6 INNOVATION AND INFILTRATION: HUMAN INGENUITY IN THE FACE OF WATER SHORTAGE IN INDIA AND KENYA

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Summary

In parts of both India and Kenya there are serious problems with shortage of water for domestic and agricultural purposes. In the Himalayan middle mountains of India, stripping of forest resources for livestock fodder impoverishes the forest floor. By changing the nature and composition of the forest, this impairs its hydrological function, and is a partial cause of the growing 'low spring flow' problem during the summer months. In semi-arid Mwingi District in eastern Kenya, surface runoff erodes land and constitutes waste of a precious resource. The vast majority there still depends, in the dry season, on digging for domestic water in sand rivers.

Parallel participatory research in these contrasting areas has turned up similar principles – though rather different examples - of local innovation in the face of water shortage. The common denominator seems to be a search for a route out of poverty through prudent and judicious uses of limited water resources. These initiatives often involve the improvement of rainfall infiltration opportunities for productive purposes, and are typically located close to home. Four case studies are presented from each country.

In Kenya, one farmer has developed a rich 'gully garden' over some 30 years, by using runoff water to harvest sediment. Another has improved infiltration through terracing and controlled drainage, which has led to improved spring flow. One family has invested in well digging (novel in the area) and constructed an ingenious wind pump from old bicycle parts. Finally we cite an example of a woman farmer-cum-social worker who has controlled flood waters and created a rich and productive fruit and vegetable garden.

In the Himalayan foothills we illustrate an example of innovative forest management to improve infiltration for spring replenishment. Another farmer protects a riverbank through tree planting, and manages a community forest. We describe an individual who has built a small water mill and installs such machines for his neighbours. Finally there is a case study of a 'water volunteer' who helps his village rationalise their use of a scarce supply. One direct benefit of this is intensive homestead vegetable production from rotational sharing of wastewater.

However, such micro-spots of innovation must be set in the context of continuing serious water shortages in both locations, thus: *which way forward*? Farmer to farmer (or 'householder to householder') learning has had considerable impact under various small projects in developing countries. When the focal learning points comprise technically valid, local innovation, this can be a promising alternative to the 'transfer of technology' paradigm, which has dismally failed in many marginal areas. But it is critical that the innovator, from whom others learn (and reciprocally share) should not be so exceptional that he or she falls outside society's norms. An associated danger is that of the 'favoured farmer' syndrome, where such individuals are pampered with visits and handouts by outside agencies, thus instilling jealousy amongst their neighbours. Certainly there are valid case studies of local innovation to be uncovered in water management: the challenge is to harness this creativity to test the extent to which it can have a significant impact on what is a fundamental component of rural poverty. We still need researchers and extension agents to follow their professional paths, but to recognise that local people are valuable and knowledgeable travelling companions.

6.1 Introduction: water, poverty, the household and innovation

6.1.1 Problems and potential

There is a close and clear link between availability of household water and rural poverty in the developing world (Thompson *et al*, 2001). Both growing populations and climate change are tending to make these problems worse. This poverty-water shortage association has three main elements. First, collection of water from far away is a thankless burden. Carried out normally by women, it consumes precious time that could be used better elsewhere. Second, debilitating diseases are caused by both inadequate quantities, and poor quality, of water. Third, limited water reduces opportunities for irrigation of vegetables and fruits in 'home gardens' and keeping of stall-fed livestock. But is there a way out of the poverty trap where water supplies are low? Prudent and creative use of limited water can make a big difference locally. We have chosen two water deficit areas of two water-stressed countries to illustrate this: Mwingi District in Kenya, and Uttanchal State in India. As we shall show, even in these severe conditions there are lessons from individual and community creativity that give rise to some hope.

6.1.2 Why a focus on the household?

It is increasingly recognised that, in impoverished landscapes, the household is the centre of resources. Not only are people based there – by definition – but animals tend to be housed close by and crop production is more intensive and varied round the homestead. In the better-watered zones 'home gardens' are renowned for their variety and productivity: stall-fed dairy livestock are integral parts of these systems (e.g. Young, 1997; Tanner *et al*, 2001). It is also becoming acknowledged that people deliberately build up fertility in certain 'microenvironments' in the landscape (Chambers, 1990; Defoer *et al*, 2000). The most common hotspot of fertility and production is around the homestead. From the point of view of water, home again is a concentration point: not only is water brought here for various domestic purposes (and wastewater thus available after use), but roof tops and compacted compounds give rise to runoff. Here are opportunities to increase infiltration into the soil for production. Added to the fact that there is a resident pool of people ('human capital' as the new jargon has it) there, it is not surprising that home – or thereabouts - is often the locus of creativity with respect to innovation, integrating water with other resources.

6.1.3 Indigenous knowledge and the dynamic of innovation

The topic of indigenous knowledge (IK) hardly needs an introduction to those who are sympathetic to 'participatory' methods of research and development . IK has been written about extensively over the last two decades, and much has been made of its potential in participatory processes – in contrast to the research-scientist driven 'transfer of technology' paradigm (Chambers, 1983; Richards, 1985; Agarwal and Narain, 1997). One particular interesting application of IK is to look for the local *dynamic* process of experiment and innovation, rather than dwelling too much on the virtues of ancient tradition (Chambers *et al*, 1989; Gupta, 1998). In various regions of Africa there has been very positive experience with identification of, and working with, 'farmer innovators' (Critchley *et al*, 1999; Reij and Waters-Bayer, 2001). The logic is simple: if a local innovation 'works', then by definition it is appropriate in that situation. If it has been developed by someone who is respected in that area, then there is a good chance that it can be spread, farmer to farmer. While farmer innovation is no panacea, at least it can help point the way forward.

6.2 Methodology: the two locations and a novel approach

6.2.1 Background to the Study Areas

The two study areas chosen for comparative research were first, semi-arid Mwingi District in eastern Kenya, where water is chronically short in supply, and second the middle mountains of the Himalayan range within Uttaranchal State in northern India, where there is an increasing 'low flow' problem in the dry season. Both of these areas are drier and poorer than their respective national averages.

6.2.1.1 Uttaranchal, India

The middle mountains of the Kumaon and Gharwal Himalaya in Uttanchal State lie between 1,200 and 2,500 m a.s.l. These mountains were once densely covered with a moist temperate forest, characterised by *banj* oak *Quercus leucotrichophora* and other deciduous species. However with the human population more than doubling in the three decades from 1961 to 1991 (Rawat, 1996), this oak forest has been heavily utilised for fodder and firewood, and in many places gradually replaced with the hardier, quick growing *chir* pine *Pinus roxburghii*. Under pine forest, fires are common and are a direct threat to both the trees themselves and the hydrological function of the forest, by reducing ground cover and decreasing infiltration. It is widely believed that this is the main reason that springs (*dharas),* stepwells (*naulas)* and streams began, and have continued, to yield less water. In the 1960s the Indian government constructed pipelines throughout rural northern India. Most villages in the Kumaon and Gharwal region have such schemes now, either with a cemented tank to store the surplus of water or simply with standpipes and taps. But many are poorly maintained or disfunctional. Daily household rations in some villages may be as little as 40 l per family at their lowest (Brommer, 2002).

The economy in this area is based on a traditional rain-fed farming system, which accounts for 85% of the total agricultural land. The long term average annual rainfall in Uttaranchal ranges between 1,500 and 2,000 mm. During the hot dry summer between March to May, only around 5% of the annual rainfall occurs (ICAR, 1980). This is the season of water deprivation. Irrigation accounts for only 15% of the farm land – less than half of the proportion in its 'mother state', Uttar Pradesh, from which Uttaranchal was partitioned in 2000.

6.2.1.2 Mwingi, Kenya

Mwingi District lies in Eastern Province, Kenya. It was formerly the northern part of Kitui District, which was sub-divided in 1993. The average annual rainfall ranges from 500 - 800 mm. The climate is sub-humid to semi-arid. Altitude is from 500 – 1,000 m asl. The soil is fertile only in places but is low in organic matter, and is highly erodible. Typical household size in the area is around 8 persons and there is an average population density of around 35 persons per km². Agricultural land is used for rainfed production, with the main crops being annual grains (maize, sorghum, millet) as well as legumes (pigeon pea, cowpea) with fruit trees and bananas in places. There is scarcely any irrigated land at all within the district. Livestock are common throughout. Soil erosion, associated land degradation and, particularly low rainfall and drought are major constraints to crop production.

Data from the District Headquarters at Mwingi town underlines the severity of the water problems in the District. Not only is the rainfall low and unreliable, but it is estimated that only 20% of the population (and most of these are in the towns and settlements) receive a piped supply of water. Of the remainder, the majority still dig for their dry-season water in 'sand rivers' and carry water home in plastic jerry cans using donkeys for transport.

Mwingi District has had a long history of outside development initiatives from Government and NGOs. However its poor accessibility (only recently joined to Nairobi by a tarred road), regular droughts and insecurity problems in the north have kept this a poverty stricken District – even by Kenyan standards. What is also relevant to this current research is that Mwingi was the Kenyan focal point of the project 'Promoting Farmer Innovation' from 1996 to 1999 (see methodology section).

6.3 Research: field methodology[1]

It should be said at the outset that there was, deliberately, nothing in our research methodology that was either sophisticated or complicated. While we used a range of participatory tools – based on semi-structured interviews, participatory mapping and historical profiles – we specifically avoided being drawn into the new orthodoxy of participatory methodology. The participatory movement was born out of applied common sense and keen observation. It should not, as Chambers laments (personal communication, 2000), be hijacked by 'participatory zealots'. Furthermore those researchers with whom we were working in India were unfamiliar with participatory tools and approaches. This was less the case in Kenya[2].

The basis behind our investigations was simply a sensitive approach to identify and characterise what we defined as 'local innovators'[3] in the field of water resource management, and especially in the face of shortage. Our intention was to demonstrate that it would be relatively easy to find such individuals (or communities), and then valuable to document what they are thinking and doing. Initial identification of promising cases was carried out by local colleagues: these were then vetted by us and a selection made for investigation and characterisation. We finally analysed these innovators/ innovations for common themes and potential for improvement, and/or spread to others. The documentation of the technologies was helped by the range of technical disciplines represented by the teams.

This process actually mirrors the first part of the methodology developed under the 'Promoting Farmer Innovation' (PFI) project in East Africa. Under that project, which was development-oriented with targets for spread of technologies, innovative farmers were first identified and characterised in much the same way as described above. Then several further steps followed, including monitoring of their innovations/ initiatives, networking between those innovators and finally arranging exchange visits between 'ordinary' farmers and the innovators. This methodology is described in detail in Critchley *et al.* (1999) and Mutunga *et al*. (2001), and the results documented in UNSO-UNDP (2001).

[1] The research was financed in part by NUFFIC (Dutch inter-university cooperation: IK unit) under a wider commission for a global review entitled 'Indigenous knowledge and water interactions' which will form a keynote paper to be presented at a conference in mid 2003. A further part was internally financed by the Vrije Universiteit Amsterdam, and part was self-financed.
[2] See acknowledgements for names of colleagues
[3] 'Local innovators': simply defined in this context as those doing something different or novel in the local context, based on their own efforts and ideas, which have technical (or organisational) merit

6.4 Results: case studies of innovative individuals

Eight case studies are presented here according to a common format, in the following pages. The location of the individual is given, followed by the main problem faced (as expressed by that 'innovator') and including, sometimes, interesting perceptions. We go on to describe the initiatives or basket of technologies, in simplified terms. Finally there is an analytical or 'comment' section where the main conclusions are drawn.

6.4.1 Mr Madhawanand Joshi: the 'pata pani' spring protector, Mora District, Uttaranchal State, India

6.4.1.1 Problem

Joshi's local water supply – a spring arising from a forested catchment directly above his farm - has been dimishing continuously for a decade or so. He attributes this decrease in flow largely to the human-induced degradation of the original banj oak forest, and the consequent ingress of chir pine .

6.4.1.2 Initiatives

Joshi began in 1995 to create an experimental protection-cum-conservation area of 1.5 ha around the spring head, where he has (with the help of the soil conservation branch) designed and dug conservation trenches and planted trees. 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'[4]: 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 broad leafed 'forest floor' conditions. As a result of his initiative, according to him, several springs in the neighbourhood are again yielding water. Joshi has constructed pipelines from the main spring source both to his own farm and to the village. He has a storage tank of 10 m³ capacity which he uses to irrigate his agricultural land, through furrows and a drip irrigation pipeline. Joshi has also begun to raise fish in his tank.

6.4.1.3 Analysis

There is certainly technical as well as human potential here. Joshi's spring protection has yielded visible results. However he should beware that the very trees he nurtures may consume more water than they conserve as they grow taller. Thus he should avoid planting trees in the immediate vicinity of the springs. While Joshi has already helped implementing the experimental *pata pani* for other communities, and has influenced the soil conservation department and scientists from the nearby G.B. Pant Institute (who have set up a similar, monitored experiment elsewhere: Negi *et al*, 2001), there are two important points to be noted. The first is a potential opportunity: there could be organised visits from other villagers to learn from him. He clearly enjoys imparting knowledge. The second is a potential danger: he has already received various hand-outs from government and an NGO, and runs the risk of being viewed as a 'project pet'. Nevertheless, as a counterpoint to this danger, he is a man who actively assists his local community.

6.4.2 Mr Ajay Anjanisain: water mill owner, Pauri District, Uttaranchal State, India

6.4.2.1 Problem

Many years ago, Anjanisain built a traditional, small water mill with wooden blades in his back garden, working on the flow from a stream. He used the mill to grind wheat. The mill however became more and more difficult to operate due to the gradual reduction of flow over the years. According to Adjanisain, the decrease in stream discharge is mainly due to indiscriminate lopping (for fodder) and felling of the *banj* oaks in the catchment above. He also cites an earthquake which may have altered the underground flow pathway. Ten years ago the water supply decreased so much that the flow was too little to drive the mill continuously. He and his family depend on grinding of wheat for their main source of income, so he was faced with a serious challenge.

6.4.2.2 Initiatives

The idea of storing the stream flow in a man-made pond came to his mind when he remembered that he had seen people doing so on the plains below. He thus excavated a pond. This he connected to his mill with a wooden pipe, which he later converted to a plastic tube. When he could afford it, and assisted by the G.B. Pant Institute, he made a concrete tank connected to the mill by a steel pipe, fitted with a lockable tap. The mill pond – which fills up at night time - permits him to grind as much wheat in three hours as he could previously in a whole day. The water that powers the mill is further used creatively – to irrigate his terraces, located beneath the outlet of the water mill.

[4] we use italics and quotation marks in these case studies where the individual – or one of the team – has made a particularly telling comment

6.4.2.3 Analysis

While there is nothing fundamentally 'innovative' in what Anjanisain has done, he is imaginative and is a local source of inspiration. There is '*a teacher within him*' – and people come to him to watch and get ideas. He helps other farmers to install similar water mill and pond systems without asking for payment. He is also the local contact point for the G.B. Pant Institute and attends training courses there. However, as with Joshi in the previous case, there is perhaps a danger of too much attention being lavished on him from 'outside', though he remains a modest and humble man, helpful to his neighbours.

6.4.3 Mr M P S Rautela: water volunteer, Amora District, Uttaranchal State, India

6.4.3.1 Problem

In Chhabisa village, just as elsewhere in Uttaranchal, the dry season water supply is decreasing from year to year. In the driest month of May and sometimes for longer the villagers are solely dependent on the unreliable and limited supply from the Government pipelines. The four *naulas* (stepwells) are dry at that time. In areas of water scarcity, no drop of water should be wasted, which, sadly, is not always the case. Dripping taps and broken pipelines are still common features in Chhabisa and other neighbouring villages.

6.4.3.2 Initiatives

Mr M.P.S. Rautela resigned his job in Delhi and returned to his home village, Chhabisa, five years ago. He invented a new post for himself: that of a part-time 'water volunteer'. He wanted to help rationalise the use of scarce village water, and to oversee maintenance of the supply lines. He felt that someone was needed to manage the water on community level, to '*do justice to the shy ones*', and to make the villagers aware that they don't need to be continuously dependent on the government for help. A particularly interesting sub-story is that of wastewater from the main storage tank in Chhabisa. Women wash their clothes at one specific point by the tank. The wastewater then drains into an adjacent open storage pond. Rautela manages the use of that water – for irrigation of people's kitchen gardens where chillies, tomatoes, pulses and potatoes are planted. He has devised a rotational system whereby each nearby family receives the flow on a given day.

6.4.3.3 Analysis

The idea of a self-appointed, and locally accepted, water volunteer is the point of importance here. Rautela realised that the seriousness of the water problem required someone to take charge in the village. That person is needed to keep an eye on technical problems with supply lines, to stimulate less dependency on government and to rationalise use of wastewater, as well as mediating in local water disputes. This is a vital role, and while it doesn't address the causes of the low-flow problem, the position of water volunteer certainly help minimise the negative impacts. Of course the key is how to attract and keep such volunteers: men like Mr Rautela are, we were told, *'as scarce as the water in this area'*.

6.4.4 Mr Ramdatt Sati: riverbank protector, Almora District, Uttaranchal State, India

6.4.4.1 Problems

Some of Sati's terraced fields are located on a riverbank, about two metres above the riverbed level. While the river was previously perennial, it now dries almost completely in the summer months – but it still floods during the monsoon and erodes the adjacent agricultural land.

6.4.4.2 Initiatives

When Sati once travelled to Delhi, he saw - in the lowland plains - people planting trees in the riverbed, adjacent to the riverbank, to protect the land above from being eroded. He took this idea back with him and created his own riverbank protection after a serious flood in 1980, when a large section of his terraced land was washed away. His riverbank protection zone is 240 meters long and has a width of 15 meters. The trees planted here (Eucalyptus mainly) and associated vegetation have caused siltation in that zone to the depth of 1.5 m. There is a stone protection wall below the fields and he has erected a wooden fence between the protection zone and the riverbed. Sati is also in charge of a community forest which was started in the 1950s – a very unusual initiative in this area. It is interesting to hear Sati explain why this forest is planted to pine rather than oak. *Banj* oak, he explains, while being better at moisture conservation, *'has many enemies'*. The danger is that people would strip the oak of its foliage for fodder and leave nothing for firewood - which is the village's priority.

6.4.4.3 Analysis

Sati, in common with other innovators is constantly observing and being creative. He is also concerned about the environment and problems associated with the "too much and too little" water syndrome. He takes pleasure in showing visitors not only his riverbank protection zone, but also his well-stocked tree nursery. There is certainly potential here to use Sati as a learning point for other land users. He is well accepted in his local village and does not give the impression of being intimidating. From a technical point of view, riverbank protection through establishment of a living barrier makes good sense, though Eucalyptus is probably not the best tree of choice, being such a voracious consumer of water.

6.4.5 Mr Daniel Mutisya: gully gardener, Nzeluni Division, Mwingi District, Kenya

6.4.5.1 Problems

Daniel Mutisya had a large gully running through his farm in the early 1960s. It was basically an ephemeral watercourse that had eroded down to bedrock and was continuing to erode land at either side. Both sediment and runoff water were thus effectively lost to him. His other driving problem was poverty.

6.4.5.2 Initiatives

His vision was to use the sediment carried by the water to fill the gully and thus develop a fertile garden. He began – in 1965 – by diverting the water into a channel that ran parallel but above the original floor. He then developed checks of stone, trash and vegetation in the gully bed to filter out sediment from the water that he allowed to pass through, when it was not too erosive. Over the next three decades the 'gully garden' grew into a highly productive, intensively managed plot, measuring some 50 m long by 20 m wide, and up to 2 m sediment deposited in paces. He irrigates when necessary, either from the channel, or from wells that he has dug within the plot. He grows a rich mixture of crops and fruits: sweet potatoes, sugar cane, a variety of vegetables, pawpaws and other fruits. Though he is now old, he continues to be creative and is constantly manipulating water flow and modifying the system to make it more productive. He has educated his children from the proceeds. One very interesting point is that he says recent terracing in the catchment above him (by others) has increased the dry season flow: but at the *cost* (to him!) of a reduced sediment load.

6.4.5.3 Analysis

Daniel is a quiet, unassuming man, but his creativity and enthusiasm are eye openers in a District which is constantly in the news for drought and failed development schemes. His efforts are emphatically not project driven: they are his own ideas - or rather *'the ideas from God put into my head'* as he says. This is not the only gully garden in Mwingi, all of which incidentally are local initiatives, but it is probably the most impressive uncovered so far. In fact it is so impressive it might be a bit daunting to visitors. How can one individual have done so much? Certainly it is the principles, rather than the complex technical details, that carry the strongest messages.

6.4.6 Mr Josephat Muli: spring improver/drainage specialist, Nzeluni Division, Mwingi District, Kenya

6.4.6.1 Problems

Josephat had two major problems when he returned from his job in Mombasa and 'retired back to the land' to his ancestral home in Mwingi District. The first was the lack of a reliable drinking water source. The second was occasional flooding of his fields.

6.4.6.2 Initiatives

The focal point in Josephat's farm is his improved spring, which is the only perennial, local source of drinking water for his family and neighbours. The spring has increased in quantity and reliability as a result of his careful terracing of his hillside fields. He explains that the terracing improves infiltration of rainfall – which it undoubtedly does. Consequently the terracing ensures more reliable crop production. He has built up retaining walls around the spring to increase its capacity. Josephat believes that he has *'skill with water'* and further prides himself on what he calls his *'Suez Canal'*. This is a carefully designed drainage ditch that diverts floodwater from a watercourse and from a rock outcrop above his farm. The resulting controlled flow – together with the effect of his terracing – has apparently led to one new spring appearing downstream, for which his neighbours are grateful. It should be noted that all the work and achievements are the result of his own efforts and ideas.

6.4.6.3 Analysis

Josephat has skills which relate to water: specifically its infiltration, and drainage pathways. But as with so many similar innovators it is rather difficult to pinpoint a replicable technical initiative. The reason is simply that what he does and achieves is related to a very specific situation. For that reason it is Josephat's 'innovativeness' rather than his technologies that should be in the shop window. Nevertheless those technologies are sound and could hardly be bettered by technicians. What is particularly appealing in the case of Josephat is that he is proud of the way he has helped his neighbours to get access to water, both directly from his spring and also indirectly from the spring downstream that he believes he has influenced positively through his controlled drainage and terracing.

6.4.7 The Ututus: four brothers, five wells and a windpump, Nzalae Division, Mwingi District, Kenya

6.4.7.1 Problems

The four Ututu brothers had the common and interrelated problems – until a few years back – of water scarcity and poverty. Although they had inherited a large area of fertile and terraced farmland they remained poor because of the lack of water both for drinking (thus 'wasted' time bringing water from 15 km away in the dry season) and for irrigation (thus low yields from the meagre rainfall). Poverty in turn led to its own set of problems.

6.4.7.2 Initiatives

They were told of a nearby church that had sent some local youths to be trained in well-digging. The Ututus were intrigued by the possibility that there might be water lying beneath their land that could be tapped. They employed a group of newly trained youths to explore for underground water. The first well was dug in 1997 – and water was found at 10 m depth - and since then they have excavated a further four wells. What makes this story all the more intriguing is that one of the brothers, Joseph Ututu, has designed and built a working windpump on one of the wells. He constructed the moving parts from bicycle spares, and made the sails from corrugated iron sheets. 1,000 l can be pumped in this way overnight. Why five wells? The answer is that there is a good market for water, and from the income earned they have managed to educate all their children. They have also raised vegetables for food and for sale.

6.4.7.3 Analysis

While it may seem extraordinary that wells had not be 'discovered' in this part of Kenya until the last decade or so, the Ututu brothers have certainly capitalised on their initiative. Since then, 30 more wells have been dug by neighbours. And the windpump is certainly a revelation in indigenous skill: Joseph had no manual, and just used his imagination and the benefit of two years at technical college. What does this case study teach us? Perhaps three main lessons. First, there may be obvious potential that lies unexploited. Second, poverty can be a compelling force to explore all possibilities. Third, imaginative design capability can be found in, seemingly, the most unlikely places.

6.4.8 Agnes Mughi: tamer of the flood, Kyuso Division, Mwingi District, Kenya

6.4.8.1 Problems

Agnes Mughi has a typical example of what Chambers (1990) would call a 'microenvironment undiscovered'. Immediately around her house the soil is compacted and eroded. But in the valley a hundred metres away a seasonal stream has created rich growing conditions. However the stream tended to flood and sweep away the crops she planted.

6.4.8.2 Initiatives

Using her own creative ideas, Agnes dug a series of earth banks across the direction of flow in the valley bottom above her plot. These have had the effect of slowing the flow, improving infiltration and protecting her vegetables and fruit trees. Furthermore this has had the additional positive impact of raising the water level in a well that Agnes dug in the centre of her plot. Thus she has more water for irrigation, more for home use and more for sale. A second innovation is well worthy of note here: Agnes has developed a local bio-pesticide. It is a concoction of dried chilli peppers, *Neem* tree leaves and the leaves of an indigenous local *Aloe*. Agnes knew that each of these ingredients had either medicinal or (mildly) toxic properties. The combination mixed with water and left to soak is a powerful deterrent to insects and other pests. It is cheap, and it doesn't harm the user.

6.5 Analysis: common denominators and lessons learnt

Our brief analysis is based on a search for common denominators between the individuals featured here - taking into account others also that we have visited and studied. The threads that run through the case studies can, we believe, give a clue to what drives people to break away from convention and innovate.

There are four themes that are repeated over and over, four characteristics that apply to each of the innovators, regardless of their country of origin or particular situation. These are:

- *Searching for a way out of poverty:* Innovation is not just carried out through curiosity: none of the foregoing is a hobby farmer. They are poor people who invest in their talents to derive income to satisfy basic needs.
- *Innovating in multiple ways:* It is rare to find that just a single technology is being tested in isolation by a land user: normally there are a basket of ideas being tried at the same time.
- *Microenvironments:* Innovation relating to water (from these examples) invariably points to concentration of water and interaction with other resources in locations (often the homestead) where productivity is nurtured.
- *Infiltration for production:* Getting the water into the ground to produce: that is a theme that runs through all the studies. Each of those presented here is involved primarily or secondarily with plant production.

There are a number of other ‘themes’ that come up, but several of these are particularly applicable to certain individuals. We cite one example in each case to illustrate the theme.

- *Thinking through problems over a number of years: dynamic systems:* Here Daniel Mutisya is a good example: he has been busy innovating for nearly 40 years.
- *Optimising productive use of a scarce resource:* Ajay Anjuraisan uses water first for energy, then secondly for production.
- *Interested in or at least appreciative of ‘nature’:* Madhawanand Joshi told us he was *‘a nature loving man who observes keenly’*
- *Dedication to ‘the cause’:* MPS Rautela is a volunteer, helping the community
- *Spreading their skills:* Agnes Mughi actively teaches others the skills she has developed.
- *Independent development of similar innovations:* The bio-pesticide developed by Agnes in Kenya is almost the same as that used by Joshi in India
- *Principles easier to learn from than specific practices (because site-specific):* Josephat Muli has a clever drainage technique: but it is only applicable in special situations
- *‘Favoured-farmer syndrome’ pushing them beyond acceptability to others:* Joshi perhaps comes closest here – receiving attention from various agencies
- *Some innovators are ‘close to the fringes of society’ and may repel ordinary people:* Probably none of our selected cases fall into this category: we have noted several others that do

This analysis we believe, helps in three main ways. It assists us to understand what is behind innovation – and thus secondly gives us a clue to how the process of innovation can be stimulated in people. Thirdly it highlights some important issues related to using these innovations as learning points, including some warnings of where things can go wrong.

6.6 Concluding Discussion: part of the way forward?

We conclude that there is potential for many more innovators to be identified in the field of water management: local people who have specific and valuable skills *and* attitudes. It is important that we learn to look for local solutions to apparently intractable problems that conventional research has been unable, at least yet, to solve. However such micro-spots of innovation must be set in the context of continuing serious water shortages in both locations. The challenge is to harness this creativity to test the extent to which it can have a significant effect on what is a fundamental component of rural poverty. *How can that be achieved?* Farmer to farmer (or ‘householder to householder’) learning has had considerable impact under various small projects in developing countries. When the focal learning points comprise technically valid, local innovation, this can be a promising alternative, or at least supplement, to the ‘transfer of technology’ paradigm. However there are dangers attached. It is critical that the innovator, from whom others learn (and reciprocally share) should not be so exceptional that he or she falls outside society’s norms. An associated danger is that of the ‘favoured farmer’ syndrome, where such individuals are pampered with visits and handouts by outside agencies, thus instilling jealousy amongst their neighbours. And there is a real danger also of romanticising indigenous knowledge, and exaggerating its potential contribution. IK and innovation are just one part of an overall research and development process. The implication is a need for re-training of ‘professionals’ and, at a higher level, the institutionalisation of this new approach. That is no easy matter: it takes considerable investment in time and human capacity. While we still need researchers and extension agents to follow their professional paths, they must recognise that local people are valuable and knowledgeable travelling companions.

6.7 References

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