herbaceous monocot plant (Kumar et al., 2012). The height of this plant is 1.5 to 3.0 m (Bisht et al., 2011) and on the upper part of the stem there are leaves. The rhizomes are off dull red color and the flower buds protrude from the base of the rhizome. Spring is the flowering period of large cardamom flowers. Short peduncle and buds covered with tight red bracts. The individual flowers remain open for three days or more. At the same time, new ones are opened. Flowering remains intact with the flowers for one month (Sharma et al., 2000).

The plants are generally grown at an altitude of 765 to 1675 m above sea level in humid and shaded parts of mountain streams and uneven slopes (Kumar et al., 2012). Plants depending on the climate; the best production is the temperature ranges 4-20°C, annual precipitation ranges 2000-2500 mm and more than 90% humidity (NSCDP, 2009). The ripe fruit contains seed capsules and fruit is trilocular, reddish brown, and contains dark pink seeded capsules (Hussain et al., 2009).

Nepalese laborers who went to Sikkim India for seasonal work brought some cardamom seedlings/suckers when they were returned back to home and started to cultivate. Therefore, it is believed that Sikkim is the place of origin for cardamom (Adhikari, 2016). In the initial days, growing of cardamom is limited to some villages of Ilam such as Fikkal, Pashupatinagar, Gorkhe Shree Antu etc. after few years the cultivation and transaction of cardamom was rapidly disseminated to others districts due to its high market value. However, planned development of large cardamom in Nepal at a government level was started in 1975 after the establishment of Cardamom Development Center at Fikkal Ilam. In the same year government disseminated 4 lacks cardamom variety named Kopinge, Rangbhang, Saune etc to the farmers of Ilam. In 1982, Ilam, Panchthar and Tehrathum districts were selected as cardamom development areas for the development of large cardamom in Nepal. Large cardamom cultivation is increasing from eastern Nepal to all over Nepal (Timsina & Poudel, 2016). In Nepal, over 21960 households in 51 districts are engaged in its farming (MoAD, 2017). Presently, Nepal is the largest producer of large cardamom in the market, followed by India and Bhutan. There are a lots of opportunities to grow cardamom in 40 districts of Nepal but eastern Nepal alone share 95% of area and production. In the recent years the area for production and involvement of farmers is increasing due to its continuous rise in market value and demand. Since 2003 large cardamom producers are facing a big problem of insects and diseases. Data of Ministry of Agriculture 2016/17 showed that large cardamom was cultivated in 17002 ha land with the production of 6521 metric ton. The current trend cardamom cultivation and production was increasing in Nepal but large cardamom gardens in eastern Nepal were suffered from Chirke, Furke and Rhizome rot diseases (ICIMOD, 2016). Contrastingly there is a great scope of large cardamom cultivation in Nepal because of wide climatic variation to grow different varieties of cardamom and its market value and demand in foreign market. Similarly, there is a great scope to improve farmer’s living standard and to uplift national economy.
Botanical classification of large cardamom:

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Liliopsida
- Subclass: Zingiberidae
- Order: Zingiberales
- Family: Zingiberaceae
- Genus: Amomum
- Species: A. Subulatum
- French: Cardamome
- German: Kardamom
- Italian: Cardamomo, cardamone
- Spanish: Cardamomo
- Burmese: Phalazee
- Chinese: ts’ai-o-ku or 草果
- Indian: Chhoti elachi, e(e)lachie, ela(i)chi, illaichi
- Indonesian: Kapulaga
- Sinhalese: Enasal
- Thai: Grawahn, kravan

Figure 1: Map showing large cardamom growing districts in Nepal
Other Name:

- Botanical Name: *Amomum subulatum*
- English Name: Black Cardamom
- Hindi Name: Kali Elaichi
- Sanskrit Name: Brihatupkunchika
- French Name: Cardamome noir
- German Name: Nepal Cardamom
- Big Cardamom, Brown Cardamom, Moti Elaichi, Large Cardamom etc.

It is a perennial bush of the ginger family, with sheathed stems of 10-12 feet in height. It has a large tuberous rhizome and long, dark green leaves with 30-60 cm (1-2 ft) long, 5-15 cm (2-6") wide. Trailing leafy stalks from the base of the plant bears the seed pods. The flowers are white with bluish stripes and yellowish borders. The fruit is a small capsule with 20 to 30 brown seeds which are used as a spice. Large cardamom consists of oil content 8%, terpineol 45%, myrcene 27%, limonene 8%, menthone 6%, beta-phellandrene 3%, 1.8-cineol 2%, sabinene 2%, and heptanes 25% Other sources report 1.8 cineol (20–50%), alpha-terpinyl acetate (30%), sabinene, limonene (2–14%) and borneol (2–4%), cineol (up to 70%) plus beta-pinene (16%); furthermore, alpha-pinene, alpha-terpineol and humulene.

2. Large cardamom as cash crop in Nepal

ITC, 2017 says that Nepal and Bhutan are the main producers and exporters accounting 90% of the exported production. The annual production of large cardamom is about 5000 to 6000 tons. The average production is 25-40 kg/ropani. Nepal shipped large cardamom worth NRs. 3.3 billion during the period mid-July to mid-February, up from Rs 2.2 billion year-on-year (ekantipur, March 28, 2018). Nearly 99 percent of the large cardamom grown in Nepal is exported to India. From India, spices are re-exported to Bangladesh, Pakistan, Gulf countries and other overseas destinations. The current average market price of large cardamom has gone up to NRs. 1000 per kg. Taplejung, Panchthar, Ilam and Sankhuwasava are the major large cardamom producing districts producing over 80% of the total national production. Among these, Taplejung is the largest area of production of large cardamom with 4500 hectares under the huge cardamom plantation over 2400 tons. The eight most suitable and popular large cardamom species (cultivars) being planted and grown in Nepal are: Ramsai (1500-2000 meters above sea level (masl)), Golsai (1200-1600 masl), Saune (700-2000 masl), Chibesai (700-1000 masl), Dambersai (700-1200 masl), Salakpure (1500-2000 masl), Varlangae (1500-2000 masl), Jirmale (600-1200 masl). Virus free large cardamom saplings are produced through the tissue culture techniques in the laboratory. In Nepal, the tissue culture laboratory at Agricultural Research Station, Pakhrinas, Dhankuta produces around 10000 disease free large cardamom saplings annually and sell to the farmers.

3. Area, production and productivity of large cardamom

Total world production of large cardamom is about 12278.20 MT (Singh & Pothula, 2013). Nepal is a world’s top producer of large cardamom (Singh & Pothula, 2013; Kafle, 2013). Currently, its commercial cultivation spreads over 51 districts of Nepal. The Eastern development region of Nepal specifically accounts for around 97% of the total national production. The four major districts (Taplejung, Ilam, Sankhuwasabha and Panchthar) accounts for 81% of the national production (MoAC, 2010) but most of them are producing
in small scales. The annual production in Nepal has been exceeding 6,600 Metric Ton (MT) and many local farmers persuade to increase its production every year (Adhikari & Sigdel, 2015).

The cultivation of large cardamom is increasing day by day from east to west of the country. It thrives well in barren slope land of hills near watershed and rivers. It doesn’t require huge amount of fertilizer and intercultural operations but is labor intensive in terms of harvesting, cleaning, and weeding. It requires slightly shady areas with good irrigation for cultivation.

### Table 1. Area, production and yield of large cardamom by districts in Nepal

<table>
<thead>
<tr>
<th>Districts</th>
<th>Total Area (ha)</th>
<th>Productive Area (ha)</th>
<th>Production (ton)</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taplejung</td>
<td>4500</td>
<td>4150</td>
<td>2490</td>
<td>600</td>
</tr>
<tr>
<td>Sankhuwasav</td>
<td>2824</td>
<td>1900</td>
<td>1108</td>
<td>583</td>
</tr>
<tr>
<td>Solukhumbu</td>
<td>157</td>
<td>68</td>
<td>40</td>
<td>588</td>
</tr>
<tr>
<td>Panchthar</td>
<td>1950</td>
<td>1731</td>
<td>667</td>
<td>385</td>
</tr>
<tr>
<td>Ilam</td>
<td>1600</td>
<td>1163</td>
<td>558</td>
<td>480</td>
</tr>
<tr>
<td>Tehrathum</td>
<td>730</td>
<td>637</td>
<td>253</td>
<td>398</td>
</tr>
<tr>
<td>Dhankuta</td>
<td>275</td>
<td>240</td>
<td>145</td>
<td>604</td>
</tr>
<tr>
<td>Bhojpur</td>
<td>412</td>
<td>374</td>
<td>157</td>
<td>420</td>
</tr>
<tr>
<td>Khotang</td>
<td>1320</td>
<td>940</td>
<td>564</td>
<td>600</td>
</tr>
<tr>
<td>Okaldhunga</td>
<td>38</td>
<td>15</td>
<td>6</td>
<td>400</td>
</tr>
<tr>
<td>Udaypur</td>
<td>33</td>
<td>22</td>
<td>14</td>
<td>620</td>
</tr>
<tr>
<td>Morang</td>
<td>65</td>
<td>60</td>
<td>62</td>
<td>1028</td>
</tr>
<tr>
<td>Dolakha</td>
<td>562</td>
<td>100</td>
<td>38</td>
<td>382</td>
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<tr>
<td>Sindhupalchowk</td>
<td>133</td>
<td>49</td>
<td>39</td>
<td>800</td>
</tr>
<tr>
<td>Rasuwa</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>375</td>
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<tr>
<td>Ramechap</td>
<td>90</td>
<td>68</td>
<td>28</td>
<td>405</td>
</tr>
<tr>
<td>Sindhuli</td>
<td>27</td>
<td>20</td>
<td>14</td>
<td>700</td>
</tr>
<tr>
<td>Kavre</td>
<td>68</td>
<td>59</td>
<td>61</td>
<td>1037</td>
</tr>
<tr>
<td>Lalitpur</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1000</td>
</tr>
<tr>
<td>Kathmandu</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>333</td>
</tr>
<tr>
<td>Nuwakot</td>
<td>65</td>
<td>45</td>
<td>25</td>
<td>560</td>
</tr>
<tr>
<td>Dhading</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>500</td>
</tr>
<tr>
<td>Makawanpur</td>
<td>14</td>
<td>6</td>
<td>0</td>
<td>71</td>
</tr>
<tr>
<td>Gorkha</td>
<td>155</td>
<td>100</td>
<td>35</td>
<td>350</td>
</tr>
<tr>
<td>Lamjung</td>
<td>304</td>
<td>180</td>
<td>63</td>
<td>350</td>
</tr>
<tr>
<td>Tanahun</td>
<td>9</td>
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<td>1</td>
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<td>Kaksi</td>
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<td>11</td>
<td>1</td>
<td>57</td>
</tr>
<tr>
<td>Parbat</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>529</td>
</tr>
<tr>
<td>Syangja</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>500</td>
</tr>
<tr>
<td>District</td>
<td>Area (ha)</td>
<td>Production (ton)</td>
<td>Productivity (t/ha)</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>1994/95</td>
<td>8782</td>
<td>3010</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>1995/96</td>
<td>9252</td>
<td>3622</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>1996/97</td>
<td>9553</td>
<td>4456</td>
<td>0.47</td>
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<tr>
<td>1997/98</td>
<td>9725</td>
<td>5146</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>1998/99</td>
<td>9770</td>
<td>4335</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>1999/00</td>
<td>10627</td>
<td>6530</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>2000/01</td>
<td>10668</td>
<td>6080</td>
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<tr>
<td>2001/02</td>
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<td>6179</td>
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<td>2002/03</td>
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<td>11220</td>
<td>5983</td>
<td>0.53</td>
<td></td>
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<tr>
<td>2004/05</td>
<td>11347</td>
<td>6086</td>
<td>0.54</td>
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<td>2005/06</td>
<td>11498</td>
<td>6647</td>
<td>0.58</td>
<td></td>
</tr>
</tbody>
</table>

Table above data showed the cultivated area, production and yield of large cardamom in different districts. The total cultivated area and production was comparatively higher in eastern districts than western districts. The CAGR analysis of 23 years available data on area, production and productivity shows that, the area is increasing significantly with 0.532 percent annually. Similar is the case for the production with CAGR of 0.491. But, the productivity is decreasing by -0.041 (Shrestha, 2018)
<table>
<thead>
<tr>
<th>Year</th>
<th>Area (ha)</th>
<th>Production (Ton)</th>
<th>Productivity (Ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006/07</td>
<td>11712</td>
<td>6950</td>
<td>0.59</td>
</tr>
<tr>
<td>2007/08</td>
<td>12015</td>
<td>7087</td>
<td>0.59</td>
</tr>
<tr>
<td>2008/09</td>
<td>11849</td>
<td>7037</td>
<td>0.59</td>
</tr>
<tr>
<td>2009/10</td>
<td>11766</td>
<td>5232</td>
<td>0.44</td>
</tr>
<tr>
<td>2010/11</td>
<td>12584</td>
<td>5517</td>
<td>0.44</td>
</tr>
<tr>
<td>2011/12</td>
<td>11665</td>
<td>6026</td>
<td>0.52</td>
</tr>
<tr>
<td>2012/13</td>
<td>11434</td>
<td>5753</td>
<td>0.50</td>
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<tr>
<td>2013/14</td>
<td>11501</td>
<td>5225</td>
<td>0.45</td>
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<tr>
<td>2014/15</td>
<td>12460</td>
<td>5170</td>
<td>0.41</td>
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<td>2015/16</td>
<td>12120</td>
<td>6440</td>
<td>0.53</td>
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<tr>
<td>2016/17</td>
<td>12511</td>
<td>6528</td>
<td>0.52</td>
</tr>
<tr>
<td>CAGR</td>
<td>0.532***</td>
<td>0.491**</td>
<td>-0.041NS</td>
</tr>
</tbody>
</table>

Area in hectare, Production in Ton, Productivity in Ton/ha, CAGR = compound annual growth rate, NS = Non significant (Source: MoAD, 2016/017; Shrestha, 2018)

Apart from Nepal, India and Bhutan; large cardamom is also cultivated to some extent in some of the Southeast Asian countries such as Thailand, Indonesia, Laos (Naik et al., 2005) and China. Of them, Indonesia has recently emerged as the additional key producers (Gautam et al., 2016).

4. Cultivation practices of large cardamom

4.1. Planting of large cardamom

To grow well, large cardamom needs shadow. Its cultivation can be carried out at an altitude of 600 to 2000 meters above sea level. Large cardamom plants grow best at a temperature between 10-22°C and require 2000-4000 mm of annual precipitation. In addition, a large cardamom cannot grow in direct contact with the sun; planting of soil should be in the shade (Pratap et al., 2014). A large cardamom plant developed through seeds, and its planting begins with soil preparation, seed management and other related activities. In general, the plantation began in June, when the field gets enough rain. After planting seeds in the field, reaching mature cardamom plant takes 3 to 4 years, and then only begins to produce cardamom. In addition, it requires continuous irrigation during the dry season and 4 to 6 months after harvest. However, depending on the needs, other factors, such as fertilizers and plant protection measures, are required from time to time.

4.2. Intercultural practices

The large cardamom plantations require a regular schedule of intercultural operations in order to bear heavy yields. The operations include weeding, mulching and cleaning, packing and digging earthing up, besides manuring, irrigation and provision of shade and plant protection measures.

- **Mulching**

  It is an important cultural operation in cardamom.
  - Fallen leaves of the shade trees or uprooted weeds are utilized for mulching.
  - Mulches should be applied during November-December to reduce the ill-effects of drought conditions during ensuring summer.
**Water management**

**Critical Stages of Irrigation**
- Irrigate the large cardamom stands or nurseries during dry seasons until the first monsoon showers.
- Irrigate twice a week (3–4 hours a day) (Sharma et al., 2017).

**Water Harvesting and Management Techniques**
- Develop small water-harvesting dig-out ponds at suitable locations in your farm to arrest rainwater during monsoon.
- Also store water brought from nearby sources.
- Develop many storage pits throughout the plantation stands to collect rainwater and to increase soil moisture.
- Regularly repair and rebuild the existing traditional irrigation system (kulo) or water supply pipes.

**Ways to Manage Irrigation**
- Establish a proper irrigation facility.
- Drip irrigation or sprinkler irrigation is easiest.
- Hose, sprinkler, or flood irrigation supplied through channels can also be adopted.

a) **Weeding**
In the first year of planting frequent weeding are necessary to eliminate the competition between young large cardamom plants and the weeds.
- Depending upon the intensity of weeds, 2-3 weeding may be necessary in a year, during May-June, August-September and December-January.
- In sloppy lands, slashing of weeds is alone to be carried out. Otherwise it encourages soil erosion.
- Weeds may also be controlled by spraying weedicides.
- Weedicides like Glyphosate @ 625 ml in 500 liters of water may be sprayed in the interspaces between rows leaving 60 cm around the plant base.
- By and large, cardamom is a surface feeder and therefore in the first year of planting frequent weeding is necessary to climate root competition between the young cardamom seedlings and the weeds.
- Thereafter depending upon the weed intensity one to three weddings per annum would be necessary.
- The weeds removed can be utilized as mulch around the plant.

b) **Clearing (Trashing)**
- Clearing consists of removal of old and drying shoots of the plant once in a year with the onset of monsoon rains under rain fed conditions and 2-3 times under irrigated conditions.
- Weeding and clearing may be done simultaneously during May-June to promote the healthy growth of new shoots.
- A second and final clearing may be done during August-September to prevent the damage to fruits by rodents.

c) **Racking and digging**
At the end of the monsoon rain a light raking or digging of soil should be given around the plant up to a radius of 60-75 cm, to conserve the moisture for ensuing dry period particularly
in low rainfall areas.

d) Earthing up
After the completion of monsoon, a thin layer of fertile soil, rich in organic matter may be earthed up at the base of the plant, up to collar region, to encourage new growth.

e) Cropping:
• Cardamom plants start bearing in two to three years after planting.
• Flowering starts in April-May and continues up to August-September.
• Peak flowering will be in the months of May-June.
• From flowering to maturity, the fruit takes about 5-6 months.

4.3. Management of shade in field

Large cardamom is a shade-loving plant that needs high humidity and is usually grown in areas where the average annual rainfall is between 1500 and 3500 mm. Large cardamom grows well in moist soil. Soil moisture is conserved from seasonal sources by reverse water on the upper slopes. The system is ideally suited for the conservation of soil, water and tree cover characteristics on the steep slopes of the area. Interestingly, in recent years farmers have raised large cardamom in the open fields of Bari or Khet land with shady or very rare trees. When grown in open conditions, farmers grow Titepati (Artimesia vulgaris), Bilaune (Maesaindica) or Masyamdal (Vigna umbellata). Exposure to direct sunlight during the day is very harmful for a large cardamom. It causes sunburn on leaves and significantly reduces the content of soil moisture. Proper management of the shade and related species is key to maintaining yield for optimum productivity.

About 30 important tree species are used to provide shadow to cardamom plants. Alder (Alnus nepalensis), nitrogen fixation and fast-growing tree, are usually planted with large cardamom cultivation. Rapidly decomposing leaves and twig litter of alder supply nutrients flushing to large cardamom plants. According to a research report, approximately 155 kg of nitrogen is added to the soil by fixation with alder root nodules in a 15-year stand. Alder trees are also used for wood and timber. Cardamom can be used in various plant species to provide shade. Trees used to provide shade in the agro forestry system are also an important source of fuel, feed and timber.

4.4. Nursery management for large cardamom

4.4.1. Primary nursery
Cardamom seeds are generally sown in September-October. Farmers are advised to develop seedbeds of around 15-25 cm height and around 1 m width and of a convenient length in December (Sharma et al., 2017). Seed sowing should be carried out in February (Falgun) as soon as winter ends and the soil start becoming warm. Seed beds should be prepared in the fertile field. Well-decomposed livestock manure is mixed with soil on the seed beds and the soil surface is made to fine tilt. Based on the length of the seed bed, seeds are sown in lines 5-10 cm apart across the bed. The seeds are then covered with a thin layer of soil. The seed beds are covered with ferns, dry weeds, or rice straw or small twigs of siris tree. Siris leaves make the best mulching biomass as they decompose fast and supplies nutrients such as nitrogen and phosphorus. Farmers should periodically water the seed bed to keep it moist. Sprouting begins by the month of June (Asar). In the second year of nursery establishment, once the new saplings attain the 3-4 leaf stage, they are transplanted to new seed beds at a
spacing of 1 × 1 ft. The new seed beds are supplied with good quality manure and managed through regular irrigation during winter. From the third year, saplings can be sold or transplanted to establish new plantations. Some plants such as Titepati (*Artemisia vulgaris*), soybean or legumes are grown to provide partial shade to the saplings.

![Figure 1: Primary nursery of large cardamom](image1)

4.4.2. Secondary nursery

Farmers can also establish a secondary nursery which can be seed beds of considerable length depending upon the availability of the land. Well-decomposed manure is mixed with soil and the saplings supplied from the primary nursery are transplanted. Saplings are planted in a row at 1 × 1 m spacing in May (Sharma et al., 2017). By the second year of transplantation, the new saplings are ready for field planting.

![Figure 2: Secondary nursery of large cardamom](image2)
Nursery should be established away from the old orchards to avoid the occurrence or transmission of pests and diseases. Farmers should grow a continuous tree sapling in the shade and grow large cardamom in places where shades are covered and direct sunlight falls for at least a few hours during the day. Farmers should consistently raise a nursery of shade trees and plant in spots where the canopy cover is opening up and direct sunlight falls on the ground at least for a few hours a day but not throughout the day.

4.5 Propagation of large cardamom

Large cardamom can be propagated by 3 methods viz. seed, sucker and micro propagation. Propagation through seed enables the production of large number of seedlings. Viral diseases are not transmitted through seeds and therefore the seedlings are free from viral diseases if adequate care is taken to isolate and protect the nursery from fresh infection. Planting suckers on the other hand ensures, true to type and high productivity if they are collected from high yielding plants (Pathak, 2008).

4.5.1. Propagation through seed
Large cardamom can be propagated by seed

4.5.2. Propagation through sucker
Selection of planting material is very important for developing a productive orchard. The suckers should be selected from high-yielding, disease-free plants (yielding around 600-800 kg per ha for 3-4 years). Mature tillers with 2-3 immature tillers or vegetative buds can be used for planting in the new fields. Such tillers start bearing fruit within two years of planting (Pathak, 2008; ICIMOD, 2016).

Figure 3: Propagation of large cardamom through Sucker

Sucker Multiplication Nursery:
Sucker should be generated only in sucker multiplication nursery to ensure that viral diseases
are not transmitted through the suckers produced. The site for nursery and large cardamom plantation should be at least 500 meters away either under shade of forest or under shade pandals with 50% shades using agro shade nets. The soil should be well decomposed with cattle manure or compost and the trenches need to be filled to the brim. Trenches of size 30 x 30 cm$^2$ are prepared with an inner space of 30 cm. Then the suckers with an emerging bud are planted at 30 cm apart in the trenches. The time of plantation is May-June. After plantation, the plant base is mulched with dried forest leaves. The multiplication rate is about 1:8 in one year. The grown up tillers are split into units of one tiller with an emerging bud and planted to main field.

4.5.3. **Micro propagation**

Rapid multiplication of high yielding clones, vegetative buds from disease free high yielding mother plants are collected and plantlets are produced through tissue culture techniques.

![Micro propagation of large cardamom](image)

These plantlets are hardened in polybags or in second nurseries and once sufficient growth is attained, they can be planted in the main field during Jun-July (Pathak, 2008).

**Explants for micro propagation:** The vegetative buds and rhizome bits with buds are taken from the mother stock of large cardamom bush for micro propagation. They collected and prepared by trimming and washing in detergent solution and finally treated with fungicide solution before they are taken to the laminar flow for sub culture in the growing media.

**Culture conditions and media:** Surface sterilization with 0.1% ppm plant preservation mixture, incubation at 22±2°C with 14 h photoperiod of 3000 lux.

- MS medium + 1.0 mg/L BAP + 1.0 mg/L IBA for micro-propagation.
✓ 1/2 MS medium + 10 g/L sucrose + 10 g/L mannitol for in vitro conservation by slow growth.

**In vitro responses:** Multiple shoots (5-10) could be induced from vegetative buds explants in MS medium with BAP (1.0 mg/L) and IBA (1.0 mg/L) within 120-150 days of culture (Poudel et al. 2018). Plantlets could be maintained up to 1 year without sub-culture in 1/2 MS + 10 g/l sucrose + 15 g/l mannitol in screw capped culture tubes.

**Hardening and field performance:** After 5-6 sub-cultures, these saplings become ready to transfer from lab to the screen house condition for acclimatization in soil with over 80% of success. The plants after transferred to screen house remain for 7-8 months for growth and tillering. After full hardening the saplings are transferred to the outer environment.

### 4.6. Harvesting of large cardamom

The standard large cardamom collection time is from mid-August to the end of October, depending on the height and inclination of the field. The growths of crops at lower heights begin to mature faster compared to the higher heights. The effectiveness begins from the third year after sowing. For the production of high quality large cardamom pods, the harvests must be harvested at the appropriate maturity stage. The brown color in the seeds of the topmost capsule indicates the complete maturity of the capsule. When the topmost capsule is fully mature, shoots with shoots are cut at a height of 45 cm and left for another 10-15 days to ensure the maturity of all the capsules (Pathak, 2008). The spikes are collected using mechanical tools, for example, a knife (Kafle, 2013). The collected spikes are stored for 2-3 days after collection to easily separate the capsules (Board of Spices, 2001). The separation of the capsules is done by hand and until now no device has been used. The separate capsules are cleaned by hand before curing (Singh & Pothula, 2013) to remove other plant materials.

### 4.7. Curing and Segregating

Curing is important for obtaining the quality of a large cardamom. Curing is usually associated with the balance of color, humidity and maturity. Fresh large cardamom capsules contain about 70 to 80% of moisture (in wet basis) (Mande et al., 1999), depending on the levels of capsule maturity at harvest. In order to achieve an optimal level of hydration and another factor determining quality, spikes with mature capsules are collected and heaped (hardened) for 2-3 days. After the harvest, fresh cardamom needed to separate the roots. The root contains from 3 to 8 carton capsules according to their development. These capsules are pale pink, brownish-pink or dark pink, depending on the variety, which after drying becomes black.

### 4.8. Drying of large cardamom

Cardamom is dried below 10% (wet basis) moisture content for the safe storage level and marketing of cardamom (Mande et al., 1999). Drying of large cardamom is carried out in different bhatti.

### 4.9. Tails cutting and Packing

The cardamom capsule has a tail and capsules without the tail get a higher price. Generally, tails are removed with a scissor. This is final work for farmer before selling the final product
to the local collectors. Tails are particularly clearly visible that attached with cardamom capsule after taking out from the Bhatti. The outer layer of capsule need to remove and this process called tails cutting. Normally, the tails are manually cut by scissors. Moreover, tail cutting and without tail cutting also graded when it comes to check quality of large cardamom (Singh & Pothula, 2013).

Packing of large cardamom begins after removing tails from the cardamom capsules. It looks black and brown and light in weight and moisture contains 10 - 12 percent which only considers as an A class of cardamom (Timsina et al., 2012). Polytheneline jute bags are normally using to pack cardamom capsules that should seal and store in dry place. To avoid the moisture absorption, farmers are using wooden platforms to store cardamom’s capsules. There is little bit weight loss and damages were reported during the storage (Singh & Pothula, 2013). At this moment cardamoms are ready for sale and as per the price conditions farmer sold the cardamom to local collectors.

5. Drying technology of large cardamom

5.1. Traditional Dryers (Local Bhatti)

This curing system is constructed using mud and bricks. Raw cardamom capsules are spread over the drying platforms. Hot smokes from firewood are passed through the capsules. The Bhatti operates with very poor operating thermal efficiency of the order of 5-15% resulting in wastage of huge quantities of fuel wood. The specific fuel consumption is in the range of 1-2.5 kg fuel wood per kg fresh cardamom. The drying is no uniform and produced poor quality, charred and smoky capsules. Constant attention is needed during drying for managing fire, maintaining low flame preventing fire hazards, and turning over the beds of capsules (Mande et al., 1999). There is also loss in the volatile oil content of the capsules by this method.

**Drying of capsules in Local Bhatti:** Local bhatteries are the wood-fired dryers, which are built in the orchard. However, this traditional processing method causes blackening of the capsules and gives smoky flavor. Cardamom capsules are spread uniformly in a thick layer of 25-30cm on a bamboo mat placed over the frames of wood firing pit. Capsules are then dried by the combined effect of heat and smoke generated by the burning of wood. Drying process takes about 24 to 28 hours and frequent racking is made to get uniform drying. After uniform drying, the capsules are rubbed against the rough surface in order to remove the tail. The quality of cardamom capsules dried in traditional bhatters is poor and they have a dark brown color with a smoky flavor. There is a production of large quantity of burned, cracked capsules having less volatile oil in traditionally dried capsules. However, no scientific knowledge is required to build this kind of traditional bhatteries. In the villages of producing areas, building, operation and management cost of bhatter is cheap and they are mostly constructed from locally available materials.

5.2. Improved Dryers

This is Flue pipe curing house. This system is developed by Indian Cardamom Research Institute, Gantok. This is an indirect system of drying and smoke does not come in contact with the produce at any stage. Flue pipe is connected to a fire place with an exit provided outside the building. The capsules are spread over the floor/shelves. When the firewood is burnt, hot air passes through flue pipes and capsules gets dried by the heat generated. Proper
ventilation is provided to control temperature inside the room. Since smoke does not come in contact with capsules, its original maroon colour is retained fetching better price in the market. The capacity of this system varies from 200 to 400 kg of fresh capsules. Drying time is reported as 17-24 hours, volatile oil content of 2-2.4 percent. A cost of one unit is US$ 102 (Deka et al., 2003). Few farmers in Arunachal Pradesh are using this system. Spices Board of India introduced it in Sikkim, but farmers are hesitating to utilize it due to high installment cost.

Drying of large cardamom in improved bhatties: In this bhatties, there is use of heat in the absence of smoke in improved dryers, they give more natural color and better-quality product than traditional method. Department of food technology and quality control (DFTQC), Nepal has developed six drum dryers containing two sections- firing and drying sections for more efficient and effective drying of cardamom capsules. These sections are enclosed in a wall made of stone and mud and the whole assembly is kept under the enclosed covered structure. The capacity of this dryer varies from 360 kg to 400 kg of fresh cardamom and the drying time is reported to have 24 hr reported that in the improved method, cured capsules are dried into two stages, at 60ºC and 55ºC respectively to get the desired moisture content (approx. 10-12%). The content is then cooled, cleaned, tails are removed and capsules are graded according to their size. Those capsules are packed in jute bags (waterproof lined with polythene) and stored in dry places.

5.3. Solar dryer
This system was designed at College of Agricultural Engineering and Postharvest Technology, Central Agricultural University, Ranipool, Sikkim. On an average 55.7 percent of higher temperature was obtained in the solar dryer over the ambient temperature. It takes 24 hours (3 sunny days) for curing of capsules than open sun drying which takes 48 hours to obtain the same level of moisture contents resulting in a net saving of about 50 percent of drying time for the solar dryer in comparison to the open sun drying (Gatea, 2011). This solar drier would definitely help to prevent the deforestation by saving the precious forest wood for drying of large cardamom in comparison to the traditional drying of large cardamom in the “traditional furnace” in India (Seveda & Jhajaria, 2012).

Table 3. Comparative study of traditional and smokeless wood combustor driers on large cardamom

<table>
<thead>
<tr>
<th>SN</th>
<th>Parameter</th>
<th>Local Bhatti</th>
<th>Smokeless wood combustor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Product quality-Sensory characteristics</td>
<td>Dark black, smoky</td>
<td>Light red to dark red</td>
</tr>
<tr>
<td>2.</td>
<td>Drying time (hr)</td>
<td>23</td>
<td>4.05</td>
</tr>
<tr>
<td>3.</td>
<td>The specific fuel consumption of firewood per kg fresh cardamom (kg)</td>
<td>2.41</td>
<td>0.45</td>
</tr>
<tr>
<td>4.</td>
<td>Recovery (%)</td>
<td>21.48</td>
<td>19.75</td>
</tr>
<tr>
<td>5.</td>
<td>Types of drying of capsules</td>
<td>Non-uniform drying</td>
<td>More uniform drying</td>
</tr>
</tbody>
</table>

*This data is based on research and survey at Dhankuta, Nepal, 2017*
Table 4. Quality evaluation of the dried capsules of large cardamom from different driers (smokeless=smokeless wood combustor, improved=double drum dryer and Local=local/traditional dryer/bhatti)

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Sample No. and Dryer Type</th>
<th>Polyphenol (mg/100g)</th>
<th>Flavonoid (mg/100g)</th>
<th>Tannin (mg/100g)</th>
<th>Moisture Content%</th>
<th>Fat %</th>
<th>Essential oil %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>001 Smokeless</td>
<td>139.438</td>
<td>6.742</td>
<td>56.622</td>
<td>8.645</td>
<td>2.955</td>
<td>0.974</td>
</tr>
<tr>
<td>2</td>
<td>002 Improved</td>
<td>80.992</td>
<td>6.320</td>
<td>38.246</td>
<td>13.710</td>
<td>2.132</td>
<td>1.978</td>
</tr>
<tr>
<td>3</td>
<td>003 Local</td>
<td>97.928</td>
<td>3.884</td>
<td>36.723</td>
<td>13.393</td>
<td>3.565</td>
<td>2.930</td>
</tr>
<tr>
<td>4</td>
<td>004 Local</td>
<td>109.989</td>
<td>4.717</td>
<td>40.566</td>
<td>13.400</td>
<td>1.813</td>
<td>2.941</td>
</tr>
<tr>
<td>5</td>
<td>005 Improved</td>
<td>87.054</td>
<td>5.019</td>
<td>28.681</td>
<td>10.771</td>
<td>1.944</td>
<td>1.390</td>
</tr>
<tr>
<td>6</td>
<td>006 Local</td>
<td>75.901</td>
<td>4.222</td>
<td>29.412</td>
<td>12.824</td>
<td>2.087</td>
<td>0.923</td>
</tr>
<tr>
<td>7</td>
<td>007 Smokeless</td>
<td>118.973</td>
<td>14.464</td>
<td>35.747</td>
<td>11.347</td>
<td>3.004</td>
<td>3.937</td>
</tr>
<tr>
<td>8</td>
<td>008 Local</td>
<td>84.996</td>
<td>8.180</td>
<td>40.085</td>
<td>11.237</td>
<td>2.531</td>
<td>2.901</td>
</tr>
<tr>
<td>9</td>
<td>009 Local</td>
<td>65.545</td>
<td>6.361</td>
<td>19.286</td>
<td>13.932</td>
<td>2.148</td>
<td>1.741</td>
</tr>
<tr>
<td>10</td>
<td>010 Local</td>
<td>97.564</td>
<td>9.642</td>
<td>25.832</td>
<td>11.010</td>
<td>2.200</td>
<td>1.711</td>
</tr>
<tr>
<td>11</td>
<td>011 Local</td>
<td>30.279</td>
<td>6.457</td>
<td>18.383</td>
<td>12.311</td>
<td>2.336</td>
<td>1.770</td>
</tr>
<tr>
<td>12</td>
<td>012 Local</td>
<td>102.255</td>
<td>10.340</td>
<td>33.781</td>
<td>9.099</td>
<td>2.510</td>
<td>2.434</td>
</tr>
</tbody>
</table>

*This data is based on research and survey at Dhankuta, Nepal, 2017*

5.4. Electric dryer

Electric dryer contains mechanical trolley system operated by diesel or electricity. This curing system consisting of a blower, a heating unit, and a multi-tray curing chamber which is similar to a mechanical cabinet tray dryer. This system works effectively and produces high-quality dried capsules. Its capacity is 600 kg and curing time is 12 hrs.

5.5 Low cost modern dryers for large cardamom

A major component of this modern cardamom dryer is the wood combustor, which generates clean and hot gas for direct heating and drying of large cardamom raw capsules in cardamom growing areas. The combustor burns firewood completely in a smoke-free environment and reduces wood consumption by 75% as well as shortening the curing period, thereby
improving the quality of the dried cardamom. A roughly 45% increase in the essential oil content of cardamom dried this way is observed over cardamom dried using traditional methods. The dryer can also be used for drying of other spices such as chilli, ginger, garlic, etc.

**Product features**

The combustion chamber of the wood is equipped with a corrugated grater, perforated combustion chamber, hood, and others. It is portable and removable. Combustor completely burn firewood with the help of primary and secondary airflow to produce pure hot gas. Burners are located on the bottom of the brick / mud wall or on a traditional bhatti. The upper part is covered with steel nets or bamboo mat to fit crude large cardamom capsules. The wood combustor feed hot gas under a wire rod of equal temperature to dry the spices. The method of drying cardamom capsules is similar to traditional processes, so it is widely accepted among farmers.

**Raw materials, equipment and tools required for fabrication:** Mild (low carbon) steel angle and sheets, galvanized iron sheets, brick or mud walls, welding and drilling machines, hand tools.

**Impact:** This new type of dryer is popular in north-eastern states of India and is conserving huge quantities of firewood and forests while also improving the quality of large cardamom, resulting in higher profits to farmers.

*Figure 6: Modern dryer for drying large cardamom*
Table 5. Quality standard of large cardamom capsule

<table>
<thead>
<tr>
<th>Quality parameters</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Odor and taste</td>
<td>Free from foreign odor and taste, including rancidity and mustiness</td>
</tr>
<tr>
<td>2. Insects, molds and other infestations</td>
<td>Not more than 10% on visual observation</td>
</tr>
<tr>
<td>3. Extraneous matter: Calyx and Stalks</td>
<td>Not more than 5% (by weight)</td>
</tr>
<tr>
<td>3.2. Other extraneous matter</td>
<td>Not more than 1% (m/m)</td>
</tr>
<tr>
<td>4. Empty and malformed capsules</td>
<td>Not more than 2% (by count)</td>
</tr>
<tr>
<td>5. Immature and shriveled capsules</td>
<td>Not more than 2% (by weight)</td>
</tr>
<tr>
<td>6. Light seeds</td>
<td>Not more than 3%</td>
</tr>
<tr>
<td>7. Insect damaged matter</td>
<td>Not more than 1% (by mass)</td>
</tr>
<tr>
<td>8. Moisture</td>
<td>Not more than 12% (by weight)</td>
</tr>
<tr>
<td>9. Volatile oil</td>
<td>Not less than 1% (mL/100 g) on dry basis</td>
</tr>
</tbody>
</table>

(Source: BIS (Bureau of Indian Standards), 2009).

6. Determining the quality of large cardamom

In Nepal, quality of large cardamom is determined through the process of ‘Grading. Basically, it is a locally based process where products are segregating into three types such as Jumbo Jet (JJ), Standard type/super deluxe (SD) and usual type which locally called Chalan Chalti (CC). This segregation is made on the base of its Size, Colour and tail cutting (ITC, 2017). Following table no. 8 shows the various quality measurements in large cardamom.

Table 6. Quality indicators of large cardamom

<table>
<thead>
<tr>
<th>Types of cardamom</th>
<th>Size</th>
<th>Colour</th>
<th>Tail cutting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jumbo Jet, JJ</strong></td>
<td>Above 14 mm</td>
<td>Pinkish to well brownish</td>
<td>Well tail cutting</td>
</tr>
<tr>
<td><strong>Super Delux, SD</strong></td>
<td>Between 10-14 mm</td>
<td>Pinkish to medium brownish</td>
<td>Medium tail cutting</td>
</tr>
<tr>
<td><strong>Chalan Chati, CC</strong></td>
<td>Less than 10 mm</td>
<td>Pinkish to less brownish</td>
<td>Poor tail cutting</td>
</tr>
</tbody>
</table>

(Source: ITC, 2017)

Furthermore, among above-mentioned types of large cardamom, JJ type of large cardamom considers the as high grade of product. Similarly, SD type is medium grade and CC type is low taken as a low grade. Consequently, the price of the large cardamom depends on it grades. The following section shows the price trend of large cardamom based on its quality.

Table 7. Grading of large cardamom

<table>
<thead>
<tr>
<th>Grade and specifications</th>
<th>Jumbo Jet (Makhan)</th>
<th>Super Delux</th>
<th>Chalan Chati</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hygiene</td>
<td>Free of dust, stones, fungus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Large</td>
<td>Large</td>
<td>Small</td>
</tr>
<tr>
<td>Tail cut</td>
<td>Yes</td>
<td>Yes</td>
<td>&lt;15% tail</td>
</tr>
<tr>
<td>Colour</td>
<td>Natural</td>
<td>Natural</td>
<td>Natural</td>
</tr>
<tr>
<td>Moisture</td>
<td>&lt;12%</td>
<td>&lt;12%</td>
<td>&lt;12%</td>
</tr>
<tr>
<td>Medium sized</td>
<td>&lt;5%</td>
<td>&lt;10%</td>
<td></td>
</tr>
</tbody>
</table>
7. **Common varieties of large cardamom in Nepal**

**Varieties selection criteria:** Farmers should consider below criteria while they are selecting the planting materials, a) the varieties should be high yielding (>500 kg dry capsules/ha), b) varieties that produce 2-4 spikes per tiller, c) varieties should have high number of capsules per spike, d) varieties should produce large capsules, more seeds (50–70 seeds/capsule), e) varieties should be disease and pest resistant/tolerant, f) cultivars should be adaptive to desired agro climatic conditions, g) variety that grows well in low soil moisture condition (Sharma et al., 2017).

The local varieties of large cardamom found in Himalayan regions are Ramsai, Golsai, Chibesai, Dambersai, Saune and Kantidar. Among them, Ramsai, Golsai and Chibesai are widely distributed in Nepal. Cultivars are more susceptible to viral diseases like *foorkey* and *chirke* especially if planted at lower altitudes due to high movement of vector (aphid). Scientists have identified some varieties of large cardamom, which seem to be significantly more tolerant to diseases than the other varieties (Rai, 2011) and research work is currently on progress. The description of common large cardamom varieties grown in Nepal are following:

a) **Ramsai:** This cultivar is well suited for higher altitudes, even above 1500 m. on steep slopes. Grown up clumps of 8–10 years age group possesses 60–140 tillers. The tillers color is maroonish green to maroon. Second half of May is the peak flowering season. Capsules are small, the average being 2.27 cm in length with 2.5 cm diameter, with 30–35 capsules in a spike, each containing 16–30 seeds. The harvest is during October–November. Peak bearing of capsules is noticed in alternate years. This cultivar is more susceptible to viral diseases like *foorkey* and *chirke* especially if planted at lower altitudes. It occupies a major area under Large cardamom in Sikkim and Darjeeling district of West Bengal. Two strains of this cultivar viz., Kopringe and Garadey from Darjeeling district having stripes on leaf sheath, are reported to be tolerant to *Chirke* virus.

b) **Golsai:** This cultivar is suitable to low altitude areas below 1300 masl especially in Dzongu area in North Sikkim. Plants are not robust like other cultivars, and consist of 20–50 straight tillers with erect leaves. Alternate, prominent veins are extended to the edges of leaves. Unlike Ramsai and Saune, tillers are green in color. Each productive tiller on an average produces two spikes. Flowers are bright yellow. On an average each spike is 5.3 cm long with 9.5 cm diameter and contains an average of seven capsules. Capsules are big and bold, 2.46 cm in length and 3.92 cm in diameter and contain about 60–62 seeds. This cultivar becomes ready for harvest in August–September. Golsai is tolerant to *chirke* and susceptible to *foorkey* and leaf streak diseases. The cultivar is known for its consistent performance though not a heavy yielder. Many local cultivars are known in different locations such as Ramnag from north Sikkim. Ram meaning ‘mother’ and Nag for black, which refers to its dark pink capsules. Seto-Golsai is from west district of Sikkim with robust leafy stems/tillers and green capsules. Madhusai with elliptic and pink colored capsules is having robust leafy stem and has sweet seeds compared to other cultivars

c) **Saune:** This cultivar got the name from Sawan in Nepali, corresponds to August by which month this becomes ready for harvest at low and mid altitudes. This cultivar is widely adaptable, especially suited for mid and high altitudes i.e. around 1300–1500 m. It is robust in nature and consists of 60–90 tillers in each clump. Color of tillers is similar to Ramsai. Each productive tiller on an average produces two spikes. Average
length and diameter of a spike is 6 and 11 cm. Flowers are longer (6.23 mm) and yellow in color with pink veins. Second half of May is the peak flowering time. Capsules are bigger and bold and number of seeds in each capsule are more (35) than in Ramsai. Harvest begins in September–October and may extend up to November in high-altitude areas. This cultivar is susceptible to both chirke and foorkey viral diseases. Cultivars such as Red Sawney and Green Sawney derived their names from capsule color. Mongney, a strain found in south and west districts of Sikkim, is a non-robust type with its small round capsules resembling mostly that of Ramsai (Ravindran & Madhusoodanan, 2002).

d) **Bharlange:** This cultivar grows in low, medium and high altitude areas in South Regu (East Sikkim) and at high altitudes at Gotak (Kalimpong subdivision in Darjeeling district of West Bengal). Its yield performance is exceptionally high at higher altitude areas i.e. 1500 m and above. It is a robust type and total tillers may range from 60 to 150. Color of tillers is like that in Ramsai i.e. maroonish-green to maroon towards collar zone; girth of tillers is more than that of Ramsai. Each productive tiller on an average produces almost three spikes with an average of 20 capsules/spike. Size of capsules is bigger and bold with 50–65 seeds. Harvest begins in last week of October. This cultivar is also susceptible to foorkey and chirke diseases.

e) **Chibesai:** Farmers in mid altitudes (700–1,800 m) can select Chibesai, a local variety suited to these elevations. The production potential of this variety is very high. This variety possess short tillers, light green leaves, sword type leaves, less tillering ability and capsules in a inflorescence are more but small and contain less number of seeds. A single fruit-bearing tiller bears 2–4 spikes, each bearing around 10–12 capsules. This variety also has a very high market potential (Adhikari, 2016).

f) **Jirmale:** This variety was first grown in Ilam, then disseminated to other places. This variety is suitable for water scarce areas. This variety is characterized by dwarf type plant, green pseudo stem and leaves, produce large number of suckers and white color flower. Jirmale can be grown up to 700-1000m altitude. Each capsule bears 25-37 capsules containing 56 seeds per capsule. It is found that this variety is not highly affected by disease. Harvesting of Jirmale completes in Shrawan 15-Bhadra 15. This variety is successfully grown in Jhapa inside the supari garden (Timsina & Poudel, 2016)

g) **Dambersai:** this variety is cultivated in the altitude ranging from 700-1200masl. It is believed that the cultivation of this variety was started 150 years before in Bhojpur district. This variety posse’s dwarf and less tiller, leaver are short and erect the veins of leaves are seen easily. The pseudo stem possess light red with green. This variety ripens in August-September, having large capsules, more number of seeds. The fruits of this variety is comparatively sweet than other varieties (Adhikari, 2016).

h) **Ramala:** The plant is similar to Ramsai with the same height and vigour (Figure 6). The leaves are broad and slightly elongated. Tillers are similar to Ramsai. Capsules are dark pinkish in colour with around 30–40 seeds. Cultivation of this variety is restricted to a few high-altitude areas of Sikkim state, Kalimpong region of West Bengal state of India, and Taplejung district of Nepal. Flowering starts with the onset of monsoon and the capsules are ready for harvest in late October. Farmers are advised not to select this variety in the initial phase of revival. They can select this variety only if other varieties do not perform well in their farms.
i) **Madhusai**: This variety is not commercially cultivated in Nepal but cultivated in Kalimpong India. Flowering of this variety resembles to Turmeric flower that grows more from soil surface. Local scientists and farmers of India found this variety as little bit resistance to Chirke-Furke diseases. NCARP Pakhribas, dhankuta started research in Madhusai for its suitability in Nepal and for disease resistance capacity.

j) **Kantidar**: This variety is named as Kantidar due to its pin like capsule structure. Pseudostem of this variety is thin, small and red in color and narrow leaves. The capsule of this variety are small and elongated. Seed contain in each capsule is little in number. Kantidar variety can be grown up to 800-1300m altitude (Timsina & Poudel, 2016).

k) **Seremna**: This cultivar is grown in a small pocket at Hee-Gaon in west Sikkim at low altitude and is known for its high yield potential. Plant features are almost similar to Dzongu Golsai but the leaves are mostly drooping, hence named as Sharmney. Total tillers range from 30 to 49 and is not robust in nature. On an average 2–3 spikes emerge from each productive tiller with an average of 10.5 capsules per spike, each having 65–70 seeds.

<table>
<thead>
<tr>
<th>S N</th>
<th>Traits</th>
<th>Ramsai</th>
<th>Golsai</th>
<th>Saune</th>
<th>Madhusai</th>
<th>Dambersai</th>
<th>Varlane</th>
<th>Jirmale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plant height (cm)</td>
<td>65.8</td>
<td>52</td>
<td>51.4</td>
<td>45</td>
<td>62.8</td>
<td>51.4</td>
<td>44.8</td>
</tr>
<tr>
<td>2</td>
<td>Plant vigour</td>
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<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>Stem color</td>
<td>Red</td>
<td>Green</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>Leaf length (cm)</td>
<td>25.7</td>
<td>27</td>
<td>29.34</td>
<td>25</td>
<td>32.67</td>
<td>32.67</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Leaf breadth (cm)</td>
<td>6.47</td>
<td>5.38</td>
<td>6.66</td>
<td>6.12</td>
<td>6.68</td>
<td>5.92</td>
<td>5.05</td>
</tr>
<tr>
<td>6</td>
<td>Leaf color</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
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<tr>
<td>7</td>
<td>Number of adult tillers per bush</td>
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<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<td>8</td>
<td>Number of new tillers per bush</td>
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<td>5</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Susceptibility to diseases</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>10</td>
<td>Number of leaves</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>11</td>
<td>Altitude of cultivation</td>
<td>High</td>
<td>Low to Middle</td>
<td>Low to Middle</td>
<td>Low to Middle</td>
<td>High</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

8. Insect pests and their management in large cardamom

a) **Leaf caterpillar (Artona chorista)**

Initially feeds on chlorophyll content of leaf lamina from under the surface; infested portion appears like a white paper. Defoliation of the leaf takes place as the infestation advances.

**Management**

- The only way to manage this disease is to inspect the infested plant and kill the caterpillars. Farmers are advised to sprinkle bio-pesticides (cow urine with tobacco leaf juice) on the infected plants.
- Collect and destroy the hairy caterpillars.
- Set up light traps to attract and kill the moths.
- Spray Phasalone 35 EC 750 ml in 500 - 1000 L of water per ha.
b) **Shoot fly (Merochlorops dimorphus)**
These flies damage the emerging shoots. As the infestation progresses, the tip of the young shoot becomes brown and later the whole shoot dries up. New leaves do not come out in an infested shoot.

**Management**
- The way to manage this fly is to inspect the infested plants and separate them and then kill the flies.
- Remove the affected shoots at ground level and destroy them.
- Spray dimethoate 30 EC or quinalphos 25 EC 1 L.

c) **Stem borer (Glyphipteris sp.)**
Bore into the pseudo-stem above the collar region and feed on the central part of the pseudo-stem, causing dead heart. Upon close observation, minutely frass materials (fine powdery excreta or fragile perforated pseudostem produced by the activity of boring insects) can be seen outside the holes of the pseudostem.

**Management**
Farmers are advised to monitor the infected plant and destroy the stem borer at different times so as to stop its life cycle.
The infected portion of the plant should be separated and disposed in a different location.
Regulate shade in thickly shaded areas.
Spray insecticides like quinalphos 25 EC or phosalone 35 EC 1 L during March, April, May, August and September in 500 - 1000 L per ha.

d) **White grubs (Holotrichus sp.)**
Damage the base of the pseudo-stem and the rhizome part. The infested plants look yellow after its activity starts during May-October when it feeds on the rhizome part.

**Management**
To manage white grubs, farmers need to monitor the plant and kill the insect.

e) **Aphids (Mollitrichosiphum spp.)**
Aphids appear all along the newly emerging shoots and completely cover them.

**Management**
Farmers should regularly irrigate the plant and destroy the aphids wherever they appear on the plant.

f) **Capsule borer**
The holes in the capsules are prominently seen in the infested capsule and a lot of infested capsules rot and decay. The pupation of the larvae develops in the capsule and comes out from the hole after maturity.

**Management**
As a management practice, farmers are advised to clear the leaves, twigs, or weeds that appear over the fruit-bearing bushes so as to prevent different types of insects from infecting the spikes.
Spray quinalphos 25 EC 1.5 L or carbaryl 50 WP 1 kg in 500 - 1000 L of water per ha.
9. Diseases and their management in large cardamom

a) Rhizome Rot

Rhizome rot is caused by fungus *Pythium vexans, Rhizoctonia solani, Fusarium spp.* Cardamom clumps have often been found to suffer from a disease which results in gradual decline in vigor of the plants. A number of fungi appear to be involved in the rhizomes and root-rot of cardamom. The infection starts from the joint part of Pseudostem and Rhizome. After infection leaves turned to yellow color and soon dried. Pseudostem of infected bush cracked and produced thick tillers. These tillers unable to grow and starts to rot from the tip. Bright sunlight after a heavy rain stimulates to rot in a faster rate.

**Management**
- Use plants produced from tissue culture.
- Early sowing of suckers in August-September will ensure mature seedlings which are less prone to diseases during south west monsoon.
- Collect and destroy disease infected and insect damaged plant parts.
- Provide irrigation at critical stages of the crop.
- Avoid water logging.
- Regulate shade in thickly shaded areas.
- Avoid water stress during flowering stage.
- Remove and destroy collateral/alternate hosts such as castor, ginger, turmeric in the immediate vicinity.
- Encouragement of golden backed woodpecker and crow-pheasant in the plantation and installation of bird perches to attract birds of economic importance in biological control.
- Maintain optimum plant density.
- Spray/drench the soil after germination of seedlings with copper oxy chloride @ 1 g/L water
- Suckers treated with metalexil 25WP @ 2g per liter water or benomyl 25WP or bevistin 50WP or plantvex 75WP @ 2.5g per liter water and then showed. Apply sprayed of dithan Z-78 or Lonacol or Difolatan or Indofil M-45 or Mencozeb @ 2.5g per liter water at 7-10 days interval (Belbase et al., 2018).

b) Blights

This disease is caused by fungal disease *Colletotrichum gloeosporiodes, Fusarium Oxysporium, Cephalosporium Sp, Verticillium solani etc.* This disease often starts after Monsoon rain. At first brown color lesions appear in a leaves and soon changes in black surrounded by yellow. Pseudo stem changes into Black-brown color. The pseudostem breaks after heavy infection.
Figure 7: Blight of large cardamom

Management
• Destroy blight affected portions and plant debris during May i.e., before the onset of monsoon. Intensity of the disease can be reduced by providing adequate shade in the plantations.
• Maintain optimum shade levels by allowing upto 40-60% filtered light. Undertake shade management before the onset of south-west monsoon.
• As a prophylactic measure, spray Bordeaux mixture (1%) @ 500 ml per plant during May-June. Once the disease appears in the field, spray the combination of carbendazim and mancozeb (0.1%) or carbendazim (0.2%) @ 500 - 750 mL per plant. Spraying should be undertaken during August-September and the sprays may be repeated at 30 days interval for 2-3 times depending on the severity and extent of disease spread. Adequate care should be taken to ensure that the entire foliar portion is covered with the spray solution.

C) Chirkey and Furkey Disease
Chirke and Furke both are viral disease of large cardamom but shows dissimilar symptoms in plants. Chirke shows the symptoms on leaves and pseudo stem but Furke shows the symptoms on upcoming new pseudostems/suckers. These diseases can be differentiated by their symptoms on cardamom plants.

Chirke: The symptom of chirke disease are delineate by streak. Mosaic on the tender leaves with dark green streaks in the light green background of the lamina. In the rigorously affected plant the mosaic streaks coalesce and the leaf gradually turns brown and dries up subsequently. The affected clumps produce less number of flowers and cause serious yield loss. The loss was found up to 80-85%.

Furke: Pronounced stunting and formation at numerous minute tillers which fail to form inflorescence. The tillers do not grow beyond a few inches in height and appeared bushy. Yield loss found up to 94%. Furke disease do not affect other plants and limited to cardamom only.

Management
• Production and use of virus-free planting materials.
• Removal of infected host plants.
• Creating awareness, preventing the movement of diseased planting materials to check
introduction of viruses.

• Regular phyto-sanitation, removal of virus (Paudel et al., 2018)

10. Major problems in large cardamom farming in Nepal

Constraints declination in the production of large cardamom in the recent years has caused a negative impact on the trade in India (Sharma et al., 2009). Improved curing methods need to be popularized because of their better quality capsule however, the constraint lies in their high installment cost for the growers. Improper grading due to lack of grading machines has also caused famers to obtain lesser price in the market. Unorganized Marketing channel for selling quality capsules have also become a limitation (MoAC, 2008; Sharma et al., 2009).

As per the MoAD report 2015, in last 15 years only the production area and the number of the farmer has been increasing in Nepalese cardamom farming. But compared to that, production remains fluctuating in fact it is in decreasing trend from last 3 years. Consequently, production yield which measures the total production quantity per hectare has gone down from 0.61 to 0.45 (KC & Upreti, 2017). The selling price of large cardamom has gone down from NRs 2,750 per kg to NRs 1,350 per kg in last year (Kathmandu post, 2016). Apart from price and quantity, there are numerous problems which are indirectly faced by Nepalese cardamom farmers and these are the causes which lead to the declination in Price and Quantity of large cardamom in Nepal.

Table 9. Problems in Nepalese large cardamom farming

<table>
<thead>
<tr>
<th>Causes/ Problems</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology related</td>
<td>Less priority in Soil health, plant nutrients, manuring management and irrigation management, Lack of seeds of recommended varieties as per elevation, Poor knowledge among farmers regarding disease and pesticide to protect, Lack of access to the grading, drying, packing and processing technologies.</td>
</tr>
<tr>
<td>Human Resource related</td>
<td>Lack of skilled manpower in terms of research and technology generation, Available manpower are even not in right man in right Place</td>
</tr>
<tr>
<td>Financial related</td>
<td>Less investment and funding in HRD and R&amp;D in cardamom farming</td>
</tr>
<tr>
<td>Government’s policy related</td>
<td>Lack of precise policy towards cardamom farming, Less coordination, cooperation and linkage between government’s sector, Very less attention from policymaker and politician in the filed</td>
</tr>
<tr>
<td>Private/Public sector related</td>
<td>Lack of cooperation, coordination and support from an established public organization such as; FNCCI, AEC, LCEAN etc. No investment from private sectors/stakeholders or cooperatives and so on.</td>
</tr>
</tbody>
</table>

(Source: Chaudhary & Vista, 2015)

Furthermore, farmers have very limited access to the information related to cardamom farming. Such as price, quality, technologies, facilities, grants and so on. Moreover, communication between districts traders and farmers is also lacking. Therefore, sometimes local collectors are taking benefits over it. Less attention has been shown from the government side even though it has exciting and bright future which is also the other demotivating factors for the farmers.
11. Biotic and abiotic stresses and their management

Drought
- Provide irrigation in large cardamom field through channels/sprinkle irrigation
- Build construction of small ponds and lakes to collect rain water during the monsoon and apply water during the dry season.
- Follow regular weeding and maintenance of proper shade helps to reduce the competition for water and preserve available soil moisture (Chapagain, 2011).

Disease
- Remove and destroy disease infected plants in field.
- Provide pro sanitation condition in field.
- Replace old plants with new seedlings produced from disease free seeds.
- In vegetative propagation, utmost care should be given to choose the disease free parent plants.
- Apply Integrated Pest Management (IPM) and local organic pesticides to control the diseases and pests (Chapagain, 2011).
- Provide irrigation to increase the disease resistance capacity
- Choose proper species for specific climatic condition
- Develop disease resistant varieties

Rhizome uplift/ exposure to air
- Cover uplifted part of rhizome with soil, organic fertilizer and plant residues
- Shifting of entire bush by digging a bigger pit in nearby area (Chapagain, 2011).

Old plant
- Replacement by the pure, high productive, disease free, and suitable species seedlings produced from seeds
- In vegetative propagation, the sucker should be chosen from the young, high productive and disease free parents.
- Establishment of nursery in different parts of the country to supply enough seedlings to farmers (Chapagain, 2011).

Landslide
- Plantation and increase of vegetation cover in landslide prone areas
- Application of bioengineering to prevent and recover landslides
- Proper drainage management in farm (Chapagain, 2011).

Soil fertility
- Application of external organic fertilizer (Animal manure, compost, oil cake, etc) (Chapagain, 2011).

Water logging
- Maintenance of drainage system in the flat and swampy areas
- Thinning of shade by removing few shade trees and weeds (Chapagain, 2011).

Hail, Frost and Snow
- Proper maintenance of shade trees can minimize the impact of hail, frost and snow (Chapagain, 2011).

Lack of knowledge on framers.
- Regular training and capacity buildup activities and materials to the farmers about
scientific farming, crop management and dealing with hazards.

- Regular technical and expert support to the farmers (Chapagain, 2011).

**Whole crop damage**

- Shifting to the new crop: Tea, Aamriso (vegetation to make brooms), ginger are the other possible cash crops in the region
- Millet, Maize, Potato, Rice, etc are the traditional crops that can be grown in the region.
- Exploration of possibilities of other crops in the region
- Strengthening the capacity of the farmers to cope with the disasters by means insurance policy, establishing cooperatives and saving schemes (Chapagain, 2011).

12. Development practices in large cardamom farming

In recent years, farmers have taken the initiative of themselves and have experienced several development methods to grow large cardamom. However, these methods cannot produce surprising results. In some way, the production and quality of the large cardamom has decreased in recent years along with the sale price of large cardamom that has fallen more than 50 percent in some years and in a downward trend (Baskota, 2016). Some of the methods of development that the farmers carried out in large cardamom production have been presented below.

12.1 Development of local cultivars according to altitude

In past years, farmers have tried to develop a lot of local varieties in large cardamom production. There are many local varieties that are currently cultivated by Nepalese farmers. They are Seremna, Bharlangey, Chibesai, Ramsai, Ramla etc. These varieties can be grown at 400 masl - 2300 masl altitude.

12.2. Weather smart practices

In line with this practice, farmers change cultivating time and planting cultivars, which is considered to be strong in weather conditions. In addition, it includes valuation of rainfall requirement and other measures that deals with various problems, for example; snow and ice

12.3. Soil nutrient and Water management activities

In recent years, as farmers emphasize soil nutrients, they began to produce manures from arable crops and appropriate application of these. In addition, farmers are now involved in the production of green manure, compost manure and weeds and provide enough nutrients for the large cardamom plants. In addition, water management activities focus primarily on efficient and efficient use of water at different stages of plant development. In addition, effective use of available water management techniques are irrigation, mulching, shadow management. These methods that farmers implement to increase production

12.4. Agro forestry Concept

The concept of agroforestry is developed and managed by the Nepal Agro-forestry Foundation (NAF) in the advantage of Himalayan farmers, so it can satisfy self-sufficient requirements for wood, animal feed, culinary wood, etc. In addition, this concept is developed primarily for Hill farmers who face shortages of agricultural fertilizers and a shortage of nutrition feeds for livestock. The concept of agroforestry is a system of farming methods that combines planting of tress, crops and livestock rearing. In principle, in this concept, farmers use fodder and fodder crops and trees for livestock, and animal fertilizers
feed crops. In addition, this concept helps to minimize deforestation, reduce soil erosion and maintain soil fertility. As a result, it helps support agricultural production in hilly areas.

13 Marketing of large cardamom in Nepal

When large cardamom capsules are cleaned, cured and sorted, farmers can continue to market. Many farmers sell their products directly to local middle man or nearby cities. On the other hand, the broker visits each farm locally, buys and collects cardamom from each farmer on the road. Then, the broker sells the product to local merchants or wholesalers in India in Siliguri. This method is common in areas where there is little or no access to roads and especially to small farmers, who do not have the time or money to bring their products to the market. In this case, the farmer is disadvantaged because he has to provide the cardamom to the extent that the broker proposes to pay, which is usually less than what he would get directly to the merchant. When in the hands of a local or external wholesaler, cardamom is sold in a superior local, national and international market. Although India is still the largest consumer of the world's largest consumer of large cardamom in the world, a huge percentage is also sold internationally. The second largest consumer of large cardamom is Pakistan, followed by United Arab Emirates, United Kingdom, United States of America, Canada, and South Africa.

13.1 Export Markets

Earlier the main market hub for large cardamom was Siliguri in India. In the last 10 years the market hub has shifted to Kolkata and Delhi. About 50 % of Nepali large cardamom moves to other countries (particularly to Pakistan) from Kolkata and Delhi through Mumbai and Amritsar. Payment is cost and freight (CFR)—Delhi. Major market centers for large cardamom (Munakarmi & Gautam, 1988)

India:
- Siliguri: Alupatti New Market
- New Delhi: Garodia Market
- Kolkata: Amartola and Armenian Streets

Pakistan:
- Karachi: Jodia Market
- Lahore: Akbari Mandi
- Rawalpindi: Ganj Mandi

Bhutan:
- Phuntsholing Auction Market

Nepal:
- Fikkal
- Hile/Dhankuta
- Birtamod

Foreign markets accept 10 kg and 25 kg bags of plastic-coated jute. When shipping, five of the 10 kg bags are packed in one large plastic bag and two of the 25 kg bags are packed in one large plastic bag. Therefore, the shipment is always in 50 kg plastic bags. Some consignments are also packed in 50 kg jute bags depending on the buyer’s requirements.
13.2. Analysis of Marketing Channel/ Actor

The marketing of cardamom starts from production farm inside the district. Marketing has shown dual phenomenon: farmers sell their product by themselves to buyer of local agents, district and Birtamod traders on the other hand traders from district through their agents or directly themselves and supply to the destination market in Birtamod.

Figure 8. Marketing channel of large cardamom in Nepal

13.3. Local collectors
Local collectors are the agents of large collectors or traders in district-level market centres, who themselves work on behalf of district traders or wholesalers in Birtamod. In each district, clusters of villages have their own collection centres. There are normally 3-10 such village collection centres in each district. Local collectors play the following roles in the cardamom business:

- Meet farmers in village collection centres and discuss the prospects for collection of large cardamom during the season (September to November) with a view to assessing the overall business forecast and possible price trends.
- Provide assurance of buying large cardamom during the season.
- Provide feedback and farmers’ views to district-level traders.
- Provide pre-harvest advance payment in cases where farmers need money in advance.
- Advise on the types of product processing and preparation including tail cutting, grading and packaging required by district level traders.
- Collect harvested products from farmers or at the collection centres.
- Transport the products to the district market centre.
- Arrange payments to farmers.

13.4. District traders
Each district has 2-5 shopping centers with many district merchants who own large cardamom. Products are transported and collected at district market centers from village gathering centers. Local collectors play an important role both in the transport of cold store products and the transfer of products to district traders.

The major functions of district traders include:

- Mobilize local collectors in villages and village collection centres to develop linkages with farmers and exchange information on pre-harvest production status and stocks with farmers.
- Make provision for advance payments to farmers for purchase after harvesting.
• With the help of local collectors from village collection centres, make transportation arrangements to district markets.
• Arrange cleaning, grading, repackaging and storage until the product is demanded by wholesalers in Birtamod.
• Determine the final price of large cardamom based on the Birtamod price.
• Make final payments to farmers through local collectors.
• Arrange transportation of product up to wholesalers at Birtamod.

Reasons for the existence of limited number of exporters of large cardamom
• There are only two transporters who can manage safe transportation of goods to Delhi.
• Exporters have to prepare invoices as per the advice of the transporter and the importing party.
• There are many hassles en route to Delhi and informal costs come to INR 25 per kg.
• There are many risks associated with transportation and export of large cardamom from Nepal to India. Indian buyers are prepared to take the risks and transport the goods, even without an invoice, which is not possible for Nepali traders.
• There is a provision of 4.5 % state movement tax in India. It is not possible for Nepali traders to compete in the market if these types of taxes have to be paid on value. Formal export is possible only if such tax is specific or imposed by quantity.
• It is also not possible for Nepali traders to insure the consignment as (Indian) importers wish to have undervalued invoices.
• It takes one month for a consignment to travel through Kolkata to Karachi and during this time prices may fluctuate, potentially resulting in a huge loss either to buyer or seller.
• It has not been possible to establish business relationships and trust with buyers in Pakistan and Bangladesh.
• The Customs tariff on large cardamom in Bangladesh is more than 54 % for Nepal, while the tariff imposed on Bhutan for large cardamom is substantially waived.
• India has waived all types of tax on the movement of Bhutanese products through the territories of India.

<table>
<thead>
<tr>
<th>SN</th>
<th>Country</th>
<th>2009 Quantity (t)</th>
<th>2009 Value (USD.000)</th>
<th>2010 Quantity</th>
<th>2010 Value</th>
<th>2011 Quantity</th>
<th>2011 Value</th>
<th>2012 Quantity</th>
<th>2012 Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>World</td>
<td>10008.7</td>
<td>19963.4</td>
<td>4755.7</td>
<td>20735.6</td>
<td>4120.7</td>
<td>30387.4</td>
<td>4120.7</td>
<td>30387.4</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>9807.1</td>
<td>19549.4</td>
<td>4693.1</td>
<td>20565.7</td>
<td>4101.0</td>
<td>30101.1</td>
<td>5879.7</td>
<td>45792.0</td>
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<td>265.0</td>
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<td>53.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>U.A.E.</td>
<td>81.1</td>
<td>149.0</td>
<td>30.0</td>
<td>91.1</td>
<td>10.6</td>
<td>87.1</td>
<td>18.0</td>
<td>195.4</td>
</tr>
<tr>
<td>5</td>
<td>Singapore</td>
<td>-</td>
<td>-</td>
<td>11.3</td>
<td>25.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Japan</td>
<td>-</td>
<td>-</td>
<td>0.3</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Ukraine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.0</td>
<td>117.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>China</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
<td>77.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Canada</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>15.0</td>
</tr>
<tr>
<td>10</td>
<td>Nicaragua</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.1</td>
<td>0.7</td>
</tr>
</tbody>
</table>

(Source: TEPC, 2013)
### Table 11 Export of Large Cardamom from Nepal over one decade (2008/09 to 2017/18)

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity, kg</th>
<th>Value Rs.,</th>
<th>Export Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008/09</td>
<td>9,820,454</td>
<td>1,343,571,227</td>
<td>India, Pakistan, Bangladesh, UAE</td>
</tr>
<tr>
<td>2009/10</td>
<td>5,783,372</td>
<td>1,171,597,401</td>
<td>India, Pakistan, UAE</td>
</tr>
<tr>
<td>2010/11</td>
<td>4,821,971</td>
<td>2,043,715,936</td>
<td>India, China, Singapore</td>
</tr>
<tr>
<td>2011/12</td>
<td>5,311,393</td>
<td>3,496,733,092</td>
<td>India, UAE, Canada, UK, Ukrain</td>
</tr>
<tr>
<td>2012/13</td>
<td>5,102,811</td>
<td>3,849,994,604</td>
<td>India, China, Nicaragua, Korea</td>
</tr>
<tr>
<td>2013/14</td>
<td>4,913,469</td>
<td>4,267,865,241</td>
<td>India, China</td>
</tr>
<tr>
<td>2014/15</td>
<td>2,930,339</td>
<td>3,839,810,569</td>
<td>France, France, Germany</td>
</tr>
<tr>
<td>2015/16</td>
<td>3,414,638</td>
<td>4,596,322,024</td>
<td>India</td>
</tr>
<tr>
<td>2016/17</td>
<td>3,425,120</td>
<td>3,871,823,135</td>
<td>France, France</td>
</tr>
<tr>
<td>2017/18</td>
<td>5,396,011</td>
<td>4,844,295,245</td>
<td>India, Bangladesh, UAE, China, Germany</td>
</tr>
</tbody>
</table>

(Source: TEPC, 2018)

### 14. Value chain analysis and large cardamom in Nepal

Value chain is conceptualized as the full range of activities required to bring a product or service from conception through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final customers and disposal after use (Kaplinsky & Morris, 2000). Past studies related to value chain and supply chain analysis for different vegetables, fruits and cash crops in Nepal has ignored the consumers’ perspective in the analysis (Timsina et al., 2012; Shrestha et al., 2012; Chapagain et al., 2011). However, recent value chain study in Nepal started to consider consumer perspective (Timsina et al., 2016a, 2016b, 2018). Therefore, it is suggested to carry out value chain study combining both producers as well as consumer’s perspective. Moreover value chain analysis should include social, economic and environmental dimensions along with its enabling environments for its sustainability. The development of Nepal’s large cardamom quality and sustainability requires changes throughout the value chain. While production moves from one chain actor to another, it gains in the form of price increases along with value addition. After the large cardamom harvest, the value chain actors consists of farmers, collectors, traders and exporters. The main processing steps of large cardamom that are happening in the current market are hardening, tail cutting (Figure 9), grading and packaging (Figure 10). The common value map of large cardamom in Eastern Nepal is given in figure 11.

![Figure 9. Tail cutting of large cardamom](image1.png)

![Figure 10: packaging of graded large cardamom](image2.png)
15. Analysis of Large Cardamom from business perspective

15.1 Theoretical description

To analyze the profitability of cardamom, we used discounted financial evaluation measure like Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) and undiscounted measures like payback period and Rate on Investment (ROI). An on-farm benefit-cost analysis is the most appropriate analytical tool to measure the overall profitability of farming operation of farmers. For financial evaluation of perennial crop like Large Cardamom we require a stream of cost incurred over the years and the returns realized during its life period. As the study is confined to a few locations, a life cycle representing the entire life period of the crop is practically difficult. To overcome this, different costs and return of the crop under different altitude are obtained through a survey and secondary sources (BS, 2017; ABPMDD, 2016). The details explanation of NPV, IRR and BCR are given below:

**Net Present Value (NPV)**

NPV is the cumulative present worth of positive and negative investment cash flow using a specified rate to handle the time value of money. It is a core component of corporate budgeting. It is a comprehensive way to calculate whether a proposed project will be value added or not.
The formula for NPV can be written as:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

Where:
- \(C_t\) = net cash inflow during the period \(t\)
- \(C_0\) = total initial investment costs
- \(r\) = discount rate, and
- \(t\) = number of time periods

Any NPV greater than 0 (zero) is a value-added project, but in the decision-making process among competing projects, the one with the highest NPV is the one that should be chosen. One pitfall in this approach is that while financially sound from theory point of view, an NPV calculation is only as good as the data driving it.

**Benefit Cost Ratio (BCR)**

BCR is a figure that is used to define the value of a project versus the money that will be spent in doing the project in the overall assessment of a cost-benefit analysis. This ratio provides a value of benefits and costs that are represented by actual spent and gained. By definition the BCR should be expressed using present values that are discounted.

**Benefit Cost Ratio = PV of Net Positive Cash Flow/PV of Net Negative Cash Flow**

A BCR equal to one suggests a cost-neutral project. The business will neither make nor lose money if it green-lights this scheme. A BCR greater than one is a positive return. The business should consider moving forward with this project, especially if the BCR is significantly greater than one. A BCR less than one means the costs outweigh the benefits and the project would run at a loss.

**Internal Rate of Return (IRR)**

IRR is a metric used in capital budgeting to estimate the profitability of potential investments. IRR is a discount rate that makes the NPV of all cash flows from a particular project equal to zero. IRR calculations rely on the same formula as NPV does.

$$NPV = 0 = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_n}{(1+IRR)^n} = \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t}$$

For calculating the IRR with the help of this IRR formula, the NPV value is set to zero and then the discount rate is found out. This discount rate is then the IRR value. It should be calculated either trial and error method or using some software system programmed to calculate the IRR.

**Undiscounted Measures**

We used undiscounted measures of financial analysis such as Return on Investment (ROI) and payback period. The calculation method and formula are given below

**Return on Investment (ROI)**

ROI is a performance measure, used to evaluate the efficiency of an investment or compare the efficiency of a number of different investments. ROI measures the amount of return on an investment, relative to the investment’s cost. To calculate ROI, the benefit of an investment is divided by the cost of the investment. The result is expressed as a percentage or a ratio.

$$ROI = \frac{(Gain \ from \ Investment - Cost \ of \ Investment)}{Cost \ of \ Investment}$$
**Payback Period**
The payback period is the number of years it takes to recover an initial investment outlay, as measured in after-tax cash flows. It is an important calculation used in capital budgeting to help evaluate capital investments. For example, if a payback period is stated as "2.5 years," it means it will take two-and-a-half years, or 30 months, to receive your entire initial investment back.

\[
\text{Payback Period} = \frac{\text{No. of Year before full recovery}}{\text{Cash flow in the year of first positive cumulative cash flow}} + \frac{\text{Absolute value of last negative cumulative cash flow}}{\text{Cash flow in the year of first positive cumulative cash flow}}
\]

**15.2 Price trend analysis of large cardamom over one decade in Birtamod market**

The price trend of large cardamom at Birtamod market is presented in figure 12. The price was 300 per kg in 2006/07 where it was increased to 1750 in 2016/17. The trend shows the gradual increase in price until 2012/13 but it was increased sharply in 2013/14 and fall gradually in subsequent year. The fluctuation in prices is determined by international market. Majority of the traders at Birtamod market get informed about price from Siliguri market. Sometimes traders also creates product shortage in the market to get higher price, which was an example of price increased in 2013/14 (communication with chairperson federation of large cardamom entrepreneurs Nepal, 2018).

**Figure 12. price trend of large cardamom at Birtamod market**

**15.3 Estimation of income from large cardamom production**
The income from cardamom production was estimated using production data received from field survey and secondary data of agribusiness promotion and marketing development directorate. It is reported that the 20% of potential yield receives at 4\textsuperscript{th} year and after fourth year potential yield (100%) receives until 16 years (BS, 2017). So the estimation was done accordingly. For price estimation, 3 years moving average was calculated from 2006/07 to 2016/17 and compound annual growth rate (CAGR) was calculated (4.48 percent per annum). Based on obtained CAGR, the price was estimated using 3 years prices (2013/14 to 2015/16) as base year price. The details of revenue is given in Table 12.
Table 12: Revenue estimation for large cardamom production over 10 year’s period

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield</th>
<th>Price</th>
<th>Total Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base year (2013/14)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Year 1 (2014/15)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Year 2 (2015/16)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Year 3 (2016/17)</td>
<td>200</td>
<td>1716</td>
<td>343178</td>
</tr>
<tr>
<td>Year 4 (2017/18)</td>
<td>650</td>
<td>1793</td>
<td>1165518</td>
</tr>
<tr>
<td>Year 5 (2018/19)</td>
<td>650</td>
<td>1874</td>
<td>1217967</td>
</tr>
<tr>
<td>Year 6 (2019/20)</td>
<td>650</td>
<td>1958</td>
<td>1272775</td>
</tr>
<tr>
<td>Year 7 (2020/21)</td>
<td>650</td>
<td>2046</td>
<td>1330050</td>
</tr>
<tr>
<td>Year 8 (2021/22)</td>
<td>650</td>
<td>2138</td>
<td>1389902</td>
</tr>
<tr>
<td>Year 9 (2022/23)</td>
<td>650</td>
<td>2235</td>
<td>1452448</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>8171838</td>
</tr>
</tbody>
</table>

15.4 Expenditure for large cardamom production

The cost for cardamom production was estimated using production cost data received from field survey and secondary data of agribusiness promotion and marketing development directorate. Therefore, from base year to third year, actual expenses was collected through field level Focus group discussion. For the cost items from fourth year onwards 10% addition in production cost of previous year was reported (ABPMDD, 2015). So the estimation was one accordingly. The details of cost estimation is given in Table 13

Table 13: Details of cost estimation for large cardamom production over 10 years

<table>
<thead>
<tr>
<th>SN</th>
<th>Particulars</th>
<th>Unit(s)</th>
<th>Quantity</th>
<th>Rate</th>
<th>Total NRs. Year 1 (2014/15)</th>
<th>Total NRs. Year 2 (2015/16)</th>
<th>Total NRs. Year 3 (2016/17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Variable Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Human Labor for land preparation, digging pit, transport, manuring, planting, irrigation, intercultural, harvesting and curing)</td>
<td>Days</td>
<td>250.0</td>
<td>360</td>
<td>90,000</td>
<td>36,000</td>
<td>36,000</td>
</tr>
<tr>
<td>B</td>
<td>Large Cardamom Saplings</td>
<td>No.</td>
<td>6000</td>
<td>5</td>
<td>30,000</td>
<td>5,000</td>
<td>3,000</td>
</tr>
<tr>
<td>C</td>
<td>Alnus saplings</td>
<td>No.</td>
<td>400</td>
<td>10</td>
<td>4,000</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Manures/Compost</td>
<td>kg</td>
<td>12000</td>
<td>1.5</td>
<td>18,000</td>
<td>12,000</td>
<td>14,000</td>
</tr>
<tr>
<td>E</td>
<td>Fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>DAP</td>
<td>kg</td>
<td>120</td>
<td>50</td>
<td>6,000</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>G</td>
<td>Urea</td>
<td>kg</td>
<td>60</td>
<td>30</td>
<td>1,800</td>
<td>2,100</td>
<td>2,100</td>
</tr>
<tr>
<td>H</td>
<td>Potash</td>
<td>kg</td>
<td>60</td>
<td>36</td>
<td>2,160</td>
<td>2,200</td>
<td>2,200</td>
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</table>
### Table

<table>
<thead>
<tr>
<th></th>
<th>Irrigation pipe 1 inch</th>
<th>Meter</th>
<th>800</th>
<th>55</th>
<th>44,000</th>
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<tbody>
<tr>
<td>J</td>
<td>Plant protection chemicals</td>
<td>NRs.</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>K</td>
<td>Orchard Management</td>
<td>NRs.</td>
<td>6,000</td>
<td>6,000</td>
<td>6,300</td>
</tr>
<tr>
<td>L</td>
<td>Curing and Processing</td>
<td></td>
<td></td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td>M</td>
<td>Land lease/rent</td>
<td></td>
<td>36,000</td>
<td>36,000</td>
<td>40,000</td>
</tr>
<tr>
<td></td>
<td>Total Variable cost</td>
<td></td>
<td>241,960</td>
<td>105,000</td>
<td>108,800</td>
</tr>
</tbody>
</table>

### Fixed Cost

<table>
<thead>
<tr>
<th></th>
<th>Land tax</th>
<th>NRs.</th>
<th>170</th>
<th>170</th>
<th>200</th>
<th>200</th>
</tr>
</thead>
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<tr>
<td>b</td>
<td>Water Tax</td>
<td>NRs.</td>
<td>200</td>
<td>200</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>C</td>
<td>Repair and maintenance</td>
<td>NRs.</td>
<td>300</td>
<td>300</td>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td>D</td>
<td>Depreciation</td>
<td>NRs.</td>
<td>700</td>
<td>770</td>
<td>847</td>
<td>932</td>
</tr>
<tr>
<td></td>
<td>Total Fixed cost</td>
<td></td>
<td>1370</td>
<td>1440</td>
<td>1697</td>
<td>1881.7</td>
</tr>
<tr>
<td>3</td>
<td>Total Cost (1+2)</td>
<td></td>
<td>243,330</td>
<td>106,440</td>
<td>110,497</td>
<td>219,382</td>
</tr>
</tbody>
</table>

### Financial analysis for large cardamom enterprises over 10 year’s period

For determining the performance and suitability of any business, enterprises, projects, and any types of financial entities, financial analysis is very important. Here we did financial analysis to see the profitability of large cardamom enterprise in the context of Nepal. We used both discounted measures such as Benefit Cost Ratio (BCR), Net Present Value/Worth (NPV/W), Financial Internal Rate of Return (FIRR) and undiscounted measures such as Pay Back Period (PBP) and Rate on Investment (ROI) to analyze the financial condition of the cardamom enterprises. If a project has a BCR that is greater than 1, the project will deliver a positive NPV and will have IRR above the discount rate used in the calculations. If the BCR is equal to 1, the ratio indicates that the NPV of expected profits equal the costs. If a project's BCR is less than 1, the project's costs outweigh the benefits and it should not be considered. In our case, the BCR at 12% discount factor (DF) is 2.74, which indicates that the project's benefits outweigh its costs. Moreover, farmers could expect NRs 2.74 benefits for each NRs 1 of its cost. NPV compares the value of a rupee today to the value of that same rupee in the future, taking inflation and returns into account.

If NPV is positive, that means, the value of the revenues is greater than the costs. Our results shows NVP NRs 2,545,013 at 12% DF, which means cardamom enterprises is viable. IRR is the discount rate which is used in capital budgeting that makes NPV equal to zero. In general if IRR is higher the more desirable is the project. IRRs can also be compared against prevailing rates of return in the securities market. If a firm can't find any projects with IRRs greater than the returns that can be generated in the financial markets, it may simply choose to invest its retained earnings into the market. In our project analysis, 64% IRR shows good indication of the project which is higher than the market interest rate. PBP is time required for the amount invested in an enterprises to be repaid by the net cash flow generated in the business. In our analysis PBP is 5.36 which means project will be repaid by 5.36 years. ROI provides a direct and easily understood measure of investment profitability. Generally, any
positive ROI is considered a good return. This means that the total cost of the investment was recovered in addition to some profits left over. In our case ROI is 121.5% means good return.

Table 14: Details of financial analysis of large cardamom enterprises over a decade

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Income (cash inflow)</th>
<th>Total Expenditure (cash outflow)</th>
<th>Net Benefit</th>
<th>DF at 12%</th>
<th>Discounted benefit at 12%</th>
<th>Discounted cost at 12%</th>
<th>Net benefit at 12%</th>
<th>Cumulative Cash Flow (undiscounted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base year</td>
<td>243,330</td>
<td>(243,330)</td>
<td>1.00</td>
<td>0</td>
<td>243,330</td>
<td>243,330</td>
<td>(243,330)</td>
<td>0</td>
</tr>
<tr>
<td>Year 1</td>
<td>106,440</td>
<td>(106,440)</td>
<td>0.89</td>
<td>0</td>
<td>95,036</td>
<td>(95,036)</td>
<td>(338,366)</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>110,497</td>
<td>(110,497)</td>
<td>0.80</td>
<td>0</td>
<td>88,088</td>
<td>(88,088)</td>
<td>(426,453)</td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td>219,382</td>
<td>123,796</td>
<td>0.71</td>
<td>244,267</td>
<td>156,152</td>
<td>88,116</td>
<td>(338,337)</td>
<td></td>
</tr>
<tr>
<td>Year 4</td>
<td>241,320</td>
<td>924,198</td>
<td>0.64</td>
<td>740,708</td>
<td>153,363</td>
<td>587,345</td>
<td>249,007</td>
<td></td>
</tr>
<tr>
<td>Year 5</td>
<td>265,452</td>
<td>952,515</td>
<td>0.57</td>
<td>691,107</td>
<td>150,625</td>
<td>540,482</td>
<td>789,490</td>
<td></td>
</tr>
<tr>
<td>Year 6</td>
<td>291,997</td>
<td>980,778</td>
<td>0.51</td>
<td>644,827</td>
<td>147,935</td>
<td>496,893</td>
<td>1,286,382</td>
<td></td>
</tr>
<tr>
<td>Year 7</td>
<td>321,197</td>
<td>1,008,853</td>
<td>0.45</td>
<td>601,647</td>
<td>145,293</td>
<td>456,354</td>
<td>1,742,736</td>
<td></td>
</tr>
<tr>
<td>Year 8</td>
<td>335,316</td>
<td>1,036,586</td>
<td>0.40</td>
<td>561,358</td>
<td>142,699</td>
<td>418,660</td>
<td>2,161,396</td>
<td></td>
</tr>
<tr>
<td>Year 9</td>
<td>388,648</td>
<td>1,063,800</td>
<td>0.36</td>
<td>523,767</td>
<td>140,150</td>
<td>383,617</td>
<td>2,545,013</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8,171,838</td>
<td>2,541,579</td>
<td>5,630,259</td>
<td>4,007,682</td>
<td>1,462,669</td>
<td>2,545,013</td>
<td></td>
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</tr>
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ROI 121.5%

PBP 5.36 year

NPV at 12% 2,545,013

IRR 64.1%

BCR 2.74


Although the market of large cardamom is relatively small and concentrated in India and Pakistan, it is a lucrative business for all value chain actors: it is a major cash crop for more than 67,000 farmers in the hilly regions and 40 wholesalers in Birtamod, the regional trading hub. Government of Nepal have selected large cardamom as priority sector part of the Nepal Trade Integration Strategy (NTIS 2016).

The draft of the large cardamom policy 2073 is being reviewed by MoAD. National economic plans, such as the 13th and 14th plans, which ended in July 2016, are expected to support the growth of large handheld cash crops such as tea, large cardamom and coffee. The 2015 Agriculture Perspective Plan (1995 was completed in 2015). However, its sustainability is planned by the Agriculture Development Strategy (ADS) 2015 and the large cardamom is one of the cash crops that prioritize the plans, strategies and programs for MoALD. Important programmes under the 14th Plan include:

13.4.1 Trade promotion programmes
13.4.2 Trade, information and private sector support programmes
13.4.3 Nepal Trade Integration Strategy (NTIS) programme
13.4.4 Trade infrastructure, logistics and procedural development

The Ministry of Commerce (MoC) launched NTIS 2010 and found large cardamom that was included in one of 19 products exported from Nepal. The main priorities for a large cardamom were continued in NTIS 2016. The government recently implemented several programs to develop a large cardamom under NTIS. Key programs include programs aimed at using low-energy dryers for grass-roots farmers in the Panchatar, Sankhhuwasava, Terhathum, Bhojpur and Taplejung areas. MoC's 2015 Trade Policy places export crops, including large cardamom, at the forefront. MoAD has regular cardamom development programmes including technical support to farmers, distribution of disease free saplings, etc. through the respective District Agriculture Development Offices (DADOs) at Fikkal. Bima Samiti has already developed insurance product for cardamom insurance. Nepal Agricultural Research Council (NARC) is conducting a routine research program in Pakhrribas to develop varieties for large cardamom and to acquire agricultural skills.

17. Conclusion and way forward
Large cardamom, an important aromatic spice, is very much preferred in many domestic kitchens and abroad, especially in South Asia. Large cardamom is important for the medicinal value; it would be possible to have other beneficial health compounds that have not yet been identified. Whole or powdered cardamom, essential oil and oleoresins have a much wider application in food cuisines and pharmaceutical drugs. The large cardamom sector has significant potential for socio-economic impacts for Nepal due to the growth in the domestic market and exports. It is commercially cultivate in Nepal. The financial analysis of large cardamom over a decade shows its financial viability to run this business. However, advanced production, harvesting, post-harvest technologies and its direct linkage should be explored. The Issues and challenges that can directly link Nepalese cardamom to Delhi or other international market should be identified and act accordingly. Agro economic prospects should focus on market expansion and market values during the research and development of large cardamom.

Government should produce and/or trained technical manpower for the delivery of extension services for the production, processing and quality control in the farmer’s level. The local government and provincial government should be responsible for the availability of disease free saplings to the grower farmers and emphasis should be given to the tissue culture. Establishment of infrastructure like collection shed at local level and Auction market and Warehouse at main trading hub like Birtamod. The modified drying Bhattis should be extended to the grower farmers with demonstration by the local government as well as provincial government. Price intelligence should be made strong equipped so as they could deliver price information to traders as well as farmers level in daily basis. The research institution like NARC should develop appropriate high yielding varieties suitable to different biophysical domains of Nepal. Similarly, the measures to overcome the Chhirkey, Furkey, Rhizome rot and disease and pest should be developed. Market study should be done so as how market link should be developed to the international market developed. Irrigation technology should be developed so as flood irrigation should be minimized to reduce the dispersal of soil born disease and maximum utilization of drying water resources. Grower farmers should be aware about the insurance policy in large cardamom and it should be regulated through special incentive package.
Acknowledgement

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REFERENCES


