

Alley Farming in the Humid and Subhumid Tropics

Proceedings of an international workshop
held at Ibadan, Nigeria, 10–14 March 1986

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Alley Farming in the Humid and Subhumid Tropics

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Editors: B.T. Kang and L. Reynolds



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Abstract / Résumé / Resumen

Abstract — An urgent challenge facing scientists working on upland food-crop production in many parts of the humid and subhumid tropics is the need to find viable, sustainable, and environmentally sound alternatives to the ancient shifting cultivation and bush-fallow, slash-and-burn cultivation systems. As a food-cropping and livestock-production technology, alley farming requires a low level of inputs and helps conserve soil resources while sustaining long-term farm productivity. This publication presents the results of an international workshop on alley farming in the humid and subhumid tropics. Held in Ibadan, Nigeria, 10–14 March 1986, the workshop was attended by 100 participants from 21 countries. The theme of this workshop was the development of more productive, sustainable farming methods with low inputs in the humid and subhumid tropics using alley farming techniques. This book reviews the present state of alley farming research and its application, discusses the use of woody species in tropical farming systems, highlights training and research needs, and proposes the establishment of channels for collaborative research.

Résumé — Les scientifiques s'intéressant aux cultures vivrières en zones d'altitude dans de nombreuses régions des tropiques humides et sub-humides doivent répondre à un besoin urgent : trouver des solutions de rechange viables, soutenables et environnementalement saines aux anciennes méthodes de rotation des cultures et mise en jachère et de culture sur brûlis. A titre de technique de culture et d'élevage, l'agriculture en couloirs ne nécessite que peu d'intrants et contribue à conserver les sols, tout en favorisant la productivité agricole à long terme. Cette publication présente les résultats d'un atelier international sur l'agriculture en couloirs dans les tropiques humides et sub-humides qui s'est tenu à Ibadan, au Nigéria, du 10 au 14 mars 1986 et qui a réuni 100 participants de 21 pays. L'atelier portait sur la mise au point de méthodes culturales plus productives et plus durables ne nécessitant que peu d'intrants pour les régions des tropiques humides et sub-humides, grâce aux techniques de l'agriculture en couloirs. Le livre fait le point sur la recherche actuelle en matière d'agriculture en couloirs et ses applications, discute de l'utilisation des arbres dans les systèmes agricoles en milieu tropical, met en lumière les besoins en matière de formation et de recherche et propose l'établissement de canaux aux fins de la recherche en collaboration.

Resumen — Un reto urgente al que se enfrentan los científicos que realizan investigaciones sobre la explotación de cultivos de montaña en muchas zonas húmedas y subhúmedas de los trópicos, es la necesidad de encontrar alternativas viables, sustentables y correctas desde el punto de vista del medio ambiente, al antiguo método de cultivos migratorios y a los sistemas de cultivo en barbecho y de corte y quema. Como tecnología utilizada para cultivos alimentarios y la producción ganadera, la agricultura de pasillo o entresurcos necesita pocos medios y ayuda a conservar los recursos del suelo en tanto mantiene la productividad agrícola a largo plazo. Esta publicación presenta los resultados de un grupo de trabajo internacional sobre agricultura de pasillo o entresurco en las zonas húmedas y subhúmedas de los trópicos, celebrado en Ibadán, Nigeria, del 10 al 14 de marzo de 1986, y al que asistieron 100 participantes de 21 países. El tema de este grupo de trabajo fue el desarrollo de métodos de cultivo más productivos y sostenidos con pocos recursos en las zonas húmedas y subhúmedas de los trópicos, utilizando técnicas de agricultura de pasillo o entresurco. Este libro revisa la situación actual de la investigación sobre la agricultura de pasillo o de entresurco y su aplicación, discute el uso de especies maderables en sistemas de cultivo tropicales, subraya la necesidad de realizar investigaciones y dar cursos de capacitación y propone la creación de canales para la investigación conjunta.

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Land tenure systems and the adoption of alley farming

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Abstract — Alley farming is an agroforestry technology that requires access to land and the right to plant, own, and use trees. This paper considers the implications of land-tenure systems in southwest and southeast Nigeria for the acceptability and viability of alley farming. Considerable variation in the rules governing the use and control of land exists within and between the two regions, and any tenure system may include many categories of land to which different patterns of use and tenure apply. Broadly speaking, tenants in parts of southwest Nigeria may be disadvantaged, as their rights over rented land do not necessarily include the right to plant trees. In the southeast, communal systems of land ownership and management exist on some categories of land. This undermines both the ability to plant trees and the incentive to invest labour in the maintenance of soil fertility.

Introduction

Agronomically, ecologically, and economically, the case for alley farming is compelling (Kang et al. 1981; Hoekstra 1982; Sumberg et al. 1985; Reynolds and Adeoye, this volume). If alley farming is to have a significant impact on land-use patterns, however, it must be widely adopted by the resource-poor farmers who make up the vast majority of the farming population. This paper considers the implications of southern Nigerian land-tenure systems for the adoption of alley farming.

A land-tenure system is the body of rights and duties that regulates the use and control of land. Most African customary property systems distinguish between trees and the land on which they are planted. Rights to the one may be held and transferred independently of rights to the other. Thus, parallel and distinct systems of land and tree tenure may exist. However, because trees are, for practical purposes, attached to the land on which they stand, the two systems are not entirely separate. Planting trees obviously has long-term implications for the use of land, and those whose rights in land are temporary may be debarred from establishing permanent crops. Once planted, however, trees are generally considered the property of the planter. In some circumstances, therefore, tree planting may increase the security of rights to land.

Land-tenure systems govern a multiplicity of land uses and may be extremely complex. It is necessary to distinguish the land and tree rights that are necessary to practice alley farming. First, the prospective alley farmer with the right to plant trees on a certain piece of land requires access to this land. Second, rights over these trees must be sufficiently secure to justify the planting effort. Third, the farmer's right to harvest and use the trees' foliage must be exclusive enough to ensure an adequate return on investment. Fourth, rights to plant arable crops on the land where the trees are established must be of sufficient duration and security to enable the farmer to benefit from the system's ability to maintain or improve soil fertility.

The land rights that any person holds depend on the means by which access to that land was obtained (inheritance, purchase, loan, lease, or pledge). Thus, the implications of adopting alley farming for tenants, strangers, and pledges may differ from those for landowners and indigenes. Furthermore, status within the household may determine rights over land and trees. The rights of men may differ from those of women; the rights of household heads may differ from those of other household members; and the rights of the first-born child may differ from those of the other children.

Planting tree crops is scarcely an innovation in southern Nigeria, which has been a major producer of cocoa, kola, and palm products. However, the cultivation of these trees does not involve the intercropping and simultaneous management of trees and arable crops. Thus, the simultaneous exercise of rights over both the tree (the right to use its foliage), and the land on which it is established (the right to plant crops) has also been unknown. Furthermore, alley-farmed trees have multiple uses and, hence, there are many possible beneficiaries. Most of their products, however, are intermediate and have no market value.

Mulching will benefit the present cultivator, the future cultivator, or the landowner, depending on the system of land tenure. Cutting for livestock will benefit stockowners in the household; this group may include people who are not owners of the alley farm. Cutting for firewood will tend to benefit those (generally female) members of the household whose responsibility it is to provide firewood. There is, thus, no precedent in the institutions of tenancy to regulate the use of land for economic trees. There is also no precedent for the pattern of distribution of benefits between such parties.

This paper considers the implications of land-tenure systems for the acceptance of alley farming in southwest and southeast Nigeria. In each case, a general review of the region's tenure system, which draws mainly on secondary sources, is followed by case studies of the communities where the Humid Zone Programme of the International Livestock Centre for Africa (ILCA) has been conducting on-farm trials of alley farming (Fig. 1). The case studies consist of brief accounts of the communities' social constitutions and farming systems and an outline of the relevant features of the local land-tenure system. The way in which the opportunities and constraints presented by these systems have shaped the adoption and use of the browse trees by farmers is then considered. A final section considers the general implications of these findings.

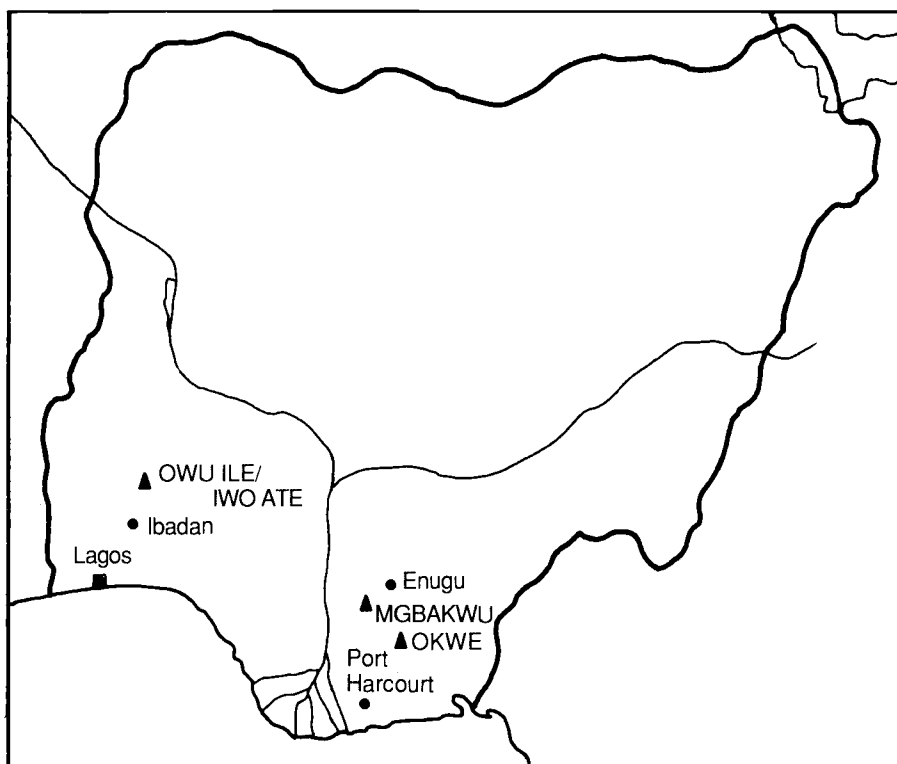


Fig. 1. Communities in which the International Livestock Centre for Africa (ILCA) has conducted on-farm trials in Nigeria (▲).

Southwest Nigeria

General features

Land-tenure systems in southwest Nigeria show marked regional variation. Under the influence of increasing population densities and the spread of cocoa cultivation in this century, land-tenure systems have also been subject to considerable change.

Rights over land may be vested in a variety of social groups. These groups may be defined in political, residential, or kinship terms, or a combination of these. In most areas, the important unit of land ownership is lineage. Criteria for lineage membership are by no means uniform; in particular, recognition of the validity of nutritional links (i.e., "the mother's side") is variable. In general, there is a fairly strong patrilineal ideology; in practice, however, kinship links of other kinds, as well as coresidence, may form the basis for participation in lineage affairs and access to land. Lloyd (1962) recorded that lineage land in some areas was reallocated annually to members and, elsewhere, lineage members required the permission of the lineage to plant permanent crops. In general, however, whether land is obtained through membership of a community or lineage or through

inheritance, the wider group exercises little control over its use and the individual is free to plant either food or tree crops.

Nonmembers of landowning groups may also obtain the use of land. Within the traditional system, granting land to immigrants was merely an aspect of their integration into the community. Where tribute was paid, this was a question of political, rather than economic, significance. As scarcity has given land a value, relations between the grantors and grantees of land have become more narrowly economic, although the process has been an uneven one. "Strangers" may obtain access to land in many ways. Most critical for the purposes of this discussion is the fact that grants of land do not necessarily include the right to plant trees (Galletti et al. 1956; Francis 1984).

These restrictions notwithstanding, outsiders have been able to obtain land from landowning groups for the cultivation of economic trees. The terms of such arrangements vary from place to place. In general, an initial payment was made when the land was granted and this was followed by annual payments to the landowner in cash or kind. These payments came to be known as *isakole* and were enforceable in customary courts. Over the years, the social obligations and implications of tenancy have tended to diminish; at the same time, the cost of obtaining land rights has risen.

Cocoa farms, like other improvements on the land, are considered the property of the planter rather than the landowner. In most areas, tenants have the right to rent, pledge, or otherwise use the cocoa trees as security for loans; they may also bequeath the trees to their heirs. Tenants are also usually allowed to sell their trees. Berry (1975) reports, however, that landowners in Ibadan are reluctant to allow such transactions, possibly for fear of the new owners laying claim to the land itself.

Allocations of farmland, either to members of landowning groups or to tenants, do not include the right to exploit economic trees already on the land, whether they were self-sown or planted by a previous occupant. The right to reap palm trees, in particular, implies rights of ownership; thus, disputes about palm trees are often disputes about land. In general, firewood may be collected freely, although one may not enter another's cultivated farm for this purpose.

Owu Ile and Iwo Ate

The adjacent settlements of Owu Ile and Iwo Ate are situated some 22 km northeast of Oyo on the road to Ejigbo in Oyo State. They lie in the transitional zone between forest and savanna and many of the inhabitants have farms in both ecological environments. Soils are mainly Alfisols and Entisols. Annual rainfall averages 1700 mm. The two villages consist of some 172 households with an average of 3.6 adults per household (Okali and Cassaday 1985). Agriculture is the principal occupation for men. Women frequently farm independently of their husbands and, in general, are engaged in gainful activities such as food processing and petty trading in addition to their domestic responsibilities. Typically, farms consist of a cultivated area of 1 or 2 ha scattered over many holdings. Farms are situated up to 4 km from the villages. No cultivation takes place in the villages themselves and livestock are allowed to roam unrestricted. Small ruminants are owned in most households (3.4 sheep and goats per household).

The main arable crops are cassava, yams, and maize. Subsidiary crops include cocoyams, pepper, cowpeas, banana, tomato, pigeon peas, and okra. Palm trees are harvested and the fruit is processed to provide oil. In the forest area, cocoa, kola, and citrus are grown. In the savanna, locust bean (*Parkia clappertoniana*) and shea butter (*Butyrospermum paradoxum*) trees are allowed to grow and are harvested for their products.

The ILCA alley farming research and extension project was introduced to Owu Ile and Iwo Ate at the end of 1983 (see Atta-Krah and Francis, this volume). These communities had been selected on the basis of their involvement in agriculture in general and small ruminant production in particular.

The land is managed using a bush-fallow rotation system. After clearing and burning, cultivation typically occurs for about 5 years. After this period, the land is allowed to lie fallow for around 5 years. The actual length of the fallow depends on the availability of land and the means to cultivate it. Hand labour is the rule, although some farmers hire tractors to plough their savanna farms. Labour is provided by household members, seasonal migrants from the north, and a few permanently resident labourers from the southeastern states. Labour is generally hired on a task basis.

The potential benefits of alley farming were explained to farmers at community meetings and those expressing interest were offered tree seeds and advice on planting. Critical decisions about the management and use of the trees were left to farmers themselves. Participation, management, and utilization were monitored closely, while a resident government extension agent continued to offer advice to farmers. Seventy-six farmers in Owu Ile and Iwo Ate planted alley farms in the 1st year of the project; 40 more planted in the 2nd year.

The alley farms were planted on land obtained through inheritance (generally from the father, but in one case from the mother), purchase, gift, lease, or loan. Those who originally rented land (whether or not they had continued to make payments) or who were farming on borrowed land, had to receive the permission of the landowners before planting the trees. Although some landowners say that they would be reluctant to allow their tenants to establish alley farms, no cases have come to light of prospective alley farmers being refused permission to plant trees.

Women farming on their husbands' land usually sought their spouse's permission before planting alley farms. Widows, in most cases, established the farms on the land of their late husbands. In 1984, the 1st year of the project, women were underrepresented among alley farmers. Although they account for 60% of the adult population of the two villages, they accounted for only 17% of alley farmers in 1984. However, many women do not regard farming as their primary occupation. Most are engaged in food processing (primarily of cassava and palm oil) or petty trading, in addition to their domestic responsibilities.

In the 2nd year of the project (1985), particular emphasis was given to encouraging women's participation. In 1985, 50% of the alley farms established were planted by women. Therefore, the participation of women in alley farming at the southwestern project site seems to have been determined less by land tenure factors than by the existence of competing demands on their time and the initial approach taken to the extension of the technology.

At Owu Ile and Iwo Ate, access to land for planting trees does not seem to be a constraint on the adoption of alley farming. In this, Owu Ile and Iwo Ate are probably typical of the less densely populated parts of the region (the population densities of Ejigbo and Ogbomosho Local Government areas are 198 and 186 persons/km², respectively (Idachaba et al. 1981). Farther south, however, especially in the cocoa-growing areas around Ibadan, Ife, and Ilesha, rural population densities are considerably higher and land is much less readily available.

Writing about the cocoa belt in the early 1950s, Galletti et al. (1956) were already noting that *free* land was no longer available where population density approached 60 persons/km² and that most families did not have enough land to allow adequate fallow periods. Data collected by Galletti et al. (1956) also indicated that land held on temporary or permanent grant from other families accounted for about 18% of land in use. This proportion has increased greatly in the intervening years. Between 1952 and 1968, evidence from Ife division indicated that the proportion of land held on permanent lease increased from 15 to 39% (Van den Driesen 1971). By 1968, more farmers in Ife division were lessees than owners of land and only 10% of households had land in reserve. Accompanying these changes was an increase in the proportion of land held on temporary leases. Thus, in areas where land pressure is more intense and the terms of tenancy are more definite and permanent, tenants, many of whom grow food crops under temporary leases, may be disallowed from planting alley farms.

Southeast Nigeria

General features

The land-tenure systems of southeast Nigeria are less well documented, more complex, and more varied than those of the southwest (Francis 1986). Their complexity is largely due to the existence of various categories of land to which different tenure rules and patterns of use apply. The variation between areas is a reflection of differing ecological conditions, population densities, and farming systems. There is also considerable variation in dialect and terminology in the region.

The major sociopolitical divisions of traditional Igbo society are the town (generally known ethnographically as the village group), the village, the localized patrilineage, and the extended family. All of these units, as well as individuals, may own and control land.

The classification of land in terms of the social unit exercising control and ownership is related to two other bases of classification: by spatial arrangement and in terms of use. The spatial categorization of land distinguishes compound land, near farmland, and distant farmland. The classification of land according to use distinguishes groves, pastureland, and farmland. Within the category of farmland, several types of land are distinguished according to vegetation and soil type (Jones 1949; Obi 1963).

Obi (1963) classifies economic trees and plants as a separate category of property distinct from land and movables. Customary law relating to trees treats different types of trees in different ways. The most basic distinction is that between

self-sown trees and trees planted by people. If trees are deliberately planted, they belong to the person who planted them. Rights over self-sown trees, in contrast, are generally vested in the owners of the land. Thus, self-sown trees on individual holdings are the exclusive property of the landholder; economic trees growing wild on communal land, however, belong to the entire land-holding group. In the case of communally owned farmland under cultivation, the individual farming the area on which the tree is growing has exclusive rights over the tree during the period of cultivation.

Okwe

Okwe, in Imo State, lies within the forest zone some 10 km southeast of Umuahia. Most of the land is situated on a gently undulating plateau; to the east, the terrain is hillier and the slope is steeper. Soils are sandy and well drained. Mean annual rainfall is a little under 2200 mm. The population density of the Ikuanu-Umuahia Local Government Area is 369 persons/km² (Idachaba et al. 1981). The 1963 census showed the population density of the Okwe area to lie between 100 and 200 persons/km². On the basis of farm sizes, Lagemann (1977) estimated the population density of the Okwe area at 250 persons/km² in 1975. Okwe's 276 households, representing an adult population of around 600, are grouped into five subvillages.

At Okwe, there are three main categories of land. Each category has a corresponding land use. Around the compound, there is a multistory cropping system with a diversity of trees (kola, pawpaw, coconut, citrus, and others), and arable crops (*Telfaria*, pepper, cassava). The compound area is cultivated continuously and household waste and animal manure are returned to it. "Near farms" are the second category of land. This land is generally cultivated in alternate years, although the pattern of rotation varies according to land availability and fertility. Cassava, *Telfaria*, and other vegetables and condiments are grown on this land. The third category of land is "distant land." The main crop on distant land is cassava (maize, melon, and bitter yam are also grown). This land has a 6-year cropping cycle and reverts to fallow after the harvest of a single crop of cassava.

As the availability of sites near the road is limited, compound land is often purchased in Okwe. Patterns of ownership of both near and distant farmland are largely determined by inheritance, which is the principal, but not the only, means through which land is obtained. Like other property, land is inherited patrilineally. Following the principles of Igbo inheritance, the eldest son of the deceased acts as the administrator of the estate. The different types of land are shared separately. They are divided first into the number of shares according to the number of wives with surviving male offspring. Full brothers may then divide the land between them or, more commonly, continue to hold the land jointly, sharing it either before or after clearing. After inheritance, the most common source of land is the redemption of a pledge originally made by a deceased ancestor. Such land is the individual property of the redeemer.

Land ownership in Okwe is predominantly individual; however, there are collective mechanisms for management. In this discussion, the most important of these is the setting of rotations on distant land by the subvillage. The territory is divided into various zones and exploited according to a 6-year cycle, which determines which land will be cultivated in any particular year. Following the

harvesting of cassava in the subsequent year, the land reverts to fallow for another 4 years. The system is well established and generally believed to be of long standing. It seems that the subvillage rarely exercises any sanction to maintain the cycle of rotation; indeed, it is unclear whether it could do so. However, pests (mainly bushpigs, grasscutters, and rodents) cause severe damage on the edges of farmed areas and would constitute a real hazard to anyone farming in an otherwise uncultivated area. Those without land in one of the zones being cropped in any particular year rent from those who have excess land or from absentee owners. These leases are annual arrangements. The lessee clears the land and is entitled to use or sell the wood obtained. Women obtain land from their husbands or may rent for themselves.

Timber trees remain the property of the landholder's kin group. Rather than being shared on inheritance they are held jointly and income from them is divided among the heirs. Any member of the community may hunt or fish in Okwe territory.

The tenure of palm trees is also differentiated by land-use zone. Palm trees on compound land and near farms, which are often deliberately planted and include improved varieties, are held individually. In contrast, the palm trees on distant land, which are generally self-sown, are communally controlled.

What are the implications of the land and tree tenure systems outlined here for the acceptability of alley farming? The individual tenure of compound and near farm land is secure and includes the right to plant trees. However, the relatively small area of compound land is the site of an intensive and complex agricultural system, and the opportunity cost of land here is relatively high. Near fields, however, would seem to be suitable for alley farming.

On the outlying fields, which constitute the most important category of land in terms of area and production, and where the question of soil fertility is more critical, the system of land use and administration makes the adoption of alley farming problematic. The cropping cycle includes only one period of cultivation; after the harvest of its intercropped crops at the end of the 1st growing season, cassava is left until its harvest with minimal weeding or other management. In southwest Nigeria, where land is cropped for 2 seasons a year for several years before being allowed to revert to fallow, the adoption of alley farming does not necessitate extra weeding in the 2nd and subsequent years of cropping as the land remains under cultivation. Under the land-use system at Okwe, however, land would normally be abandoned once the cassava crop was harvested; thus, any labour expended on maintaining the alley farm is an additional input. Given the relatively poor, acid soils of the area, the potential of the trees to produce enough mulch during the year following planting to enable the extension of the cultivation period beyond this year is poor. Furthermore, if the cropping period was extended by an individual farmer, the new system would be out of phase with the collectively recognized system of rotation practiced at Okwe. That farmer would soon be farming in isolation and risking crop damage from animals. Finally, those obliged to rent land would have no incentive to invest in soil fertility as lease arrangements are always for a single cropping cycle.

On-farm trials of alley farming were introduced at the two sites in the southeast in a similar manner to that described for the southwest. The pattern of decisions made by participants reflects the institutional constraints described (Fig. 2). In 1984, 8 Okwe farmers planted the trees; in 1985, 11 more planted. In the 1st year,

19 browse tree planters (4 women)

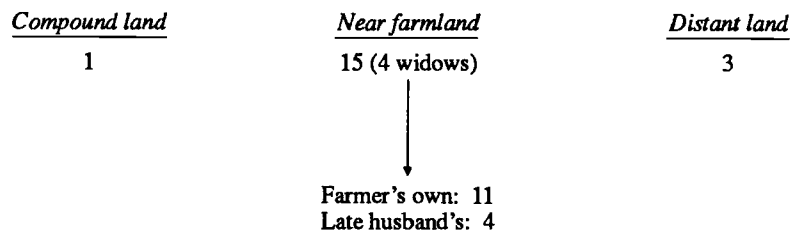


Fig. 2 Plantings by land type and gender, Okwe.

only one woman, a widow, planted trees. Three of the 11 planters in 1985 were women and all 3 were widows. The question of women's participation in browse tree planting in the southeast and its relation to land use rights is considered in the next section.

All but four of the farmers chose to plant on individually held near farms. In one case, this was on abandoned compound land. The four women planted on the individually owned near farms of their late husbands. One farmer planted next to his compound. In three cases, trees were planted on distant land; all of these were unsuccessful. Two feed gardens established on distant land in 1984 were abandoned as the land returned to fallow. The alley farm planted on distant land in 1985 never established properly because of waterlogging of the soil.

Mgbakwu

Mgbakwu, the second community in the southeast where ILCA has been conducting on-farm trials, is 8 km north of Awka in Anambra State. It lies in gently undulating, open terrain in the transitional savanna zone. Soils are Ultisols and are low in nutrients and pH. Mean annual rainfall is around 1 800 mm with a bimodal distribution. The population density of Awka Local Government Area is 432 persons/km².

Mgbakwu consists of 983 households, equivalent to an adult population of around 2 800. The population is segmented into *umunna* ("sons of the same father"), each consisting of around 10 households. *Umunna* are exogamous groups and are the important social unit for the control of land. The mean number of adults per household is 2.8.

As in Okwe, three major types of land may be distinguished: compound or house land, near farmland, and distant farmland. All adult male members of an *umunna* are entitled to a plot of land on which to build a house. The house plot and the house on it would be inherited by his children. The *umunna* does, however, retain some reversionary rights: if a plot of house land is not developed by an individual within a reasonable period, the *umunna* may, after giving due notice, allocate it to another applicant.

Trees are planted around the compound and the main arable crops are cocoyam and bitter leaf. Cultivation in the compound area, which benefits from the application of household waste and animal manure, is continuous. As at Okwe, goats and sheep are kept confined in the compound and feed is carried to them.

Near farmland is situated close to the residential area and is cultivated either every year or in alternate years. The main crops are cocoyam, cassava, yam, and vegetables. Household sweepings are often carried to this area. Trees, such as pawpaw, plantain, and African breadfruit, are also fairly common.

Distant land owned by Mgbakwu residents extends about 10 km to the north of Mgbakwu. The main crop on this land is cassava. It is planted on its own in ridges or, less frequently, intercropped with yam in mounds. Pigeon pea is also grown on distant land. After the harvest of cassava, the land is left fallow for several years. The land-use cycle on distant land is usually 4 or 5 years long.

With the exception of land already allocated as house plots, almost all near and distant farmland is owned by *umunna*. Typically, such a land-holding unit consists of 10 to 60 adult males jointly owning an area of near farmland and blocks of distant land. Allocation of both types of land takes place annually following the major town festival of *Egwu Alusi* at the beginning of the rainy season. The near farmland is divided and members choose their shares in order of seniority within the lineage. Near farmland is reallocated every 1 or 2 years, and the *umunna* may place restrictions on the crops that may be grown there.

The *umunna* also decides which blocks of distant land will be exploited in any season. The adult members, accompanied by prospective tenants, go to the land in question and divide it into plots, whose boundaries are marked with sticks. The area of each plot is around 700 m². All adult male members of the *umunna*, whether or not they are a resident of Mgbakwu, are entitled to a plot in each block of land exploited. The lineage members select from the plots in order of seniority. Women usually either obtain land through their husbands or, where this is not sufficient, rent it. Widows are entitled to shares of both near and distant farmland from their late husbands' *umunna*.

Surplus land is rented. Sometimes the proceeds are shared immediately; in other cases, the money may be kept for collective purposes such as funerals and other ceremonial expenses. Individuals allocated land may opt to rent any excess land. The money from such transactions is their own. Renters are mostly individuals from other Mgbakwu *umunna* that do not have sufficient land available for that season. Leases of distant land are always for one farming cycle only. Near farm plots are also rented; however, this is less common than the renting of distant land. The period of rental is one cropping cycle.

Sales and pledges of land are both recognized in Mgbaku; however, they occur only rarely. The collective ownership and control of land means that only the *umunna* can authorize such transactions.

Trees may be planted on collectively owned, near farms by members of the *umunna*. They remain the property of the planter, who has exclusive harvesting rights. Both men and women may plant trees. The land, however, remains vested in the *umunna* and there is no guarantee that the planter will have use of the land in future cycles (although they may be permitted to choose the same plots when land is reallocated).

Trees are not planted on distant farms. Timber and other useful trees (e.g., raffia) in wooded areas belong to the *umunna* owning the land on which they grow. Proceeds of sales go to the group. Firewood may be collected from any area of distant farms except cultivated areas. In contrast to Okwe, firewood is not sold outside the community. Any member of the community may hunt or fish in Mgbakwu territory.

The systems of land and tree tenure found at Mgbakwu differ from those found at Okwe. The predominant unit of ownership at Mgbakwu is the *umunna*; even individually held land is obtained from this group. As at Okwe, however, rights over compound land are both individual and secure, and tree planting in this area is a universal practice. The communal ownership and control of both near and distant farmland, however, has important implications for the feasibility and acceptability of alley farming. Although *umunna* members have the right to plant trees on near farmland, the right to cultivate this land continuously is not guaranteed. On distant land, the *umunna* decides which blocks to exploit in any year and, thus, the length of the fallow period. The cultivator's rights to use this land extend for a single cropping cycle and the land reverts to the *umunna* after the harvest. Even when the block is cropped again 4 or 5 years later, the land will be redivided and the individual is likely to receive a different portion. Again, those renting land only have its usufruct for a single season. Thus, neither *umunna* members nor tenants have any incentive to invest in soil fertility. Even were an alley farm to be planted on distant land, at Mgbakwu as at Okwe, weeding labour would be additional. Also, extending the cropping period would leave the cultivator farming in isolation, with the associated risks from pests, when the other members of the *umunna* moved to another block of land.

In 1984, 11 Mgbakwu farmers established browse trees; in 1985, 7 more farmers planted (Fig. 3). The participants in 1984 were all men. The low participation of women, both here and at Okwe, suggests that they were disadvantaged in their access to land for tree planting. In 1985, a female senior technician was posted to the southeastern sites. One of her responsibilities was to examine the reasons for this phenomenon. In the same year, five of the seven plantings were by women. As in Okwe, all of these women were widows.

Even though wives were completely absent from the list of participants at both Okwe and Mgbakwu, they often played an important role in the management of the feed gardens and alley farms. In particular, they were usually responsible for the weeding. They also cut the trees for fodder. All the goats in the household (which are owned individually) received the benefit of browse, which is cut by either the husband or the wife. The structure of agricultural decision-making within the Igbo household is more responsible for the apparently low participation of women in the projects than are the land-tenure rules.

Thirteen plantings (72%) were made on individually owned compound land. Seven of these were on the farmer's own compound. In another three cases, trees were planted on plots of house land that had been allocated to the farmer but on which building had not yet taken place. The other three farmers planting trees on individually held land were women. One planted within her son's compound, where she lives; another planted on a plot of house land where her son is to build a house; the last planted the trees on a plot of house land allocated to her late husband.

18 browse tree planters (5 women)

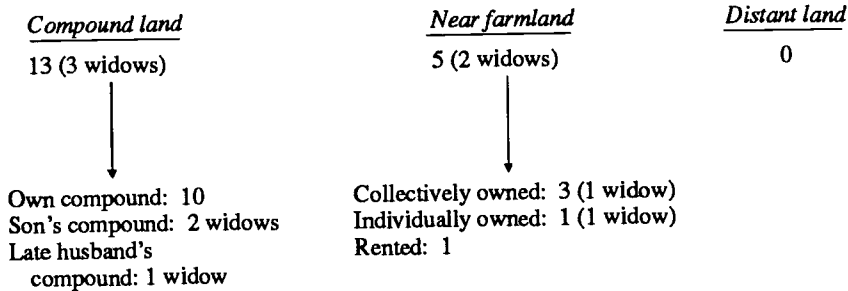


Fig. 3. Plantings by land type and gender, Mgbakwu.

The other five plants were made on near farmland. One woman planted on land that her husband had owned personally. In three more cases (two men and one woman), trees were planted on the collectively owned land of the planter's *umunna* (or, in the woman's case, her late husband's *umunna*). The other planting on near farmland was the only case at either site in which trees were planted on rented land: a man planted trees on a piece of near land rented from his wife's family. The land was *umunna* property held by the in-laws on a temporary grant. It was abandoned after the crops were harvested. In no case were trees established on distant farms.

Conclusions

Land-tenure systems are critical in determining the acceptability and viability of alley farming. This does not mean that they operate as inflexible constraints on agricultural innovation. As the example of southwestern Nigeria shows, land-tenure systems are subject to change and evolution under the influence of land pressure and changes in agricultural techniques. Furthermore, any land-tenure system may include many different categories of land to which different tenure rules and patterns of use apply. Patterns of technology adoption will be shaped by the opportunities and constraints presented by the rules of tenure. Thus, a knowledge of the system, its dynamics, and the potential "niches" for innovation that exist within it is required in both the design and the extension of alley farming and related agroforestry technologies.

Just as the potential acceptability of alley farming depends on the category of land being considered, so the ability to plant and use trees will differ according to the social status of the cultivator and the way in which access to the land was obtained. Key distinctions to be taken into account here are the implications of the system for men as compared with women, for natives as compared with strangers, and for landowners as compared with tenants.

As alley farming permits the extension of cropping periods, its benefits are greatest in situations where land is scarce. Considering the dynamic nature of

land-tenure systems and their role in determining the success of alley farming, it is important to know what effects increasing population pressure and agricultural intensification will have on these systems. In the southwest, rising population densities, agricultural commercialization, and the spread of cocoa cultivation have led to the individualization of rights and the emergence of tenancy. For landowners, individual and long-term control over land have created conditions that are conducive to alley farming. The growing importance of tenancy in the region (in particular, temporary leases), however, means that a large and increasing section of the agricultural population may be excluded from its benefits.

Under the higher population densities of the southeast, a spatial differentiation of land has emerged. Here, intensively cultivated compound farms are associated with the confinement of livestock and the recycling of household and animal waste. Lagemann (1977) compared agricultural systems in three ecologically similar parts of the southeast with differing population densities; the least densely populated area studied was Okwe. His findings indicate that, with greater pressure on the land, the size of the compound farm and the complexity of recycling and intercropping within it increase. More livestock is also kept. At the same time, the total area of land cultivated per household declines; the plots cultivated outside the compound are smaller and more fragmented. Fallow periods on these plots are shorter, the soils poorer, and yields lower in the more densely populated areas.

The compound farm appears always to be held under individual tenure (or, more accurately, under the control of the household head). Its increasing importance under conditions of agricultural intensification seems to admit the incorporation of alley farming into the system (although the area is typically already densely planted with both tree and annual crops). It is unclear from the available evidence how increasing population pressure affects the tenure of other categories of land. Low, declining soil fertilities in the more densely populated areas make the need for innovation more urgent. However, the case studies considered here suggest that the pressure on land neither leads to a breakdown of communal systems of land ownership and management nor to the emergence of individual proprietorship. ILCA is now examining the possibility of a community-level initiative to modify cropping cycles and rotations on communally controlled land. In the absence of such a development, it is difficult to imagine any way in which the systems of communal control outlined in this paper could evolve into individual proprietorship.

References

- Berry, S.S. 1975. *Cocoa, custom, and socio-economic change in rural Western Nigeria*. Clarendon Press, Oxford, UK.
- Francis, P.A. 1984. "For the use and common benefit of all Nigeria": consequences of the 1978 land nationalisation. *Africa*, 54(3), 5-28.
- . 1986. *Land and tree tenure in humid West Africa: a bibliography*. International Livestock Centre for Africa, Ibadan, Nigeria.
- Galletti, R., Baldwin, K.D.S., Dina, I.O. 1956. *Nigerian cocoa farmers*. Oxford University Press, London, UK.
- Hoekstra, D.A. 1982. *Leucaena leucocephala* hedgerows intercropped with maize and beans: an ex ante analysis of a candidate agro-forestry land use system for the semi-arid areas in Machakos District, Kenya. *Agroforestry Systems*, 1, 335-345.

- Idachaba, F.S., Umebese, C.E., Akingbade, I.O., Adeniyi, A. 1981. Rural infrastructure in Nigeria: basic needs of the rural majority. Volume 2: State annexes. Federal Department of Rural Development, Lagos, Nigeria.
- Jones, G.I. 1949. Ibo land tenure. *Africa*, 19(4), 309–323.
- Kang, B.T., Wilson, G.F., Sipkens, L. 1981. Alley cropping maize (*Zea mays* L.) and leucaena (*Leucaena leucocephala* Lam.) in Southern Nigeria. *Plant and Soil*, 63, 163–179.
- Lagemann, J. 1977. Traditional farming systems in Eastern Nigeria. *African Studies*, Special Series 98.
- Lloyd, P.C. 1962. Yoruba land law. Oxford University Press, London, UK.
- Obi, S.N. Chinwuba 1963. The Ibo law of property. Butterworth & Co. (Publishers) Ltd, London, UK.
- Okali, C., Cassaday, K. 1985. Community response to a pilot farming project in Nigeria. African–American Issues Study Center, Boston University, Boston, USA. Discussion Paper 10.
- Sumberg, J.E., McIntire, J., Okali, C., Atta-Krah, A.N. 1985. An economic analysis of alley farming with small ruminants. International Livestock Centre for Africa, Addis Ababa, Ethiopia. Internal document, 18 pp.
- Van den Driesen, I.H. 1971. Patterns of land holding and land use in the Ife Division of Western Nigeria. *Africa*, 41(1), 42–53.