

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Agroforestry

The definition of agroforestry as adopted by ICRAF is a collective name for land-use systems and technologies where woody perennials are purposely used on the same land management units as agricultural crops and animals, in either a spatial arrangement or a temporal sequence, there being both ecological and economical interactions between the different components (Fernandes and Nair, 1986). This definition has four main points:

- i.* Agroforestry normally involves two or more species of plants (or plants and animals), at least one of which is a woody perennial (trees, shrubs, palm, bamboos, etc.);
- ii.* An agroforestry system always has two or more outputs;
- iii.* The cycle of an agroforestry system is always more than one year; and
- iv.* Even the most simple agroforestry system is more complex, ecologically (structurally and functionally) and economically, than monocropping systems.

By considering the natural components; woody perennials, herbaceous plants, and animals, Nair (1993) recommended three major categories: agrisilviculture, silvopastoral and agrosilvopastoral.

## 2.2 Homegardens as an agroforestry system

Homegardens have a long tradition in all tropical countries. Tropical homegardens consist of an assemblage of plants, which may include trees, shrubs, vines, and herbaceous plants growing in or adjacent to homes (Nair, 1993). They are very complex systems with sophisticated structures and a large number of components (Fernandes and Nair, 1986).

Homegardens, by definition include land-use practices which involve deliberate management of multipurpose trees and shrubs in close association with agricultural crops and invariably livestock. Within the individual household, the whole crop-tree-animal unit is intensively managed by family labour (Fernandes and Nair, 1986). Homegardens follow many agroforestry concepts for example, whilst the intimate mix of diversified agricultural crops and multipurpose trees fulfils most of the fundamental needs of the local populations, their multi-storey configuration and high species diversity also avoids the environmental deterioration commonly associated with monocultural production systems (Fernandes and Nair, 1986). It is determined by the structure of the system, its ecological functions and its continued ability to fulfil the socio-economic needs of the people (Soemarwoto, 1987). In other words, they have been producing sustained yields for centuries in the most resource efficient way (Fernandes and Nair, 1986). The typical agroforestry systems allow symbiotic economic and ecological interactions between the woody and non-woody components to sustain, increase, and diversify the total land output. Homegardens are

thus a traditional agroforestry system (Soemarwoto, 1987). According to Nair (1985), homegardens are one of four dominant agroforestry systems in the tropical region.

### 2.3 History of homegardens

Intensive agriculture of the Bronze Age introduced and spread new techniques and new varieties of domesticated food crops from 3000 BC (Goody, 1994; Soemarwoto, 1987). This involved the transformation of wild plants into domesticated plants not for what they will become but for what they are, whose greater productivity permitted the establishment of a significant hierarchy of wealth and culture (Goody, 1994). At that time, wild plants were grown in the gardens of the house or in the fields immediately surrounding a settlement. In other words, according to Soemarwoto (1987), homegardens might originate in prehistoric times when hunters and gatherers deliberately or accidentally dispersed seeds of highly valued fruit trees in the vicinity of their camp sites.

Homegardens can be found in all tropical and sub-tropical countries where subsistence land-use systems predominate (Fernandes and Nair, 1986). In South India, Kerala homegardens represent a traditional agroforestry system (Babu *et al.*, 1992). The mixed-gardens of Mexico was discovered by Soleri and Cleveland, 1992. Rahim and Islam (1998) reported the multi-storey tree or crop systems of Bangladesh. Home gardens in Tucson, Arizona were studied by Soleri and Cleveland (1992), whilst Sommers (1992) researched those at Honiara, Solomon Islands.

Farmers have historically protected, planted and managed trees on their land in order to maintain supplies of products no longer available from natural forests

(FAO, 1989). Several types of homegarden have been identified in different locations, each with its own characteristic features (Fernandes and Nair, 1986). They are the mixed-garden of Terra (1954), the home-garden of Ramsay and Wiersum (1974), the mixed garden or house garden of Stoler (1975), the compound farm of Lagemann (1977), the kitchen garden of Brierley (1985), the household garden of Vasey (1985), the homestead agroforestry of Nair and Sreedharan (1986) Leuschner and Khaliq (1987), and the Javanese homegarden of Soemarwoto (1987) cited by Nair (1993).

Homegarden systems have evolved over-time under the influences of resource constraints. These are population pressure and consequent reduction in available land, capital, labour and physical limitations. In particular, remoteness of the area forcing the inhabitants to produce most of their basic needs for themselves since they lack adequate access to market (Fernandes and Nair, 1986).

### **2.3.1 Homegardens in Asia**

#### **2.3.1.1 China**

In China, homegardens are an ancient agricultural system and are commonly found throughout the country. Every garden is a unique creation, with a complex set of tree and crop species and animals (FAO, 1995). Fishponds are used to raise fish or high-value species such as eels or soft turtles. Biogas digesters supplied with animal dung are common. The advantage of this system is usually small in scale, however, the potential to generate income is generally very high and flexible in that adjustments to production can be made as prices change. In addition to providing income, homegardens contribute to the nutritional improvement of a household, as

well as improving the beauty of the homestead. Its limitation come in the high level of skill required to operate and manage an intensive homegarden (FAO, 1995).

### 2.3.1.2 Indonesia

Traditional agroforestry systems are found throughout Indonesia including the *kebun-talun* and *pekarangan* systems in Java, and the multi-storey homegarden systems in Sumatra.

According to FAO (1995), the *pekarangan* (homegarden) is a mixture of annual crops, perennial crops, and animals (including livestock) in the area surrounding a house. It is an integrated system with definite boundaries that serves a variety of economic, biophysical, and sociocultural functions. This homegarden system originated in central Java and spread to east Java in the middle of the eighteenth century. The structure of *pekarangan* has 5 layers. The top layer is more than 10 m high with coconut, albizia and other trees. The second, about 5 to 10 meters high has fruit trees such as soursop, jackfruit, guava, mountain apple, and cloves. The third layer is from 2 to 5 m high with banana, papaya and other fruit trees. The fourth is arranged with beans, spinach, cassava, and gembilli (*Dioscorea esculenta*) and the fifth with taro, xanthosoma, chili, pepper and eggplant. In West Java, where homegardens are known as *kebun-talun*, they can generate relatively good incomes as well as providing good sources of calcium, vitamin A and vitamin C. The *kebun-talun* system usually consists of three parts: *kebun* (garden), *kebuk campuran* (mixed garden) and *talun* (mixed tree garden).

### 2.3.1.3 Thailand

Homegardens are multiple plant systems found in family compounds surrounding homes. Permanently settled communities in upland areas throughout the country have cultivated homegardens for centuries, most notable with the Karen and Lua ethnic groups. In the North, homegardens are mostly located in communities around the foot hills. According to FAO (1995), homegardens in Thailand have three layers. *Erythrina dadap* and banana are common tree species providing shade for crops and vegetables. *Moringa oleifera* and *Sesbania grandiflora* are commonly planted as multi-purpose trees. In the South, durian, rubber trees, *Parkia speciosa*, and *Artocarpus integer* dominate the top storey of the garden (FAO, 1995).

### 2.3.2 Homegardens in Vietnam – Types and practices

Considering the nature and type of components, most homegardens are agrosilvopastoral systems consisting of herbaceous crops, woody perennials and animals. Others are agrisilvicultural systems (Fernandes and Nair, 1986).

In Vietnam, homegardens can be seen as a popular traditional agroforestry technique with local characteristics, especially, in the upland area. Dependent upon local climate, soil, customs, and expected products of local farmers, there are four main types of this kind of land use (Quat, 1994). They are homegarden, orchard garden, forest garden and industrial tree garden.

- a) The homegarden is combined with a fish pond and animal shed. Outputs of each component become inputs of the others. The popular name is V.A.C system (*Vườn*

+*Ao+Chuông*). This system is quite popular from the North to the South of the country especially, in the upland areas. The main purpose of the system is to meet the household's needs in foods for their daily meals.

- b) The orchard garden's main output is fruit. This is main type of agroforestry in the southern part of Vietnam. Orchards are built for the needs of local and sometimes part and whole country markets. Some of the popular plant species are rambutan, durian, coconut, mango, banana, jackfruit, pomelo, grapefruit, mangosteen, custard apple, lemon, and guava. Canal networks are always observed to lay around and sometimes through the gardens in order to supply the water to orchards as well as provide water products for local farmers.
- c) The forest garden is a type of homegarden containing forest trees. This kind can be found in the upland areas of the northern Vietnam. There is one main storey of forest plantation with some popular species such as *Bambusa* spp., *Illicium verum*, *Cinnamomum camphora*, *Aleurites montana*, *Canarium* spp., *Quercus* spp., *Pinus* spp.. The ground of the forest is covered by food and herb species such as cassava, legumes, ginger, turmeric, amomum (*Amomum villosum*), pineapple, mixed with soil improving trees *Cassia occidentalis*, *Cajanus cajan*.
- d) The Industrial tree garden contains species of high demand to industry, such as coffee, pepper, cashew nut, and rubber. This type of garden is popular in the Central Highland provinces, and some provinces in the Eastern West region. The most popular gardens in the upland northern part of Vietnam are the tea garden.

Products obtained from this type of garden are exported and some of them are used for industrial process of that region.

There are four main types of homegarden systems in Vietnam. However, homegarden structure at each location depends largely on geography, landscape, climate, soil types, unique characteristics of local culture and the economic condition of each region.

### **2.3.3. Homegardens and its role in agricultural systems in upland areas**

The house or door-yard, by which the homegarden system is also known, plays an important role in the life of rural upland people. Tropical homegardens are important resources that can be highly productive and sustainable. A surprising number of plant species may be found (David and Warwick, 1994). With population pressure, the proportion of land under homegardens has been increasing, in some cases to up to 75 percent of the cultivated land area (Stoler, 1978 cited by FAO, 1989). Moreover, homegardens supply the recommended daily requirement for vitamin A, vitamin C, iron, and calcium. Farmers can also obtain a sizeable part of their thiamine, riboflavin, and niacin requirements from the homegarden (Nair, 1993).

Food production is the primary function of most, if not all, of the homegardens (Nair, 1993), and much of what is produced is consumed by the household. When the tree and other food producing components are added together, homegardens can supply a substantial portion of the family's food needs. More than 40% of the total calorific intake of farming communities in some areas were reported from Javanese gardens (FAO, 1989).



Crops with different production cycles are combined to provide year round supplies of food. Although it has peak and slack seasons for particular products, systems are designed so that as far as possible there is something to harvest every day (FAO, 1989). Having diversity of species in homegarden implies wider genetic variability and ensures that the various crop types or species have different levels of sensitivity to a range of stresses (Tsegaye, 1997). Therefore, another important feature of homegardens is their ability to produce food throughout the year with relatively low labour inputs (FAO, 1989; Nair, 1993).

A sustainable management system for land which increases overall production combines crops and fruit plants and animals simultaneously or sequentially, and applies management practices which are compatible with the cultural patterns of the local population (Chanuan, 1995). So that, in homegarden systems, a mixture of annual crops and perennial trees, and the use of a diversity of species are the most fundamental in terms of sustaining agricultural production (Tsegaye, 1997). The benefits of diversity include multiple output, risk aversion, tolerance to stresses, suppression of weeds, increased productivity, and yield stability and sustainability. Furthermore, rotation and succession of mixed tree crops prevent build-up of pests and disease (Whitmore, 1992). In other words, homegarden practices can be sustainable without degradation of land resources (Palte, 1990)

Diversity enables farmers to sustain production despite the changes in climate, soil condition, pest and disease incidence that is often difficult for individual farmers to control (Tsegaye, 1997). Diversity in the homegardens of Kerala is a deliberate

strategy aimed at producing a harvest throughout the year so there is always some product of economic value available for either household use or cash sale (Babu et al., 1992).

Approximately 119 pure chemical substances extracted from such plants are used in medicine throughout the world. Eighty percent of people in developing countries rely on traditional medicine for primary health care of which 85 percent involves the use of such plant extracts (David and Warwick, 1994). However, the most significant function of the diversity of species in an agricultural system, are the improvement to natural resources such as watershed protection and biodiversity conservation (FAO, 1998a).

To sum up, diversity is the main feature of homegarden systems. The advantage local farmers claim from the system include, ensuring harvest security, providing variable dietary supplements, staggering the timing of labour requirements, making use of the diverse agro-ecological conditions, maintaining soil fertility, providing an alternative source of income, source of feed for livestock, source of fire wood and for providing construction materials (Tsegaye, 1997).

The traditional small homegardens are store houses of diversity managed by men and women sharing the responsibilities (Tsegaye, 1997). As a gender consideration, women are part of the system and have to be partners and beneficiaries of such activities at grass root levels (Tsegaye, 1997). Besides, a particular value of indigenous house gardens is that they provide a means for handing down traditional knowledge from one generation to the next (David and Warwick, 1994).

On the other hand, homegardens also have an important aesthetic function that is served by the planting of ornamental plants, mostly in the front of the garden (Soemartowo and Conway, 1992).

Cash crops and tree species in homegardens are particularly important for poor farmers because they provide a measure of insurance, as they can be harvested in times of emergency cash needs. For poor upland farmers, the reduction of risk maybe an important consideration (FAO, 1989). So, the output of mixed gardens usually suffices to feed the farm household and to provide income to satisfy its basic needs (Palte, 1990). Any marketable surplus helps provide a source of income to aid the harvesting of other crops, and a safeguard against crop failure (FAO, 1989). In summary, homegardens are economically efficient, ecologically sound and biologically sustainable agroforestry systems (Fernandes and Nair, 1986).