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Alley farming: have resource-poor farmers benefited?

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Over the past two decades, there has been much scientific interest in the potential of agroforestry for small-scale farming. One form of agroforestry that has received particular attention is alley farming, intended as a sustainable, intensive system that would radically improve the long-term prospects of resource-poor farmers. Although impossible to estimate precisely, total global expenditure on alley farming research, development and promotion to date runs to tens of millions of US dollars. It is now widely recognised that the technology has far less potential than originally anticipated, major limitations having emerged in both its technical and socio-economic characteristics. This paper reviews the documented on-farm performance of alley farming to date, identifying niche areas with some prospects for successful adoption, and suggesting specific areas for further research.[1]

Alley farming was conceived in the late 1970s by researchers at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria. Their aim was to create a system of farming rainfed lands in the humid and semi-humid tropics that would eliminate the need for a fallow period to replenish soil fertility. This was achieved in alley farming by combining trees and crops in a systematic manner, and utilising the deeper rooting trees as pumps to bring up nutrients from lower soil horizons. The originally selected tree species could also fix atmospheric nitrogen, thus further contributing to soil enhancement.

The spread of alley farming

Research
Following promising early on-station results at IITA, alley farming trials were adopted and promoted by a number of other international research centres within the Consultative Group for International Agricultural Research (CGIAR), most notably ILCA[2](the International Livestock Centre for Africa) and ICRAF (the International

Centre for Research in Agroforestry).[3] Subsequently, research trials by national agricultural research stations were also supported, particularly through two internationally funded networks AFNETA (Alley Farming Network for Tropical Africa) and AFRENA (the Agroforestry Research Network for Eastern and Central Africa). AFNETA commenced operations in 1989 with a strong West African base (the network was coordinated through IITA), and by 1992 linked alley farming trials in 20 African countries. Since then, the network has reduced operations due to limited funding. AFRENA is coordinated by ICRAF in Kenya and has a remit that extends to all agroforestry technologies. Until recently, alley farming formed a key feature of its research programme.

It is significant that much early alley farming research, particularly in West Africa, took place on-station. In the on-farm trials which *were* established, the level of researcher involvement was often high, even where trials were designated as farmer-managed trials. Many scientists argued that the technology had to be developed on-station before it was introduced to farmers. However, the long testing period implied lengthy delays before results could be tried on farms. There is also the danger of inadequately capturing on-station many of the factors relevant to farmers adoption (or non-adoption) decisions. Where early on-farm trials did indicate certain problems with Alley farming , research institutions appear to have been initially reluctant to act on such findings when designing further research.

Extension projects

Such was the enthusiasm over the perceived potential of alley farming in the 1980s that it was taken up and promoted by many government and NGO extension programmes, often with donor support.

NGOs appear to have been particularly active in alley farming projects both large international NGOs such as CARE and World Neighbors, and much smaller local ones. In West Africa, church groups have demonstrated a particular interest in promoting the technology. Government extension agencies active in promoting alley farming include those of Nigeria (through its ADPs Agricultural Development Projects), Ghana, Sri Lanka, and Indonesia. In some countries, alley farming continues to be promoted by agricultural extension projects, whilst researchers have begun to advocate caution: in Malawi, for instance, ICRAF researchers are now advocating a greater focus on agroforestry technologies other than alley farming. This review focuses on the experience of alley farming in sub-Saharan Africa (SSA), where the technology was developed and has been most widely tested. Ironically, it has met with greater success elsewhere in the world although in a modified form as is discussed in the penultimate section.

Alley farming adoption by farmers

Data on the number of farmers who have adopted alley farming on a long-term basis, or on the total area now farmed using the technology, remain imprecise. Some research (in Nigeria and Benin) has indicated that even amongst farmers who have tried alley farming, the majority abandoned it after several years (Whittome, 1994). It is clear that the technology has been less widely and rapidly adopted by farmers than anticipated, particularly in Africa. The full reasons for this are yet to be elucidated, but key issues common across many geographical areas and farming communities are becoming apparent. Far more is known about *problems* with alley farming adoption than about where and why the technology has been popular with farmers.

A simple reason for the more limited popularity of alley farming than researchers had expected is that, despite many apparent benefits, it did not address their particular needs. Another overall reason for low alley farming adoption is poorer performance on-farm than on-station. The factors behind this are complex. They may be broadly categorised into predominately technical or predominately socio-economic in character, although in some cases there are close links between categories.

Technical aspects affecting adoptability

Some aspects of poor technical performance in farmers fields are intrinsic to the technology itself; others are specific to local farming contexts. Key issues are outlined below.

Tree component
There is no single tree species ideally suited for alley farming. Early research focused almost exclusively on two leguminous nitrogen-fixing trees native to Central America, *Leucaena leucocephala* and *Gliricidia sepium*. These were often promoted on farm as wonder trees , regardless of their suitability to the given site conditions. Particular problems experienced by farmers include the intolerance of these species to acid soils; low drought resistance; limited availability of quality seed; susceptibility to pests (notably in the case of *L. leucocephala*); and a tendency to spread rapidly, becoming weeds. Attempts are now being made to identify a wider range of suitable tree species for use under different site conditions. However, progress in introducing new material to field-based projects has so far been very limited.
Successful alley farming requires good uniform hedgerow establishment. This has commonly proved difficult to achieve on-farm for a number of reasons other than species suitability. For example, certain activities related to the tree component require intensive labour input, and many clash with crop (and other) labour demands. This may result in tree nurseries being established late; in hedgerows not being planted at the optimal time of year; and in inadequate weeding during establishment. Other contributing factors may include damage by domestic animals, and by burning.

Crop component
Crop yields on farms have rarely been as promising as predicted from on-station work. This may partly be explained by more recent research, which indicates that hedgerow root competition is far greater than originally thought, resulting in lower than expected crop yields. Despite original claims of sustainable crop yields without artificial fertiliser, research indicates that this was over-optimistic. Small applications of fertiliser are therefore now recommended.

The most successful examples of on-farm alley farming are when maize is grown as the sole crop. However, multiple cropping in which crops are grown as mixed stands, and/or in relays is traditionally practised in many farming systems, and some of the crops other than maize are adversely affected by alley hedgerows. Cassava, in particular, responds badly to alley farming rendering the system unsuitable for many parts of the humid tropics.

Socio-economic factors affecting adoptability

Farmers have multiple criteria for assessing new technologies, including economic profitability, risk, contribution to food security, time taken to see a return on investment, and labour requirement. To be widely adopted, alley farming should perform better in meeting these criteria than existing technologies.
In the policy context, questions of who gains and who loses from the introduction of a new technology are important. Pertinent questions include: Who acquires rights to income flows? On whom do additional labour demands fall? Whose rights to land are threatened?

Economic analyses of alley farming are highly complex, but a number have been attempted. Broadly speaking, they indicate that alley farming is most likely to be profitable where maize is the main crop and hedgerows are regularly pruned. Labour supply is highlighted as a factor of key importance.

Labour demands

Alley farming is a labour intensive technology, and is unlikely to be adopted where labour is already a limiting factor of production. Further, alley farming is highly inflexible in the *timing* of its labour requirements. Maintenance work, notably hedgerow pruning and the weeding of volunteer hedgerow seedlings, must be conducted on time. Crop yields will be jeopardised if these operations are delayed, yet farmers cannot always respond as necessary. Conflicting on-farm operations, off-farm commitments, and sickness may all contribute to delayed maintenance work.

Returns on investment

Alley farming has the disadvantage of providing limited early returns on investment. Farmers usually have to wait for 3-4 years before increased yields due to soil improvement are obtained. Unless short-term benefits such as fuel, fodder and stake provision are of high value, or (as has frequently happened) other direct incentives are offered, farmers are unlikely to be willing to adopt the technology.

Security of tenure and usufruct rights

Tenure concerns both land and trees. Secure land tenure does not necessarily guarantee secure rights over trees. Security of land tenure is almost invariably necessary for farmers to establish alley farms. Even if permitted by their landlords, tenants may hesitate to establish trees on rented land. In much of Africa, land is not owned in the western sense, but is governed by customary tenure. How this influences the adoptability of alley farming will vary according to circumstances. As a broad generalisation, alley farming is most likely to be adopted where land has been divided between heirs. Where plots are cultivated by the extended family, or the land remains completely undivided and is allocated on a rotational basis, alley farming is less likely to be adopted.

Tree tenure and usufruct rights may be determined by a variety of factors other than the tenure of the land on which the tree is growing. These include whether or not the tree was planted (and if so, by whom); the use of the tree (particularly whether commercial or non-commercial); and the species. For alley farming, the main implications appear to be gender-related, as outlined below.

Who is likely to gain or lose from the technology?
This question has been addressed only to a limited extent by research. However, it appears that those most unlikely to adopt alley farming are tenants, other farmers with primary access to very little land, and women. Reasons for the gender bias include a bar in many societies on women owning land or planting trees, and the male orientation of many extension programmes. Women and men also commonly value different tree products in different ways, and this needs to be addressed in extension messages. Where extension has been appropriately tailored, women *have* adopted alley farming. Widows may be particularly likely to do so, as they often have greater independence in making farming decisions.

Overall, it appears that although alley farming was intended for resource-poor farmers, it is not appropriate for those who are poorest in resources.

An important feature in alley farming adoption is *incentives*. The literature indicates that where farmers have established alley farms, they have usually been offered some form of encouragement to do so. Incentives have variously taken the form of: seed of improved crop varieties; free fertiliser; food aid; farm implements; labour (in the case of on-farm trials); livestock (goats), and free vaccinations for goats (Leach and Marslan, 1994; Versteeg and Koudokpon, 1993; Whittome, 1994). In addition, there may be the expectation amongst farmers of other benefits arising from their association with apparently wealthy research institutes or projects. Many workers argue that incentives are necessary when introducing a new technology that does not provide immediate benefits, and that they can be phased out once the technology is proven. Unfortunately, incentives are rarely phased out, and by providing them in the first place projects have often masked some of the real reasons behind farmers hesitation to adopt the technology which have thus only slowly become apparent.

In what circumstances might alley farming be an appropriate intervention?

It is now possible to define on a broad basis the bio-physical and socio-economic circumstances under which alley farming is most likely to succeed. If the bio-physical criteria are considered alone, it is clear that the geographical areas in which alley farming can be recommended are far more limited than originally claimed by IITA scientists. Superimposing the socio-economic criteria inevitably further reduces the potential client population, as indicated in Box 3. The experience of ICRAF in East Africa confirms these parameters, and suggests the addition of two more (K. Shepherd, *pers. comm*). These are:
- cultivated, moderately sloping land; and
- fertile subsoils.

One of the main clear benefits of hedgerows is soil and water conservation. This is particularly significant on moderately sloping land; on flat land such benefits are minimal, and on very steep land (over 30%), hedgerows tend to break down. Further to this, greatest benefits are likely where soil erosion results in large decreases in plant productivity. With acid infertile subsoils, there are very low levels of nutrients to recycle and it is more difficult to find species that can grow rapidly without being very competitive with crops in the topsoil.

If work on alley farming is to continue in the future, it is logical to target activities in areas within the recommendation domain , where both bio-physical and socio-economic criteria are met.

Adaptations of alley farming that show promise

Modified alley farming systems have been adopted by farmers in certain circumstances. They include the following:

- alley farming on sloping land, in the form of contour hedgerows;
- the use of pigeon pea (*Cajanus cajan*) as the hedgerow species;
- widening alley spacing to allow more mechanised cultivation;
- a form of alley grazing, in which widely-spaced hedgerows are grazed directly.

Where forms of alley farming have met with success amongst farmers, there has been a common feature to the approach adopted. This is an adaptation of the system to the particular needs of the farmers concerned, building as far as possible on their existing knowledge.

Contour hedgerows are widely used in the intensive cultivation of slopes, and are one of the components of SALT (Sloping Agricultural Land Technology), developed in the Philippines over a decade ago. In other countries of South East Asia, such as Indonesia, contour hedgerows on sloping lands are a common innovation, despite a temporary setback in the late 1980s caused by the widespread loss of *Leucaena leucocephala* to pest (*psyllid*) attack. An important feature facilitating the adoption of contour hedgerows in Indonesia is that it builds on indigenous management systems, and is thus not a completely new technology.

Pigeon pea is a leguminous, nitrogen-fixing species widely recognised by farmers to improve soil fertility. Further, it produces edible leaves and seeds suitable for human consumption, whilst perennial varieties can also be used for fuel. Researchers have considered the plant to have limited potential for alley farming due to its short life (3-4) years, especially if repeatedly pruned). However, in view of its apparent popularity with farmers, further investigation is justified.

Many farmers perceive the need for regular pruning of hedgerows as one of the main disadvantages of alley farming. Some have therefore used wider spacing, both to reduce the amount of pruning necessary as well as facilitating ploughing within the crop alleys. The extent to which this modification enhances soil fertility is uncertain, but would merit research.

Alley grazing was tested and abandoned by ILCA in early trials in Nigeria because of poor hedgerow performance. However, the use of fodder alleys is reported to have met with success in a different farming context, in Bolivia. Here hedgerows of fodder species such as *Flemingia* spp. between pasture have been used for grazing dairy cattle. In temperate parts of Australia and South Africa, a system of wide alleys, with hedgerows spaced 20 to 80 m apart or more, has been developed by farmers for sheep grazing. However, this is an extensive range management situation which bears little relation to small-scale farming in the tropics.

Conclusion

It is clear that alley farming is likely to be adopted on a much more limited scale than was originally supposed. Its adoption faces a number of constraints, among them its unsuitability for the crops (and crop combinations) used by many farmers in SSA, its high and inflexible labour requirements, and its inappropriateness for farmers who do not have secure, long-term access to land. Some modifications to the original concept are gaining ground in certain areas. The success of such niche adoption is often attributable at least in part to farmers own inventiveness in modifying traditional farming practices or to locally specific research. If future research and extension focuses on where and how niche adoption is possible, more resource-poor farmers might yet benefit from the experience gained to date.

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Acronyms used in the text

ADP - Agricultural Development Project (Nigeria)
AFNETA- Alley Farming Network for Tropical Africa
AFRENA- Agroforestry Research Network for Eastern and Central Africa
CGIAR- Consultative Group for International Agricultural Research
FPR- Farmer Participatory Research
FSR- Farming Systems Research
ICRAF- International Centre for Research in Agroforestry
ILCA- International Livestock Centre for Africa
IITA- International Institute for Tropical Africa
NGO- Non-governmental organisation
SALT- Sloping Agricultural Land Technology
SSA- Sub-Saharan Africa

Notes

1. For readers interested in more detail, supplementary information sheets are available from the author on its technical performance and on socio-economic factors influencing alley-farming adoption. The supplement (Supplement A) on socio-economic factors also contains an extended list of references.
2. Since 1995 merged with the International Laboratory for Research on Animal Diseases to create the International Livestock Research Institute (ILRI).
3. ICRAF joined the CGIAR system only in 1991.

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