RESEARCH ARTICLE

Homestead Farming in Kerala: A Multi-Faceted Land-Use System

Jacob John*

Abstract: Homestead farming, prevalent in different parts of the world, presents an excellent example of the many systems and practices of agroforestry. The homestead is an operational farm unit in which a number of crops (including tree crops) are grown, along with rearing of livestock, poultry or fish, mainly for the purpose of meeting the farmer's basic needs. Homesteads or home gardens, with special reference to Kerala, have been enumerated and their key characteristics summarised in this paper. Homestead farming satisfies the requirements of sustainability by being productive, ecologically sound, stable, economically viable, and socially acceptable. However, land-use changes, availability of agricultural labour, and falling commodity prices are major constraints in homestead farming in Kerala. Future strategies to improve homestead farming should aim at watershed-based development with focus on a whole-farm or systems approach; restructuring and refining existing home gardens, and developing sustainable models through a farmer-participatory approach for each agro-ecological zone; forming homestead clusters; creating germplasm registers; bridging the yield gap by improving crop productivity; developing post-harvest technology of home garden products; generating non-farm employment opportunities; promoting and improving rural financial networks; providing essential rural infrastructure; creating coalitions to address policy concerns at all levels; and broadening consumer perspectives.

Keywords: Agroforestry, homestead farming, home gardens, Kerala, sustainable agriculture, home gardens in Indian States, home gardens of Kerala, home gardens for sustainable development, constraints in homestead farming, homestead clusters, land-use system.

Introduction

Homestead farming or home gardening is a historical tradition that has evolved in many tropical countries over a long period of time. It is generally understood to be a system for the production of subsistence crops for the cultivator and his/her family. Numerous terms are used to denote these practices: mixed garden horticulture, home

* Associate Professor, Cropping Systems Research Centre, Kerala Agricultural University, Thiruvananthapuram.

gardening, Javanese home gardening, compound farming, mixed or house gardening, kitchen gardening, household gardening, and homestead agroforestry.

The goal of sustainable agriculture is to conserve the natural resource base, protect the environment, and enhance the prosperity of a family or household over a period of time. The United Nations General Assembly has declared the year 2014 as International Year of Family Farming, recognising the importance of this system of farming in conserving biodiversity, household nutritional security, and in maximising production.

Definitions of Homesteads

Ninez (1984) sees homesteading as a production sub-system that ensures the production of items for household consumption. Soemarwoto and Soemarwoto (1984) define a home garden as an agroforestry system that is "ideal" in that it combines the ecological functions of forests while also ensuring the socio-economic needs of people. Soemarwoto (1987) describes a homestead as a system for the production of subsistence crops for his family by the farmer – who may or may not opt for any additional production of crops. Hanman (1986) refers to a homestead as the home and its adjoining land (including the immediate area surrounding the dweller's unit) owned and occupied by a household, and the space used for cultivation of trees and vegetables.

The scope of definition of a homestead was widened by Nair and Sreedharan (1986), who define it as

> an operational farm unit in which a number of crops (including tree crops) are grown with livestock, poultry and/or fish production mainly for the purpose of satisfying the farmer's basic needs.

Jacob (1997) proposes a more comprehensive definition of a homestead:

> a functional/operative and self-sustaining farm unit which consists of a conglomeration of crops and multipurpose trees, planted arbitrarily, with or without animals/poultry/apiculture, owned and primarily managed by the dwelling farm family, with the objectives of satisfying the basic family needs (food, fuel, timber) and producing marketable surplus for the purchase of non-producible items.

For the purposes of this paper, I use the definition given by Nair and Sreedharan (1986).

Home Gardening Practices Around the World

One of the most systematic efforts made towards understanding the structure of agroforestry systems has been by the "Global Inventory of Agroforestry Systems and Practices in Developing Countries," a project of the United States Agency for

International Development (USAID), conducted by the International Centre for Research on Agroforestry (ICRAF), Nairobi. The distribution of home gardens around the world and their key characteristics are summarised in Table 1.

In their evaluation of the structure and function of ten home gardens in different ecological regions of the tropics, Fernandes and Nair (1986) conclude that home gardens are characterised by a mixture of several annual or perennial crops, grown in association and commonly exhibiting a vertical profile of three to four layers. These layers include trees, shrubs, and ground-cover plants, promoting nutrient recycling, soil conservation, and the protection and maximal use of space both above and below the ground. The multi-level plantations and home garden systems, found to be common in small landholdings, are analogous to a rain forest with a multi-layered canopy – though the systems and their components vary with location (Swaminathan 1987). Thus the structural complexity, species diversity, varied output, and wide genetic variability of home gardens pose challenging opportunities for a researcher, and offer innovative technological solutions for improved functioning of the system.

Home Gardening in Indian States

The State of Kerala has a high population density, and the size of small-farm holdings in Kerala ranges from 0.02 ha to 1 ha (Nair and Krishnankutty 1984). There is virtually no scope for increasing the net area sown. A common trend is to utilise available cultivable area for purposes such as urbanisation. Land, the major factor of production, is especially limited for families with marginal or small landholdings, and the farmer's objective is not to maximise the production of a single commodity but to grow tiers of several crops on the same piece of land. According to the Ninth Agricultural Census of Kerala, the average size of an operational holding in the State was 0.22 ha in 2010–11, as opposed to 0.24 ha in 2000–01. Marginal farmers holding below 1 ha of land accounted for 96.3 per cent of the total number of landholdings. The area covered by these holdings is 58.6 per cent of the aggregate area of operational holdings. The average holding size of the group is 0.13 ha.

While investigating the structure and function of agroforestry home gardens of Kerala, Nair and Sreedharan (1986) observed that the size of landholding ranged from 0.02 to 1 ha, with an average of 0.22 ha. In such micro-holdings, coconut was noted to be the most dominant and important tree crop. Other perennial crops in the homestead were areca nut, black pepper, cocoa, cashew, and various tree species such as teak, jackfruit, wild jack, casuarina, portia, silver oak, and erythrina. Most homesteads also reared cattle and poultry. A four-tier structure was found to be common in Kerala, and it was observed that the intensive land-use practices of homestead farming were increasingly becoming popular among a majority of the marginal farmers.

Table 1 *Distribution and key characteristics of home gardens, selected countries*

Type of homestead	Location	Characteristic features	Reference/s
Pekarangan	West Java	Average size: 0.02 ha. Average 19-24 species per garden, five-layered canopy structure, dominated by starchy food plants like cassava, sweet potato, taro, xanthosoma, canna, vegetables, and spices	Karyono (1981); Michon (1983); Soemarwoto and Soemarwoto (1984).
Chagga home garden	Northern Tanzania	Average size: 0.68 ha. Five-layered canopy structure dominated by arabica coffee and banana, with food crops like taro, herbs/grasses, fuel, fodder, and timber trees.	Fernandes *et al.* (1984).
Home garden/kitchen garden/hut garden	Khon Kaen province in north-eastern Thailand	77–100 species per garden. Dominated by fruit trees, legumes, tuber crops, vegetables, spices, and medicinal plants.	Boonkird *et al.* (1984); Kamtuo *et al.* (1985).
Home garden	Papua New Guinea, Fiji, Tonga, Kiribati, Nauru Island, and Nauru	65–114 species per garden. Food plants and non-food plants for handicraft, fuel, medicine, fibres, dyes, for ornamental purposes, perfumes, livestock feed, and construction materials.	Thaman (1985).
Home garden	Pacific Islands	Coconut, casuarina, other plantation crops, and a large number of subsistence crops, as well as cattle, pigs and poultry.	Vergara and Nair (1985).
Agroforestry home garden	West Sumatra, Indonesia	Multistoreyed structure with ornamental plants and valuable fruit species.	Michon *et al.* (1986).
Homestead agroforestry	Rwanda and Nigeria	Four-layered structure. Food, fodder, tree crops, and animals.	Balasubramanian and Egli (1986).
Kandyan garden	Sri Lanka	Average size: 1 ha. 8–15 crops per farm. Mostly trees, dominated by areca nut, jackfruit, and coconut.	Jacob and Alles (1987).
Homestead	Bangladesh	Average size: 0.097 ha. Dominated by fruit trees such as mango, jackfruit, and areca nut; also fuel and timber trees.	Leuschner and Khalique (1987).
Compound farm	West Indies	Four-layer canopy dominated by tall indigenous fruit trees with agricultural crops and small livestock.	Okafor and Fernandes (1987).
Mayan home garden	Mexico	No specific arrangement of plants. Major species include fruit trees like annona, guava, papaya, citrus, mango, and banana.	Rico-Gray *et al.* (1990).

Jambulingam and Fernandes (1986) reported that farmers in Tamil Nadu integrated numerous species of multi-purpose trees and shrubs in close association with agricultural crops. The woody perennials were found to perform even under harsh or poor growing conditions. Such integration on farmlands was a strategy adopted to minimise the risk of crop failure. They also observed that these traditionally managed systems have scope for increased productivity if accompanied by suitable scientific interventions.

Sharma *et al.* (1991) recorded that crop cultivation, animal husbandry, and forestry constitute the three main, closely integrated components of farming systems in the hills of Himachal Pradesh.

Nair (1993) observed that all home gardens consist of a herbaceous layer near the ground, a tree in the upper layer, and intermediate layers with different crops. The lower layer may be partitioned into two, with the bottom layer (of a height less than 1 m) dominated by different vegetable and medicinal plants, and the layer above it (1–3 m in height) composed of food plants such as cassava, banana, yam, and so on. The upper layer of the home garden, again divided into two, may comprise fully grown timber and fruit trees of 25 m height or more, and medium-sized trees ranging from 10–20 m in height. The intermediate layer may hold fruit trees of a height of 3–10 m but which could potentially increase in height. This layered structure also includes tuber crops such as taro, cassava, yam and/or sweet potato, since these crops require less care and provide reasonable yields.

A conspicuous feature of the tree-crop component of home gardens is the predominance of fruit trees and food-producing (not specifically fruit-producing) trees. Jacob (1997) has recorded that a major portion of the upper canopy of home gardens in southern Kerala, above 25 m in height, includes coconut, areca nut, fruit trees, and trees used for timber. This is followed by medium-sized fruit, spice, and timber or fuel trees, growing to a height of 10–20 m. The third layer of 3–10 m height comprises crops like pepper, tree spices, and fruit trees. The lowest layer, between 1–3 m in height, includes banana, cassava, and other tuber crops. At ground level, pineapple, vegetables, and other herbaceous crops are grown.

Based on a study of 400 home gardens in Thiruvananthapuram district, Kerala, Jacob (1997) reported that the number of crop and tree species in homesteads varied from less than 5 to more than 40. Most home gardens (57.75 per cent) consisted of 10–20 species. An average of 14–15 species and 397 plants per homestead were observed in the region as a whole, indicating a very high degree of crop combination and diversification. An inventory of the different crop categories revealed that tuber crops ranked first in the region, followed by fruits, oil-yielding palms (such as coconut), rubber, spices, vegetables, and trees used for timber and fodder. The density of trees increased as the size of holding decreased.

In all these cases, crops were grown in tiers, with a leaf-canopy structure to harvest sunlight to the maximum and thereby result in greater productivity. This variety of homestead gardening, which is designed and practised in Kerala, ensures that the varied crop-canopy profiles capture light and an efficient crop-residue nutrient cycle, under congenial soil and weather conditions. A comparative study of such homesteads in the Konkan coast, Meghalaya, Mizoram, and the Andaman Islands may reveal new knowledge to enhance the sustainability and productivity of this unique farming system.

Homestead Farming for Sustainable Development

Homestead farming is an option open to farmers who seek to increase productivity and income in a sustainable manner. Homestead farming satisfies the requirements of sustainability by being productive, ecologically sound, stable, economically viable, and socially acceptable.

Productivity

The productive aspect of homestead farming arises from the fact that home gardens are resource islands that provide a wide variety of goods for domestic consumption, such as food, beverages, construction materials, firewood, and other household supplies. The system has the capacity to sustain crop or pasture production in the presence of trees, in addition to production from the trees themselves. The different crop or tree species in the home garden satisfy the multifarious needs of the farmer. The produce from trees often provides a substantial proportion of the energy and nutritive requirements of the household's diet. A characteristic of food production in home gardens is that the combination of crops with different production cycles results in a continual supply of edible food.

In addition to food plants, a very wide range of non-food plants are also found in home gardens which are of considerable importance for fuel, fodder, timber, medicine, fibre, latex, ornamental and religious purposes, and in producing items of commercial value (such as dyes, paints, perfumes, handicrafts, matchsticks, etc.). The livestock component, besides providing financial support at times of distress, supports the farmer by providing draught power, milk, meat, and organic manure.

Ecological Security

Home gardens comprise a system in which plants, animals, and man coexist in a symbiotic manner, which is an essential component of ecological security. Biodiversity is one of the main indicators of ecological sustainability. With very high species diversity and complex structural arrangement of components with strong ecological foundations, the home garden system simulates the structure and function of a natural tropical forest ecosystem. The species diversity of home gardens

is also well suited to pest and disease management. Monoculture, on the other hand, increases the incidence of pests and diseases, necessitating the use of large quantities of agrochemicals.

In order for a system to be ecologically sustainable, it needs to maintain equilibrium between the input and output of natural resources, so as to prevent soil exhaustion. Studies conducted in homesteads revealed that the addition of nutrients from various sources (litter fall, stem flow, organic manure, and fertilizer) compensates for the loss of nutrients from the system through harvested biomass. Nutrient cycling processes that take place to varying degrees in all land-use systems become particularly relevant in homesteads because of the effect of trees on such processes.

A considerable portion of the accumulated nutrients in the tree biomass is returned to the soil through litter fall. Jackfruit (*Artocarpus heterophyllous*), wild jackfruit (*Artocarpus hirsuta*), mango (*Mangifera indica*), and guava (*Psidium guajava*) are some of the multipurpose trees that are planted extensively in homesteads in Kerala. These trees shed litter round the year and thereby return a considerable amount of nutrients to the soil. The annual leaf-litter production by jackfruit, wild jack, mango, and guava is estimated to be 3.37, 3.95, 2.42, and 1 tonnes ha per year, respectively. The crops and plants in the system derive most of their nutrient needs from the established external litter decay. Foliar leaching is an important process for soil enrichment, e.g., especially through potassium. Manure obtained from livestock and poultry is used in the homestead for various other crops, thus reducing the costs of using inorganic fertilizers. Such recycling results in efficient use of the available resources by the farmer. The constant addition of organic matter to the soil through litter fall and recycling of biomass helps improve and maintain the physical–chemical and biological properties of the soil.

The recycled biomass, besides being a source of inorganic nutrients for plants, is a substrate for micro-organisms, and a factor in soil aggregation, root development, and soil and water conservation. The fundamental reason why a home garden is said to improve soil properties is because the multi-layered canopy protects the soil from surface compaction, run-off, and erosion. The cover may be provided by a tree-top canopy, annual crops, or a surface-litter layer produced by the vegetation.

Organic farming can be successfully practised where adequate biomass is generated in and around the farms. Significant quantities of nutrients can be ploughed back into the soil. Crop residues and vegetative portions of tubers, vegetables, and pseudo-stems of banana seem to be the main items recycled in home gardens.

Stability

Homestead farming, by virtue of diversification, is more stable than monoculture agriculture. By growing a variety of crops, homestead farmers avoid economic risks,

and are less susceptible to radical price fluctuations associated with changes in supply and demand. No single item found in home gardens may be economically significant, but when the contribution of all products of home gardens is considered, their value to farmers' households is considerable. Harvests throughout the year ensure that there is always some product of economic value available to the household, whether for use or for sale. Moreover, the system has the advantage of being largely dependent on locally accessible resources, requiring neither costly external inputs nor complex technology. The socio-economic advantages of home gardening lie not only in the increase of the overall productivity of a household, but also in helping avoid over-reliance on a single commodity.

Home gardens also ensure the use of idle labour. An assessment of the diversification adopted by farmers in their home gardens revealed that in 17.5 per cent of homesteads, cattle-rearing was a complementary enterprise, and 30.25 per cent raised poultry along with crops. Of all farm families, 30.5 per cent owned cows, bullocks, goats, sheep, buffaloes, and poultry (chicken, duck, quail, and turkey) (Jacob and Nair 1999).

Farmers with limited financial resources find it difficult to cope with the expenses incurred during the growing season. Such farmers are now attempting to return to traditional homestead farming. Also, with marked fluctuations in the prices of copra (dried kernel of the coconut used to extract oil) and coconut oil, the integration of livestock or other enterprises with coconuts has become economically attractive. The stable demand and high prices for wood (fuel or timber), in contrast to the unstable prices for agricultural crops, are another major incentive for farmers to plant more trees in association with crops.

Economic Viability

There is great variation across homesteads in the number of residents, the amount of land allocated for cultivation, wealth, and income, resulting in different types of land use and choice of activities. Each home garden thus becomes a unique entity. The products produced are those preferred by each specific household, within the limits set by household assets, and the bio-physical and socio-economic environment. Plants in home gardens are utilised for multiple purposes, thus helping families avoid or reduce purchases. Home gardens provide a variety of primary and secondary products in a staggered manner over the entire year. Homestead farming can utilise family labour efficiently over a calendar year, and make complementary use of the soil to increase the overall productivity of land on a sustained basis. It has been reported from Kerala that homestead farming was profitable, and that the income generated from home gardens was sufficient to meet the household consumption demands of the farming family (Salam and Sreekumar 1990; Jacob and Nair 1999).

In West Bengal, the savings realised by homestead farms for direct consumption were seen to reduce the expenditure of the household and to provide means with

which to buy nutritious food. Promotion of homestead farming can also help develop entrepreneurship among women (Sundaray *et al,* n.d.). There are reports that homestead farming in Tripura has helped farmers realise consistently improved yields and earn up to Rs 67,705 per year from a holding of 0.16 ha (see ICAR, n.d.). According to Ramakumar's (2004) survey of a village in the Kannur district of Kerala, the average net income from homesteads constituted about 6 to 10 per cent of the poverty line for agricultural labour households.

Social Acceptability

Homestead farming enhances the quality of life for farmers and the society as a whole by promoting food security at relatively low cost. Home gardens achieve larger harvests with a relatively small work force, covering a relatively small piece of land unsuited for cereal-crop husbandry. Homestead cultivation is less prone to total crop failure than the cultivation of regular field crops, and ensures a sustained series of nutritive harvests. It provides a regular supply of edible harvest that can be bartered or sold. Proximity to the home ensures greater participation of women in income-generating activities, and the ability to integrate organic output from the house with the surrounding tree–crop–livestock system. For all these reasons, homestead farming has been widely accepted as a land-use system in Kerala.

Major Constraints to Homestead Farming

Land Use

Changes in land use in Kerala have been exceptional over the past two decades. A large proportion of home gardens in Kerala have been converted into small-scale plantations of coconut and rubber as a result of commercialisation and fragmentation of landholdings (Kumar and Nair 2004). This has been aggravated by the conversion of land for urbanisation by the land mafia, rendering many farmers landless. Conversion of agricultural land for urban uses is a major concern as rapid urbanisation has triggered the escalation of the cost of land. This further propels the conversion of prime farmland for purposes other than agriculture. Existing farmland conversion patterns often discourage farmers from adopting sustainable practices and a long-term perspective on the value of land. At the same time, the close proximity of newly developed residential areas to farms is increasing the public demand for environmentally safe farming practices. By helping farmers adopt practices that reduce chemical use and conserve scarce resources, research and education in sustainable agriculture can play a key role in building public support for preservation of agricultural land.

It is imperative that stringent policies be framed and implemented to control the conversion of agricultural land to non-agricultural purposes. The Kerala Conservation of Paddy land and Wetland Act enacted by the Government of Kerala to conserve paddy land and wetland and to restrict the conversion or reclamation thereof, in order to promote growth in the agricultural section and to sustain the ecological

system, is a useful example of such policy initiatives. Educating land-use planners and decision makers about sustainable agriculture is a priority.

Labour

Agricultural labour during peak seasons is scarce, creating problems for the harvest of paddy and coconut. Although several labour banks have been established, they are not fully utilised. The demand for labour is a crucial problem needing immediate attention. There is a need for programmes that address this problem, working towards socially just and safe employment that provides adequate wages, fair working conditions, health benefits, and chances of economic stability. To ensure greater sustainability, labour must be supported by government policies, and carefully considered when assessing the impact of new technologies and practices.

Rising Costs and Falling Commodity Prices

The prices of several agricultural food commodities have been on a sharp downward trend in Kerala. In a given region, the level of attainable productivity from various possible product combinations is uneven; farmers generally abandon cost-ineffective combinations in favour of profitable product combinations that generally involve only a few advantageous and technically compatible production lines. Thus, each region gradually determines an efficient and specialised product or enterprise.

A study of the problems faced by homestead farmers in Palakkad district, undertaken by the Kerala Agricultural University in 2009, showed that acute shortage of labour was a significant issue, as were irrigation and harvesting. In the case of areca nut cultivation, irrigation, harvesting, and marketing were major concerns, while for banana farmers, storage, processing, irrigation, and marketing were important constraints. For vegetable farmers, irrigation, availability of seeds, processing, and storage were considered to be major difficulties.

Future Strategies

Diverse strategies are necessary to create a more sustainable food system in homesteads. These range from specific and concentrated efforts to alter particular policies or practices, to the long-term tasks of reforming key institutions, rethinking economic priorities, and challenging widely held social values. Areas of concern, and to which greater attention must be paid, include the following:

1. *Watershed-based development with focus on whole-farm or systems approach.* Improvement of home gardens is hampered not only by lack of research, but also by the inadequacy of existing extension services. While watershed-based development is gaining momentum, developmental activity and extension work still focus mainly on single crops, and not on an integrated or

whole-farm or systems approach that is needed for complex and diverse homesteads. Within a micro-watershed, it is desirable to consider the homestead as a sub-unit and formulate development projects following a systems approach.

2. *Restructuring existing home gardens in every agro-ecological zone and developing sustainable models through farmer participation.* Kerala is delineated into 23 agro-ecological units (AEUs), and it is only appropriate that the differences between these AEUs be taken into account while attempting to develop home gardens. Existing farms can be developed by restructuring and introducing technical interventions. Multi-disciplinary scientific teams, along with officers of agricultural and allied departments, should visit farms, and factors such as size of holding, current cropping and farming practices, tastes, preferences, and innovativeness of farmers, the technical feasibility of suggested interventions, local markets, and income-bearing possibilities should be considered by them. Policies that are formulated must consider the importance of issues such as biomass generation, economic returns, and nutritional security.

   In Kerala, an attempt was made under the National Agricultural Technology Project (2002–04) to develop an integrated and sustainable homestead model for the Central Zone (Jacob and Joy 2007). A homestead in Thrissur of 0.268 ha (0.67 acre) was one among several homesteads selected for restructuring. The technical interventions included measures to increase crop intensity, grow nitrogen-fixing trees, raise fodder and forage crops for livestock, integrate animal husbandry and fisheries, promote biomass generation (and recycle farm waste), and correct methods of nutrient management. These were introduced and monitored for two years. Interventions such as the introduction of intercropping and scientific management practices made the system more productive. Integrated plant nutrition, integrated pest management, soil and water conservation measures, and the planting of multipurpose trees (especially nitrogen-fixing trees) contributed to the protection of natural resources. The interventions thus had the effect of creating more stable systems, reducing the costs of cultivation and increasing profits, and providing more nutritional security to farm families than before.

3. *Formation of homestead clusters.* Several homesteads in a watershed can be brought together to form a cluster, in order to ensure effective implementation of plant protection programmes, efficient marketing, and better access to and use of machines.

4. *Creating germplasm or biodiversity registers.* Homesteads constitute real reservoirs of germplasm of cultivated plants because varieties with diverse environmental requirements and resistance are raised. As a result of commercialisation, non-commercial crop varieties will soon be eliminated from home gardens and replaced by commercial monocultures. Genetic erosion can result in increased risk of attacks by pests and diseases. It is therefore necessary to create germplasm (or biodiversity) registers at the panchayat level, which contain descriptions of local varieties of crops. Such registers can be created and maintained by women's self-help groups (like "Kudumbasree"), trained by technically qualified personnel.

5. *Bridging the yield gap*. One of the major reasons that have been identified for the yield gap between homesteads and best-farmer yields in an agro-ecological zone in Kerala is the low adoption of new technologies by homestead farmers (Jacob *et al.* 2013). Improving technology adoption and bridging yield gaps should be a priority while formulating development programmes for homesteads.
6. *Post-harvest processing*. Homesteads have tended to function largely outside the market economy to satisfy a wide variety of domestic needs. The development of post-harvest technology for home garden products can help create incomes and non-farm jobs. Examples are the processing of fruits to make jams and juices, of bamboo to make household utensils and furniture, and of areca-leaf spathes to make plates and headgear.

Conclusion

Homestead farming ensures sustainable use of natural resources for the benefit of present and future generations. Kerala presents great opportunities for such sustainable farming, thanks to the enormous cultural and biological riches of this region. Development initiatives should aim at diversification that harmoniously integrates human dwellings, microclimate, annual and perennial plants, animals, soils, and water into stable, productive communities. The focus should be not on these components themselves, but rather on the relationships created among them by the way we place them in the homestead. The ultimate goal must be to integrate the components so that overall biological efficiency is improved, biodiversity is preserved, and productivity is self-sustaining. Policy initiatives and land reforms are needed to protect the integrity of the existing homesteads.

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