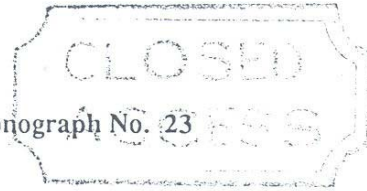


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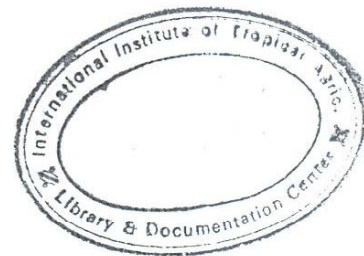


Resource and Crop Management Research Monograph No. 23

Adoption Potential of Alley Cropping

Final Project Report

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Introduction

Project objectives

Alley cropping was developed at the International Institute of Tropical Agriculture (IITA) as a soil fertility management practice.¹ In 1987, a project on the adoption potential of alley cropping was initiated.

The major objectives of the project were to determine the adoption potential of alley cropping for the lowland, humid, and subhumid tropics in West and Central Africa, and identify constraints on adoption that could be addressed by research. Because there were few precedents for evaluating the adoption potential of complex technologies over several years, methods development was also considered part of the research.

Definitions

For the purposes of this report, alley cropping is defined as an agroforestry practice in which field crops are grown between rows ("hedgerows") of trees or shrubs. For the sake of brevity, "tree" in the following discussions refers to a tree or a shrub.

This definition does not specify a particular use of the hedgerow species. For maintenance of soil fertility, hedgerow prunings are added to the soil. For "alley farming," part of the hedgerow biomass is used for animal fodder (Sumberg and Okali 1984). According to our definition, either system could be called alley cropping. Other authors have referred to alley cropping as "hedgerow intercropping" (Torres 1983) or "avenue cropping" (Wijewardene and Waidyanatha 1984). Alley cropping is classified as a zonal agrisilvicultural system (Nair 1985).

Background

In on-station experiments, mulching with *Leucaena leucocephala* prunings from hedgerows reduced nitrogen fertilizer requirements of alley cropped maize (*Zea mays*), and arrested the decline of soil organic matter in successive cropping seasons (cf. Kang, Wilson, and Sipkens 1981). Calculations of economic returns based on data from secondary sources and on-station experiments were promising (Raintree and Turay 1980; Ngambeki 1985). Economic evaluations, based on similar data sources, were likewise favorable for alley farming, wherein part of the hedgerow biomass is used for fodder (Sumberg et al. 1987). Nevertheless, in on-farm trials, researchers from the International Livestock Research Institute (ILRI; formerly during the period of research described in this monograph, known as the International Livestock Centre for Africa [ILCA]) found that a complex set of environmental and sociological factors influenced initial adoption and successful establishment of planted fodder trees (Francis 1987; Francis and Atta-Krah 1989). No published reports were available on the economics or adoption potential using on-farm labor or biological data from alley farms.

1. "Alley cropping" was first mentioned as such in the Institute's Annual Report for 1979 (IITA 1980).

Approach to research

Because of the dearth of on-farm data and the complexity of the alley cropping system, diagnostic fieldwork preceded model specification and empirical analyses (Dvorak 1991). Since 1980, a variety of alley cropping and alley farming experiments have been undertaken in Nigeria (figure 1). Objectives, criteria for selection of villages, fields and farmers, technology design, experimental methods, and data collection have varied. Rather than initiate new trials for this study, means were sought to use the existing on-farm trials for diagnostic purposes. Although the author had not been involved at the beginning of any of the trials, all scientists managing projects agreed that trial farmers could be approached to participate in the adoption study.

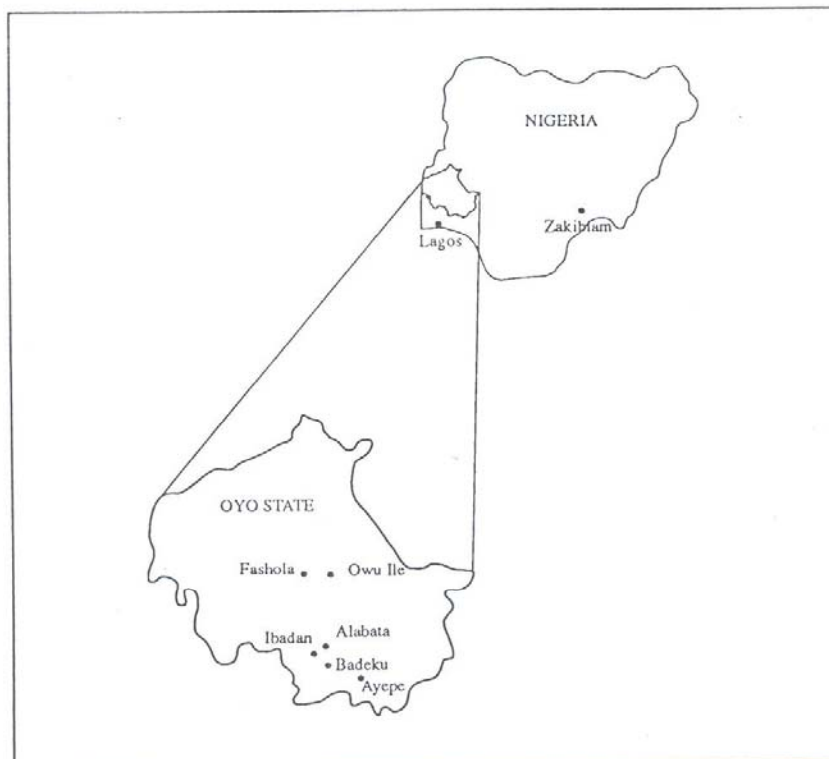
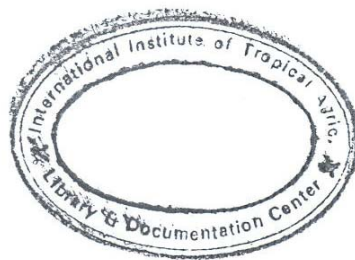


Figure 1. Location of IITA and ILRI alley cropping trial sites, Nigeria, 1980-1989

The first primary data collection activity was intensive data collection (cost-route study and field measurements) for 11 farmers with farmer-managed hedgerows in an IITA study village in southwestern Nigeria. Data collection methods are described in detail in section I. Based on this initial fieldwork, simple models of alley cropping for on-farm research were developed (section II). Section III initiates an empirical analysis of alley cropping adoption potential for soil fertility maintenance in a static framework. Data from the diagnostic fieldwork were used, whenever possible. These data were supplemented by reports on on-farm data from other trials, and on-station data. Still, it was at times necessary to make assumptions, or do an analysis for a range of illustrative values. These instances are clearly indicated in this report. Intertemporal elements are added in section IV. In section V, tree/crop interactions are briefly discussed.

The second activity was a survey of farmers who had participated in off-station trials on alley cropping or alley farming conducted by IITA between 1980 and 1989. The objectives were to establish an inventory of alley cropped fields and test hypotheses about the adoption potential of alley cropping across locations and farmer circumstances. Methods and results of the survey are presented in section VI.

Refinements and extensions of the model are presented in section VII. In section VIII, conclusions and suggestions for future research are presented.



I

Methods of Primary Data Collection: Panel Data Collection and Field Measurements

The first activities were field measurements and a panel survey of one group of alley cropping trial participants. Fieldwork was restricted to a single village because data collection was very intensive and diagnostic in nature. The trial group selected was 11 farmers, each with one field with planted hedgerows, in Ayepe village, Irewole Local Government Area (LGA), Oyo state, Nigeria. This group was selected because there had been minimal researcher-technician involvement in hedgerow management, and because some data had been collected on labor inputs in the first year.

Ayepe is an established site for IITA on-farm research (figure 1). The village is situated in the "cocoa belt" of the lowland, semideciduous humid forest (Mutsaers et al. 1986), about 60 km southeast of IITA headquarters in Ibadan. Average annual rainfall is between 1250 and 1500 mm. The main rainy season is from late March to late July, followed by a break and a short rainy season from late August to early November. Soils generally belong to the Egbeda association.

Cassava (*Manihot esculenta*) is the primary staple and food crop produced, frequently in association with maize. Cocoyam (*Xanthosoma sagittifolium*) and yam (*Dioscorea* spp.) are also produced, and small quantities of vegetables, including egusi melon (*Citrullus lanatus*), tomatoes (*Lycopersicon esculentum*), peppers (*Capsicum* spp.), leafy green vegetables (*Amaranthus* spp., *Corchorus olitorius*, and *Celosia* spp., genome type) and okra (*Hibiscus esculentus*). Plantains (*Musa* spp., genome type AAB) and bananas (*Musa* spp., genome type AAA) appear in dense stands in small "backyard" areas, scattered in food crop fields, and in cocoa (*Theobroma cacao*) plots. Cocoa plots are not well maintained, but earnings from cocoa remain an important cash source and some farmers continue to plant new cocoa. "Wild" oil palm (*Elaeis guineensis*) are protected and processing palm oil is another important source of cash income, particularly for women.

Eleven farmers (ten men and one woman) in the Ayepe area had been assisted in planting hedgerows of *L. leucocephala* in fields prepared for the 1987 rainy season. Scarified, but not inoculated, *L. leucocephala* seeds were planted in six hedgerows 4 m apart, each at least 25 m long. Three seeds per hole were dibbled at 25 cm intrarow spacing. The trees were established with a cassava+maize intercrop in the alleys. A control (i.e., without hedgerows) of the same size (20 m x 25 m) was laid out adjacent. The principles of hedgerow management to maintain soil fertility were explained. After planting, all management decisions were made and inputs were

provided by the participating farmers. Data on labor and inputs for operations in each field were collected; but the recall period and data collection procedures are not known. Data collection had been interrupted in July 1987 because of personnel changes.

In April 1988, farmers were contacted by the author of this report to initiate plot monitoring and data collection. In four fields, the pegs with identifying farmer numbers could not be located. Seven fields could be "matched" with the 1987 labor data. In April–May, each field with hedgerows was visited and the height and spacing of all *L. leucocephala* trees were measured with tape measures. One field (104) had returned completely to *Chromolaena odorata* and could not be measured. For all other fields, a tree survival index (SI) was calculated by dividing the total plant count by 606, which represents 100% survival for the field as a whole. This measurement was repeated in January–February 1989.

Field crop plots managed by each respondent were visited and measured, also using tapes. The objective was to measure all plots with field crops cultivated by respondents in 1988. This was not possible because data collection from some farmers started very late in the season, and because of failure to obtain the full understanding and cooperation of all farmers. These problems were overcome and 1989 and 1990 plot listings are believed to be complete.

Plots were measured as roughly rectangular, or simple irregular shapes using meter tapes on two sides. This is not a very accurate measurement, but the approximation was sufficient for calculating relative field size and tree density. For comparative purposes, selected cocoa plots and tree groves were measured and/or trees counted. Beginning in April 1989, tapes and compass were used for field measurements. Tree counts were done for 49 plots without alleys and for nine plots with alleys.

Distance (km) from compound to each plot, and walking time were measured. Panel surveys on agricultural inputs and outputs began in October 1988. Data were requested on every agricultural activity of the respondent, and on all activities, inputs, and outputs, for each plot under the respondent's management. Each farmer was visited every three days, and interview data were recorded on a field worksheet. Occasionally, field technicians accompanied farmers to the field and timed operations (e.g., pruning, clearing, heaping, and weeding) and area worked.

In 1989, four farmers cultivated their alleys and two farmers planted new hedgerows after having abandoned their first hedgerow fields. A fifth farmer cultivated his alley, for the first time, in 1990. For the new fields, establishment was closely monitored with weekly counts of surviving tree seedlings and observation of management practices. For the five cultivated alley farms, prunings-biomass and maize yield were measured. (At the time of reporting, cassava had not been harvested from these fields.)

Coding and data entry were done at IITA headquarters. Data records were read and analyses done using SAS software (SAS 1985).

