# 7 Local Innovation in 'Green Water' Management

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## Introduction

This chapter examines indigenous environmental knowledge in relation to 'green water' management, and particularly where this takes the form of local innovation in response to problems. We use 'innovation' in a broad sense, to imply 'creative local initiative' rather than something fundamentally new. By 'green water' we refer to that water which is stored in the soil, available for transpiration by plants, under rainfed conditions (Falkenmark, 1999; Rockström, 2001). The problems that concern us are those associated with drought and poverty in tropical and sub-tropical areas. While partially based on a review of the literature, we draw on our fieldwork in India and Kenya during 2002[1] as well as experience from a project that focused on farmer innovation in East Africa from 1997 to 2000, namely 'Promoting Farmer Innovation' (PFI)[2] (Critchley and Mutunga, 2002). The hypothesis underpinning this fieldwork, as well as the PFI project, was that where water-related problems exist, creative individuals will always look for ways to mitigate constraints to plant production. Furthermore, these innovators represent an important resource, both as sources of appropriate technologies and as messengers. If at least partially true, this must represent something of value in these times of environmental changes and climatic uncertainty. This potential value is increased further because in many countries (especially in sub-Saharan Africa), financial resources have dried up as donors and governments have become disillusioned with conventional research and extension systems based on 'transfer of technology'. Ironically this implies that a full circle is beginning to be turned – back to the age-old path of research and extension through land users themselves.

## Background: Water, Indigenous Knowledge and Local Innovation

The year 2003 was the International Year of Fresh Water, culminating in the 3rd International Water Forum in Kyoto, Japan. To coincide with the event, there was a deluge of publications drawing attention to the plight of the world with respect to water supplies. Much of the data were repeated, targets reiterated and potential solutions echoed. Generally, it was confirmed that the problem was serious and there was an intimate association with poverty (e.g. Ashton, 2002; Rosegrant *et al.*, 2002; UNFPA, 2003; *The Economist*, 2003). Certain countries, especially within sub-Saharan Africa, are close to becoming 'officially' water scarce, in the light of growing demands. Water conflicts, it is agreed, will get rapidly worse. A further complicating factor is climate change, where not only are temperatures increasing but hydrological regimes are becoming more erratic. While domestic water and sanitation naturally attracted the headlines during 2003, there was at least some attention also paid to water for plant production. The most eye-catching in this respect has always been irrigation, where to the non-agriculturalist the relationship between water and crops in dry zones is the clearest. Over-pumping of aquifers was highlighted by some as a potential disaster, especially in India and China (Brown, 2003). But what of crops in semi-arid zones that depend on rainfall alone? Every cereal crop needs to transpire approximately a cubic metre of water to produce a kilo of grain. It is therefore here that many of the world's rural poor are caught in a pincer-trap of thirst and associated hunger (Rockström *et al.*, 2003).

As the world has focused more and more on global environmental issues, including water – most clearly traceable back to the Stockholm conference of 1972 – there has been a parallel convergence by academics on the potential importance of indigenous knowledge (IK) in the development arena. During the 1980s, interest in IK and indigenous practice (not always one and the same) steadily grew amongst development professionals, and spawned a number of seminal publications (e.g. Richards, 1985; Chambers *et al.*, 1989). This was, in turn, closely allied to the development of participatory methodologies, from Rapid Rural Appraisal, through Participatory Rural Appraisal and on to Participatory Learning and Action (McCracken *et al.*, 1988; Chambers *et al.*, 1989; Pretty, 1995). The Rio Earth Conference of 1992 then literally wrote IK into the international agenda as the world hastily began to draft global environmental agreements. The Convention to Combat Desertification and the Convention on Biological Diversity, for example, both stress the importance of indigenous knowledge and community participation. But it has taken until the beginning of the 21st century for IK to become the central focus it is today. Eyzaguirre (2001, p. 40) talks of 'stunning evidence of how far IK has moved onto the global development and biodiversity agendas'. Ellen *et al.* (2000) point out that the historical marginalization of IK has not only been reversed, but warn that it may even be 'accelerating to an alarming degree', and worrying that the pendulum is in danger of swinging too far away from 'scientific' knowledge, and development decisions may be made on the shaky foundations of folklore alone. There remain, however, plenty of agricultural and environmental research stations functioning in time-honoured, conventional fashion throughout the world. IK is by no means venerated everywhere, or by everyone.

IK often tends to be associated with environmental knowledge in developing countries – indeed it is sometimes referred to as 'indigenous environmental knowledge' or 'IEK'. As we have already noted, in the poorest areas of many of these nations, water is the primary limiting resource and the fundamental concern. There are many proposed solutions to the water problem, ranging from high technology to pricing policies to privatization. In discourses about water, it has become practically mandatory to pay lip service to IK – alongside 'gender', 'participation' and 'governance'. But the role expected of IK is vague. In this chapter we are not exclusively, or even mainly, concerned with the 'dying wisdom' of the ancient systems – excellent as these are or might have been – but more particularly in what constitutes, defines and determines the dynamic, local, innovative response to problems. So, what is happening *now* at the local level and is likely to take off? Methodologies to analyse farmer innovation and harness it in a systematic manner are only now under development.

Many rural people (though not all) are prepared and pleased to share much of their knowledge and ideas, as long as this does not threaten their livelihoods by giving away the knowledge that affords them a productive edge over others. This includes both the explicit (that which can be seen) and the tacit (the hidden knowledge). Judging from the experience of the PFI project, their peers manifestly benefit from learning – not just about technologies but the very concept of 'innovativeness' (Critchley and Mutunga, 2002). In many environmentally marginal areas where IK and innovation flourish, there are often insufficient 'scientific' answers available to overcome local problems with the resources available. Thus finally, while acknowledging the self-evident limitations of IK, the starting point of this research was the belief that IK, and especially innovation, has an important part to play in improved green water management.

## The Evidence

What then are the sorts of practices we are likely to find where indigenous knowledge meets green water issues – and particularly when local innovation is pitted against new problems? The experience of 'Promoting Farmer Innovation' has already shown conclusively from East Africa that there are certain common technical threads. PFI was deliberately located in areas where water limited rainfed production of, mainly, annual cereals (sorghum, millets) and pulses (beans, cowpeas, pigeon peas). It is, therefore, not surprising that two generic types of innovative techniques – in local terms – stood out. These were, respectively, manipulating flows of runoff or 'water harvesting' and various forms of organic matter improvements to the soil. PFI demonstrated that aridity and poverty were no barriers to innovation. Discussing IK and innovation in India, Gupta *et al.* (undated) point out that 'some of the most durable indigenous institutions for natural resource management are found in the most marginal environments'. Furthermore the innovators responded to recognition and were persuasive ambassadors. This latter point will be expanded upon later.

The following description of indigenous/ innovative technologies takes those of PFI as a starting point. On to these we build our fieldwork findings from Uttaranchal, India – a poor, mountainous state in the foothills of the Himalayas – and semi-arid Mwingi District in eastern Kenya. During a 2-month period in the high summer of 2002, we identified and characterized local innovators who were addressing the increasing problem of decreasing spring flow in the dry season (Critchley and Brommer, 2003a). Overlapping strongly – but sometimes complementing these two studies – are the most important and interesting types of local practice emerging from a global literature search (Critchley *et al.*, 2004, unpublished). In total, eight groups of technologies are presented. This is not a comprehensive or hierarchical list, nor have we set out to quantify impact or extent of practices. That could constitute a further, future exercise, guided by a framework such as that provided by WOCAT (The World Overview of Conservation Approaches and Technologies; see Liniger and Critchley, Chapter 9, this volume). WOCAT has been used to describe some of the practices uncovered by PFI (see Critchley and Mutunga, 2002; www.wocat.net). Some of the practices are well known and documented already – others are relatively novel or interesting variations on a theme. It must also be said that, as often as not, there are combinations of technologies, and the division into the categories we provide below would probably seem artificial to the land user.

There are many innovative agroforestry practices that we have not included here, and other systems also – for example in wetlands where irrigation at one time of the year and drainage at another are interchangeable functions. The selection below serves to illustrate the most important and widespread groups of practices, and the ones that have the widest relevance.

### Mulching

This is effectively the carpeting of the ground between crops and is renowned for its multiple benefits. Amongst these are water conservation in the soil, reduced splash erosion, modification of soil surface temperature and supply (depending on the material of choice) of soil nutrients – and more recently recognized, mulch contributes to carbon sequestration by addition of organic matter to the soil. The variety of mulching materials used by farmers is extraordinarily wide, and not just limited to the textbook examples of cereal residues, manures/ composts or, in recent decades, artificial fibres.

In south-west Uganda, where bananas are almost invariably mulched, use is sometimes made of a stoloniferous (creeping) grass, which has been weeded from annual crop plots. First it is tied into bundles to desiccate (on the outside) and rot (internally), and then it is spread as mulch (personal observation). This is, cleverly, turning a problem into a solution. From Uttaranchal in India, spring sources are protected by a handful of innovators. Microforests are recreated, with the leaf litter encouraged to build up (see Box 7.1 for an example). In Burkina Faso, under semi-arid Sahelian conditions, farmers have increasingly turned to using cereal stover (from millet and sorghum) as a source of mulch, aiming to increase organic matter in the soil (Slingerland, 1996). In Uttaranchal, rejected and trampled wheat straw, from housed livestock, is used to mulch vegetables (Negi and Kandapal, 2003). In the same area, pine needles are collected, spread on fields and burned to kill weed seeds, and, it is believed by farmers, this increases the water-holding capacity of the soil. The most unusual and (literally) spectacular mulching material of all may be that used on Lanzarote in the Canary Islands. Here, black volcanic ash from the massive *Timanfaya* eruptions of 300 years ago is transported to areas of red soil and spread in a thin layer. The ash is hygroscopic, absorbing dew and mist.

**Conservation agriculture; no-till farming**

One of the most talked-about recent developments in land husbandry methods is that of no-till farming (NTF) or 'conservation agriculture' (Benites *et al.*, 2002; Pieri *et al.*, 2002). The systems basically comprise various combinations of reduced mechanical inversion of the soil – particularly ploughing – combined with the establishment of cover crops or green manures. Where such systems are feasible, benefits are substantial. Amongst these is the conservation of soil water, which, because no soil inversion is involved, is not lost through evaporation. While this has been practised for a number of decades by large-scale farmers in Europe and the USA, the recent spread of the practice amongst small-scale farmers in Latin America appears to have been driven by a process of local initiative in the face of declining yields and increasing erosion (Benites *et al.*, 2002). In many parts of semi-arid Africa, minimum tillage has always been standard practice, as scratch hoeing is enough to establish a seedbed in effectively weed-free conditions at the end of the dry season. In Uttaranchal, India, it is local custom to till only when the moisture level is low before broadcasting finger millet (*Eleusine coracana*) (Negi and Kandapal, 2003). Benefits of reduced tillage are not solely accruable to the user of the system but also significantly increase sequestration of carbon in the soil, and because

**Box 7.1.** Mr Madhawanand Joshi, Almora District, Uttaranchal, India

Joshi's local water supply – a spring arising from a forested catchment directly above his farm – has been diminishing continuously for a decade or so. He attributes this decrease in flow largely to the human-induced degradation of the original *banj* oak (*Quercus leucotrichophora*) forest, whose branches are lopped for fodder, and the consequent ingress of *chir* pine (*Pinus roxburghii*). In 1995, Joshi began to create an experimental protection-cum-conservation area of two hectares around the springhead, where he has (with the help of the local Soil Conservation Branch) designed and dug conservation trenches and planted trees (Fig. 7.1). Livestock are excluded. He calls it *pata pani* (*pata* = leaves; *pani* = water). Joshi has planted alder, willow and *banj* oak trees. His experience is that these trees have 'a water-conserving capacity': rainwater is captured by the trees, flows down the stems, is conserved by the litter and seeps into the ground. *Pata pani* is therefore basically a recreation of natural broadleaved 'forest floor' conditions. As a result of his initiative – according to him – several springs in the neighbourhood are again yielding water. He is recognized by the Government Department of Agriculture and the local research station as a man with a valid technique and a relevant message. Joshi has also developed a biopesticide utilizing *Melia azedarach* tree leaves and chilli peppers: remarkably, we came across a woman innovator in Kenya, Mrs Agnes Mughi, who used practically the same ingredients (in fact a closely related tree – *Azadirachta indica* – and with the addition of aloe leaves). Agnes has various other initiatives, including a verdant gully garden in semi-arid Mwingi District (adapted from Critchley and Brommer, 2003a).

**Fig. 7.1.** Mr Joshi's conservation area, planted with alder, willow and *banj* oak trees.

**Fig. 7.2.** Chilli peppers and *Melia azedarach* tree leaves are used to make a biopesticide.

less fuel-powered machinery is used, there is a reduction in greenhouse gas emissions.

## Homegardens

A consistent characteristic of households in the tropics is the local concentration of resources and increased biodiversity around household compounds. This is where rainwater is harvested from rooftops and compounds, and either captured or immediately directed towards cultivated gardens. Wastewater from washing finds its way to these spots too, either on an individual basis or from a village water point and associated wastewater tank. At home also, organic matter concentrates, whether from food wastes or housed livestock or human excreta. In Java, it has been found that some farmers deliberately overfeed their home-based, zero-grazed small stock in order to produce more manure (Tanner *et al.*, 2001). Households are hotspots of human activity and creativity. People tend, naturally, to pay more attention to plants and animals close to home. Households are, hence, also primary centres of experimentation. The term 'homegardens' is often associated with multi-storey agroforestry systems in the Far East. These are systems that in many ways mimic the original forest that they replace. They are composed of various species of different growth patterns, producing multiple products (Hoogerbrugge and Fresco, 1993). But wherever one looks in the tropics – from semi-arid to humid – close to home tends to be the epicentre of production within the smallholder farm. One example from Kamuli District in eastern Uganda tells a typical story of creativity. Here, a widow, Rose Mutekanga, cultivates at least 20 different species within a 30 m radius of her house. And 'urban agriculture' is basically the homegarden migrating from its rural origins together with the people that used to tend it there. Homegardens are prime examples of fertile, and relatively unobserved, microenvironments (Chambers, 1990).

### Terrace systems

Terraces have been the basis of agriculture in hilly tropical areas from time immemorial. The famous Inca terraces of Machu Picchu in the mountains of Peru are one example; in China, there is a legacy of rainfed terraces dating back 2000 years. Not surprisingly, given their ubiquity, terraces exist in myriad forms, and are constructed and used in very many different ways. Little thought is given to the skilful ways tillage erosion is employed to create benches naturally, a process used by farmers who dig *fanya juu* terraces in eastern Kenya (Thomas and Biamah, 1991) or who create 'natural vegetative strips' in the Philippines (Garrity *et al.*, 2004). In both cases, contour barriers (of earth or vegetation, respectively) are used to impede sediment and gradually encourage levelling of land behind them. Also in the Philippines, one author describes an intriguing system of moving topsoil from surrounding areas to form fertile terraced beds, using diverted stream flow as the transporting agent (Mendoza, 1999). In areas where terraces have a forward slope, the relative concentration of soil water and fertility towards the bund or vegetative strip may be used to favour certain high-value crops such as fruit, or merely to ensure at least a strip of security in poorer years. Fertility and moisture gradients can be put to creative use. Farmers who maintain terracing systems – often at considerable costs in terms of labour input – do so for good reasons. And, as Table 7.1 demonstrates, worldwide there seems to be a remarkable consistency of insight into erosion and conservation in these historically terraced areas.

### Living barrier systems

Judging from the literature and the field, technicians and farmers agree that living barriers across the slope or on the edges of fields are good for the conservation of water and soil. While, however, development specialists often look for species which are efficient in terms of conservation and universally applicable (for example, the much-heralded vetiver grass, *Vetiveria zizanioides*) or the best 'multipurpose' hedgerow species (for example, closely planted *Gliricidium sepium*), farmers commonly go for other, location-specific options. Their priorities are commonly grasses which are directly productive as fodder for intensively managed livestock, thus Napier grass *Pennisetum purpureum*, or at least those which are semi-palatable, such as Makarikari grass *Panicum coloratum* ssp. *makarikariensis* and Bahia grass *Paspalum conjugatum*. In the case of contour barrier hedgerows, technicians have now learned to discard complex and relatively costly systems, which have been increasingly rejected by farmers and modified into cost-cutting 'natural vegetative strips' (Garrity *et al.*, 2004). In south-west Uganda it is interesting to note that vetiver grass is grown solely along roadsides as a hedge, where its non-palatability is a positive *merit*, and not at all within fields, where it is considered a poor alternative to a more palatable grass such as *Setaria* sp. Closer investigation of farmers' innovative or experimental practice comes up with a variety of species planted as contour strips, for example pineapples in south-west Uganda (personal observation) or even sugarcane and fruit trees in Honduras (Hellin and Larrea, 1998).

### Gully gardens

Water-harvesting systems abound in indigenous systems of land management. Runoff water is

**Table 7.1.** Perceptions of erosion and conservation strategies: surveys of small-scale upland terrace farmers in Indonesia, South Africa, Uganda and India (Source: Critchley and Brommer, 2003b).

| Questions asked to farmers with rainfed, terrace-based farming systems | Indonesia<br>Gunung Kidul District, south-central Java. 24 farmers interviewed in 1994 | South Africa<br>Thohoyandou District, Limpopo Province. 20 farmers interviewed in 1997 | Uganda<br>Kabale District, south-west Uganda. 24 farmers interviewed in 1999 | India<br>Pauri and Almora Districts, Uttaranchal State. 15 farmers interviewed in 2002 |
|---|---|---|---|---|
| Is erosion happening in your own (terraced) fields? | Yes: 100% | Yes: 100% | Yes: 95% | Yes: 100% |
| If so, little, moderate or much? Is it increasing, the same or decreasing? | Little: 65%<br>Decreasing: 70% | Moderate: 55%<br>Decreasing: 80% | Little: 60% (of 'yes' replies)<br>Decreasing: 60% (of 'yes' replies) | Moderate: 60%<br>Decreasing: 70% |
| What are the main negative impacts of erosion? (Ranked) | 1 soil fertility decrease<br>2 terrace collapse<br>3 loss of soil | 1 soil fertility decrease<br>2=terrace collapse<br>2=gullying | 1 soil fertility decrease<br>2 destroys crops | 1 soil fertility decrease<br>2 gullying |
| What are your main conservation strategies? (Ranked) | 1 terraces<br>2 toe-drain upkeep<br>3=riser 'lip' upkeep<br>3=tree planting | 1 terraces<br>2 grass strips<br>3 various (inc. controlled grazing/gully checks) | 1 trash lines<br>2 tree planting<br>3 terraces | 1 terrace upkeep (building-up riser 'lip') |
| What do you perceive to be the main causes of erosion? (Ranked) | 1 heavy rainfall<br>2=sloping land<br>2=soil type | 1 heavy rainfall<br>2=ploughing up/down<br>2=overgrazing<br>2=burning grassland | 1 overgrazing<br>2 over-cultivation (i.e. not fallowing land) | 1 heavy rainfall<br>2 some people 'unconcerned about the problem' |
| What/where is the main source of erosion in landscape? (Ranked) | 1 terrace risers<br>2 terrace beds | 1=roads<br>1=hillside grazing land | 1 crop fields<br>2 grazing land | 1 degraded forest<br>2 barren land/roads |

gathered from household compounds, hillsides and roads. But one of the most interesting and widespread variations is 'gully gardening'. While gully gardens have been noted and described by various authors (cf. Chambers, 1990; Pretty, 1995), there are so many innovative versions that it is worth highlighting them again. The principle is simple. Gullies are the result of channelized and erosive water flows. There is loss of soil and runoff water. Because this is a point of concentration for water and (carried by it) rich sediment and surface organic matter, there is a unique opportunity for collection and concentration. Semi-permeable barriers of loose stone, brushwood or vegetation (or commonly combinations) serve the purpose of capturing sediment rich in organic matter, which in turn stores runoff water. In some cases, such as that of Mr Daniel Mutisya in Mwingi District, Kenya, the channel is diverted above the original gully bed after this has become effectively a terraced strip, and the intermittent flow then used to irrigate this fertile 'green ribbon' of land. This is archetypal 'microenvironment' farming at its best (Chambers, 1990).

#### Riverbank protection/reclamation

Riverbank erosion eats into productive land. The general recommendation from technicians – often supported by legislation – is to leave a buffer strip of land along the riverbank to indigenous vegetation, thus providing natural protection. Many farmers in marginal areas prefer, however, to cultivate this rich zone. So what then about potential bank erosion? Two examples serve to show different indigenous strategies. Under the PFI project in Kenya and Tanzania two innovative systems with close similarities were identified. One (from Tanzania) involves reclaiming land that had been eroded by a river through planting a perennial fodder grass to filter out sediment and re-establish the bank. The other (from Kenya) uses sugarcane planted likewise within the riverbed to build up cultivable sediments where the bank had previously been cut into (Critchley and Mutunga, 2002). In Uttaranchal, India, a farmer-cum-teacher, Mr Ramdatt Sati, plants eucalyptus and other trees for bank protection, simultaneously providing timber for cash.

#### Water-borne manuring

One of the most intriguing innovative methods of green water management/improving production is through water-borne manuring. This is a system that has been developed by farmers simultaneously in different locations: PFI has found three examples of this (two in Uganda, one in Kenya), where farmers have thought through the opportunity and come up with the same idea. Where cattle (or small stock) are corralled or zero-grazed near the house, and the home is situated above the fields, then runoff from the compound can be used to carry manure down to the fields, providing irrigation and fertilization simultaneously. Channels are dug leading towards kitchen gardens. Manure is then placed in the channels. When it rains, the runoff carries the manure to high-value crops. This is a typical example of innovation through observation and combining two resources – runoff and manure – in a way that effectively mimics modern technology, where fertilizers are added to irrigation water, a process termed 'fertigation'. The main benefit is the reduction in labour required to transport manure.

### Some Common Denominators and Lessons

We have attempted to look for common themes that run through the sort of indigenous or genuinely innovative practices described above. Some of these are technical similarities. Others are socio-economic factors that encourage experimentation and innovation. Various of these have already been noted in an analysis of innovation under the PFI project (Critchley and Mutunga, 2002) and others distilled from our fieldwork in India (Critchley and Brommer, 2003a). Below is a more comprehensive list.

#### Integrated land and water management

It is highly doubtful that farmers who experiment and innovate make artificial divisions between land and water. What perplexes scientists today – how best to integrate these disciplines – comes naturally to those who depend on the interactions between the two for their livelihoods. Of the practices described in the foregoing, it would be at least unhelpful (and usually impossible) to try to separate land (or soil) from water. These are essentially artificial distinctions to farmers, who perceive land and water as part of an organic whole and make use of symbiotic relationships: 'gully gardening', for example, which uses water to transport sediment and then the two are combined for production. How should fertility-cum-moisture gradients be classified, and, for that matter, riverbank protection? Integrated land and water management may be a holy grail for researchers but it is the inescapable reality for farmers.

### Microenvironments and intensification

Much of the innovation or initiative described in the foregoing has its roots in intensification of production, often around homesteads. The homegardens described above are the most obvious case in point. 'Niche farming' is an expression sometimes used these days to describe resource-favoured spots in the farm (Hilhorst and Muchena, 2000). Another way of looking at this is to consider the landscape and its resources in terms of 'winners and losers', where resources are 'confiscated' from one location and concentrated in another. Where there is not enough of one resource to go round then its effect is maximized in certain locations.

### Water as the prime mover: water as the primary resource

Naturally our concern in this chapter is with places where water is the primary limiting resource, and this point ties in with the previous section. Green water management is our topic, but very often we see that water is also used creatively as a medium of transport – this may be for soil or for manure (see above) – and indirectly in its role as an erosive agent, where it is effectively 'hijacked' for its bounty of sediment in gully gardens. It could be postulated that on steep land, where there is more dynamic movement of soil and water (and often the population density is relatively high), the natural environment for innovation is at its most inviting.

### Names and slogans

It is intriguing that a number of the innovators we have interviewed are guided by their personal philosophies. 'Never let a drop of water escape' is a slogan that we have heard more than once. *Pata pani* or 'leaves [are] water' is the name given by Mr Joshi (see Box 7.1) to describe his spring-protection, tree-litter system. Another farmer in Mwingi district, Kenya, Mr Josephat Muli, describes a reticulating water drainage-cum-irrigation system as his 'Suez canal'. Another creative individual from the same area talks of being 'guided by God' in each step that he takes. There is a psychology of creativity that we have apparently only touched the surface of in our research.

### Multiple innovation by one person

As we have already noted, sub-division by technical categories would not always be the conceptual framework used by farmers practising these innovations. The reason is that techniques are often intertwined by creative individuals, and an overall pattern achieved or at least perceived as a goal. Many – or even most – of the individuals studied during the research period were creative in several ways. Water-borne manuring might be combined, for example, with mulching; gully gardens with multi-storey agroforestry systems.

### Simultaneous or parallel development of the same idea in different places

Gully gardens and water-borne manuring systems are examples already cited of the same types of systems being developed in different places by different people. Referring to Box 7.1, a biopesticide has been 'discovered' quite independently by a man in India (Fig. 7.2) and a woman in Kenya. On reflection, this should not be surprising to us, as those with similar problems, equivalent resources and a common creativity will tend towards related solutions. An additional, important point here reflects back on the indigenous knowledge debate and the theory that exposing local indigenous knowledge in some way undermines it. 'Local' knowledge is probably more universal and less unique than some theoreticians might like to admit. By the same token it might very well have wider relevance also, and to protect it might in fact be concealing it from those who could benefit the most.

### The stimulating effect of travel and exchange of ideas on new creativity

An early investigation of the reasons land users innovate under PFI demonstrated that travel, communication and exchange of ideas is often a fertile source of adoption of new technologies and further creativity (UNDP, 2001; see also Tiffen *et al.*, 1994). The whole participatory farmer-to-farmer research and extension movement is in fact based on the impact of this interaction (Scarborough *et al.*, 1997). The lessons for improved green water management are surely that ideas deserve to be spread, and their originators are the ones to do this, wherever possible. Associated with this point is the extraordinary enthusiasm with which farmers spread their knowledge: not perhaps invariably but certainly in the majority of cases.

### Escaping from poverty and responding to need

The same investigation under PFI found that money and food were the primary driving forces behind development of new technologies by farmers – at least in the dry, poverty-stricken areas in which the project operated. No doubt a general curiosity characterizes these individuals also: a will to experiment. What is crucial to know however is: *to what extent do innovative individuals respond to changes in their environment?* In Uttaranchal, where diminishing spring flow and stream levels generally has become a quite recent and serious problem, there is evidence of response both upstream (for example, spring protection by Mr Joshi) and downstream (for example, careful allocation of collected wastewater for kitchen garden irrigation).

### Never conserving solely for the sake of conservation

Perhaps there is no better example of where unenlightened technicians and land users diverge more than in the concept of *why* green water and associated resources should be managed more carefully. To the land user it is most emphatically for production. To the technician, conservation of resources for the future is paramount. A cross-slope barrier, which appears to be a soil conservation device to the conservation specialist, is a means of increasing infiltration of runoff for production to the land user. While this may be a simplification of the situation, it is surely self-evident that the poor and needy will generally be motivated to implement 'conservation' measures only if they benefit here and now.

## A Way Forward: Stimulating Innovation and Spreading the Message While Monitoring the Process

So far we have concentrated on the recognition of largely spontaneous innovation by creative individuals. Clearly a laissez-faire attitude to this is not enough, or there would be no environmental or production problems. So how can this be stimulated and both the concepts and the technologies spread? There have been hints in the foregoing, with mention of farmer-to-farmer extension, where we have talked about the strong impact of travel and interpersonal exchange of ideas; basically through these practical 'back streets' of communication rather than along some futuristic 'information superhighway'. Several times, the need for specialists in the arena to rethink many of their preconceptions and ingrained notions has been alluded to. The key to taking such innovative thinking and practices forward is in methodological approaches that involve seeking out innovation, stimulating it, adding value through collaboration with researchers and then using a form of farmer-to-farmer extension. One such methodology is that offered by the Promoting Farmer Innovation project (Critchley and Mutunga, 2002). This proved very successful in East Africa in the late 1990s, and an added advantage was the relatively low cost: this was an 'add-on' project, making use of existing personnel, offices and vehicles. In this way it is more likely that institutionalization will take place, and without institutional embedding, an area and time-bound 'enclave project' inevitably fades away after completion.

The PFI approach grew and developed on the basic hypothesis that some farmers were more creative than others, and that these innovators could be stimulated to experiment further through recognition and being brought together – both of these being powerful psychological tools. There was caution, however, about certain categories of innovators. Those were the ones who were so exceptional – or so favoured by development projects – that they effectively repelled rather than attracted. Figure 7.3 illustrates this concept graphically. Better, then, to identify those who are *not* too out of the ordinary and are able to relate to, and communicate better with, their peers. And it is also important not to culture a 'favoured farmer syndrome' by lavishing attention on the selected few. Experience has shown that innovative farmers are keen to develop their skills and actively enjoy spreading their messages, thus refuting the argument that local knowledge should be left uncovered. Nevertheless, it is true that some farmers prefer not to share the techniques that they have developed, so as not to lose their market lead: this of course must be respected.

Another interesting finding was that government extension agents, previously held in disdain by farmers, were suddenly seen in a different light. Now, because they were recognizing farmers' skills rather than constantly treating the land user as being someone needing to be taught, they gained respect. Perhaps the most difficult group to convince about IK and innovation are research scientists, who have conventionally set their own agenda rather than responding to that of land users. Naturally, a whole new basket of skills needs to be developed by outsiders in a programme to harness farmer innovation. We need 'social soil scientists' and 'social hydrologists'. Potentially the systems developed by land users provide quite sophisticated entry points for scientists, who, needless to say, should aim to develop these further in collaboration with those land users.

Two interrelated points are important in the context of local innovation and 'bright' spots. These are monitoring and evaluating not just the innovative technologies themselves (for effectiveness and cost–benefit and so forth) but also the impact of programmes to stimulate innovation and spread not just technologies but 'innovativeness'. This is where a tool such as WOCAT (Liniger and Critchley, Chapter 9, this volume) can be useful, but it should be employed early in the life of a programme, tracking changes as they occur and giving guidance as to what should be monitored. Too often

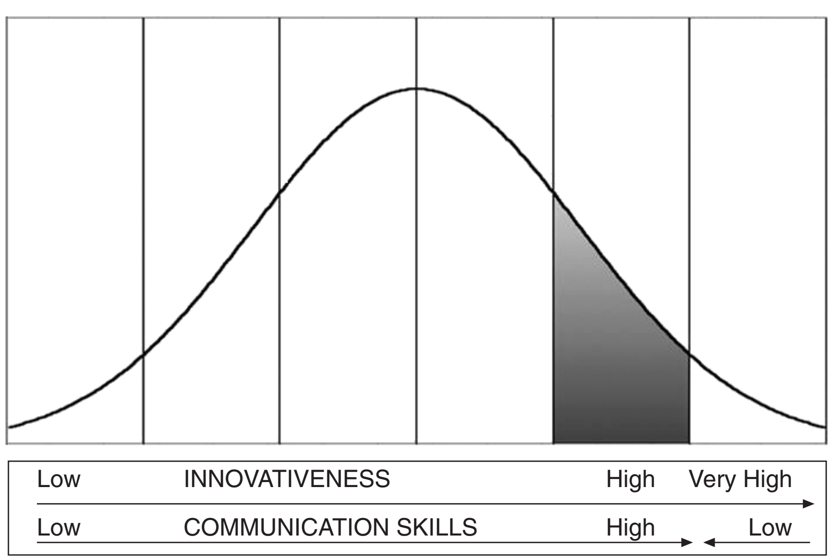


**Fig. 7.3.** A conceptualization of the relationship between innovativeness and communication skills within a community: the shaded sector indicates the innovators who constitute the best entry points into a community.

WOCAT has been brought in too late as a one-off operation and enough data simply are not available. The second point is that we do not yet know enough about the stimuli to innovation in the first place – the so-called 'drivers'. And perhaps even more importantly: what is the best way to spread the mentality of innovation and the creativity that underpins it? The few data available under PFI have shone some light on this matter, but we need to know more. The imperative for cash and food are powerful stimulants to innovate, even (perhaps especially so) in the poorest and driest conditions. But what exactly is the relationship with population dynamics, changing climate and fluctuations in the market for crops and livestock? There are a series of research questions that could, and should, be put to the test alongside implementational farmer-innovation programmes. Finally, while we must avoid the temptation to view programmes based on local innovation as a new panacea, that such programmes will be a powerful tool in the movement to better achieve green water management should not be doubted.

## Notes

1 Part-funded by NUFFIC (The Netherlands Organisation for International Cooperation in Higher Education) and in kind by both the Centre for International Cooperation, Vrije Universiteit Amsterdam and The GB Pant Institute of Himalayan Environment and Development. See Critchley and Brommer (2003a) for an overview of findings, and Critchley *et al.* (2004) for the annotated bibliography.

2 The PFI was funded by the Netherlands Government through UNDP and operational in East Africa between 1997 and 2001. PFI developed a methodology to identify and build upon farmer innovation in land husbandry within marginal areas (Critchley and Mutunga, 2002).

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