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Integrating forage technologies on smallholder farms in the upland tropics

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Abstract

In the past, adoption of forage technologies has been poor. This paper considers the reasons for this low level of adoption and how the situation has changed in recent years. Experiences, mostly in south-east Asia and some in east Africa, have shown that participatory approaches in the development of technology are the key to integration of forages into smallholder upland farming systems. This paper describes how projects went through the formal and informal stages of forage evaluation. Several key characteristics of communities were identified that determined whether forages could have an impact. A participatory approach was developed, which enhanced both forage technology development and its scaling-out to new areas. Some important data were generated on the environmental adaptation of forage varieties. A model for scaling-out forage technologies was developed. There are several stages of forage adoption, in which grass and legume species play different roles. Challenges for the future are to strengthen participatory approaches in the development of technology, especially in the process of scaling-out such developments.

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Introduction

Despite more than 40 years of research on forage technologies, remarkably little adoption by farmers has taken place, until recently. The traditional research approach of interviews with key farmers, identification of problems by development workers, development of technical solutions by researchers and demonstration of technologies by model-farmers, did not result in spontaneous adoption. In south-east Asia, success has been achieved in the past 6 years, by revolutionising research on development of forage technologies for smallholder farmers. Without any structural dissemination efforts, this work led to more than 1700 upland farmers evaluating forages in the Philippines, Indonesia, Malaysia, Vietnam, Thailand and Lao PDR (Tuhulele *et al*. 2000). Drawing from experiences in south-east Asia and east Africa, this paper explains how research can be conducted to increase the chance of the resulting forage technologies being adopted by farmers. The second part of the paper focuses on scaling-out, to yield impact in new areas. Many lessons learned apply to situations throughout the tropics.

The unique challenge of forage technologies

The traditional research and development approach mentioned earlier has worked well for certain food crops such as rice or maize. Nevertheless, there are various reasons why this method has not led to adoption of forages, such as:

- Growing forages is a new concept for most farmers, unlike growing food crops.
- Forages provide long-term or indirect benefits. They have to either pass through an animal or fertilise crops through green manure, before a cash return is realised. Food crops, on the other hand, provide short-term benefits.
- For forages in the tropics, planting material has often been unavailable locally on an affordable, commercial scale.

- In the past, researchers have concentrated on developing forage technologies that produce high fodder biomass or maximise animal productivity. Farmers' priorities are more complex than this.
- Farmers' needs for forages are diverse. There are many different types of livestock, each with their own purpose, and there are many different ways forages can be grown, managed and harvested. In contrast, the reasons for and ways of growing food crops are often straightforward.

A balanced mix of research and development approaches

Forage research through CIAT (Centro Internacional de Agricultura Tropical) and CSIRO (Commonwealth Scientific and Industrial Research Organisation), funded by AusAid and the Asian Development Bank, started in southeast Asia in 1992. More than 500 forage species and accessions from CIAT (Colombia) and CSIRO (Australia) gene banks were introduced. For practical reasons, initial screening of the numerous varieties for environmental adaptation started on-station at a few sites. Soon after, the number of candidate species for farmers was reduced to a manageable size, and experimentation started to develop not only suitable forage technologies but also appropriate research methodologies. The 'farmer evaluation' method of Ashby (1990) was used as a starting point. Table 1 shows that farmer participation became more intense with each stage of the process.

Sometimes research and development projects are initially successful in creating a quick impact, for example, when a group of 10 farmers in a district enthusiastically experiment with a new technology. The second step is often more difficult: how does the project get the technology adopted by the other 490 farming households who live in the same district? There are some key questions that one needs to consider and all of them need to be answered in the affirmative (see Table 2):

- Firstly, there needs to be a genuine problem. For instance, in one area many farmers were in need of forages but 1 year after planting most farmers had abandoned the plots, without use. In order to qualify for a livestock dispersal program, farmers had to plant enough forage to feed an animal. Only a couple of farmers who received a cow continued to manage their forages.
- The second question is whether there are people in the area who are committed and skilled to work with farmers on a regular basis. Development workers are highly instrumental in bringing groups of farmers together, or if farmer groups already exist, in providing the groups with a variety of options to address their problems. A long-term committment is needed as forage technologies involve many stages of management, adaptation and evaluation.
- Thirdly, there needs to be an awareness of the importance of forage. Many farmers, with whom we have worked, have serious problems of feed shortage but also problems with food and cash crops, land issues or even human health. If other problems rank more highly, there is often little time or resources left to improve forage systems.
- The fourth condition is that there should be many farmers in the area with similar problems. If only 1 percent of farmers have livestock, even though they have serious fodder problems, it isn't enough to justify work with that community. The potential impact would be very limited. Instead, a community should be selected where livestock play an important role.
- The fifth requirement is the availability of potential solutions to the problem. For example, farmers using permanently cultivated

Table 1. Formal and informal stages of forage evaluation.

Stage of evaluation	Number of species and accessions	Number of locations	Management	Type of farmer participation
1. Nursery	Many (>50)	Few	Researchers manage	Contractual
2. Regional evaluation	Few (<20)	Many	Farmers manage	Consultative
3. Formal farmer evaluation	Few (6–8)	Many	Farmers manage and evaluate	Collaborative
4. Informal farmer evaluation	Few (2–4)	Many	Farmers make decisions, manage and evaluate	Collegial

flooded rice systems, wanted to improve their goats' diets by using fodder legumes. They needed legume species that would grow well in waterlogged areas. They tried *Sesbania* spp., which are known to tolerate such conditions, but found production was unsatisfactory. There were no solutions that we could offer in that particular system.

Table 2. Key questions to ask when selecting communities and farmers for on-farm agricultural technology development.

Critical key questions:	
1)	Is there a genuine problem?
2)	Are there committed local individuals who can work with farmers to solve this problem?
3)	Do farmers think that this problem is important enough?
4)	Are there many other farmers with the same problem?
5)	Do we have potential solutions for substantial benefits?
Key questions for which the desirable answer is 'yes':	
6)	Are there farmers who are already trying to solve the problem?
7)	Is there a local enthusiast who would 'champion' the resulting technologies in future?

Participatory technology development (PTD) is a broad concept referring to development approaches, which have 'active farmer participation in all stages of the development process' as a central principle. There is an enormous diversity of tools and approaches that fall under this concept but all are based on surprisingly similar experiences and principles. The tools are covered effectively in other publications (van Veldhuizen and de Zeeuw 1997; van Veldhuizen *et al*. 1997; Hagmann 1998).

Figure 1 summarises the PTD concept used by the Forages for Smallholders Project (FSP) of CIAT. The key to this process was active involvement of the community at all stages of technology development (prioritising problems, identifying possible solutions to test, experimentation and evaluation). Having identified a community where forages appeared to have potential, the first step in PTD was to confirm this potential through a village meeting where the community diagnosed and prioritised the problems they experienced in their farming and livestock systems. This was a process similar to Participatory Rural Appraisal (PRA) and used many of the tools of PRA; however, it was generally much quicker. It moved beyond simply gathering lists of problems into problem diagnosis and action planning. There were several common steps in the diagnosis:

- Familiarisation with the area (*e.g.* a village walk);
- Resource inventories (farmers describe their village resources through mapping, seasonal

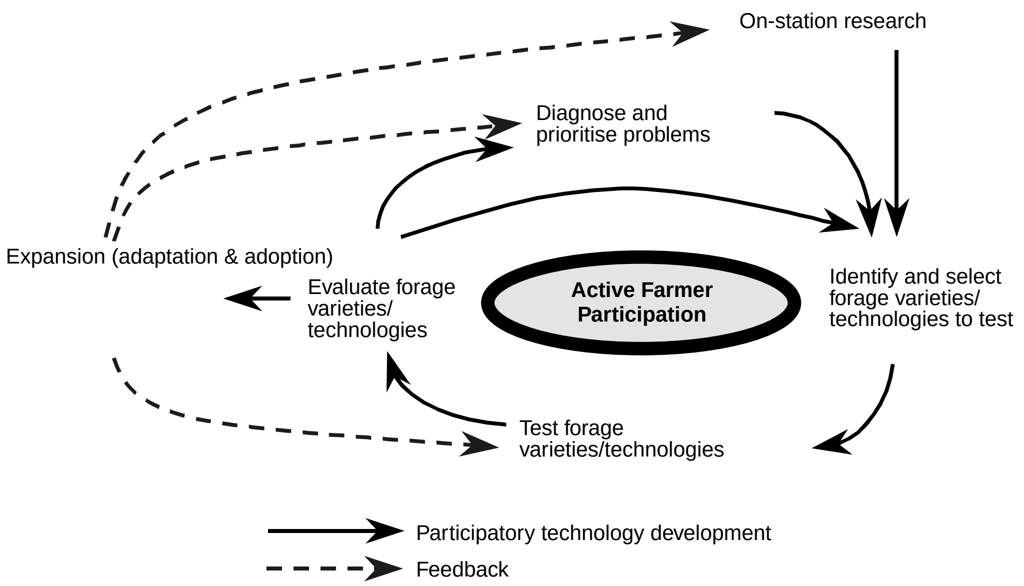

Figure 1. The Participatory Technology Development (PTD) approach used by the Forages for Smallholders Project of CIAT (Horne *et al.* 2000).

calendars and historical calendars. It serves as a basis for discussion of problems in the farming systems and also breaks down communication barriers in a participatory process that is initially strange to farmers);
- Problem identification (with active facilitation, often using cards on which to write problems. Farmers identify the major problems they face in their agricultural and livestock systems);
- Problem analysis (the community identifies causal linkages between these problems);
- Current management of these problems (the community describes how they have coped with these problems until now. At this stage, it becomes clear who are the motivated farmers who have been actively trying to solve these problems in the past);
- Prioritisation of problems the farmers want to attempt to solve;
- Agreement on a plan of action between the development worker and the community to evaluate a range of technological options that have potential to alleviate the priority problems.

After diagnosis, CIAT provided farmers with enough planting material to establish plots of 2m × 2m for several species. With these plots, farmers were able to evaluate performance of the species and acceptance by livestock. The small plots also provided enough material to expand the species that were appreciated most. This expansion subsequently included other niches on the farm, such as contour lines on slopes, cover crops under trees, live fences on farm boundaries, etc. As they expanded a little, other livestock types also started to benefit. For instance, in Vietnam, many farmers originally planted improved grasses to feed buffalo, but gradually also began to use the forages to feed their pond-kept fish and their pigs. Many farmers now grow forages exclusively for fish or pigs. Once a farmer has developed a suitable forage system, expansion within the farm usually continues until the needs are met (see Figure 2).

Adoption of an agricultural technology can be expressed in several ways: short term, long term, in depth or widespread. Through working with farmers, we have learned that farmers who experiment with forages do not always become

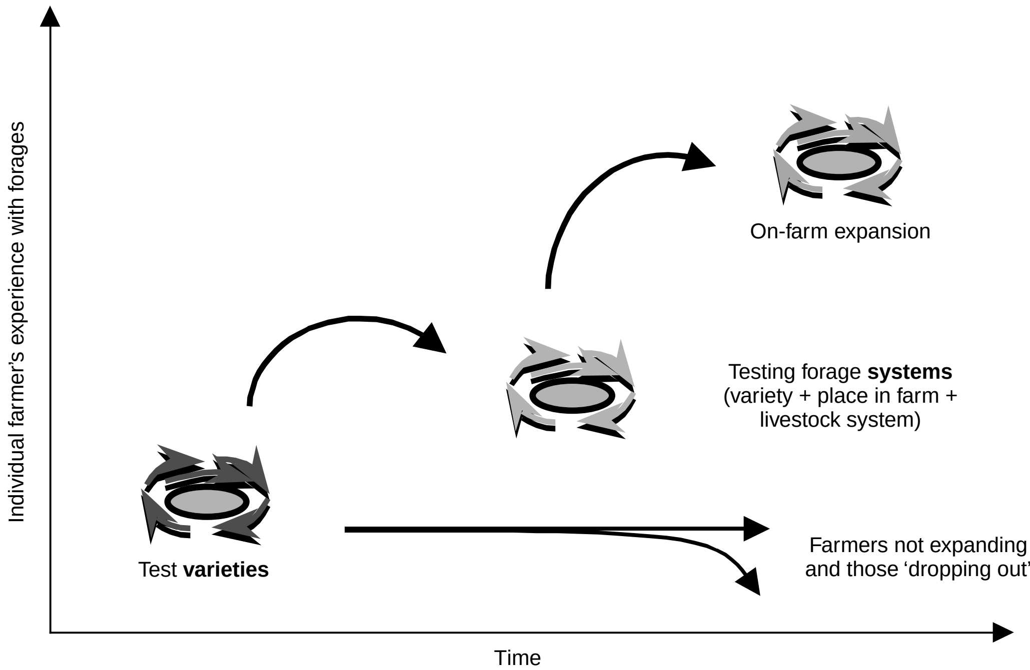

Figure 2. The process of development of integrated forage systems on farms (Adapted from Horne *et al*. 2000).

adopters. On average in south-east Asia, about 30% of farmers who are involved in formal and informal farmer evaluation (Table 1) drop out within the first 2 years. Experiences such as these led us to define adoption of forages as follows:

'When a farmer has experimented with a species or a forage technology and subsequently expands the area cultivated with the species or technology using his/her own resources, there is meaningful adoption.'

The word 'participation' in PTD implies that there is more than 1 party involved. No matter how much the process is farmer-driven, researchers and development workers still have a role to play. One of these roles is to document the process and, if everyone agrees, to make it public property. Table 3 shows the results of PTD with 2000 farmers, CIAT, CSIRO and NARs in south-east Asia; the data describe environmental adaptation of the preferred forage species in relation to climate, soil type and forage system.

Bringing increased benefits to more farmers more quickly

One of our most important lessons is that there are no short cuts to PTD. If we want more farmers to benefit from improved forage technologies, the processes depicted in Figures 1 and 2 need to be repeated in the new communities. As a project develops, however, people become more experienced and therefore more skilful as facilitators. It would be a tremendous waste not to capture this experience and use it, if we want to spread the impact in new areas. We found that key farmers in villages were the most convincing advocates of technologies which had been developed, and many were proud and happy to play a role in training new farmers. Key farmers are now an essential human resource in scaling-out forage technologies in parts of the Philippines and Indonesia; these farmer facilitators now outnumber the government development workers who initially facilitated them.

Figure 3 shows the process of scaling-out. Moving into new geographical or administrative areas requires collection and analysis of secondary information, just as this was needed in the old sites. As development workers are often restricted to carrying out their daily responsibilities at a particular location, development workers in new locations have to be trained. The Forages for Smallholders Project (FSP) successfully used development workers with several years of experience to train their new colleagues. Preferably, participatory diagnosis (PD) is conducted by experienced facilitators working with people who have a good understanding of the area and community. This is an activity where outside

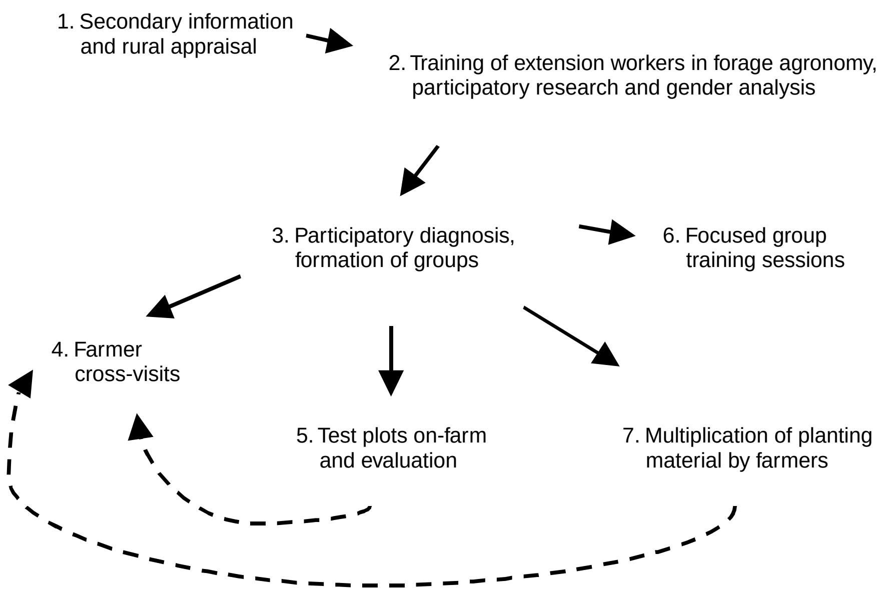

Figure 3. The process of scaling-out development of forage technologies.

Table 3. Environmental adaptation of forage varieties offered to smallholder farmers in south-east Asia.[1]

Species	Varieties	Climate			Soil fertility and acidity			Ways of growing forages							
		Wet tropics with no or short dry season	Wet/dry tropics with long dry season	Cooler tropics (*e.g.* high elevation)	Fertile (neutral to moderately acid soils)	Moderately fertile (neutral to moderately acid soils)	Infertile (extreme acid soils)	Cut & carry plots or rows	Grazed plots	Live fences	Contour hedge-rows or strips	Improved fallows	Cover crops in annual crops	Cover crops under trees	Ground cover for erosion control
Grasses															
Andropogon gayanus	Gamba	•	••		•	•	••	••	•		•				
Brachiaria brizantha	Marandu, Karanga Serengeti	•	••	••	•	••	•	••	•		•				
Brachiaria decumbens	Basilisk	•	••	••	•	••	•	•	••						•
Brachiaria humidicola	Tully	••	•	•	•	•	••		••						••
Brachiaria ruziziensis	Ruzi	••		•	••	•		•	••						•
Panicum maximum	Si Muang	••	•	•	••	•		••	•		•				
Paspalum atratum	Terenos	••		•	•	••	•	••	••		••				
Pennisetum purpureum and hybrids	Napier Mott, King	••		••	••	•		••			•				
Setaria sphacelata	Lampung Solander	••	•	••	••	•		••	•		••				
Legumes															
Arachis pintoi	Itacambira	••		•	••	••			••					••	••
Calliandra calothyrsus	Besakih	•		••	•	••		••		••	•				
Centrosema macrocarpum	Ucayali	••	•	•	••	•		•				••	••	•	•
Centrosema pubescens	Barinas	••	•		••	•		•				••	••	•	•
Desmanthus virgatus	Chaland	••		••	••	•		••			•				
Desmodium cinerea	Las Delicias	••	•		•	•		••			••				
Gliricidia sepium	Retalhuleu, Belen Rivas	••	••		•	••		••		••	•				
Leucaena leucocephala	K636, K584	••	••	•	••	•		••	•	••	•				
Stylosanthes guianensis	Stylo 184	••	••	•	•	••	••	••	•		•	••	••	•	

[1] **Source:** adapted from Horne and Stür (1999). •• highly suitable; • =possible; no mark = not recommended.

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expertise is needed. Experienced development workers have often assisted but their workload and mandate limit the extent of assistance they can provide.

After PD, the best ways to expose new farmers to new technologies are cross visits to key farmers at the old sites. Local enthusiasts (see Table 1) are the first farmers who qualify for cross visits; they will be the living source of inspiration for farmers in the village. Cross visits could involve trips of 10 km in a locally hired car or public transport, or could involve domestic or even international flights. During cross visits, farmers are encouraged to collect planting material from as many species as they could possibly grow on their own farms; this is slightly more difficult in the case of international cross visits. Subsequently, farmers usually plant small test plots for experimentation, evaluation and multiplication (see Figure 2).

In many tropical rural areas, the farmers organise themselves into groups and meet regularly. These group meetings provide an effective platform for interaction with many farmers. Groups experimenting with new forages occasionally ask for solutions that can be addressed by training. For instance, farmers with local beef cattle, improved dairy buffalo and goats asked us about the best ways to formulate rations with forages and about which livestock type would benefit most from which forage species. Group training was provided on the nutritional requirements of the different livestock and how these requirements could be met, in which combination, by available feed resources, improved grass, and legume and tree species.

In many cases, the demand for planting material is higher than individual farmers can provide during cross visits. Commercial seed for grass species is never locally available in developing countries, except for some *Brachiaria* spp. in Thailand and *Chloris gayana* in Kenya. Farmers, however, are willing to pay for vegetative planting material. In the Philippines and Indonesia, prices for vegetative planting material vary from US$ 0.01 per 10 splits to US$ 0.60 per bag of cuttings (weighing approximately 25 kg). Previously, a few farmer groups had decided that they could earn money selling these planting materials; now, many groups have followed their example.

It is slightly more difficult to produce planting material for annual and woody forage legumes; with the exception of *Gliricidia sepium* and *Erythrina* spp., none is easily propagated by cuttings. Local expert farmers can produce seed for most species but quantities are generally low. Production of legume seed is subsidised by the FSP project and subsidies are likely to be needed until alternatives are found. In East Kalimantan, Indonesia, it is impossible to collect seed due to an evenly spread rainfall pattern; consequently, some farmers have started to experiment with vegetative propagation of *Stylosanthes guianensis*.

Adoption of grasses and legumes

In one rural municipality in the Philippines, 164 farmers experimented with forages from 1997 to 1999. In 2000, 87 new farmers planted forages. All new farmers planted improved grass species but only 3 planted legumes. In the same year, amongst the farmers who had been involved in the previous years, 58 expanded their area of grass species and 9 expanded their area of legumes.

Typically, at first, new farmers experiment with grass species; only subsequently do they try to grow forage legumes. Even amongst the farmers who eventually also grow legumes, high adoption rates are realised only for the grasses. There are several reasons why forage legumes are less readily adopted than grasses. Firstly, most of the farmed ruminants in south-east Asia are cattle and buffalo, which are normally seen to select grass when they graze. Secondly, improved grass species are easy to establish, grow rapidly and produce more fodder than legumes.

The process of adoption of grass and legume species in relation to time and animal productivity, based on experiences in south-east Asia, is shown in Figure 4. The first 3-dimensional box represents the existing situation, where farmers normally feed their animals on natural grasses with or without low quality crop residues. Animal growth rates are less than 30% of potential; limiting factors are inconsistent feed supply and low intake of digestible energy. When given the opportunity, about 50% of these farmers are interested in both growing improved grass species and adopting them (see second box). Animal production increases due to improved feed and higher energy supply. At this stage, lack of protein in the animals' diet becomes a limiting factor. Only a few farmers succeed in reaching the third level, where enough legumes are grown

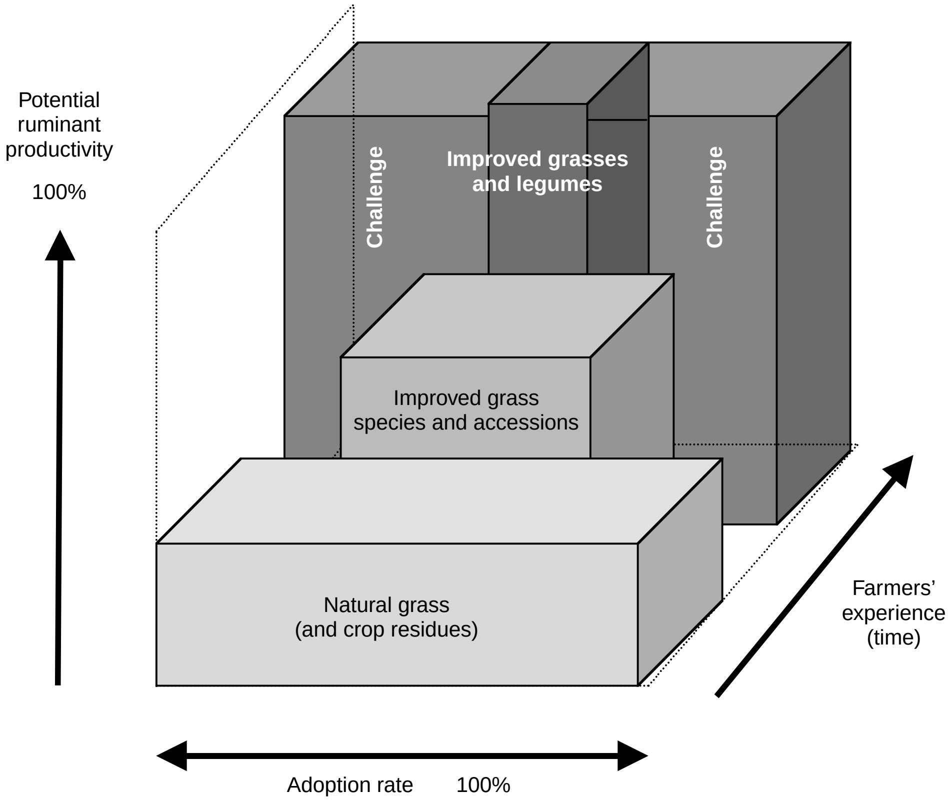

Figure 4. Relationship between adoption rate for forage technologies, potential ruminant productivity and time. (*Source:* Roothaert and Kerridge 2002).

to meet the livestock requirements for optimal production (see third, narrow box).

Dairy farmers are usually the ones who adopt legumes most rapidly; presumably, because they see rapid benefits (*i.e.*, increased milk yields within a day) after including legumes in cow diets. Moving from the second to the third box requires the farmers to make decisions; this requires at least one more PTD cycle (Figure 1).

Governments of countries importing large numbers of cattle for slaughter and donors of cattle are challenging researchers and development workers to work towards wider adoption of legumes and grasses to boost local beef production.

Future directions

The key to adoption of forage technologies is to allow farmers to experiment, adapt and expand; small-scale upland farming systems are all unique and have diverse priorities, which prevents mere replication of technologies. The challenge for researchers and development workers is to create a local pool of expertise and participatory skills, which can handle the demand to facilitate the PTD process in new areas. Most agriculturists have been trained in conventional dissemination techniques that follow a clearly prescribed pattern; these techniques do not allow farmers to experiment or make decisions at every stage. In contrast, participatory approaches are fragile, particularly because of pressure from donors and national organisations for quick results. Moreover, the required flexibility of participatory approaches by default implies a lack of structure, which many new practitioners find difficult. Despite these possible barriers, we hope that the examples and processes explained in this paper will provide a guideline for many other workers.

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