Tropical Homegardens

Advances in Agroforestry

Volume 3

Series Editor:

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Aims and Scope

Agroforestry, the purposeful growing of trees and crops in interacting combinations, began to attain prominence in the late 1970s, when the international scientific community embraced its potentials in the tropics and recognized it as a practice in search of science. During the 1990s, the relevance of agroforestry for solving problems related to deterioration of family farms, increased soil erosion, surface and ground water pollution, and decreased biodiversity was recognized in the industrialized nations too. Thus, agroforestry is now receiving increasing attention as a sustainable land-management option the world over because of its ecological, economic, and social attributes. Consequently, the knowledge-base of agroforestry is being expanded at a rapid rate as illustrated by the increasing number and quality of scientific publications of various forms on different aspects of agroforestry.

Making full and efficient use of this upsurge in scientific agroforestry is both a challenge and an opportunity to the agroforestry scientific community. In order to help prepare themselves better for facing the challenge and seizing the opportunity, agoroforestry scientists need access to synthesized information on multi-dimensional aspects of scientific agroforesty.

The aim of this new book-series, *Advances in Agroforestry*, is to offer state-of-the art synthesis of research results and evaluations relating to different aspects of agroforestry. Its scope is broad enough to encompass any and all aspects of agroforestry research and development. Contributions are welcome as well as solicited from competent authors on any aspect of agroforestry. Volumes in the series will consist of reference books, subject-specific monographs, peer-reviewed publications out of conferences, comprehensive evaluations of specific projects, and other book-length compilations of scientific and professional merit and relevance to the science and practice of agroforestry worldwide.

The titles published in this series are listed at the end of this volume.

Tropical Homegardens

A Time-Tested Example of Sustainable Agroforestry

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PREFACE

Tropical homegardens are a topic of discussion in most agroforestry conferences especially those covering humid tropical lowlands, but publications on this topic are scattered in the literature; comprehensive books and reports focused on it are rare. The motivation for this book was the desire to address that deficiency, following a session on Tropical Homegardens at the 1st World Congress of Agroforestry, Orlando, Florida, USA in June – July 2004 (http://conference.ifas.ufl.edu/wca). The initial idea was to bring out a publication based on the presentations at the Congress session; but consequent to enthusiastic responses from the professional community, the scope of the book was broadened to make it more comprehensive than a conference publication.

As it turned out, only five chapters out of the total 20 in the book are based on presentations at the above Congress session. Three chapters are adaptations from papers that have recently been published (or have been accepted for publication) in *Agroforestry Systems* journal on issues that are important from the point of comprehensiveness of the book. Seven of these eight chapters are research articles and are presented in the conventional research-publication format (Introduction, Materials and Methods, Results, and Discussion); they present a glimpse of the nature of current research in homegardens. All other chapters are review and synthesis of current state of knowledge on homegarden issues from all three developing continents (Africa, Asia, and Latin America & the Caribbean). The chapters are organized into five sections (Historical and Regional Perspectives; Structure, Function, and Dynamics; Some New Thrust Areas; and Future of Homegardens); each section contains a mix of research and review articles. We believe that these 20 chapters represent the state-of-the-art of tropical homegardens today.

The expeditious publication of the book would not have been possible without the cooperation and dedication of the authors and reviewers. All chapters were rigorously peer-reviewed. We thank the reviewers (see the list attached) for their insightful comments and critical suggestions, which helped to enhance the quality of the chapters. The authors too have been a very pleasant and professional group to work with; we greatly appreciate their cooperation and understanding in putting up with our requests for repeated revisions within very short and strict time schedules. Once again, we sincerely thank all the authors and reviewers for their splendid cooperation. Special thanks go to Dr. Michael Bannister, who did an excellent job of reading through the manuscripts and scrutinizing the literature citations.

B. Mohan Kumar, Thrissur, Kerala, India
February 2006 P. K. R. Nair, Gainesville, Florida, USA

CHAPTER 1

INTRODUCTION

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1. THE CONCEPT OF HOMEGARDEN

It is rather customary that any writing on homegardens starts with a "definition" of the term. The first drafts of several chapters in this book were no exception. This indicates that there is no universally accepted "definition" of the term and therefore the authors feel compelled to make their perception clear. An examination of the various "definitions" used or suggested by various authors (of chapters of this book as well as other recent homegarden literature) shows that they all revolve around the basic concept that has been around for at least the past 20 years, i.e., since the "early literature" on the subject (Wiersum, 1982; Brownrigg, 1985; Fernandes and Nair, 1986; Soemarwoto, 1987): *homegardens represent intimate, multistory combinations of various trees and crops, sometimes in association with domestic animals, around the homestead*. This concept has been developed around the rural settings and subsistence economy under which most homegardens exist(ed). But, as some chapters in this book describe, the practice of homegardening is now being extended to urban settings (Drescher et al., 2006; Thaman et al., 2006) as well as with a commercial orientation (Abdoellah et al., 2006; Yamada and Osaqui, 2006).

Even before the advent of such new trends as urban and commercial home-gardens, the lack of clear-cut distinctions between various stages in the continuum from shifting cultivation to high-intensity multistrata systems and the various terms used in different parts of the world to denote the different systems has often created confusion in the use of the term homegarden and its underlying concept. The confusion is compounded by the fact that in many parts of the world, especially

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in the New World, swidden farming such as the milpa of Mesoamerica evolve over a period of time into full-fledged homegardens consisting of mature fruit trees and various other types of woody perennials and the typical multistrata canopy configurations. In such situations, it is unclear where the swidden ends and homegarden begins – and often they co-exist. Yet another cause of confusion is the term itself: homegarden. Even for most agricultural professionals who are either not familiar with or are not appreciative of agroforestry practices, what we write as one word 'homegarden' sounds as two words 'home' and 'garden' sending the signal that the reference is to ornamental gardening around homes. While ornamentals are very much a part of homegardens in many societies, homegardens, in our concept, are not just *home gardens* of strictly ornamental nature.

As we explained in our recent paper (Kumar and Nair, 2004), we use the term homegardens (and homegardening) to refer to farming systems variously described in English language as agroforestry homegardens, household or homestead farms, compound farms, backyard gardens, village forest gardens, dooryard gardens and house gardens. Some local names such as *Talun-Kebun* and *Pekarangan* that are used for various types of homegarden systems of Java (Indonesia), *Shamba* and *Chagga* in East Africa, and *Huertos Familiares* of Central America, have also attained international popularity because of the excellent examples of the systems they represent (Nair, 1993). In spite of the emergence of homegardening as a practice outside their "traditional" habitat into urban and commercial settings, the underlying concept of homegardens remains the same as before "intimate, multistory combinations of various trees and crops, sometimes in association with domestic animals, around homesteads." Intimate plant associations of trees and crops and consequent multistory canopy configuration are essential to this concept. Equally important in this concept is the *home* around which most *homegardens* are maintained; but in some situations, multistory tree gardens (such as the *Talun* or *Kebun* of Indonesia: Wiersum, 1982) that are not in physical proximity to homes but receive the same level of constant attention from the owners' household and have similar structural and functional attributes as other homegarden units located near homes are also considered as homegardens.

2. GENESIS AND GLOBAL DISTRIBUTION OF HOMEGARDENS

Tracing the history of homegardening, Kumar and Nair (2004) describe it as the oldest land use activity next only to shifting cultivation that has evolved through generations of gradual intensification of cropping in response to increasing human pressure and the corresponding shortage of arable lands. The Javanese homegardens of Indonesia and the Kerala homegardens of India – the two oft-cited examples – have reportedly evolved over centuries of cultural and biological transformations and they represent the accrued wisdom and insights of farmers who have interacted with environment, without access to exogenous inputs, capital, or scientific skills. Wiersum (2006) mentions that the origin of homegardening in Southeast Asia has been associated with fishing communities living in the moist tropical regions *ca* 13 000 to 9000 B.C. Implying the predominance of homegardens in ancient India, *Vatsyayana* in his great book of Hindu aesthetics – *Kamasutra*, written *ca* 300 to 400 AD, describe

house gardens as a source of green vegetables, fig trees (*Ficus* spp.), mustard (*Brassica* spp.) and many other vegetables (*c.f.* Randhawa, 1980). Ibn Battuta in his travelogue (1325 – 1354) also wrote that the densely populated and intensively cultivated landscape with coconut (*Cocos nucifera*), black pepper (*Piper nigrum*), ginger (*Zingiber officinale*), sugarcane (*Saccharum officinarum*), pulses (grain legumes) and the like surrounding the houses formed a distinctive feature of the Malabar coast of Kerala (Randhawa, 1980). In both Java and Kerala, homegardening has been a way of life for centuries and is still critical to the local subsistence economy and food security (Kumar and Nair, 2004). This is true of several other Old World homegardens as well (e.g., the Chagga of Mt. Kilimanjaro in East Africa: Fernandes et al., 1984; Soini, 2005).

In spite, or perhaps because, of the pre-historic origin of the practice, accurate data on the extent of area under homegardens are not available. Estimating the area of homegardens is beset with several problems (Kumar, 2006). A major one is the lack of distinct boundaries or demarcation between homegardens and other cultivated agricultural fields. As Tesfaye Abebe et al. (2006) point out; most homegardens studies are focused on gardens that constitute a component of a farming system consisting of cultivated fields away from homes complemented by the homegardens surrounding residential houses. In those situations, it is difficult to determine where homegardens end and other cultivated fields begin. Added to this problem is the "commodity-centric" approach to recording land use statistics: statistics are prepared and presented for specific (single) crops and commodities. In most cases, the area is listed under the most conspicuous or visible crop (e.g., fruit trees, coconut palms, and other trees that occupy the upper stratum of multistoried homegarden system) and the lower-story crops are seldom reported – and, often the reporting forms do not allow entries to be made of such mixed stands. Thus, homegardens are a "non-entity" for agricultural statistics and land revenue records.

In spite of these difficulties, some efforts have been made in compiling statistics on the spread of homegardens. Such estimates include 5.13 million ha of land under *pekarangans* in Indonesia, 0.54 million ha under homesteads in Bangladesh, 1.05 million ha in Sri Lanka, and 1.44 million ha in Kerala, India (Kumar, 2006). Christanty (1990) reported that more than 70% of all households in the Philippines maintained homegardens; but the extent of area occupied by them was not reported. Area statistics of homegardens are also not available from a number of other parts of the world although the prevalence of the practice – indeed predominance in many situations – has been reported from various parts of the tropics as several chapters in this volume also attest to. In an attempt to present a global distribution of homegardens, we selected 135 entries from the CABI Abstracts for the period from 1990 to 2003 for which geographical locations are either mentioned or can be deduced; these included: Africa 21, Europe (Catalonia, Austria, etc.) 10, Central and South America 23, South Asia 45, Southeast Asia 30, other parts of Asia 2, Pacific islands 4. Based on these reports, supplemented with available statistics from other sources (e.g., reports on agricultural censuses) as well as personal experiences and observations of the authors, we have attempted a "Homegarden Map of the World" as presented in Fig. 1. The presentation only means that homegardens are present in

Explanation of Figure 1.

The global distribution of homegardens. This attempt is based on the geographical distribution of 135 selected studies (the specific geographical locations of which are reported or can be deduced) from the CABI abstracts for the period from 1990 to 2003, including Africa (21 studies), Europe: Catalonia, Austria, and others (10), Central and South America (23), South Asia (45), Southeast Asia (30), other parts of Asia (2), and Pacific Islands (4), supplemented with available statistics from other sources (e.g., reports on agricultural censuses) and authors' experiences/observations. Differing shade intensities in the figure represent high, moderate, and low frequency of occurrence of homegardens. We have used 'High' for areas where the frequency of occurrence in the CABI abstracts is more than 20 and/or if other databases (Statistical Yearbook 2000, Bangladesh Bureau of Statistics; Statistical Yearbook of Indonesia 2000, *Badan Pusat Statistik*; Census of Agriculture – Sri Lanka 2002. Agricultural holdings, extent under major crops and livestock statistics by district and DS/AGA division—based on operator's residence: small holding sector, Colombo; Land Resources of Kerala State 1995, Kerala State Land Use Board; see Kumar, 2006 for full citations) report that more than 50% of all households maintain homegardens, 'Medium' for 10 to 20 mentions in CABI abstracts or 25 to 50% of the households maintain homegardens according to the other reports listed above, and 'Low' for all those cases where presence of homegardens has been reported in one or more ways but at levels below the above limits. "Apparently present" is the term used to denote regions where homegardens are said to be abundant based on the authors' personal observations and/or communications from other sources, but on which published (accessible) information, especially on their area statistics, is limited or absent; such regions include tropical and subtropical parts of China, and some such other regions in Asia and Africa. The presentation only means that homegardens are present in the regions as indicated; it does not imply that homegardens are the only or the major land use system in any of these regions.

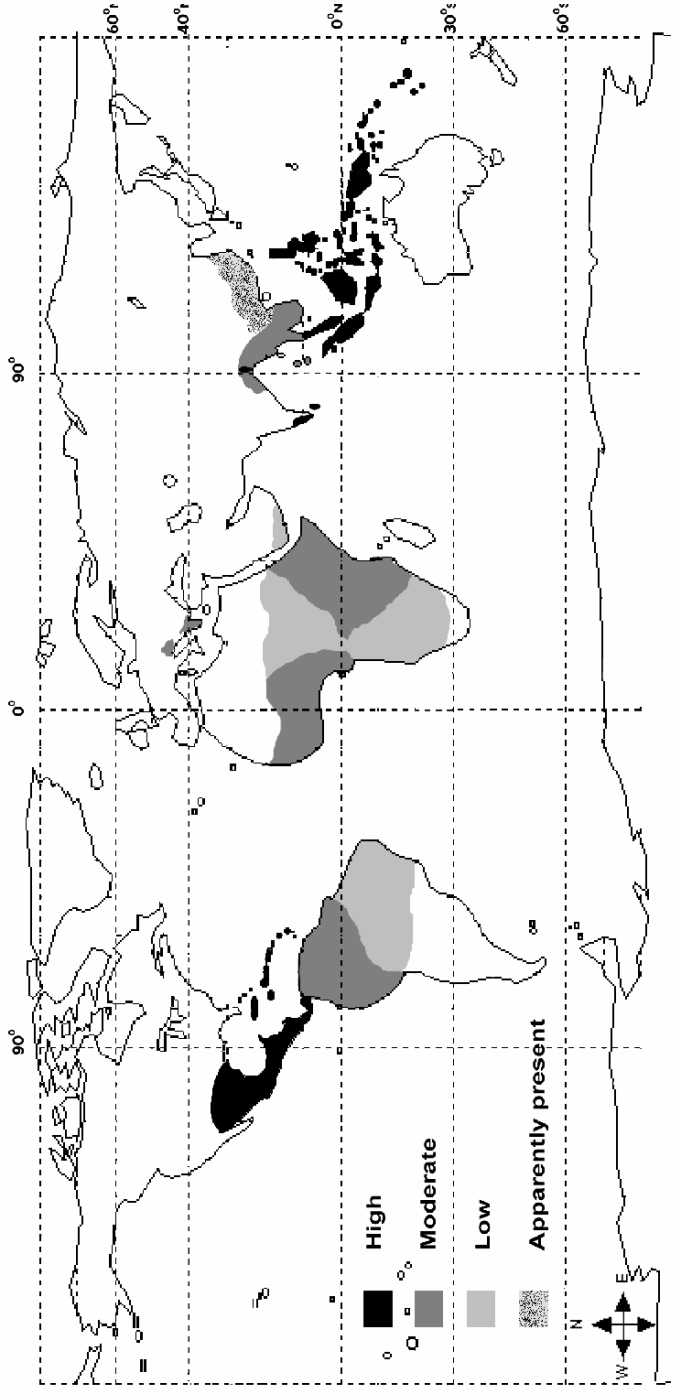

Figure 1. *The global distribution of homegardens (see description on the left hand side, p. 4).*

the regions as indicated; it does not imply that homegardens are the only or major land use system in any of these regions.

Based on the above, it is reasonable to assume that homegardens are most popular in the tropics, but can also be found between 40° N and 30° S latitudes. South- and Southeast Asia, the Pacific islands, East- and West Africa, and Mesoamerica are the regions where largest concentrations of homegardens can be found. Homegardens are also reportedly very popular in tropical and subtropical parts of China; however, other than general descriptions of the systems (e.g., Zhaohua et al., 1991; Wenhua, 2001), practically no information could be gathered on their area statistics. The Mediterranean region of Catalonia (Agelet et al., 2000) and southern Africa (High and Shackleton, 2000) also are reported to have homegardens. In terms of ecological distribution, the highest concentrations of homegardens are in the humid and subhumid tropics, but they are also common in other ecological regions, especially the tropical highlands of Asia, Africa, and Mesoamerica (Nair, 1989). Clearly, our understanding about the spread of homegardens is incomplete; more efforts are needed to compile these statistics at local, regional, national, and global levels.

Although homegardens are known as a predominantly tropical 'phenomenon', homegardening – or, conceptually similar practices – exist outside the tropical zone as well. For instance, Gold and Hannover (1987) and Herzog (1998) describe fruit-tree based agroforestry systems in North America and Europe, respectively. Vogl and Vogl-Lukasser (2003) reported that homegardens were typical elements of the mosaic of agroecosystems in the mountainous Alpine region of Austria. *Streuobst* (fruit trees grown on agricultural lands with crops or pasture as understorey), a traditional practice in Europe that has been on the decline since around 1930s, is now receiving increasing attention and acceptance among the general public and promoted by nongovernmental and conservation agencies. Although the fruit-tree based agroforestry systems are strictly not homegardening, such systems occasionally involve homegardening, and their socio-cultural, ecological, and aesthetic values often exceed their economic values. Based on an extensive survey and interview with practitioners of African-American gardening traditions in the rural southern United States, Westmacott (1992) traced the principal functions and features of African-American yards and gardens. During slavery, the gardens were used primarily to grow life-sustaining crops and vegetables, and the yard of a crowded cabin was often the only place where the slave family could assert some measure of independence and perhaps find some degree of spiritual refreshment. Since slavery, working the garden for the survival of the family has become less urgent, but there seems to be a revival of appreciation of their recreational, social, and other uses. For example, the gardeners are now finding pleasure in growing flowers and produce and deriving satisfaction from agrarian life-style, self-reliance, and private ownership. Through historical research, field observations, and oral interviews, Westmacott (1992) traces the West African roots of this gardening tradition and elucidates how the African-American community manipulated the garden space to their best advantage – something very similar to the motivations of subsistence gardeners in well-established homegardens in other parts of the world (Fig. 1).

Related to the above-mentioned "African-American Yards and Gardens" of the southern United States is the increasing interest in hobby farming and weekend gardening that is getting popular in many urban and rapidly urbanizing societies in both industrialized and developing nations. Drescher et al. (2006) describe the urban homegardens and some of the operational and institutional issues related to them from a number of locations around the world. In a survey of agroforestry practices and opportunities in southeastern United States, Workman et al. (2003) identified several "special applications" of agroforestry such as use of fruit trees combined with gardens, ponds, and as bee forage and so-called patio gardens as an increasingly popular activity especially among immigrant Latin American communities. Thus, although homegardening as a major land use practice is most widespread in thickly populated tropical regions, the concept is being adopted in other geographical regions as well to a limited extent.

3. COMPLEXITY OF HOMEGARDENS

Species diversity is one factor that is common to all homegardens, and this point has been well brought out in homegarden literature time and again. Indeed, authors tend to get nostalgic about describing how diverse the plant communities in homegardens are and rather adamant about including elaborate species lists in their papers on homegardens to the extent that many seem to consider that a paper on any aspect of homegarden is incomplete without a species list! Interestingly, most of the plants that are listed in most such publications are the same irrespective of the geographical regions from where they are reported (see Nair, 2006). As various analyses and summary reports have repeatedly indicated (e.g., Kumar and Nair, 2004), food plants (food crops and fruit trees) are the most common species in most home-gardens throughout the world. This underscores the fact that food- and nutritional security is the primary role of homegardens – again, a point well recognized in homegarden literature right from the "early" years (e.g., Brownrigg, 1985; Fernandes and Nair, 1986). Next in importance to food crops are cash crops, and with increasing trend toward commercialization, the interest in such crops is likely to only increase.

We recognize that complexity by itself may not be a desirable attribute in land use systems that are (also) expected to fulfill production objectives. Being located on the "prime land" around homesteads and receiving utmost managerial attention of the homeowners all the time, farmers have high expectations of productivity from homegardens. After all, farmers decide on the species to be planted and retained in the homegardens based on the utilitarian value of the species. Species complexity in homegardens is therefore not a natural phenomenon, but a result of deliberate attempts and meticulous selection and management by farmers to provide the products they consider are important for their subsistence and livelihood. Species complexity in homegardens is thus a manmade feature, unlike in natural systems. This distinction is seldom recognized in comparisons involving ecological indices of species diversity of homegardens, several of which have lately been reported (see Nair, 2006).

Furthermore, it is likely that the extreme structural complexity and diversity may be a "bane" of the homegardens in a sense. Each homegarden is a unique land use entity in terms of component arrangement, organization, and management, and it reflects the personal preferences of its owner. This frustrates the development community that seeks out "replicable models"; this is presumably the main reason why homegardens have not received adequate attention in the development paradigms around the world.

4. HOMEGARDENS IN THE CONTEXT OF CONTEMPORARY LAND USE ISSUES

Today land use systems are challenged as never before with mounting concerns of environment and ethics on the one hand and pressures of economic development on the other. Production and economic issues that reigned supreme as ultimate goals in agricultural and forestry development activities during the past few decades are slowly yielding to environmental, societal, and social issues. Sustainability – meeting today's needs without compromising the ability of future generations to satisfy their needs – is a key issue in all land use activities today. Central to this concept is the urge to achieve a balance between ecological preservation, economic vitality, and social justice. Land use systems today are thus evaluated based not only on their ability to fulfill any single objective such as production of a preferred commodity, but also on how best they fulfill the sustainability criteria. Contemporary issues that dominate the discussions in this context include natural-resource use in perpetuity, biodiversity conservation, gender equity, social justice, environmental integrity, appreciation of indigenous knowledge, preservation of cultural heritage, and so on.

While systematic studies on the role of homegardens in many of these contemporary issues have not been done, there is a long-held belief and intuition that homegardens score very high on most – perhaps all – of these so-called "intangible" benefits. Logic, circumstantial evidences, and limited empirical results that are available support these conjectures; but certainly more convincing evidence based on rigorous research is needed. Several chapters in this book point in this direction and provide the framework for formulating future research plans.

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SECTION 1

HISTORICAL AND REGIONAL PERSPECTIVES

CHAPTER 2

DIVERSITY AND CHANGE IN HOMEGARDEN CULTIVATION IN INDONESIA

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Abstract. Homegardens have been described as traditional agroforestry systems that are ecologically and socially sustainable. The concept of social sustainability has two dimensions: positive role to present livelihood conditions and ability to respond to socioeconomic changes. The dynamics of homegardens and its repercussions on social sustainability have received relatively little research attention. On the basis of results of extensive studies in Java and other parts of Indonesia, this article summarizes the historic and recent developments in the homegardening context. The structure and composition of homegardens depend both on their position in the overall farming system and on livelihood strategies of the managers. Rural transformations result in changes in livelihoods and farming systems, and have impacts on homegarden function and composition. The opinions of various authors on homegarden dynamics range from positive to negative; the former consider that changes in homegarden features are associated with socio-professional changes of villagers and the rural-urban interface, while the latter view these changes as indicative of the demise of a traditional system and argue for its revitalization. These different opinions represent different norms in assessing social sustainability of homegardens and differences in value judgments on the ideal structure of homegardens.

1. INTRODUCTION

Homegardening has been hypothesized as being the oldest form of agriculture in Southeast Asia. Its origin has been associated with fishing communities living in the

B.M. Kumar and P.K.R. Nair (eds.), Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry, 13–24.

moist tropical region of Southeast Asia during 13 000 to 9000 B.C. In these regions an assured supply of fish and shells allowed fixed settlements and a relatively high population density, while the fertile soils along rivers and coasts favored cultivation (Sauer, 1969). As happened also in other regions (Miller et al., 2006), home-gardening probably started as a spontaneous growth of plants from leftovers of products brought to the camps of the hunter/gatherers. Gradually, the accidental propagation became more deliberate with valuable species being planted to facilitate their use. At first such cultivation probably involved vegetative propagation techniques and only later seeding was introduced (Sauer, 1969). The earliest evidence of garden cultivation dates back to at least 3000 B.C. (Soemarwoto, 1987).

From these pre-historic and probably scattered origins, homegardens has gradually spread to many humid regions in South- and Southeast Asia including Java (Indonesia), the Philippines, Thailand, Sri Lanka, India and Bangladesh. For instance, according to Randhawa (1980), travelers already described homegardens with coconut (*Cocos nucifera*), black pepper (*Piper nigrum*), ginger (*Zingiber officinale*), sugarcane (*Saccharum officinarum*) and pulses (grain legumes) in Kerala, India, in the early 14th century, while Michon (1983) mentions that tree gardening systems were already common on the Indonesian island of Java in the tenth century AD. In all these regions, homegardening is almost always practiced in combination with other types of land use. The original association with gathering and fishing was gradually extended to shifting cultivation and permanent cropping. In the most widely studied homegarden systems in South- and Southeast Asia such as in Java (Soemarwoto, 1987), Kerala (Nair and Sreedharan, 1986; Kumar et al., 1994), and Sri Lanka (Jacob and Alles, 1987; McConnell, 1992), gardening is combined with permanent field cultivation often in the form of wetland rice (*Oryza sativa*) production. These regions with good farming conditions and relatively high population densities contributed to optimal development of the complementary system of staple food cultivation in open fields and supplementary diversified homegarden production for self-sufficiency and trade.

Since the recognition of agroforestry as a type of land use worthy of research and development, homegardens have been considered as an excellent example of a traditionally developed agroforestry system with good promise for the future (Soemarwoto, 1984; Hochegger, 1998; Gajaseni and Gajaseni, 1999). Much attention has been given to analyzing the structure and function of tropical homegardens and describing their features in respect to both ecological and socioeconomic sustain-ability (Torquebiau, 1992; Kumar and Nair, 2004). Regarding socioeconomic sustainability, these studies focused specifically on the roles of homegardens within the livelihood systems of rural producers. A commonly perceived indicator of homegardens' socioeconomic sustainability is the fact that homegardens typically contribute towards nutritional security, energy needs and income generation even under conditions of high population densities (Kumar and Nair, 2004). Recently it has been remarked, however, that the concept of socioeconomic sustainability should not only be related to the homegardens' function in the present livelihood conditions, but also to their ability to adjust to socioeconomic changes (Peyre et al., 2006). At present, many rural areas are undergoing major transformations involving diversification of rural livelihood strategies (Ellis, 1998; Ashley and Maxwell,

2001). Due to commercialization, cultivation systems are becoming more specialized on the one hand, and rural people are increasingly employed in non-primary production activities on the other. As a result, in many rural areas, farming systems in general, and homegardens in particular, are changing. Kumar and Nair (2004) have even posed the question as to whether homegardens are becoming extinct. This illustrates that the notion of socioeconomic sustainability of homegardens should be interpreted as referring not only to their ability to contribute towards the livelihood needs of traditional rural dwellers, but also to their ability to adjust to the process of rural change.

In contrast to studies on homegarden diversity, relatively little attention has been given to assessing the dynamics of homegardens. It seems that, since many studies in the past have been focused on ascertaining factors that explain the ecological stability of homegardens (Kumar and Nair, 2004), the concept of sustainability has mainly been attributed as referring to stability in an ecological sense, and that the concept of socioeconomic sustainability was by association interpreted as referring to livelihood stability. Only recently have the dynamics of homegardens been receiving some attention. In some studies, the traditional homegarden structure and composition is taken as ideal, and changes such as loss in some of the traditional species and structure are discussed in terms of homegardens becoming extinct (Kumar and Nair, 2004) and needing revitalization (Parikesit et al., 2004), while some other studies have tried to relate the various types of dynamics in homegarden structure and composition to the process of rural transformations (Michon and Mary, 1994; Peyre et al., 2006).

This review will assess the dynamics of homegarden development in Indonesia, focusing specifically on Java. First, it will describe the historic developments of homegardens on Java. Next, using data from both Java and Sulawesi, it will summarize the factors that impact on the structure and composition of homegardens and describe how under the influence of these factors different types of homegardens have evolved. On the basis of these data, the main trends in changing homegarden structure and composition will be summarized.

2. THE DEVELOPMENT OF HOMEGARDENS IN JAVA

The first studies on tropical homegardens in Southeast Asia that were started in the late 1940s in Java, Indonesia (Terra, 1953a; 1953b) remained relatively unnoticed for several years. For example, even in the 1970s it was noted that, in contrast to the open-field land use systems, homegardens had hardly yet been subject to detailed study (Stoler, 1978). This situation changed in the late 1970s when a series of new homegarden studies were initiated in Java (Soemarwoto, 1987; Soemarwoto and Conway, 1991). The Javanese experiences formed an important source of information when in the 1980s the potential of homegardens to contribute towards increasing food production and reducing malnutrition in tropical countries received greater international interest (Niñez, 1984; Brownrigg, 1985). This international interest in homegardens was further stimulated by the recognition of homegardens as a typical example of a multistoried agroforestry system (Nair and Sreedharan, 1986; Jacob and Alles, 1987). The first international conference on tropical

homegardens organized in Java in 1985 (Landauer and Brazil, 1990) is a testament to the leading role of the homegarden research in Java during that period.

The extensive research on Javanese homegardens has contributed significantly to the present understanding of the structure and function of tropical homegardens. The Javanese homegardens demonstrate the typical functions of homegardens as summarized by Kumar and Nair (2004): they yield products with high nutritional value (proteins, vitamins, and minerals), medicinal plants and spices, firewood, and sometimes a1so forage crops and construction wood; all these products are used to supplement the staple food crops that are usually produced in open-field cultivation systems. Normally, the homegarden products provide a small, continuous flow of these supplementary products for subsistence and a possible small surplus for sale through local markets. In times of sudden necessities (unfavorable climatic conditions or social necessities like marriage), higher production and marketing levels may be attained (Wiersum, 1982).

In many homegarden studies (Kumar and Nair, 2004), these gardens have been described as a distinct agroforestry system with a set of generic features. Relatively little attention has been given to studying the diversity within homegardens as well as their relation to the surrounding land use systems. Moreover, in addition to home-gardens, other types of tree gardening systems consisting of a mixture of several cultivated fruit- and other trees and crops exist (Wiersum, 2004), and the distinction between homegardens and other types of tree gardening systems is not straight-forward. In Java, Terra (1953a; 1953b) originally differentiated three different types (see also Wiersum, 1982; Soemarwoto, 1984; Christanty et al., 1986):

- The homegarden (*pekarangan*): fenced-in gardens, surrounding individual houses, planted with fruit- and other trees, vegetable herbs and annual crops. Historically they are associated with wetland rice fields and more recently also with dry fields. They occurred in regions with individual land-ownership. Typically these homegardens occur in Central Java and are inhabited by the Javanese people.
- The tree garden (*kebun* or *talun*): mixed tree plantations on communal lands surrounding villages with dense clusters of houses, sometimes also at some distance from the villages. These plots are not inhabited and they are historically associated with shifting cultivation. They occur in regions with communally owned land. Mostly they are found in West Java and are inhabited by the Sundanese people. These tree gardens are much less tended than homegardens and often include more wild trees than present in the homegardens.
- Clumps of fruit- or other trees planted on abandoned shifting cultivation sites. Such plantings could denote a right of priority of these lands for the people who planted the trees in an area of otherwise communal land ownership.

As demonstrated by the characterizations, the tree gardening systems in Java normally forms a sub-set of an integrated farming system (Terra, 1958), which also comprises annually cultivated fields used for the production of staple, high calorific foods such as rice, maize (*Zea mays*) and cassava (*Manihot esculenta*). Consequently, the structure and function of homegardens significantly depends on the nature of the overall farming system.

Over the ages, gradual changes have taken place in these systems (Soemarwoto, 1984). The most important was perhaps the extension of the Javanese culture and subsequent spread of homegardens. For instance, in the eighteenth century, the *pekarangan* system was already practiced in West Java, where it partly replaced the *talun* system of the Sundanese (Michon, 1983). Also, gradually communal lands were divided among individual landowners, who by building houses in such individual tree gardens, converted them to homegardens. In other tree gardens, annual crops were introduced and management became more intensive. Also shifting cultivation virtually disappeared and in areas with clumps of planted trees on fallow lands, a conversion to tree gardens took place. According to Wiersum (1982), in the early 1980s it was possible to distinguish the following three types of tree gardening:

- Homegardens (*pekarangan*): a land use form on private lands surrounding individual houses with a definite fence, in which several tree species are cultivated together with annual and perennial crops, often including small livestock.
- Mixed gardens (*kebun campuran*): a land use form on private lands outside the village, which is dominated by planted perennial crops, mostly trees, under which annual crops are cultivated.
- Forest gardens (*talun*, *kebun*): a land use form on private lands outside the village in which planted and sometimes spontaneously grown trees and sometimes additional perennial crops occur.

The *pekarangan* is often considered as a typical prototype for homegardens. But as illustrated by the diversity of tree gardening system in Java, the distinction between homegardens and other types of tree-gardening systems is often diffuse and may be related more to location than to vegetation structure[1]. Moreover, homegarden structure may gradually change with time.

3. DIVERSITY IN HOMEGARDEN STRUCTURE AND COMPOSITION

The diversity in tropical homegardens types is not only illustrated by the historic developments in tree gardening systems, but also by the existing variation in homegarden structure and composition. Several homegarden studies in Java have assessed what factors impact on the homegarden structure and composition as well as function. Karyono (1990) demonstrated that homegarden composition was affected both by geographic conditions and their role in the farming systems. Compared to lowlands, homegardens in highland areas have lower plant diversity and simpler species composition. Also a different pattern of species composition exists in homegardens associated with irrigated rice production as opposed to those associated with dry-land agriculture: fruit species are dominant in the former, and food crops in the latter. Stoler (1978) also emphasized the relation between garden composition (as well as management intensity) and other components of the farming system. Households with sufficient croplands to produce rice to cover basic staple food requirements cultivated more commercial fruit trees than households who could not meet staple food requirements from croplands and hence had to cultivate more subsistence crops in the homegardens. Christanty (1990) differentiated urban

and rural homegardens, and mentioned that these could be further classified depending on:

- The dominant plant species grown, e.g., fruit, vegetable, or flower species, and
- The main function of the homegarden, e.g., subsistence garden, kitchen garden, market garden, plant nursery garden, and aesthetic garden.

Soemarwoto (1984) added that in rural areas homegardens have important social functions through the provision of gifts in the form of fruits, leaves or products for religious or medicinal purposes. In urban areas this social function diminishes whereas their aesthetic function increases with ornamentals replacing food crops. Michon and Mary (1994) and Abdoellah et al. (2006) described that, in addition to urbanization, the rise of a market economy profoundly influences the homegarden function resulting in an increase in commercial crops. Abdoellah (1990) reported that the effect of various cultures (Javanese or Sundanese) was often still reflected in the structure of homegardens: for example, vegetables and ornamentals were often more common in Sundanese homegardens.

Also in the Indonesian island of Sulawesi different types of homegardens have been reported. For example, Kehlenbeck and Maass (2004) described four homegarden types distinguished by differences in garden age and size, and the level of diversity:

1. Small, moderately old, species- and tree-poor spice gardens
2. Medium-sized, old, species-rich fruit tree gardens
3. Large, rather young, species- and tree-poor gardens of transmigrant families
4. Diverse assemblages of rather old, individual gardens with very high crop diversity.

According to Terra (1958), the typical Javanese landscape with irrigated rice fields, dry croplands and mixed gardens was already common in this region in the 1950s. The types 2 and 4 mentioned above may reflect this traditional situation. But as illustrated by type 3, recently the area is becoming further settled by transmigrants from Java. These transmigrants do not only open up new agricultural lands, but also establish homegardens around their new settlements. Such homegarden development takes time. Often, at first essential food crops are grown and only gradually supplementary crops are introduced. Other factors influencing homegarden structure are related to differences in access to markets and availability of garden products in the market. Moreover, the composition is found to be influenced by official homegarden development programs (Kehlenbeck and Maass, 2006).

In other studies on Asian homegardens too, several geographic and socioeconomic factors have been found to influence the homegarden structure and composition (e.g., Kumar et al., 1994; John and Nair, 1999; Peyre et al., 2006). Table 1 summarizes the various factors that have been reported to impact on homegarden composition. As illustrated in this table, notably livelihood conditions are an important factor influencing the structure and composition of homegardens. Livelihood conditions are reflected in both the farming system and the socioeconomic status of households. For poor people, homegardens may form the only land available to them for primary production, and consequently they are likely

to serve partly for production of essential staple foods rather than only for supplementary crop production. On the other hand, for affluent people living in urbanized areas and having access to non-farm incomes, homegardens may not any longer form a part of a farming system, but function only as an ornamental area around the living quarters. Thus, not only the overall livelihood conditions, but also specific socioeconomic variables such as access to land or off-farm labor opportunities impact the homegarden structure and composition. Generally, a decrease in the availability of land results in intensification of cultivation and the inclusion of more annual crops. Also, when alternative income opportunities are present, cultivation is "extensified" (and more ornamentals are included near urban areas). Where better marketing opportunities exist (near cities), specialization in fruit production may take place.

Table 1. *Factors impacting structure and composition of homegardens with special reference to Indonesian homegardens.*

Factors	*Conditions*	*Examples and remarks*
Geographic location	Urban versus rural location	Urban homegardens often smaller and more aesthetic oriented
Environmental conditions	Climate conditions	Variation in annual crops cultivated only in favorable climatic seasons is mostly less pronounced than in permanent crops that have to be adapted to variable climatic conditions over much larger periods
	Soil conditions	With decreasing soil fertility crop diversity tends to decrease and the effect of competition by trees on understorey becomes more pronounced. Dense tree gardens occur mostly on volcanic soils, while on tertiary soils tree gardens are more open
Role in farming systems	Degree of complementarity to open field cultivation systems	If homegardens are the only land asset more inclusion of staple food crops
	Established versus incipient farming system	Incipient gardens first dominated by annual crops, with time increased incorporation tree crops
Socioeconomic conditions of the household	Wealth status	With increased wealth increased importance of commercial and aesthetic plants
	Access to markets	Commercial crops stimulated by good market access
	Access to off-farm employment	In case of access to financially lucrative employment decreased importance commercial crops
	Gender-related issues	Gardens of female-headed households often more household use oriented
Cultural factors	Food preferences	Cultural preferences in respect to consumption of vegetables and spices