9. HORTICULTURAL DEVELOPMENT IN LAMJUNG DISTRICT

In the 1960s, His Majesty's Government of Nepal (HMG/N) launched horticultural development programmes all over the country to improve the economic and nutritional status of the people (Gurung 1993). Horticultural farms were established in different locations, reflecting various agroclimatic conditions within three altitudinal ranges: the *terai* (below 1,000m), the hills (1,000 to 1,800m), and the high hills (above 1,800m). Suitable areas for growing fruit within these zones were defined in the Seventh Five-Year Plan (1985-90) by the National Planning Commission (NPC) of HMG/N. Some districts were selected for intensification of commercialisation for different prioritised fruit varieties, i.e., citrus fruits, apples, walnuts, pears, grapes, mangoes, bananas, and pineapples. Citrus fruits, mangoes, and apples were thought to be the most feasible fruits economically. None of these farms is located in Lamjung District; still, along with other districts, Lamjung was chosen for the implementation of a citrus development programme for mandarin oranges *(suntala)*, sweet oranges *(junar)*, lime *(kagati)*, and lemon *(nibuwa)*.

9.1 Master Plan for Horticultural Development

Horticulture is regarded as an effective tool for reducing environmental degradation and improving the economic situation in the hills. In 1990, a 'Master Plan for Horticultural Development in Nepal' was developed for HMG Nepal covering the next 20 years. A major concern of the Master Plan is to reverse the environmental degradation processes. Priority for horticultural development is given to those areas where degradation is the most severe (Carson 1990:86-94). Horticultural development is further seen as one option for increasing the cash income of poor households and, at the same time, reducing pressure on common resources and decreasing the exploitation of forest land.

There is potential for the development of different fruit varieties in Nepal, and twelve fruit species were selected as master plan priority crops. The selection was based on a fruit crop screening methodology, incorporating ecological and subsistence suitabilities and market capacities. Other criteria were profitability and the competitive position of Nepal.

9.2 Criteria for Horticultural Development Zones in Lamjung

The analysis of horticultural development zones in Lamjung, in general, follows the methodology developed for the Gorkha District (Trapp 1995). This case study was based on the data/information gathered and compiled by the Master Plan for Horticultural Development (Carson 1990; Ranjit 1990); in particular, requirements of different fruit crops in terms of climate (altitude, temperature), soils, and soil drainage were extracted from this plan. Furthermore, information about crop requirements was taken from Rehm and Espig (1991). This information was then linked to the database for Lamjung, i.e.,

- land system data of LRMP,
- land use data 1979 of LRMP,
- temperature zones,
- topography (DEM),
- aspect, and
- accessibility of road infrastructure.

9.2.1 *Horticultural Development Areas*

The Master Plan for Horticultural Development defines the basic area units for horticultural development as (1) farmsteads with kitchen gardens where horticulture is practised traditionally; (2)

privately-owned rainfed agricultural land; (3) irrigated land; and (4) community and private forest areas (Carson 1990:75).

In the southern part of Lamjung at least, most of the area would fall into one of these categories. This study focusses on agricultural land only and delineates potential horticultural areas that are expected to be privately owned. The land tenure system was not considered because of lack of spatial data on this issue. Agricultural land includes not only the cultivated area but also the areas covered by farmsteads, risers and bunds, and non-cultivated land between the fields, e.g., small sections of grassland, shrubland, and forest. It is doubtful whether the farm households are willing to use or to convert intensely-cultivated irrigated terraces for horticultural production, even if these crops are more profitable than grain crops, since intense cultivation areas, on both level and sloping terraces (terms used by the LRMP), are assumed to be the most productive farm land for staple crops in the middle mountains. These fields are located in valley bottoms, on flat plains, or on river terraces in particular, but they also occur on steep slopes where the climate, soils, aspect, and so on are favourable for cultivation. Thus, these areas were excluded from the analysis as well, and light and medium cultivated agricultural lands on sloping and level terraces were regarded as the potential horticultural development areas.

In this study, detailed classification was carried out for these areas, applying as parameters the LRMP land-use data 1979, classes C1/T1 and C2/T2. Agricultural land in the high mountains is very scarce and people rely on it for staple crop production even more than in the mid-hills. Still, the land is not cultivated intensively due to the harsh climatic conditions. To show the potential of horticultural development in this region, it was decided to include all agricultural land delineated by LRMP into the analysis.

In addition to the overall suitability of horticultural crops in the district, the commercial cultivation of particular crops, namely, mango, litchi, banana, and citrus, was assessed. The main difference from the former analysis was (1) the need for access to road infrastructure; (2) the assumption that all agricultural land, including intensively cultivated areas on terraces and tars, would be used for commerical production of fruits; and (3) that only well suited areas would be considered for production.

The accessibility to roads for commercial horticultural production was defined in terms of walking time; i.e., the time for a person walking from the agricultural land to the road should not exceed two hours. The analysis was based on the Digital Elevation Model (DEM) produced of the contour coverage. The walking time was calculated assuming the following prerequisites: (1) the walking speed on flat land is 3,000m/h, (2) during one hour it is possible to ascend an elevation of 400m or to descend 800m, and (3) only slopes with less than 40 degrees can be travelled. The major rivers were included as natural boundaries only to be crossed at bridges or fords.

9.3 Horticultural Crops

As already mentioned above, the Master Plan differentiated between four horticultural (climatic) zones, according to elevation and temperature, where particular fruit crops should be promoted (Ranjit 1990:32,35). The fruits recommended by the Master Plan were included in the analysis of horticultural development in Lamjung.

- Tropical (mango) zone: mango, litchi, bananas, pineapples
- Subtropical (citrus) zone: mandarin oranges *(suntala)*, sweet oranges *(junar)*
- Warm temperate (peach) zones: peaches, plums
- Cool temperate (apple) zones: apples, pears, walnuts

Analysis was carried out using raster GIS and overlay modules of GIS software. The extent of one unit for the assessment was one hectare (100m resolution).

As already mentioned, some preconditons were set, i.e., potential horticultural development areas were classified only on medium- and low-density cultivated agricultural land on sloping and level terraces (C1/T1 and C2/T2) in the Middle Mountain Region and on all cultivated land in the High Mountain Region. For each fruit crop, suitability classes were defined to include the parameters, temperature, and soil conditions which were used according to the land units of the LRMP (Annex 21). Finally, the suitabilities were clustered into four categories, keeping the result less complex and easier to understand, and the aspects were included.

Suitable Areas

Northwestern to eastern aspects (NW, N, NE, E) and southeastern to western aspects and level land (SE, S, SW, W) were considered to be suitable areas. Besides the fact that only agricultural land was considered for horticultural development, the main criteria for suitable areas for each fruit crop were the optimal temperature ranges defined by Ranjit (1990) and Rehm and Espig (1991); land units, incorporating dominant soils, defined by LRMP; and soil requirements extracted from the Master Plan. Suitable soils for horticultural development were mainly found on alluvial plains and fans; on ancient lakes and river terraces; and on moderately to steeply sloping mountainous terrain. Aspects were differentiated mainly due to the scarcity of water for fruit production on south-facing slopes and level ground areas, which were expected to be more dry than north-facing slopes and, thus, possibly requiring irrigation facilities for successful fruit growing.

Moderately Suitable Areas

Northwestern to eastern aspects and southeastern to western aspects and level land were considered to be moderately suitable areas. Moderately suitable areas were classified mainly on steeply to very steeply mountainous terrain and in temperature ranges below and above the optimum level where the fruit crops would survive but would have lower productivity (Annex 42).

Precipitation was not used as a principal parameter in the first place but was considered in the analysis.

9.4 Accessibility and Marketing

Already the Master Plan for Horticultural Development indicates that horticultural development should incorporate the marketing of the products as well as accessibility to markets and road infrastructure. The Master Plan is following a demand-driven approach with the marketing of fruit at different levels, e.g., community markets, *haat* bazaar, district headquarters, and city markets. Lack of roads is recognised as a major hindrance to the economic development of rural areas, in general, and the availability of agricultural inputs as well as marketing of farm surplus products (cash crops), including horticultural products, in particular. It was added that the further the production area is from the existing road network, the greater will be the difficulties in transporting and marketing fruit. The Master Plan distinguishes between (1) areas within a day's walk to road collection centres and (2) remote areas. For the first category it was found feasible to commercially produce and market perishable fruits of high weight and low value. Horticultural production in the second category should emphasise (i) local consumption only to meet the basic requirements of the people, (ii) producing fruit crops of low weight and high value, and (iii) processing fruit locally in order to produce a high-value product for the market (Onta 1990:3).

GIS technology was applied to assess the area for commercial cultivation of some fruit crops with sizeable market potential in the urban centres of Nepal, e.g., bananas, oranges, and mangoes. The main difference from the former analysis was (1) the need for access to road infrastructure within one or two hours, (2) the assumption that all agricultural land, including intensively cultivated areas on terraces and tars, would be used for commercial production of fruit and (3) that only well-suited areas would be considered for production.

9.5 Results

At present, the major fruit crops cultivated in Lamjung are orange trees, covering about 250ha, and mangoes which are cultivated on about 72ha. Other common tropical fruits are guava, litchi, and jackfruit. Besides mandarin orange trees *(suntala)*, sweet orange *(junar)* trees are grown. Peaches, plums, apples, and pear trees are warm temperate and temperate fruits cultivated on a larger scale (Devkota 1995) (Table 47).

Table 47: Present Area of Fruit Crops in Lamjung

Horticultural Zone	Fruit	Horticultural Area (ha)	
		DADO 1995	Census 1991
Tropical	mango	72	4.8
	litchi	34	0.2
	banana	n.a.	14.8
	guava	50	n.a.
	jackfruit	30	n.a.
	pineapple	n.a.	8.3
Citrus	orange	250	37.7
	lime	n.a.	4.0
	sweet orange	25	0.9
Warm Temperate	peach	21	n.a.
	plum	10	4.8
Temperate	apple	40	-
	pear	50	2.2
	walnut	n.a	-

Sources: Devkota 1995 & HMG Nepal 1993b

9.5.1 *Tropical Fruits*

Based on GIS analysis, mangoes, litchies, bananas, and pineapples have good potential for horticultural development in Lamjung District. These tropical fruits have similar needs in terms of soil conditions and can be planted in the same areas. The agricultural area suitable for banana production is larger due to the fact that banana trees grow better than mangoes or pineapples in cooler climates.

Mangoes, litchies, and pineapples are suited for some southern parts of Lamjung District. About seven per cent of the potential horticultural development area is suitable for all three fruits, considering temperature and soil requirements; approximately 47 per cent is moderately suitable (Map 42) (Table 48) (Annex 43). Mango trees grow best in tropical summer rainfall regions; a dry period of several months encourages flowering and fruit setting (Rehm and Espig 1991). This indicates that mangoes are adapted to the summer monsoon climate in the area. Litchis need a definite cool but frost-free season, without too much heat in summer; the water requirement is about 1,500mm and, in regions with a long dry period, they must be irrigated during winter. Pineapples grow well where there are

precipitations of 1,000 - 1,500mm/year, which can be expected in the area. In contrast to mangoes, however, pineapples may need additional sprinkler irrigation in the dry season.

Figure 9: Potential Horticultural Development Area in Lamjung District

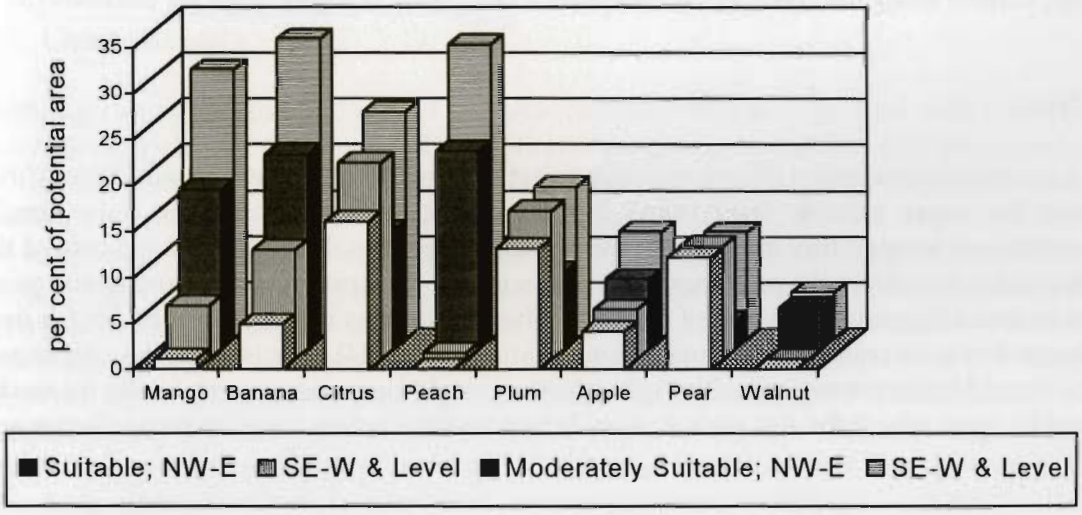

Table 48: Agricultural Land with Potential for Horticultural Development in Lamjung (in hectares)

Type of fruits	Suitable area		Moderately suitable area		Potential area	
	NW - E	SE - W & level	NW - E	SE - W & level	total	%
Tropical						
mangoes & litchis	300	1,480	4,420	7,460	13,660	53.6
bananas	1,260	3,040	360	6,120	10,780	42.3
pineapples	300	1,480	4,420	7,460	13,660	53.6
Citrus						
suntala, junar	4,120	5,460	3,310	6,300	19,190	75.3
Warm temperate						
peaches	30	180	5,490	8,160	13,860	54.4
plums	3,370	4,130	2,150	4,210	13,860	54.4
Temperate						
apples	1,070	1,390	1,960	2,980	7,400	29.0
pears	3,120	3,150	780	2,970	10,020	39.3
walnuts	-	-	1,130	1,280	2,410	9.5
Total area	10,010	15,480	10,010	15,480	25,490	

Almost 17 per cent of the potential horticultural development area is well suited to banana production, considering temperature and soil conditions; approximately 25 per cent of the area might be moderately suitable for this fruit. Bananas need evenly spread rainfall of about 2,500mm/year and cannot tolerate waterlogged conditions (Rehm and Espig 1991:183; Ranjit 1990). This implies that, in

general, bananas could be grown commercially along the road corridors since the moisture regime is humid in the area, although on south-facing slopes irrigation facilities might be necessary.

Commercial cultivation of tropical fruits has some scope in the very south of the district along the Marsyangdi River and, thus, close to the earthen road where trucks drive up to Besisahar and along the Madi *Khola* up to Bhorletar. In particular, Dhamilikuwa, Tarkughat, Sundarbazar, and Parewadanda VDCs have a sizeable potential for commercial cultivation of mangoes, litchies, and bananas, since all the crop requirements are fulfilled, and it takes less than one hour to walk to the road. In addition, further along the river, up to Besisahar VDC, there is a good area for bananas (Map 43).

9.5.2 *Citrus Fruits*

Citrus species, i.e., mandarin oranges *(Citrus reticula)*, sweet oranges *(Citrus sinensis)*, and lime *(Citrus aurantiifolia)*, are the most suitable fruit crops for the district. All three species have similar requirements in terms of temperature and soils in the suitable categories. More than 37 per cent of the potential horticultural development area might well be suitable for orange trees. *Suntala* and *junar* could be grown in an additional 37 per cent of the area, whereas the area moderately suitable for lime cultivation is larger due to its resistance to tropical temperatures (Map 44). Citrus crops may be grown successfully in a humid moisture regime, although irrigation might be necessary, especially on south-facing slopes and in areas where the dry period exceeds two months before fruit ripening (Rehm and Espig 1991:178).

There might be scope for commercial cultivation of citrus trees, i.e., mandarin oranges, sweet oranges, and lime, on the agricultural land along the western side of the Marsyangdi River in the VDCs of Udipur, Gaunsahar, Besisahar, Chandisthan, and Simpani, to some extent in Bajhakhet on the eastern river bank, and on the southern slopes of Kunchha and Parewadanda (Map 45).

9.5.3 *Warm Temperate Fruits*

The warm temperate fruit crops mentioned by the Master Plan for Horticultural Development are plums and peaches. There is only a potential for plum *(Prunus salicina* and *Prunus domestica)* cultivation on the middle mountain slopes in Lamjung, whereas there is only a limited area of agricultural land which is suitable for peach trees *(Prunus persica)* (Map 46). The largest areas for the cultivation of plums are located in Baglungpani, Chandreshwor, Gaunda, Gaunsahar, Ghanpokhara, and Puranokot (Annex 44).

In spring, especially, but also in winter, water supplies for warm temperate fruit crops must be guaranteed to produce quality fruits. Therefore, in summer monsoon areas, the trees must be irrigated before the beginning of the rains and after the monsoon (Rehm and Espig 1990:202).

9.5.4 *Temperate Fruits*

According to the Master Plan, humidity affects production of fruit crops in the cool temperate and humid zone. High cloud cover and wet conditions have undesirable effects, e.g., diseases and poor fruit quality, particularly on horticultural crops. Only proper selection of varieties can overcome this problem (PACMAR 1990:13).

Like warm temperate fruits, the development of temperate fruits, in particular pears and apples, has some potential in the Lamjung District. Pear trees *(Pyrus pyrifolia/P. communis)* are suitable for cultivation in about 25 per cent of the potential horticultural development area (Map 47). The largest

potential growing areas for pears are in Ghanpokhara and Taghring VDCs. Apple trees *(Malus domestica)* are suitable for less than 10 per cent of the potential horticultural development area, with a focus on Khudi, Ilampokhari, Ghanpokhara, and Ghermu. Among the temperate fruits, walnut *(Juglans regia)* has no potential for cultivation in Lamjung. Water availability is the biggest constraint to temperate fruit cultivation. Apples do well in areas with dry summers and wet winters (Ranjit 1990:38). However, the situation in the Nepalese mid-hills is just the opposite, with heavy monsoon rains in summer and usually rather dry winters. The Master Plan recommended irrigation for both apple and pear fruit trees in humid areas, at least during the establishment phase (PACMAR 1990:8).

9.6 Conclusions

Although an approximate figure of the present area which is cultivated with fruit crops in Lamjung is available, figures on the spatial distribution of particular horticultural crops are lacking. The results of the GIS analysis indicate that there is considerable potential for horticultural development in the middle mountains. Temperature and soil conditions are favourable for tropical and citrus fruits and, to some extent, for warm temperate and temperate fruits. Water availability might be a problem locally, especially on south-facing slopes where irrigation becomes necessary. Road infrastructure is going to be fairly well developed, although all roads so far are fair-weather roads and may not be much frequented in the monsoon season. Although most of the villagers may have access to the road network from within a one-day walk, the cost of transportation of fruits to markets and roads is a major constraint. Besides the cultivation and transportation aspects, marketing of fruits is the crucial point in the commercialisation process. As indicated by the Master Plan, horticultural development should be demand-driven; horticultural programmes need to support fruits for marketing that people want to consume and for which they are willing to pay a reasonable price. Considering this, there seems to be good scope only for citrus, banana, and mango production on a larger scale.