

# Growth Trend Analysis of Large Cardamom in Nepal

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## Abstract

*Large Cardamom is one of the oldest native spices and cash crops of Nepal. It is prioritized exportable commodity as Nepal is the largest producer and exporter in the world. This study analyzes the trend of area, production and productivity of large cardamom and suggests possible options for its improvement. The study was focused at three levels; central, provincial and district. As per the availability of secondary data for central level analysis, 23 years data and for provincial and local level 12 years data were used. Primary information was collected from three focus group discussion, six key informant surveys and 30 expert consultations. Compound annual growth trend was calculated using regression analysis. The study shows that central level growth rates in the area, production and productivity was 0.53 ( $p=0.000$ ), 0.49 ( $p=0.44$ ) and -0.04 ( $p=0.83$ ), respectively. Among six cardamom producing provinces, province no. 1 represents 92.8% of the total cultivated area of the country but the compound annual growth rate of area, production and productivity was found negative with values -0.073 ( $p=0.64$ ), -0.82 ( $p=0.152$ ), -0.74 ( $p=0.19$ ), respectively. Similarly, area, production, and productivity of the Ilam district are decreasing with -4.133 ( $p=0.000$ ), -5.493 ( $p=0.000$ ), and -1.419 ( $p=0.201$ ) percent, respectively. These results show the poor growth of large cardamom in Nepal. Therefore, research and development authorities have suggested for the development of variety, improved package of practice, production of disease and insect free saplings, control measures of major pests and diseases and dissemination of such technologies among the growers.*

**Keywords:** Area, Compound Annual Growth Rate, Production, and Productivity.

## Introduction

Large Cardamom (*Amomum Subulatum Roxburgh*) is a perennial herbaceous crop of Zingiberaceae family, under the order Scitaminae. It is known as *Alaichi* (अलैची) in Nepali, *Badi Alaichi* in Hindi and renowned as black gold, black cardamom, queen of spices. It is evergreen, perennial, herbaceous plant grown in north facing hill slope. It is most important cash as well as spice crop of Himalayan region including Nepal, India (Sikkim and Darjeeling hills) and Bhutan (Sharma et al. 2000). Sikkim is the largest producer of large cardamom in India and the second largest in the world, after Nepal (Pratap, et.al. 2014). Large cardamom (LC) is a climate sensitive crop as it strictly requires cool, moist soil, and humid condition under shaded area (Yadav et.al. 2015).

It is believed that in ancient times the wild LC plant was originated in Sikkim and Darjeeling states in India and in eastern Nepal. The Nepali workers to India introduced new cardamom plants from Sikkim during 1865. In 1830, LC was cultivated by farmers in four districts of Nepal: Ilam, Taplejung, Panchthar and Bhojpur (ITC, 2017). However, commercial cultivation in Nepal started from Ilam district in 1953. Later in 1975, Cardamom Development Centre (CDC) was established for the development of LC in Nepal (MoCS, 2010). Subsequently, cultivation of LC is spreading to the suitable areas of hilly districts of Nepal over times. Presently, its cultivation has reached over 51 districts (MoALMC, 2017) which was 41 in 2013/14 (MoAD, 2014) and 37 in 2007/08 (MoAC, 2008). According to the Ministry of Agricultural and Livestock in 2016/17, it was estimated to cover 17,002 ha of which 12,508 ha under productive area with production of 6,521 tons and productivity of 0.521 t ha<sup>-1</sup>.

LC is one of the major export potential crops of Nepal listed by NTIS 2010 (MoCS, 2010) and is also the major source of income to the hills farmers. Economic yield of LC starts from 3rd years onward after planting and its

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optimal yield period is 8-10 years. The total life span of the plants is estimated to be around 20-25 years. According to traders, Nepali LC is preferred over Indian due to its quality. It could be further enhanced by undertaking value adding activities like calyx (tail) cutting, grading by size, and cleaning which at present are mostly done in the market of Siliguri, India (ITC, 2017).

Looking all these scenarios, the growth trend of LC in terms of area, production, and productivity has not yet been scientifically studied in Nepal. Therefore, this study has been done to analyze the Compound Annual Growth Rate of LC in Nepal at central, provincial and district level.

## Methodology

### Data Collection

The majority of data used in this paper were from secondary sources particularly publications of Ministry of Agriculture and Livestock Development (MOALD), Nepal Agricultural Research Council (NARC), National Spice Crop Development Program (NSCDP), Cardamom Development Centre (CDC), Trade and Export Promotion Centre (TEPC), Nepal Trade Integration Strategy (NTIS), and International Trade Centre (ITC). Three focus group discussion (FGD) and six key informant surveys (KIS) were also conducted with LC growers of Taplejung, Panchthar and Ilam districts. The personnel communication was also made for the expert consultation with stakeholders including, DADO, traders, Federation of Large Cardamom Entrepreneurs Association Nepal (FLCEAN), Governmental and Non-Governmental officials working in the research and development of LC in Nepal.

### Data Processing

The information collected from the different sources was coded, tabulated and analyzed using Microsoft Excel for calculating national, provincial and district level in statistics. Compound Annual Growth Rate (CAGR) of area, production and productivity were calculated using regression analysis over the years. The detail descriptions of CAGR are given below:

### Model used for Compound Annual Growth Rate

Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to determine the trend of a particular variable over a period of time (Kumar et al. 2014). As it indicates the performance of the variable under consideration, it can be used to make interpretations and to evolve policy decisions (Timsina et.al.2015).

The exponential compound annual growth rates are estimated by using log linear functions on the time series data of area, production and productivity for LC. The semi log exponential functional form is used to analyze the trend in growth rate, which is one of the appropriate functional forms to estimate the growth rate. Hence, the growth rate is estimated by using the following semi log functional form:

$$\log Y_t = a + bt \dots\dots\dots (1)$$

This equation (1) can be elaborated in details as:

$$Y_t = Y_0 (1 + r)^t \dots\dots\dots (i)$$

Taking log on both sides, we get

$$\text{Log } Y_t = \text{Log } Y_0 + t \text{ Log } (1+r) \dots\dots\dots (ii)$$

Equation (ii) can be rewrite as

$$Y = a + bt \dots\dots\dots (iii)$$

Where  $Y = \text{Log } Y_t$  ;  $a = \text{Log } Y_0$  ;  $b = \text{Log } (1 + r)$ ,

In equation (iii)  $Y_t = \text{area/production/productivity}$ , as the case may be, of Large Cardamom as discussed above

$a = \text{constant}$

$t = \text{Time variable in the year } (1, 2, \dots\dots\dots n)$

$b = \text{Regression Coefficient that shows the rate of change or growth rates in a series}$

The annual compound growth rate (s) can be worked out by using:

$$\text{Antilog}(b) = \text{Antilog}(\log(1+r)).$$

$$\text{Antilog}(b) = 1+r$$

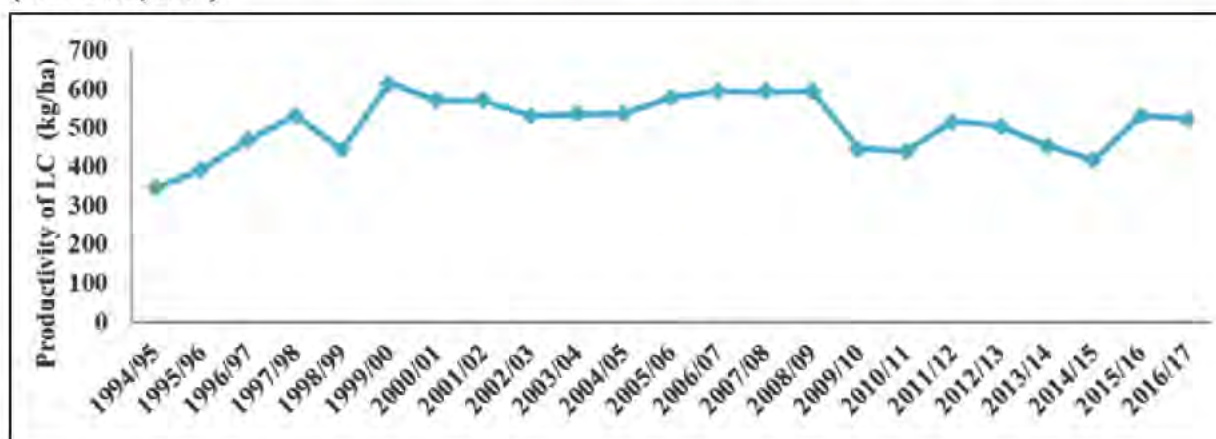
$$\text{and } r = \text{Antilog}(b-1)$$

When multiplied by 100, it gives the percentage growth rate in area, production and productivity of Large Cardamom. That is,  $\text{CAGR}\% = r \times 100 = \text{Antilog}(b - 1) \times 100$ .

## Results and Discussion

### Area, Production and Productivity in Nepal

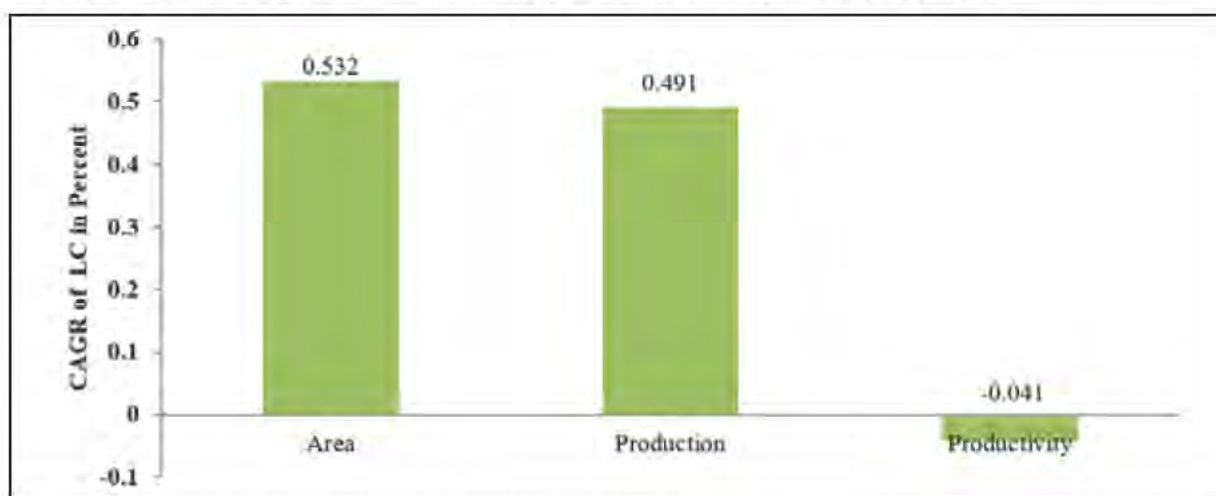
While viewing the data from fiscal year 1994/95 to 2016/17, the area under LC cultivation is known to increase in a slower rate and similar is the case in production and productivity. In the year 1994/95, total productive area under cultivation of LC was recorded as 8782 ha with the production of 3010 tons(t) and the productivity of 343 kg ha<sup>-1</sup> whereas, 6528 tons was produced from 12,511 ha of land with the productivity of 522 kg ha<sup>-1</sup> in the year 2016/17 (Fig. 1 and Annex 1). However, the total crop planted area of LC in 2016/17 was estimated to be 17,002 ha (MoALMC, 2017).



**Figure 1** Productivity trend of LC from 1994/95 to 2016/17 in Nepal.

Source: MoALD, MoAD, MoAC, 2008-2017

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 ( $p = 0.000$ ). Similarly, the production is increasing with CAGR of 0.491 ( $p = 0.045$ ). On the contrary, the productivity is decreasing by -0.041 ( $p = 0.831$ ) (Figure 2).



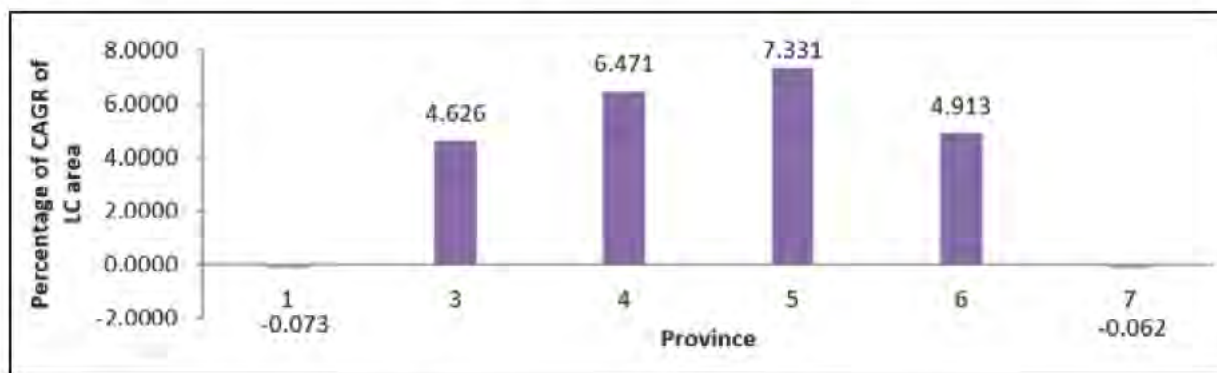
**Figure 2** CAGR of LC in Nepal: 1994/95-2016/17

Source: MoALD, MoAD, MoAC 2008-2017

The productivity is decreasing mainly due to very old plantation/orchard accompanied with devastating diseases like *chhirkey*, *furkey* and clump/rhizome rot (Rai and Chapagain, 2014)). There is limited availability of virus free tissue culture saplings as well disease free seedlings. Therefore, farmers are forced to use suckers separated from old mother bushes for planting new plantation/orchard which might have favored transmission of diseases. The other major cause of declining productivity is lack of technical knowhow of the farmers for which government has not provided sufficient technical support and training program (Shrestha, 2018). Thus, farmers are lacking proper orchard management such as proper irrigation, weeding and fertility management.

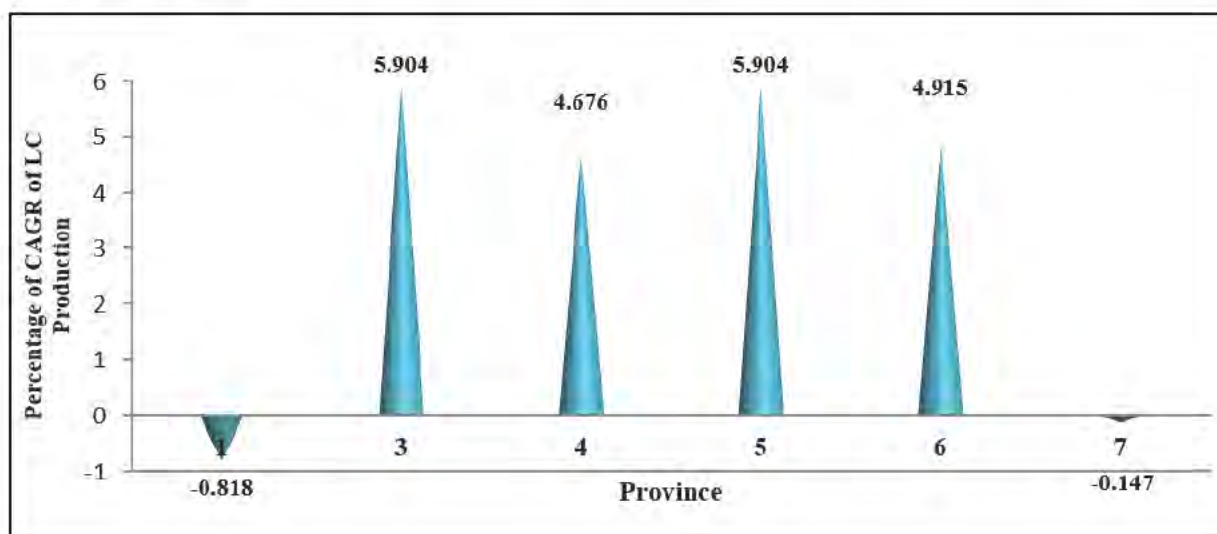
### Area, Production and Productivity at Province Level

The province 1 occupies the highest productive area within the country. The percentage coverage of productive area in province 1, 3, 5, 6, and 7 is 92.00, 79.00, 3.05, 3.45, 0.35, 0.29, and 0.07 percent, respectively (Annex 2). While analyzing the CAGR of all the provinces, it is found that province 1 occupies more than 90 percent of the total productive area of the country, but it has negative annual growth rate of -0.073% (p=0.641). However, in case of province 3, 4, 5, and 6, the CAGR is increasing with the rate of 4.626 (p=0.000), 6.471 (p=0.000), 7.331 (p=0.002) and 4.913 (p=0.047), respectively. On the other hand, the province 7 has negative CAGR of -0.062 (p=0.974) (Figure 3).



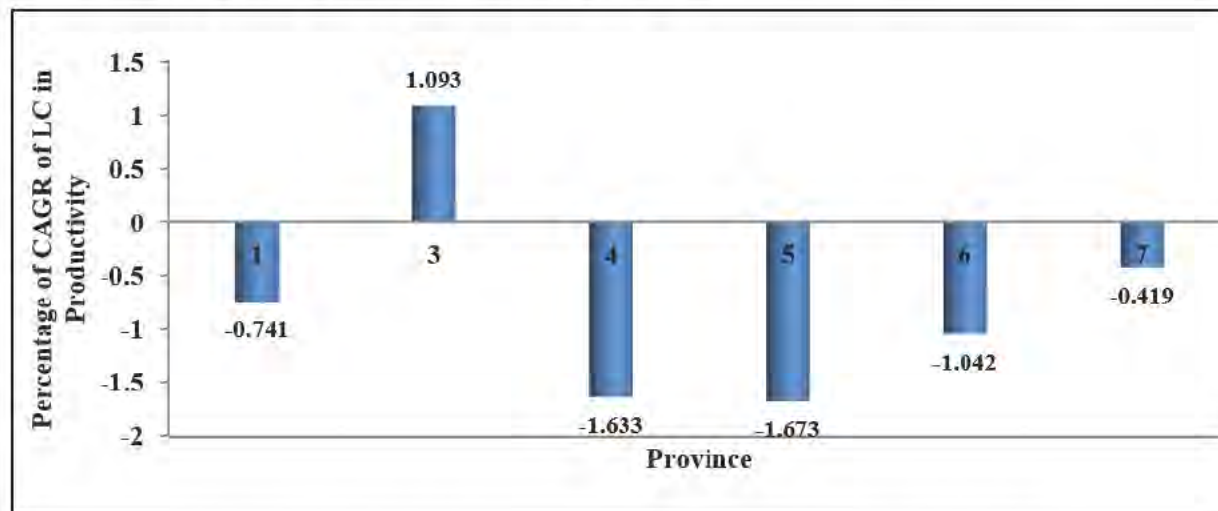
**Figure 3** CAGR in Area of LC in different province from 2005/06 to 2016/17

Similar to area, CAGR analysis for production also indicates that the trend of province 1 and 7 has negative annual growth rate of -0.818 (p=0.152) and -0.0147 (p=0.952), respectively. On the contrary, province 3, 4, 5 and 6 have increasing rate with CAGR values of 5.904 (p=0.000), 4.676 (p=0.001), 5.904 (p=0.001), and 4.915 (p=0.041), respectively (Figure 4).



**Figure 4** CAGR in Production of LC in different province from 2005/06 to 2016/17

Productivity analysis of large cardamom shows different result than the area and production. The CAGR analysis of productivity is increasing in decreasing trend in province 1, 4, 5, 6, and 7 with -0.741 ( $p=0.189$ ), -1.633 ( $p=0.045$ ), -1.673 ( $p=0.072$ ), -1.042 ( $p=0.198$ ), and -0.419 (0.702) percent, respectively. Only the province 3 has positive trend in productivity with CAGR of 1.093 percent ( $p=0.058$ ) (Figure 5).



**Figure 5** CAGR in Productivity of LC in different province from 2005/06 to 2016/17

The total area in the province 1 has been increasing but CAGR analysis shows that it has been somewhat decreasing over the past 12 years which also affect the production and productivity (MoAD, 2016). The plantations in this province are very old compared to other provinces, where devastating diseases like *furkey*, *chhirkey* and clump rot are prevalent, which resulted farmers to destroy their plantation leading to decreased production.

In case of province 3, 4, 5 and 6, the area and production are in increasing trend. It is due to disease free new LC plantations in this area offering better production and income compared to other crops.

### Area, Production and Productivity in District Level

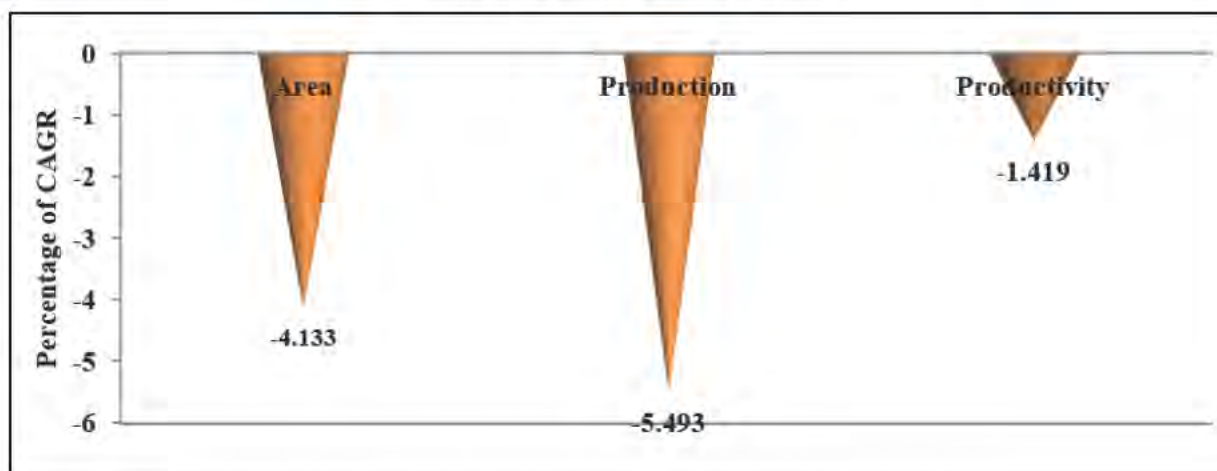
Of the total area planted under LC in Nepal, Province 1 occupies 83.6% whereas it also deserves 92.8% of the total productive area of the country. Similarly, Mechi hill districts (Ilam, Panchthar, and Taplejung) contribute 47.5% and 56.7% of the total planted and productive area of the country, respectively. Therefore, for the CAGR analysis of area, production and productivity of LC at district level only these three districts were considered.

### Area, Production and Productivity in Ilam

Both the area and production of LC was in decreasing trend in Ilam district. The area under cultivation had declined from 2785 ha in 2005/06 to 1132 in 2014/15. Similarly, the total production also declined from 1587 tons in 2005/06 to 520 tons in 2014/15. However, area, production and productivity increased in the year 2015/16 by 1163 ha, 558 t and 480 kg/ha, respectively and in 2016/17 by 1200 ha, 576 t and 480 kg/ha, respectively (Annex 3).

The CAGR analysis of area, production and productivity of LC in Ilam shows that area, production, and productivity of the districts over 12 years are significantly decreasing with CAGR -4.133( $p=0.000$ ), -5.493( $p=0.000$ ), and -1.419 ( $p=0.201$ ) respectively (Figure 6).

The CAGR analysis shows that area, production and productivity are decreasing significantly. The main reason for plummeted CAGR is the very old plantations in the district declined by diseases like *furkey*, *chhirkey* and clump rot. But when looked at the general trend of area, production and productivity from the year 2015 onwards, it is regaining positive trend due to awareness created among the growers and they are planting disease free saplings in new area with better management of cultural practices like irrigation, intercultural operation and fertility management with proper shed trees.



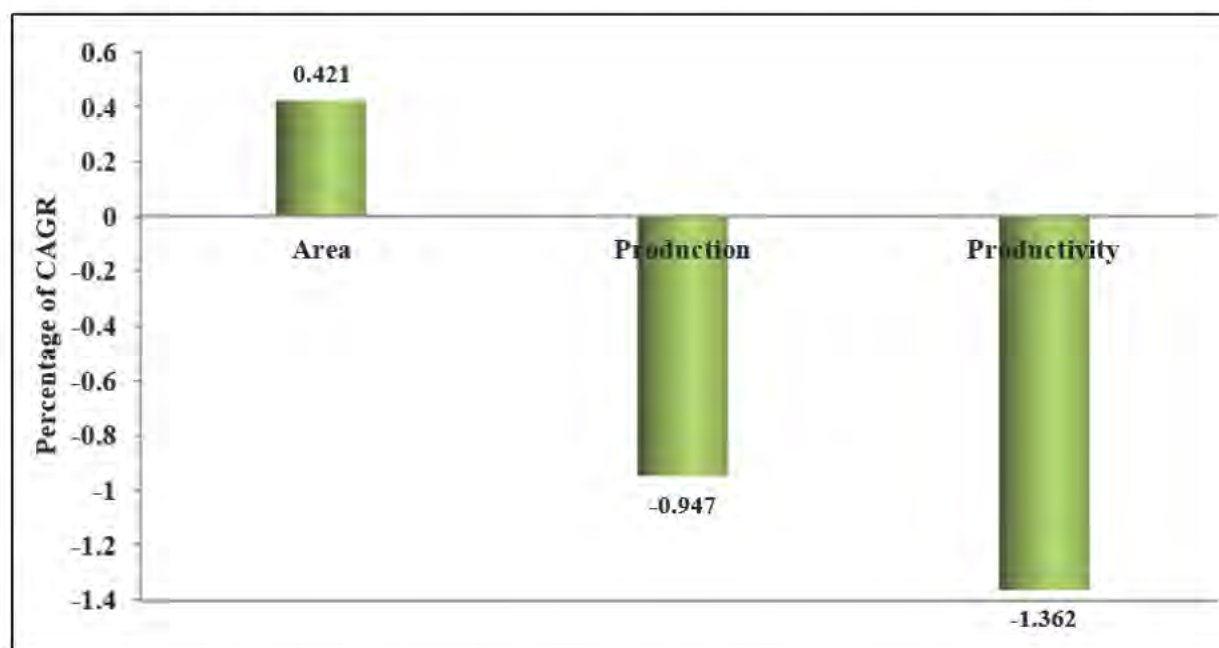
**Figure 6** CAGR of Large Cardamom in Ilam District from 2005/06 to 2016/17

### Area, Production and Productivity in Panchthar

There was a slight increment in area under cultivation of LC i.e. 1576 ha in 2005/06 to 1737 ha in 2016/17 and production was sharply decreasing from 2005/06 (1016 t/ha) to 2009/10 (654 t/ha) and then almost constant in 2010/11 (638 t) and in 2016/17 (798 t). There was similar trend for the productivity which account for 644 kg/ha in 2005/06 and 459 kg/ha in 2016/17 (Annex 4).

The CAGR analysis of area, production and productivity in this district shows that the trend of area has been increasing over 12 years with 0.421 percent annually ( $p=0.066$ ), while the production and productivity at the same period is decreasing with CAGR  $-0.947$  ( $p=0.138$ ) and  $-1.362$  ( $p=0.025$ ), respectively (Figure 7).

The CAGR analysis results are different for Panchthar and Ilam districts. It is mainly due to the new and healthy plantations in Panchthar than Ilam. Declining problem of LC plantations in Ilam made LC growers somewhat aware in Panchthar so they took precautions. Therefore, CAGR analysis shows that the area is increasing and production is in decreasing trend but both are not significant. LC is shade loving crop and shade trees in plantation enhance the productivity of the crop through maintaining the soil moisture as well as fertility. Therefore, the decreasing productivity of LC in these districts is further attributed to the problem of deforestation of shed trees like *Alnus nepalensis* from the plantations.

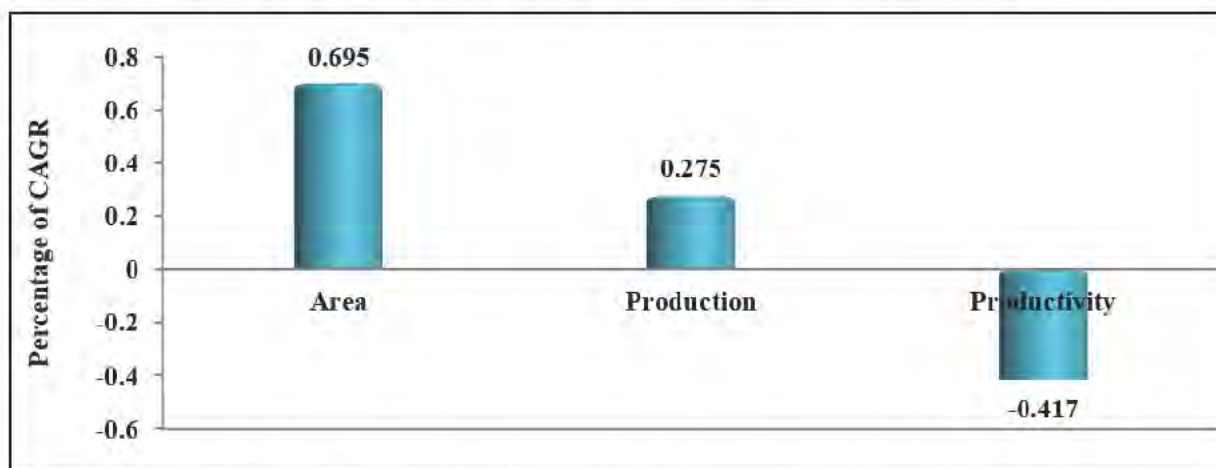


**Figure 7** CAGR of Large Cardamom in Panchthar District from 2005/06 to 2016/17

## Area, production and productivity in Taplejung

The total area, production and productivity of LC was 3324 ha, 2118 ton, and 637 kg/ha respectively, in 2005/06. Similarly, in the fiscal year 2016/17, 2490 tons LC was produced from 4150 ha of land with the productivity of 600 kg/ha (Annex 5).

The CAGR analysis of area, production and productivity in Taplejung district shows that the area and production are increasing with 0.695 ( $p=0.260$ ) and 0.275 ( $p=0.769$ ), respectively over 12 years. However, productivity at the same period is decreasing none significantly with CAGR of -0.417 ( $p=0.613$ ) annually (Figure 8).



**Figure 8** CAGR of Large Cardamom in Taplejung District from 2005/06 to 2016/17

The area and production in Taplejung district are increasing while productivity is decreasing significantly. The cultivation of LC in Taplejung was initiated later compared to Ilam and Panchthar districts but area is increasing steadily. The intervention of developing agencies like International Centre for Mountain Development (ICIMOD), Netherland Development Organization (SNV), UNNATI-Inclusive Growth Programme in Nepal and Environment Conservation and Development Forum (ECDF) have played significant role to enhance area, production and productivity in this district.

## Reccommendations

Based on this study following recommendations are made:

- Cardamom Research Institute should be established under NARC.
- Sufficient human as well as financial resources should be allocated for the research and technology dissemination in the potential districts.
- Varietal research and verification works should be done and recommended for the appropriate biophysical/ agro-ecological domains.
- Technology should be developed for the plant population suitable for each altitude domain and variety. Develop technologies according to suitable plant population in each domain.
- Effective control measures should be developed to overcome the diseases like *Furkey* (Stunty mosaic), *Chhirkey* (Streak mosaic) and clump/rhizome rot, leaf spot and wilt.
- Technology should be developed and/or verified for the effective control of insects such as hairy caterpillar, borer, and thrips.
- Research should be carried out to identify the suitable shade plants and their plant population in combination with LC genotypes and altitude domain.
- Need based training program should be developed and provided to different level of trainers, nurserymen and farmers/growers from Central level, Provincial level and Municipality level by concerned research and developmental authorities on scientific cultivation practices.

- Need to establish/strengthen tissue culture laboratory and produce virus free seedling and provide them to the resource nursery in municipal/ward level and to the commercial farm/firms and farmers.
- Need to develop and establish Resource LC nursery in the districts, municipal and ward level for the reproduction of sufficient amount of virus free saplings at the local level so as to replace the use of mother rhizome as planting materials.
- Nurserymen/owners, firms and commercial farmers should be trained on appropriate nursery management techniques for the production and multiplication of saplings.
- Cardamom Development Policy under process should be finalized and implemented.

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## ANNEXURE

### Annex 1: Area, Production and Productivity of Large Cardamom in Nepal

Year	Productive Area (ha)	Production (t)	Productivity (kg/ha)
1994/95	8,782	3,010	343
1995/96	9,252	3,622	391
1996/97	9,553	4,456	466
1997/98	9,725	5,146	529
1998/99	9,770	4,335	444
1999/00	10,627	6,530	614
2000/01	10,668	6,080	570
2001/02	10,840	6,179	570
2002/03	11,095	5,880	530
2003/04	11,220	5,983	533
2004/05	11,347	6,086	536
2005/06	11,498	6,647	578
2006/07	11,712	6,950	593
2007/08	12,015	7,087	590
2008/09	11,849	7,037	594
2009/10	11,766	5,232	445
2010/11	12,584	5,517	438
2011/12	11,665	6,026	517
2012/13	11,434	5,753	503
2013/14	11,501	5,225	454
2014/15	12,460	5,170	415
2015/16	12,120	6,440	531
2016/17	12,511	6,528	522

**Annex 2: Productive Area of Large Cardamom in different Province**

Year	Province						Total
	1	3	4	5	6	7	
2005/06	11238	128	100	17	9	6	11498
2006/07	11451	128	101	17	9	6	11712
2007/08	11730	135	117	17	9	7	12015
2008/09	11485	167	125	17	38	12	11844
2009/10	11283	273	130	20	42	13	11759
2010/11	12081	278	148	19	41	17	12584
2011/12	11033	200	244	14	41	14	11546
2012/13	10806	297	239	30	46	17	11434
2013/14	10849	274	270	67	49	12	11521
2014/15	11820	315	302	59	31	12	12538
2015/16	11300	368	321	92	36	4	12121
2016/17	11607	381	432	44	36	9	12509

**Annex 3: Area, Production and Productivity of LC in Ilam District**

Year	Area (ha)	Production (t/ha)	Productivity (kg/ha)
2005/06	2785	1587	570
2006/07	2774	1427	514
2007/08	2774	1727	623
2008/09	1922	1784	928
2009/10	2106	963	457
2010/11	1760	694	394
2011/12	1700	694	408
2012/13	1450	502	346
2013/14	1132	520	459
2014/15	1132	520	459
2015/16	1163	558	480
2016/17	1200	576	480

**Annex 4: Area, Production and Productivity of LC in Panchthar District**

Year	Area (ha)	Production (t/ha)	Productivity (kg)
2005/06	1576	1016	644
2006/07	1590	1038	653
2007/08	1595	810	508
2008/09	1605	722	450
2009/10	1605	654	407
2010/11	1500	638	425
2011/12	1500	630	420
2012/13	1506	671	446
2013/14	1687	658	390
2014/15	1711	636	372
2015/16	1731	667	385
2016/17	1737	798	459

**Annex 5: Area, Production and Productivity of LC in Taplejung District**

Year	Area (ha)	Production (t/ha)	Productivity (kg)
2005/06	3324	2118	637
2006/07	3386	2165	639
2007/08	3386	2165	639
2008/09	3850	2021	525
2009/10	2925	1316	450
2010/11	3900	1755	450
2011/12	2925	1755	600
2012/13	2952	1802	610
2013/14	3112	1680	540
2014/15	3950	1410	357
2015/16	4150	2490	600
2016/17	4150	2490	600