

## **Intercropping of agri/horti crops with special reference to mandarin (*Citrus reticulata* Blanco) in Sikkim (INDIA)**

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### **Abstract**

Sikkim has a total area of 7,096 km<sup>2</sup> with only 11% of land suitable for agriculture. About 80% of the farms are small and marginal (0.2 to 0.4 ha) with fragmented land holdings. Mandarin is the most important commercial fruit of Sikkim and is never grown alone but always intercropped throughout the year. These intercrops are grown in such a way so as to take maximum advantage of the space in between the fruit trees. Leguminous crops and ginger were found to be most beneficial in terms of economic returns. Due to its geographical location and biodiversity the existing mandarin agri/horti system is ecologically sustainable and provides farmers with their household food needs and cash income for family welfare.

### **Media Summary**

Intercropping of mandarins provides farmers with increased food security and opportunities for cash flow, while also helping to stabilize the steep slopes of the Himalayan foothills of Sikkim.

### **Key Words**

hill-farming, soil-erosion

### **Introduction**

On the western end of the Indian side of the Eastern Himalayas lies Sikkim, one of the smallest states of India. Sikkim is located between north 27° 03' 47" to 28° 07' 34" latitude and east 88° 03' 04" to 88° 57' 19" longitude with altitudes ranging from 300 to 8586 m, and almost no flat land. Of the total area of 7096 km<sup>2</sup>, more than 80% is under the administration of Forest Environment and Wildlife Department. Sikkim's geographical position (tri junction of Eastern Himalayas, Central Himalayas and Tibet), high annual rainfall of 2,000 to 5,000 mm, constant humidity (70 % and above throughout the year) and favorable temperature regime makes it one of the richest "hotspot" of biological diversity in the country.

Agriculture is practiced on approximately 11% of the total geographical area of the state, and extreme variations in altitude create microclimates suited to the production of almost all of the world's crop plants as well as animal husbandry. Mixed farming is practiced on steep slopes, which have been carefully terraced and have a long history of cultivation. About 80% of the farms are small and marginal (0.2 to 0.4 ha) with fragmented land holdings, and farmers are directly depended on scarce land resources for their livelihood.

### *Intercropping*

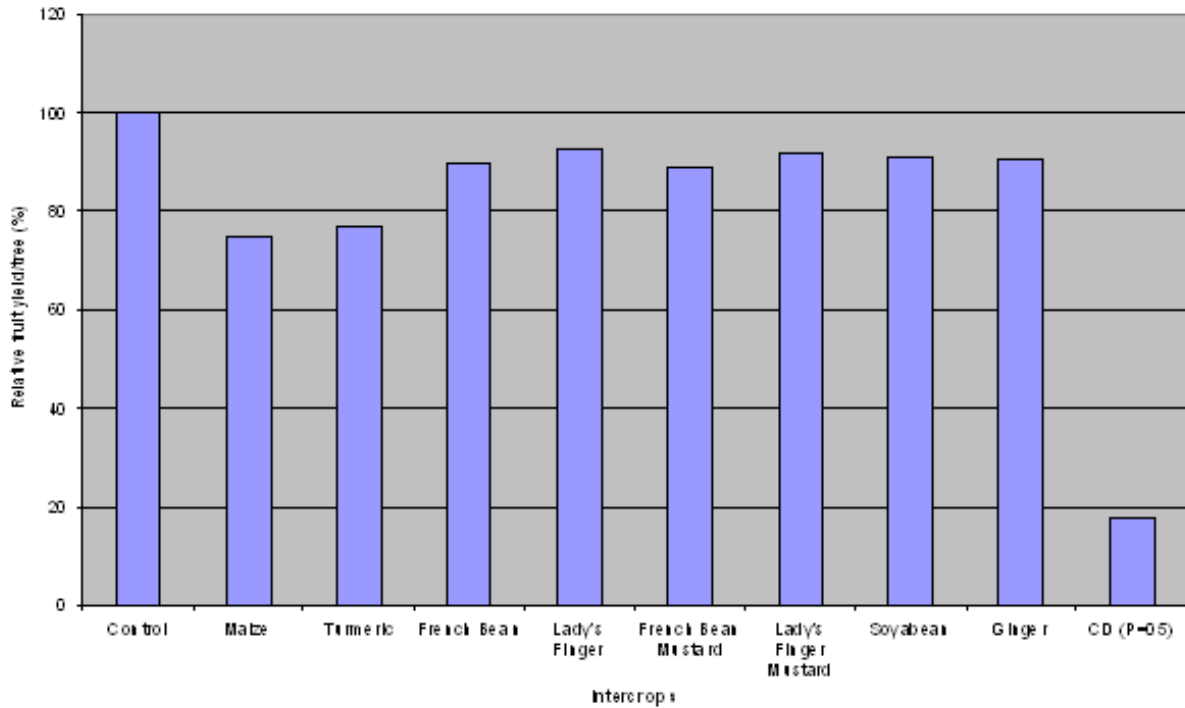
Mandarin (*Citrus reticulata* Blanco) is the most important commercial fruit of Sikkim, locally known as *Suntala*. In Sikkim its cultivation occurs in sub-tropical climates on both the sides of the Tista and Rangit rivers and its tributaries between 600 to 1,500 m above msl. The gradual slope of river valleys, with light textured deep fertile soil high in organic matter, provides good drainage and is free from soil acidity problems. At present mandarin is cultivated on around 6,800 ha, producing 9,500 t fruit (Table 1).

### **Table 1. Area, production and productivity of mandarins in Sikkim (Anon, 1999)**

Year	Total area ('000ha)	Yielding area ('000ha)	Production ('000 kg)	Productivity (kg/ha)
1980-81	2.62	1.83	3.85	2103.00
1985-86	4.60	2.99	5.00	1673.00
1990-91	6.00	3.60	6.50	1805.00
1995-96	6.60	3.63	7.00	1928.00
1996-97	6.70	4.02	9.00	2238.00
1997-98	6.80	3.90	9.50	2435.00
1998-99	6.80	4.14	6.00	1449.00

The economic survival of the farming community in Sikkim is based on cultivation of cash crops within a multi-cropping system and orchard intercropping along with animal husbandry. There is no clean cultivation of Sikkim mandarins with orchards intercropped throughout the year. The major intercrops used are ginger, ginger +maize, maize +finger millet, maize + cassava, maize +buckwheat, and vegetables (particularly beans). The intercrops are grown in such a way as to take advantage of both horizontal and vertical spaces available in between the fruit trees. Growing of intercrops not only generates additional income and improves food security, but also helps to check soil erosion through ground coverage and stabilizing terrace walls. Mandarin trees have a long gestation period and so short duration crops provide some income from the land before the orchards start producing fruit. Moreover the precipitation during the rainy season (June to August) creates ample scope for growing short duration crops.

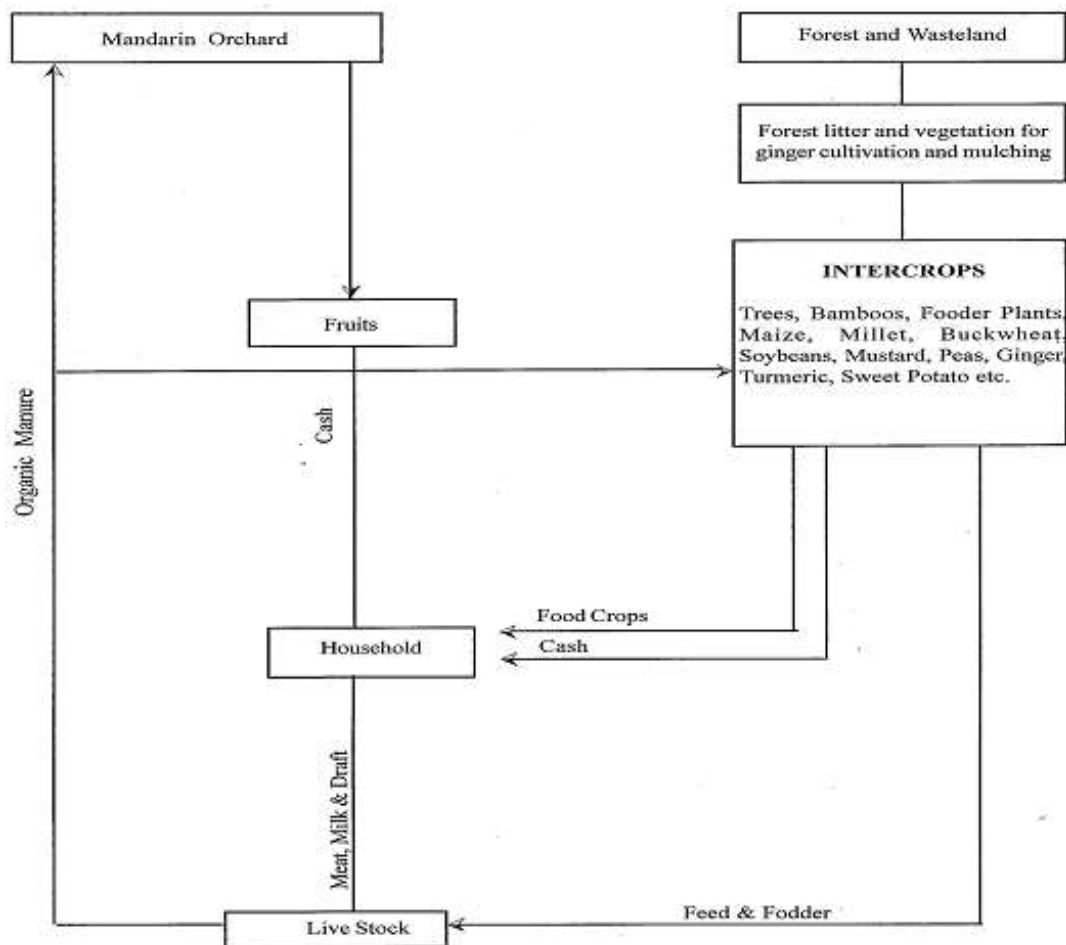
Intercropping experiments have shown maximum production of fruits without an intercrop and conversely maximum reduction in productivity with maize (Figure 1). A less than 10% drop in mandarin yield was obtained with ladyfinger bananas and 10-14% with other intercrops. On this basis it can be concluded that vegetables, leguminous crops, and ginger can be used as an intercrop to generate improved economic returns (Patiram et al. 1994).



**Figure 1. Effect of intercropping on relative yield of mandarin (Patiram et al. 1994)**

*Integrated System of Farming*

The existing mandarin agri/horti system is ecologically sustainable and meets the farmers' needs for food and cash income (Figure 2). The recycling of nutrients through organic matter to intercrops (specially ginger and vegetables crops) results in an improvement in soil fertility with increasing age of orchards (Upadhaya et al. 1994). Amongst the intercrops, maize creates strong competition for nutrients and light and is the most detrimental to mandarin productivity. In economic terms there is great potential for the development of commercial production of mandarins within the suitable agro-climatic conditions of Sikkim by providing some other enumerative intercrop to replace maize and through adoption of good cultural practices to arrest the decline in mandarin productivity.



**Figure 2. Flow chart of mandarin production system**

## Conclusion

Integrated intensive farming systems followed in Sikkim for centuries provide an environmentally and economically sustainable solution for low-resource farmers operating on small and fragmented land holdings. The practice of intercropping in mandarin orchards helps to achieve maximum output per unit area within a short time frame without depleting the ecosystem of the Sikkim Himalaya. Limitations and solutions to low citrus productivity in this region are currently the focus of an ACIAR Project "Improving subtropical citrus production in Sikkim and Australia".

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