2015

Good Agricultural and Collection Practices (GACP) of *Cinnamomum tamala* (Buch.-Ham.) Nees & Eberm.

Government of Nepal
Ministry of Forests and Soil Conservation
Department of Plant Resources
Thapathali, Kathmandu, Nepal

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Photo: *Cinnamomum tamala* twigs & Bark
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FOREWORD

Medicinal and Aromatic Plants (MAPs) are considered as a major source of household and economy of the local communities in Nepal. The increasing global demand of the natural herbal products opened great commercial potential which led to over exploitation and hazardous collection of natural resources which impacted negatively on their existence as well as on the environment and in quality consistency. Use of adulterants and contaminated raw materials are another issue that further complicates the quality standards of plants-based traditional remedies. Besides, the production and primary processing of the medicinal plant/herbal substance has a direct influence on the quality of the active pharmaceutical ingredients for which they are used. Few cases have been widely publicized in which consumers have suffered from adverse health effects due to use of herbal products made from contaminated or adulterated plant materials. Because of this reason, the manufacturers of herbal products in many countries are demanding high quality raw material from their suppliers. Ultimately, the responsibility of producing high quality raw material depends on the farmers or growers as well as primary processors of MAPs.

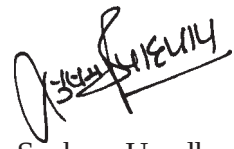
A good agricultural and collection practices (GACP) of medicinal plants is a guidelines that provides a comprehensive framework starting from correct identification/authentication of specific protocol and package of practices for cultivation as well as pre and post-harvest handling practices for the production of medicinal and aromatic plants (MAPs) and designed to ensure optimal yield of the plant for medicinal purposes in both quality and quantity without creating negative impact on sustainability as well as environment. In order to ensure appropriate and consistent quality of medicinal plant/herbal produces it is necessary to establish good agricultural and collection practice in cultivation and collection processes.

In this concern, Department of Plant Resources (DPR) felt urgent need to develop appropriate GACP guidelines to enable farmers or

growers and primary processors in producing high quality raw materials that ultimately provide consumers safe and quality products. It has formulated generic Good Agricultural Practice (GAP) and Good Collection Practice (GCP) as well as series of species specific GACP guidelines.

This booklet is fifth Nepalese country specific GACP guidelines. This guidelines for *Cinnamomum tamala* (Buch.-Ham.) Nees. and Eberm (Tejpat) is thought to be of great help for all stakeholders involved in promoting and commercializing this species. This report is prepared on the basis of research works carried out by the Department of Plant Resources and the research institutions in India and abroad.

The Department highly appreciate the efforts of team members (Rose Shrestha, under Secretary Technical, Jyoti Joshi Bhatta, Chief, NPRL, Kalpana Sharma (Dhakal), Assistant Scientific Officer) for developing this guidelines. Further research is required to validate the information provided in this GACP guideline. The department is committed to promote of conservation and sustainable use of MAPs in Nepal



Ms Sushma Upadhyaya
Officiating Director General
Department of Plant Resources

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List of Abbreviations and Acronyms

ANSAB	Asia Network for Sustainable Agriculture and Bioresources
dbh	Diameter at Breast Height
DFO	District Forest Office
DPR	Department of Plant Resources
ESON	Ethno-botanical Society of Nepal
ft	Feet
GoN	Government of Nepal
HPPCL	Herb Production and Processing Company Limited
MAPs	Medicinal and Aromatic Plants
MT	Metric Tons
NPRL	Natural Products Research Laboratory
TISC	Tree Improvement and Silviculture Component
WHO	World Health Organization
WTO	World Trade Organization

Introduction

Cinnamomum tamala (Buch.-Ham.) Nees and Eberm., commonly known as Cinnamon leaf or Indian bay leaf, is a moderate sized evergreen tree found in the forests and farmlands in the Chure and Mid-Hill. It belongs to Lauraceae family. It is widely distributed throughout Indian sub-continent. In Nepal, out of its seventy five districts, Cinnamon leaf is commercially harvested from thirty three districts covering all development regions (Bhattarai 1997).

Since the early 1960s, farmers of different middle hills districts of Nepal have been planting, protecting and harvesting this plant. In areas with marketing facilities, local people sell raw or processed cinnamon products including leaf and bark for cash income to fulfill their household needs in several mountainous districts. It is especially cultivated in Palpa and Udayapur districts for commercial purpose. It is one of the major non-timber forest product species in Gulmi, Arghakhanchi and Palpa districts. Because of its growing market demand and wide household use people are willing to cultivate this species (Poudel et al. 2011).

In Nepal mostly dried or fresh leaves are consumed as spices. Similarly, leaves, stem bark and root bark are used as ingredients in preparing medicine, perfumes, soap, and toothpaste etc. It has been used in traditional medicines as astringent, stimulant and carminative. Formerly, leaves of this plant were lopped just for fodder and making green manures. Nowadays both wild and domesticated Cinnamon leaves fulfill subsistence requirements of many ethnic groups. The stem bark is used as substitute of *Cinnamomum zeylenicum*, which is high value exotic spice tree. Essential oil is extracted from leaf which has high international market demand. On average 1 kg of dried leaves costs Rs. 40 -70 and essential oil costs 6000-7000/kg (HPPCL and ANSAB 2014)

Bay leaves are among the top ten species in term of value and volume traded from Nepal to India and also features among the 178 species that have demand exceeding 100 MT in India (Ved and Goraya 2007).

In general, raw dried leaves as well as oil extract are traded in India. Nepal exports about 2100 tons of bay leaves to India each year (Choudhary et al. 2011). About 900 tons of bay leaves are produced in Udayapur district only. Exports of these products to India and other neighboring countries has continued to increase for the last two decades, indicating that the species has great potential for income generation for poor and disadvantaged people (Parajuli 1998; Maharjan 2002). Based on newly developed 17 sets of criteria for selection of top most commercial species, Cinnamon leaf from midhill is identified as very remunerative plant species for commercial promotion involving private party investors (Poudel 2007). It is listed among 30 medicinal plants prioritized for research and development by the Government of Nepal (GoN 2006).

To exploit and maintain increasing National/International market demand of bay leaf, the quality of raw materials productions should also be maintained which depends on genetic as well as environmental factors along with good agricultural practices followed for production. Inadvertent microbial or chemical contamination during any of the production and collection stage may lead to deterioration in quality and efficacy of resultant consumer products. So it is very necessary to follow good agricultural and collection practices and postharvest procedures to produce international standard quality products. Their purity and quality level of standards should also be documented for wider market acceptance and comply with international trade regulation of WTO. But the farmers and collectors are unaware of these essential factors that can hamper their trade volume. The present guideline is to facilitate such farmers and producers to produce optimum yield along with international quality standard products for consumers' welfare as guided by World Health Organization (WHO 2003).

1. Plant identity

Scientific name	**:**	*Cinnamomum tamala* (Buch.-Ham.) Nees and Eberm.
Synonyms	**:**	*Cinnamomum albiflorum* Nees *Laurus tamala* Buchanan-Hamilton. *Laurus albiflora* Wallich
Family	**:**	Lauraceae
English name	**:**	Indian bay leaf, Cinnamon leaf, Indian cassia
Vernacular name(s)	**:**	Dalchini, Tejpat, Sinkouli (Nepali), Tamalpatra (Sanskrit), Tejpatta (Bhojpuri), Tejpat (Danuwar), Lep (Gurung),Sangsornyo(Lepcha), Sorong tetala (Limbu), Tejpat(Newari), Belakhan (Rai), Sijakaulisapha (Sunwar), Dalchini, Lepte (Tamang).
Trade name	**:**	Dalchini, Tejpaat, Sinkouli

2. Parts used

Bark and leaves

3. Uses

3.1 Food properties

Bark and leaves are used as spices in curries, meat, vegetables, pickle.

3.2 Medicinal properties

Bark and leaves are aromatic, astringent, stimulant, carminative and used for checking nausea and vomiting. Leaf and bark are extensively used to treat colic and diarrhea. It is also used for hyperptyalism, ophthalmic, proctitis, proctalgia, hepatopathy and splenopathy (Baral and Kurmi 2006)

In Ayurveda, Plant is considered to be used in paralytic conditions, piles, vomiting, anorexia, and sinusitis. Leaf is useful in scabies, cough, hemoptysis, nose defect, gout, oedema, skin disease, diseases of anus, heart troubles (ESON 2009).

3.3 Pharmacological properties

Plant extract exhibits hypoglycemic effect and reveals a phenomenon of less hypoglycemic response at higher dose, eugenol acts against herpes simplex virus (ESON 2009).

3.4 Ayurverdic products

Avipattikara Churna (Powder); Chandraprabha Vati (Tablet) Chitraka Haritaki (Avaleha/ Semi solid); Chyavanaprasha Avaleha (Semi solid); Dashmularistha (Liquid); Draksharishta (Liquid); Jeerakadyarishta (liquid); Jyesthalavangadi Churna (Powder); Kanchanara Guggul (Tablet); Khadiraristha (Liquid); Lavanabhaskara Churna (Powder); Raktalavangadi Churna (Powder); S.V. Tulasi Jadibuti chiya (Coarse powder); Shringarabhraka Rasa (Tablets); Sudarsan Churna (Powder); Sutashekhara Rasa (Tablet); Yogaraja Guggulu (Tablet) (ESON 2009)

4. Distribution

The species is distributed in Himalayas (Kashmir to Bhutan), NE. India, Bhutan, China. In Nepal, it is distributed from west to east at an elevation of 450-2000m.

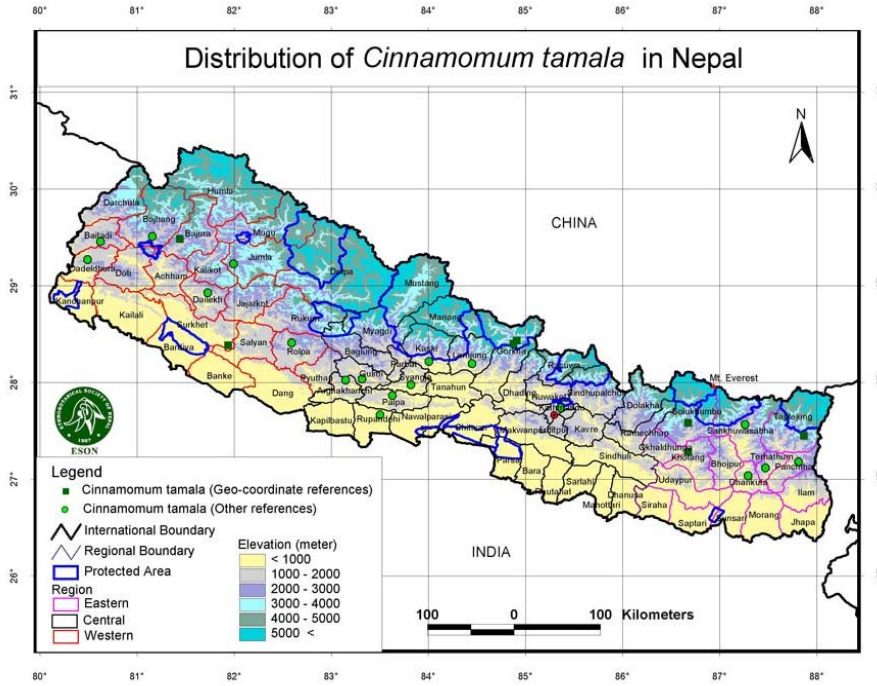

Fig. 1: Distribution map of *Cinnamomum tamala* in Nepal
(Source: ESON 2009)

4.1 Ecological characteristics

This species mostly found in north-west facing slopes of chure and midhills regions. This species preferred moist and shady places with sandy loam soil rich in organic matters. The associated species are *Shorea robusta, Syzygium cummini, Terminalia chebula, Terminalia bellerica, Magnifera indica, Walsura trijuga, Terminalia alata, Castanopsis indica, Aesandra butyric, Myrica esculentus, Lagerstroemia indica* etc.

4.2 Major production areas

Now a day's commercial cultivation of this species has been started in many parts of the country. Palpa and Udaypur districts are renowned for commercial cultivation of this species.

Representative districts: Pyuthan, ,Baitadi, Bajhang, Bajura, Dadeldhura, Dailekh, Gorkha, Jumla, Arghakhanchi, Gulmi, Makawanpur, Kathmandu, Palpa, Rolpa, Sankhuwasawa, Sindhuli, Solukhumbu, Taplejung Syangja, Rukum, Salyan districts (ESON 2009, DPR 2071).

5. Morphological characteristics

An evergreen tree of 15-20 m high with dark brown, wrinkled bark, aromatic. Leaves are coriaceous, opposite or sub-opposite, lanceolate or ovate-lanceolate, 10-15 x 3-6 cm, shortly and bluntly acuminate, entire, base cuneate, glossy above, glaucous beneath; with 3 conspicuous nearly parallel veins arising from near the base, leaf-tip often curved; petioles are short-stalked, 1.5-3 cm. long. Leaves are bright pink when young in spring, aromatic when crushed. Flowers are pale yellowish, arising in terminal and axillary branched clusters about as long as the leaves. Peduncle pubescent. Perianth 6, pubescent. Stamens numerous. Drupes are black, aromatic, succulent, ovoid, 1-1.2 cm long and borne on enlarged perianth cup with lower part of segments persisting as short lobes. Seeds are light brown, globose, smooth. Seeds require approximately one year to mature. Thus flowers and fruit co-exit from March to May. Flowering time: March- April; Fruiting time: April-May (Manandhar NP. 2002, Polunin and Stainton 1984)

6. Preferred growing conditions

6.1 Soil/Climatic conditions

Well-drained, deep sandy loam, black soil with pH 4-5.5 and rich humus is suitable for the crop. Soil analysis should be done to know about its humus contents and pH so that it could corrected according to need of the targeted crop. Soil should also be free from residual pesticides or potentially toxic heavy metals.

Humid tropical evergreen rain forest conditions favour the best growth of Cinnamon. The location of the growing area should be

such that there is no additional risk of pest or disease attack of the plant due to the growing environment i.e. away from waste disposal areas, or occurrence of alternative host of problematic diseases. The growing areas should be clean and weed free.

7. Good agricultural practice (GAP)

7.1 Selection of mother plant

Mother plant should be accurately identified up to genus and species, sub-species, variety, cultivar, and/or hybrid and that should ensure free of pests and diseases. The mother plants containing high oil percentage as well as high eugenol and other important chemical content should be selected.

7.1.1 Vegetative propagation

Stem cuttings

Bay leaf can be propagated from stem cuttings of one year old branches during February- March. Cutting should be taken from matured and healthy vigorous trees. Stem pieces of 10-15 cm long and 1-2 cm diameter having at least 3 nodes are taken for cutting. Stem pieces are cut in slanted way with sterilized sharp knife or secateurs without breaking the slanted part. The cuttings are dipped in root hormone (rootex no.3) and then are planted in poly bags or nursery bed containing mixture of compost, sand and soil with the ratio of 1:1:2. The cutting should be buried in slanted way with one node inside the soil. The nursery bed should be in shady places or covered by temporary shade. After 50-60 days of planting, roots start to develop. Then it can be transplanted in the field during rainy season (DFO Palpa, 2069/70).

7.1.2 Propagation from seeds

It is best propagated by seeds. Healthy and fully matured fruits are collected from selected mother plant in April- May The fleshy part of the fruits are removed and washed with clean water and dried in shade for few hours. The seeds are desiccation-sensitive i.e., they

are recalcitrant in nature and the seeds cannot be stored over a period of one week either at room temperature or at low temperature (4^{oC}) (Dev et al. 2012).

The seed sown immediately after collection show higher Percentage. So seeds should be sown within 7days of harvesting to get high percentage of germination. Such seeds are sown in nursery bed or polybags filled with mixture of loamy forest soil and fine sand (2:1 ratio). After 15-20 days of seed sown, it starts to germinate and complete germinaton within 30-35 days. The germination percentage has been found to vary between 60-80%. The seeds sowed immediately after collection and depulping showed germination percentage more than 80% (DPR 2071). Nursery beds are irrigated frequently to keep them evenly moist. To provide shade, the nursery bed or polybags should be kept in poly house or under thatch roof (DFO Palpa, 2069/70).The equipment and water used should be free of contaminants or well sterilized. Nursery location should be away from contamination prone area like waste disposals, industrial area etc. Seedlings are ready for transplanting in poly bags when they attain a height of about 20–25 cm.

7.2 Cultivation Management

7.2.1 Site Selection

Site is selected having well-drained, deep black, slightly acidic sandy soil enriched with humus. South west and north facing site with access to water for irrigation is preferable. Slope of the site should be characterized with minimum erosion or loss of topsoil.

Soil sampling, testing should be done for qualitative and quantitative analysis of essential soil nutrients and contaminants such as residual pesticides and toxic heavy metals. History of cropping pattern of the sites should be well examined and documented for the most recent crop grown on the site, crops grown on any adjoining sites in the previous years, recent use of herbicides and fungicides, potential accessibility of animals and corrective actions that have been taken against environmental contamination.

Farmers or growers and primary processors shall comply with legal requirements prior to land preparation (including registration, permits, etc.)

7.2.2 Land preparation

Land preparation is done by clearing weeds and potential contaminants. Nutrients or fertilizers with organic matter based on the soil analysis and requirement should be added and recorded in farmer's diary. Well decomposed compost, not from city waste and human excreta, shall be used. Drainage system should be well designed and composting sites should be so that it wouldn't contaminate the main field. Soil is well tilled and pits of 30 x 30 cm size were prepared at 2-2.5 m spacing.

7.2.3 Plantation

For planting, healthy seedlings with green leaf petioles and free of pest should be selected. When seedlings are 1-2 years old or about 45 cm tall, it become ready for planting. If these seedlings are purchased, they should be properly identified and source of origin should be well documented. Healthy and vigorous traits should be selected for plantation. Plantation is done in prepared pits of 30 x 30 cm size at a spacing of 2-2.5 m during rainy season i.e. during June-July (Field observation). It needs 1600 plants per hectare in this spacing.

7.2.4 Irrigation

Irrigation is necessary regularly in the siblings establishment phase. The proper irrigation system should be established to meet water demand, minimize wasting of water and to avoid high soil moisture levels (that may accelerate fungal contamination). Trickle down irrigation system can be used as this has the benefit of ensuring appropriate level of water supplies. Contaminated water (especially with sewage or run off from chemically treated plots) should be avoided. The water source of origin and transportation from source to destination should be traceable to assess potential risk

contamination. Appropriate mitigation measures should be taken to minimize the risk of contamination.

7.2.5 Manures and fertilizers

Fertilizers and soil additives shall be selected and applied according to soil analysis minimizing the risk of heavy metal contamination. In general about 5 kg of well decomposed cow dung or organic compost per pit/plant is applied as a basal dose before plantation. Fertilizing afterwards is not necessary further. Compost fertilizers produced with sewage sludge and human feces should not be used. Openly produced or stored on farm manure/compost should have gone through a heating phase of 70°C for minimum 3 weeks and monitored for run-off from composting and storage sites.

7.2.6 Intercropping

If intercropping practice followed, compatible species should be selected, dominating crop should be avoided. Intercropping with deciduous tree like *Walsura trijuga* is found to be beneficial. *Walsura trijuga* is considered as most important green manure as it decomposes easily.

7.3 Crop Protection

7.3.1 Weeding and shading

Weeding should be carried out frequently in initial stage. It should be done by hand without using any kinds of weedicides. During seedling stage it should be saved from climber. Later weeding may be done as and when needed. Shading is needed in earlier time of plantation. It can be given by intercropping with plants like banana, *Walsura trijuga.*

7.3.2 Pest and diseases management

Very few diseases have been reported on *Cinnamomum tamala*. Rust caused by *Aecidium cinnamomi* occurs during the onset of the south west monsoon attacking leaves and young twigs (Go swami and Bhattacharjee 1973). Leaf blight caused by *Glomerella cingulata*

(Khan and Hussain 1985) and leaf spot caused by *Colletotrichum gloeo-sporioides* (Rov et al. 1976) has also been reported. Besides, stem borer infestation is also recorded from Makwanpur District (Pathak et al. 2014).

Agrochemicals should not be used unless and until it is severe affecting its yield. The quantity of application should be minimum, if used and should be well documented. Integrated pest management techniques should be applied as an alternative to chemical pesticides. If needed national agricultural agency can be consulted for guidance. The person involved in application of pesticides, herbicides, insecticides, or fungicides should be properly trained and have adequate knowledge of its use. Application and storage of agrochemicals, if used shall be in accordance with label recommendation and all applicable requirements for hazard minimization.

7.4 Harvesting and Post-Harvest Procedures

7.4.1 Harvesting

Since Cinnamon leaf is an evergreen tree, farmers collect its leaves throughout the year. However, leaf quality is better in the winter period. While bark collection is effective in the pre-monsoon and post monsoon seasons when the tree is still active. Harvesting should be carried out under dry climatic conditions. Both leaves and bark should not be collected in high humid condition (during rain, high soil moisture and extreme humidity, even in early day hours to avoid dew) as this would encourage fungal infections. Time in between harvest and drying should be minimized to reduce risk of microbial contamination as well as change in level of active constituent. In case of harvest under wet condition due to sudden change of weather, extra care should be taken to dry the material as soon as possible in order to avoid damage from mold and other possible pests.

Leaves collection: Generally leaves are collected from October - February by breaking immature branches of 4-5 years old tree. Lower two-thirds portion of the trees were suitable for harvesting. For long term sustainability, harvesting should be conducted without debarking

of trees or damage to branches (Choudhary 2014). If breaking not possible the branches should be cut by sharp knife. Leaves are collected one time/every year from young tree while from matured tree leaves are collected in two years rotation.

Bark collection: The bark of Cinnamon is stripped or peeled by cutting the main stem and limbs of 5 to 6 years-old trees having 3-5 m height and 6-10 cm diameter or when the stem color become brown in color. Longitudinal incisions are made to connect the rings. Then the bark is removed in stripes and rolled into bundles for sale. Barks are collected once a year, during March-April.

All harvest equipment should be cleaned and in proper working conditions. They should be made of non-toxic and non-corrosive materials and should avoid wood or other materials (that cannot be easily and thoroughly cleaned). There should not be access of domestic animals, birds, rodents and insects to on-site harvesting facilities. All personnel involved in harvesting should have adequate knowledge and skill to handle harvesting equipment ensuring safety and minimize damage to harvesting materials. During harvesting, adequate care should be taken so that there is no presence of foreign matter in the harvested materials (for example, soil, weeds, trash and other undesirable materials etc). Cross contamination with remnants of prior harvest should be avoided.

Foreign matter should be checked and removed, if present, prior to transportation of harvested materials. Damaged and/or degraded plant material should also be removed, if any.

7.4.2 Post harvest processing

7.4.2.1 Transportation to destination

Harvested leaves and bark are transported to drying place as soon as possible. Mechanical damage due to heat, rain, high compaction and stacking during transportation should be avoided. Plastic bags should be omitted as a container. New or properly cleaned jute sacks should be used for packaging and they should not be over filled. Compression should not occur due to piling up of sacks. The vehicle used should

be cleaned and dried properly before use. They should not be transported along with other drugs as well as contaminants like pesticides, chemical fertilizers etc.

7.4.2.2 Primary processing site

A clean location, protected from direct sunlight that is near from the place of harvest is chosen as primary processing site where cleaning, drying and grading of plant produce is done prior to processing. A well ventilated shade is formed over the working area that also protects the produce from rain. It should be away from potential sources of contamination. Access of animals, birds, rodents and insects should be prevented in the site.

7.4.2.3 Grading

A clean surface, preferably a cemented floor or a tarpaulin sheet that is in good condition is used for laying out the collected plant produce. Plant materials should be immediately unpacked after arrival. All remaining weeds and other extraneous physical matter along with unwanted plant parts should be removed. If handlers have an infectious disease or open wounds, they should not work on plant produce. People should not step a walk on the plant produce.

7.4.2.4 Drying

The harvested materials should be dried properly in shade in primary processing site. While drying clean sheet of plastic, bamboo mats or drying yards should be used. They should not be placed on bare ground. The layer of drying leaves should be less than 4 cm thick. They must be regularly raked (5-10 times per day). Care should be taken not to step a walk on it. There should be good air flow over it. Alternatively, for convenience the 2 feet long twigs with leaves are collected and made bundles of 5- 6 twigs. Then they are hanged on ropes for drying. Drying area should be free from pests and inaccessible to other domestic animals. Harvested leaves should be handled carefully during the drying process avoiding loss of its medicinal characteristics.

7.4.2.5 Packaging

After complete drying, they are packed in clean and moisture free container or jute bags. Wherever possible new sacks are used. If this is not possible then ensure they are well cleaned and dried before use. Optimum moisture content should be ensured before packaging to minimize growth of yeasts and molds and loss/alteration of active ingredients. Sacks that have previously been used to store agrochemicals should not be used. It must be guaranteed that no contamination of the product occurs by the use of packaging materials. The container should be sealed and labeled with collection details and batch number (Annex-1).

7.4.2.6 Storage

Storage room should be free from pest and inaccessible to other domestic animals. It should be clean and well aerated.Sealed and labeled containers or jute bags should not be stacked directly on the floor. They should be placed on wooden pallets kept in cool and dry place. Mechanical damage due to high compaction and stacking should be avoided. Frequently the materials should be checked for the physical condition (moisture content, mold, damage) when stored for longer period.

7.5 Personnel hygiene and sanitation

Persons, handling plant produce should always wash hands and feet with soap and wear clean masks, dress and gloves before starting to work. Do not allow anyone to handle plant produce if they have wounds or infectious diseases.

7.6 Documentation and traceability

All processes and procedures that could affect the quality of the product must be documented. Farmer's diary should be kept with details of all on-farm activities starting from land preparation to post harvest processing. All agro-chemical inputs have to be documented along with its ingredients, methodology, doses, time and frequency of application. Extraordinary circumstances during the growth period

that may influence the chemical composition of the medicinal plant/ herbal substance such as extreme weather conditions and pests, particularly in the harvest period should be recorded. All records should refer to the lot number or batch number allocated to harvested materials.

Use 'harvest tags' to record details of each harvest and the plant materials subsequent processing activities. Any product entering and leaving the storage should be documented (date, product name, quantity).

8. Expected yield

On an average, 13 kg of dry leaves and 12 kg of dry bark may be obtained from a 10 year old tree but the quantity depends upon the local factors; a tree can yield from 8-20 kg of dry leaves in a year (TISC, 2003; DFO Palpa, 2069/70).

9. Adulterants/substitutes

Its bark is used as a substitute for *Cinnamomum Zeylenicum* Nees.

10. Cultivation calendar

Flowering		March-April
Fruiting		April-May
Seed collection		April-May
Nursery preparation		March-April
Seed sowing		April-May (or Within 7 days of fruit harvesting)
Stem cutting		Feb-March
Poly bags preparation		May-June
Planting		June-July (1-2 years old seedling)
Harvesting	Leaves	October-February
"	Bark	March-April

11. Economics of cultivation per hectare

S.N.	Description	Quantity	Labour	Rate (Rs.)	Amount (Rs.)
	Cost				
1.	**For Nursery preparation**				
A	Land Preparation		20	400/-	8,000/-
B	Prepared seed	1kg		500/-	500/-
C	Nursery Prepararion		30	400/-	12,000/-
D	Poly bag Preparation		20	400/-	8,000/-
E	Polybags	4kg		250/-	1,000/-
F	Care and Management		30	400/-	12,000/-
2.	**For Plantation**				
A	Pit Preparation		60	400/-	24,000/-
B	Plantation		40	400/-	16,000/-
C	Compost manure	5 tonnes		3000/-	15,000/-
3.	**For Care and Management**				
A	Irrigation and Weeding		30	400/-	12,000/-
B	Miscellaneous				20,000/-
4.	**Plant care and management (9 yrs)**				1,75,050/-
5.	**Harvest**		120	400/-	48,000/-
6.	**Dry and Storage**		40	400/-	16,000/-
7.	Total cost				3,82,500/-
	Production				
1.	Dried leaf	20,000kg		60/-	12,00,000/-
2.	Dried bark	96,00kg		70/-	6,72,000/-
3.	Total income				18,72,000/-
	Net income every year after 10yrs				14,89,500/-

Source: modified from Dhruba Raj Bhattarai 2058 with current rate of labour.

12. Good field collection practice (GCP) requirements

12.1 Site Selection

The site for the collection of Cinnamon leaf and bark should have rich population with good quality standard i.e. the collection sites should have healthy stands of plant in their normal range and is free from any toxic elements and from places not prone to contamination. Information on exposure of the collection place from insects, chemicals, toxic gases, sewage should be noted.

12.2 Compliance to regulatory requirement

Collection permits and other documents from government authorities (District Forest Office in case of government managed forests), community forest user groups (in case of community forests), and landowners (in case of private property on which collection occurs) must be obtained prior to collecting any plants from the wild. Sufficient time for the processing and issuance of these permits must be allocated at the planning stage. The collection of plants is not allowed in any National Parks.

12.3 Harvest and collection management

12.3.1 Quality considerations

Before collecting the sample from the field, the botanical authenticity of the species should be verified from Department of Plant Resources and voucher specimens should be preserved. During collection leaves and bark infested with insects, pests, fungi, bacteria or virus should be avoided. Collectors should be well trained to identify what they are collecting. Be aware of any local species that are known to be readily confused with the cinnamon leaf species, and take additional care to exclude these from the harvest.

12.3.2 Sustainable collection

Collectors must apply collection practices that address not only their need to gain economic benefits from the trade of wild-harvested plants, but also make sure that each of the collected species survives.

Collection must be in a manner that ensures that the rate of regeneration is greater than the rate of extraction. In this way, plants will continue to grow year after year and provide the collector with regular income.

It is becoming very difficult to found Cinnamon leaf in wild. The cultivation of Cinnamon leaf in farmer's field and community forest had been already started. If it is to be collected from wild, the collectors should collect in sustainable way. Only leaves with small twigs should be collected before their flowering from matured tree. Lower two-thirds portion of the trees were suitable for harvesting. For long term sustainability, maximum 60% of total harvestable material (leaf) should be collected. Harvesting should be conducted without debarking of trees or damage to branches. Leaves turned pale, infected, deficient and unhealthy should be discarded. Avoid harvesting from stands where the plant is sparse or that are outside of the species' normal range. Refrain from harvesting in the same location as earlier harvests until the population is sufficiently re-established.

Stem bark should not be harvested when the tree is under new growth. As far as possible, only 20% of the bark should be collected from mature branches of the trees leaving the main trunk intact. Bark from entire branch or trunk should not be taken at one time. Bark should be stripped longitudinally from one side of the tree to allow smooth conduction of water and nutrients. Stem bark should not be collected again from same tree unless adequate time has been allowed for it to be reformed completely (GoI, 2009).

Care should be taken to avoid any mixing of foreign matter with the leaves like soil particles, organic matter like stem, leaf or root of other associated species.

12.3.3 Environmental considerations

Collection should be done from those areas where its frequency of occurrence is sustainable. 40% of leaves should be left to ensure normal physiological regeneration processes of the plant. Care should

be taken not to damage surrounding plants and animals as well as habitat. Baseline assessment and regular monitoring should be done for sustainable level of harvest. Cutting the branches to ease collection of its leaves should not be done.

It is recommended that the gap between two collection cycles in same place should be at least 2 years to synchronize the regeneration cycle of the plant.

12.3.4 Social considerations

The organized collection of the leaves of Cinnamon from the wild should not affect the availability of species for use by local people.

12.4 Post Harvest Management

Post harvest management should be done as described earlier in GAP ensuring their quality and preventing from contamination from every possible pollutant.

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Annex - 1

The label of the container of plant produce should bear following information :

1. Name of the produce :
2. Part of the produce :
3. Grade, if any :
4. Batch No. :
5. Lot No. :
6. Quantity :
7. Date of colleciton :
8. Collected from :
9. Date of receipt from collector :
10. Signature of the Store Manager and Date :

Fruits of Tejpat

Prepared seeds for sowing

Polybag preparation

8 months baby plants of Tejpat

3 branches (Two yrs) sprouting after coppicing

Unripe fruits of Tejpat

Collecting leaves by local farmers

Distillation plant of Tejpat in Udaypur district