

# Domesticating Lapsi, *Choerospondias axillaris* Roxb. (B. L. Burt & A. W. Hill) for fruit production in the middle mountain agroforestry systems in Nepal

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*Choerospondias axillaris* is a potential agroforestry tree species for income generation and nutrient supplementation in the middle mountains of rural Nepal. The occurrence and distribution of *C. axillaris* (locally known as Lapsi in Nepal) has been surveyed and documented. Status of indigenous knowledge about cultivation, management and utilisation has been studied and documented; indigenous indicators for early sex determination and criteria for fruit quality assessment has been established. Based on farmers selection and fruit quality assessment, elite trees for quality fruit production has been selected and methods for their successful propagation has been developed. Lapsi was reported growing in 301 Village Development Committees of 29 hill districts. Over 40000 trees has been producing fruits and additional 500,000 new trees has been planted. Interest on lapsi cultivation and marketing is increasing. Farmers have wealth of indigenous knowledge on lapsi ecology, husbandry practices and variation in different lapsi types. This knowledge combined with scientific methods has offered better opportunities for lapsi domestication. Bud grafting, side grafting, hardwood and softwood cutting propagation were successful methods for lapsi propagation, while research in tissue culture is still underway. Bud grafting during the first three weeks in February is recommended for lower cost and effectiveness (90% success). Selected trees are recommended for mass propagation and planting for quality fruit production.

## What is domestication?

Domestication means bringing in to human use. To domesticate is to naturalise to human conditions and it involves human-induced change in the genetics of a plant (Harlan 1975; in Leakey and Neuton 1994). The domestication of agroforestry trees, as in other species, involves accelerated and human induced evolution to bring species into wider cultivation through a farmer-driven and often market-led process (ICRAF 1997). Domestication is an iterative procedure involving the identification, production, management and adoption of desirable germplasm, and it can occur at any point along the continuum from the wild to the genetically-transformed state (Leakey and Tomich 1999). Basically, domestication of agroforestry trees is targeted towards the benefit of small holders. There is a close linkage between domestication and commercialisation.

## Introduction of lapsi

Lapsi [*Choerospondias axillaris* Roxb. (B. L. Burt & A. W. Hill)] is a wild, large, deciduous and dioecious fruit tree under the family Anacardiaceae. The tree is largely known for its delicious fruit in Nepal, for timber in China and for medicinal value in Vietnam. The tree is native to Nepal (Roxburgh 1832)

and is distributed from north-east India to south-east China and Japan including Nepal, Assam and Sikkim in India; central and south China; Vietnam, Thailand, Japan and Happy valley in Hong Kong.

The trees producing pistillate flowers are locally called as 'pothi lapsi' (female trees) and others producing staminate flowers are called 'bhale lapsi' (male trees). Study on the flowers of *C. axillaris* (both in glass house and field conditions) confirms this to be a cross-pollinated tree. Pistillate flowers have empty anthers and the staminate flowers lack gynoecium. The pollens are transported by insects, honey bees and wind. Study on pollen grains derived from the anthers of staminate flowers, under a scanning electron microscope shows them to be tricolporate, tagillate, subprolate and medium in size. More description about the species is available in various flora and other publications (Roxburgh 1832, Ohwi 1953, Paudel 2001, Blackman *et al.* 1937).

## Importance of lapsi in Nepal

Lapsi is a wild, edible, indigenous fruit tree of multiple benefits. The tree has social, cultural, ecological and economic value in Nepal. Existence of lapsi as pre-historic vegetation types of 'Sleshmantak Ban' (meaning lapsi forest) around 'Pashupatinath' in Kathmandu has been quoted in the 'Swasthani Bratakatha.'

Nepal is unique for processing and use of lapsi fruits. Lapsi fruits are consumed fresh or pickled, and processed for preparing



varieties of sweet and sour, tasty food products locally called as 'Mada' (dried lapsi mat prepared from the pulpo/peel of ripen/raw fruits) and candy. Recent study shows that the fruits are very rich in essential amino acids, especially arginine (106 mg/100gm), glutamic acid (36 mg/100gm) glutamine (32 mg/100gm); vitamin C and minerals such as potassium (355 mg/100gm), calcium (57 mg/100gm) and magnesium (34 mg/100gm) (Paudel *et al.* 2002a). This property in lapsi fruit signifies its importance in human health. The candy products are popular among women, children, trekkers, and tourists. Most of these fruit products are at present consumed within the country but there is a potential international market for export promotion. Lapsi wood is used as light construction timber and fuelwood; seed stones are used as fuel in brick kilns and the bark has a medicinal value for treating secondary burns (Quang 1994, Nguyen *et al.* 1996).

Only very recently, lapsi has been recognised as one of the potential agroforestry tree species for income generation to hill farming communities in Nepal (Paudel and Parajuli 1999, Gautam 1997, LARC 1997). The Agricultural Perspective Plan of Nepal (APP 1995) has clearly identified the research needs in the area of agroforestry in general and that of multipurpose trees and non-timber forest products in particular.

Farmers collect lapsi fruits from forest and farm grown trees and sell between October and January. The price of fresh fruit in Kathmandu in 1999 varied from NRs.10/kg in October to NRs.40/kg in February/March, equal to the price of the mandarin orange. The annual transactions based on fruit in Kathmandu alone was estimated at around US \$ 1m worth, i.e. over 50m Nepalese Rupees (BM 1999). Because lapsi is often grown in uncultivated lands, it makes an indirect but substantial contribution to providing wood and food crops through the utilisation of marginal lands (e.g. community and leased forestlands) and also contribute to soil conservation and environmental protection.

### Problems

Current production and supply of lapsi fruit do not meet the market demand for quality products on the one hand, and the production from remote areas has not been able to fill this gap on the other. Expansion of lapsi cultivation for quality fruit production is limited mainly due to the associated risk of non-bearingness, as only female trees produce fruits, normally after 7-10 years of planting. Neither appropriate techniques for early sex determination nor simple and reliable vegetative propagation methods were developed and disseminated. Because of this problem, farmers are worried whether the trees they have already grown, will produce fruits.

Although lapsi is reported to be growing sporadically in various hill districts of Nepal, detailed information about the occurrence and distribution of lapsi in Nepal is not available. Available information on existing forest types does not inform adequately about the existence of lapsi as a natural vegetation; neither does the agricultural sector address its abundance and importance in the farming systems. Identification, selection, evaluation, and propagation of selected germplasm of lapsi are still in its infancy in Nepal. Farmers are planting lapsi trees without information about their origin, quality, or yield potential,



**Plate 1 : Lapsi fruits in 3 year old vegetatively propagated plant**

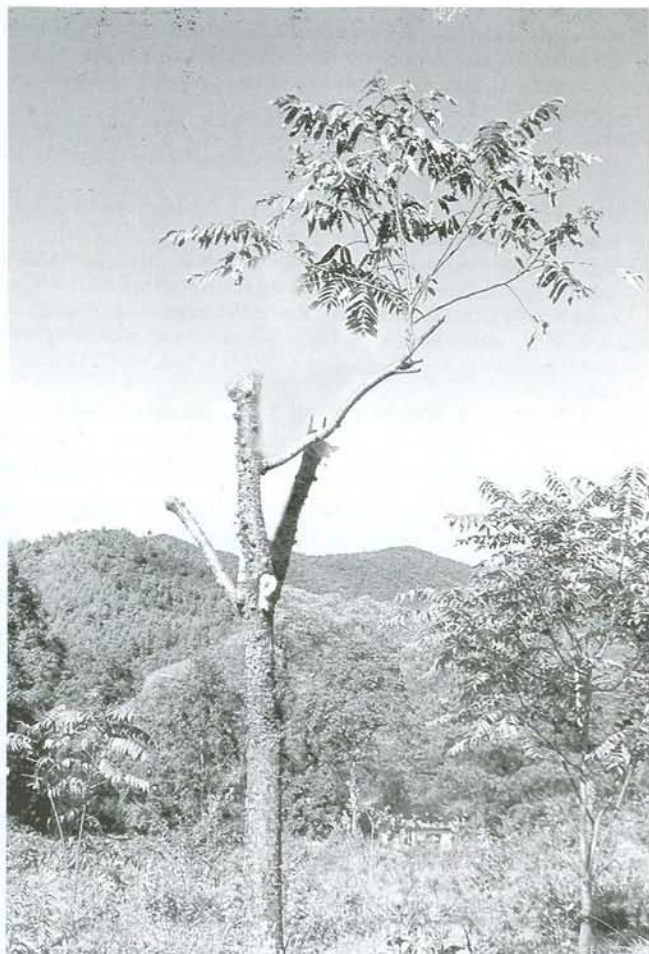
which in the long run may not be paying as expected. A systematic approach to selection, evaluation, multiplication and conservation of available best trees/stands is required before they are extinct. Examples on extinction of superior trees are already realised. Since lapsi is a relatively new crop for scientific research and often an ignored crop both from agricultural and forestry sector, there exists very little and inadequate information in the form of published literature.

### Occurrence and distribution of lapsi in Nepal

A total of 301 village development committees (VDCs) in 29 hill districts have reported cultivation and protection of lapsi trees for some socio-economic purpose. Lapsi was grown from east to west Nepal from 850 masl to 1900masl. Distribution of Lapsi has been found in a much wider areas in the country than reported earlier. Over 40,000 trees are at fruit bearing stage and more than 450,000 new trees are planted in these districts. There is a tremendous opportunity for income and employment generation through proper management and use of Lapsi tree. (Paudel 2001)

A distribution map of lapsi at national and VDC level has been produced for the first time in Nepal. Accordingly, high intensity Lapsi production areas can now be selected and be used as potential seed production areas. Major Lapsi production areas, fruit processing locations and market centres for fresh and processed fruit products have been identified and





**Plate 2 : Successful grafting of female branch on male plant**

documented (Paudel 2001). Major limitations to expansion of Lapsi cultivation as identified included lack of technical know-how, extension support, uncertainty of fruiting, unavailability of planting material, long gestation period and lack of market.

Information collection about distribution of a high value agroforestry tree at national level using participatory approach through existing government forestry network and their staff has been proven to be a time and cost effective way of starting domestication efforts in a resource-poor country like Nepal.

#### **Indigenous knowledge about cultivation, management and use of lapsi**

Local farmers have wealth of indigenous knowledge about Lapsi cultivation, management and utilisation. Almost all Lapsi fruit coming to markets to date was produced from wild grown trees. Farmers have been protecting and growing naturally regenerated Lapsi plants in forest and farmland. They have increased cultivation of this tree for the last 10-20 years, especially when forest nurseries have begun to produce and distribute Lapsi seedlings. No evidence on the use of improved technologies/varieties for quality fruit production was found in Nepal and no improved horticultural practices such as irrigation, fertilisation, and pruning were applied.

Lapsi was considered as one of the best agroforestry tree

species to be grown in farmlands due to several reasons such as – thinner crown density, tall and deciduous in nature that causes low level of shading effect on cereal crops. However, the disadvantage of growing Lapsi in farmland was also realised by farmers as crop damage occurs while Lapsi harvesting. It was also evident from interaction with Lapsi growers that they are quite aware about the crop impact of Lapsi trees in their bari (un-irrigated farms) lands and they try to minimise this effect by locating trees in the margins of farmland, corners and pasture lands.

Lapsi cultivation has been much influenced by marketing facilities such as access to motorable road and market centres; processing companies and traders activity (Paudel 2000). The extensive cultivation of Lapsi around the districts of Kathmandu valley, and its catchment area provide an absolute evidence on positive influence of market facility on Lapsi production.

Farmers have categorized Lapsi into different types according to their indigenous indicators that are based on fruit size, time of maturity and fruit quality (Table 1). Although these indicators did not hold uniformity across sites, they are of good value for studying genetic diversity of lapsi trees.

**Table 1: Types of lapsi fruits according to criteria used by farmers**

Criteria	Type
Fruit size: small and large	<i>Sano</i> and <i>Thulo</i> lapsi
Fruit maturity: early and late	<i>Aghaute</i> and <i>Pachaute</i> lapsi
Taste of fruit: sweet and sour	<i>Guliyo</i> and <i>Amilo</i> lapsi
Pulp content: high and low	<i>Bose</i> and <i>Hade</i> lapsi

Early sex determination of Lapsi at seedling stage was realised as a big problem for increased fruit production by the farmers in all the study sites. Exploration about indigenous technical knowledge has indicated some morphological differences between two sexes (Table 2). This knowledge needs to be further tested and verified.

**Table 2: Morphological differences observed between bearing and non-bearing trees**

Criteria	Female lapsi	Male lapsi
Leaf emergence	Later	earlier
New leaf color	yellowish	purple/reddish
Leaf margin	entire	mostly serrated
Color of latex	milky, thick	watery, thin

#### **Selection of superior mother trees and their conservation**

Criteria for the selection of elite mother plants were based on farmers perception of fruits and trees, but also processors' preferences including size, appearance, pulp content, color, sugar content and health status. Farmers' criteria for selecting superior trees were mainly based on the quantity of Lapsi production per tree as this means value in monetary term. This criterion was a combined criterion associated with the fruit size, fruit retaining quality until maturity, insect and disease tolerance.



They were also aware of the quality criteria such as the taste of the fruit, appearance, seasonality of fruit ripe etc.

Farmers preferred *bose lapsi* (fruits with high proportion of pulp) for fruit production. Early varieties were preferred by most of the farmers as it fits to the time of main festival in Nepal when they can harvest and sell to meet their household needs. Analyses of sample fruits from selected trees have shown a great variation in fruit size, weight (8-18 gm), pulp, and acid/sugar content. (Paudel 2001, Paudel *et al.* 2002b).

## Conclusions

Lapsi has been identified as a potential agroforestry tree species for domestication for rural income generation and human nutrient supplementation. Lapsi fruits are rich in essential amino acids, minerals and vitamin C. The participatory approach used in the occurrence and distribution of Lapsi in Nepal has been effective to draw a distribution map of a single species of farmers' interest. Lapsi has been growing in 301 VDCs in 29 hill districts of Nepal and is further expanding. Information on distribution of lapsi would help to identify better stands, individual trees for tree improvement. It is clearly evident that farmers are rich in indigenous knowledge about lapsi ecology, husbandry practices and utilisation of lapsi fruits. Indigenous knowledge combined with collection and evaluation of lapsi fruits has strongly contributed to select elite mother trees in the middle mountains of Nepal. As a result, over 60 superior trees with consumer preferred fruit quality has been selected and propagated. Analysis of fruit quality from among selected trees showed significant difference between the trees of different location and among the trees within locations.

Research scientists are suggested for the continuity of ongoing research and contribute on starting new research in breeding, developing morphological markers for early sex determination and study on tree crop interaction for better quality fruit production to meet growing demand of lapsi fruits. ■

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