Agro-urban ecosystem health assessment in Kathmandu, Nepal: a multi-scale, multi-perspective synthesis.

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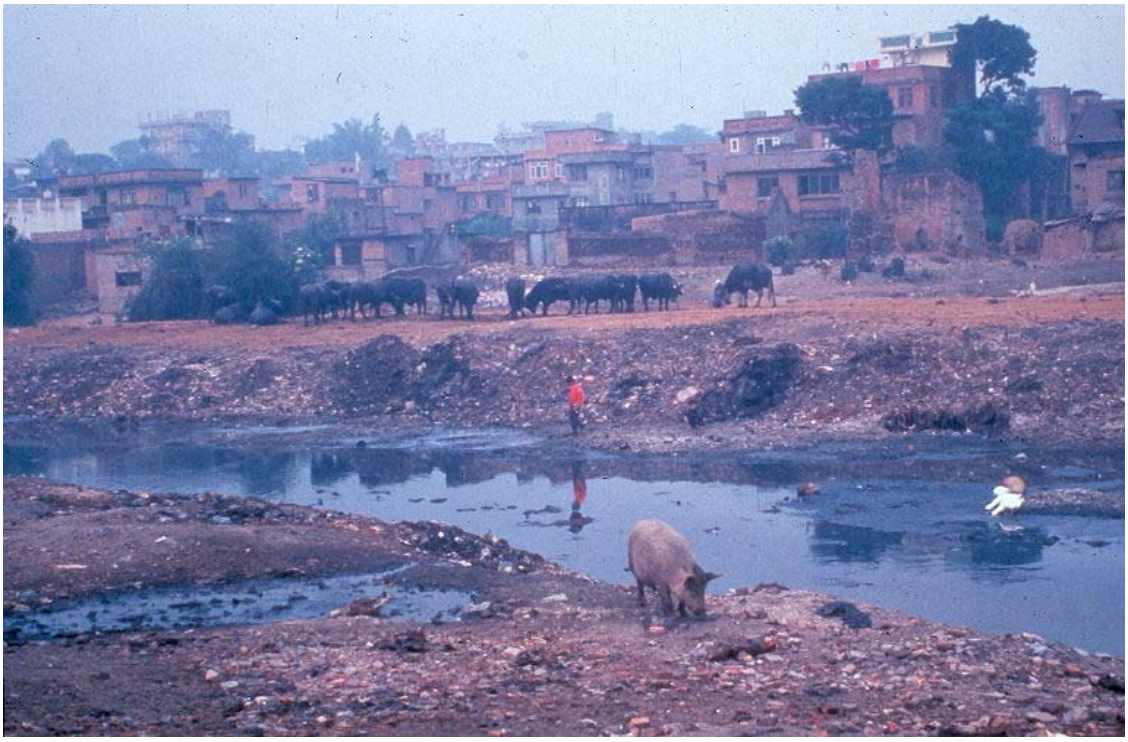
Abstract

This case study illustrates the links between problem structuring, multiple epistemologies across nested scales, assessment and remediation. Cystic echinococcosis is a parasitic disease of people associated with a gastro-intestinal tapeworm of dogs. Since it usually cycles between canids and other vertebrates, the parasite is linked to food safety through slaughtering techniques, which in turn are related to changes in the characteristics of the agro-urban ecosystem. These in turn cannot be dealt with without addressing the socio-economic and cultural aspects of the system, that is, the eco-social narratives which people (including scientists) use to structure their daily lives. A ten-year series of research projects in Nepal demonstrated that conventional science could provide explanations but had a mixed record at achieving solutions. Effective solutions were arrived at only after local stakeholders and governance structures were engaged in the definition of the problem structuring. Assessment (placing values on scientific measurements) and remediation (acting on those values) require both citizen engagement and a nested complex systemic epistemic stance. These are synthesized through the creation of culturally acceptable narratives.

Introduction

Urban agriculture has become an increasingly important source of food and income for rapidly growing populations in almost every large city in the southern hemisphere. In many situations, these agricultural activities in the midst of dense urban sprawl have arisen when rural peoples have migrated to the city and set up enterprises doing what they know best. The context for these urban farms, however is utterly different from that within which agricultural practices evolved. Along the banks of the Bishnumati River in downtown Kathmandu, for instance, gardening and animal slaughtering practices imported from the countryside had, by the early 1990s, created an environmentally devastated landscape (Figure 1).

Figure 1. Riverbank of Bishnumati River, Kathmandu, 1992.



The public health, environmental and eco-social consequences of such urban agriculture are both immense and poorly studied. The complementary problem in the northern hemisphere - the rapid expansion of urban settlements into intensively farmed landscapes – is embedded in a similar problematic situation. The temptation is high to believe that local, technical assessments and engineering solutions are adequate to the task; That belief has led – and will continue to lead – to the waste of a great deal of

good science. This paper presents a case study and a general argument for a multi-criteria, multi-scale, participatory and narrative-based synthesis and management.

Echinococcus granulosis is one of several tiny tapeworms of dogs, essentially worldwide in distribution, which infects livestock and people. In canids, which acquire the parasite from eating infective cysts, this parasite is of little consequence. In people and livestock, who acquire the infection through exposure to dog feces, the parasite is expressed clinically as hydatid disease, a slowly growing parasitic tumour. Depending on where these cysts reside, they may have major or minor clinical consequences in these other species. Dogs are re-infected when cysts are excised from livestock at slaughter and are cast away. With very few exceptions, for instances where people may be buried in shallow graves accessible to canids, humans are usually a dead end host. There are few good treatments other than surgery which, in many parts of the world, is a high risk undertaking. In the late 1980s and early 1990s, this appeared to be particularly true in Nepal, where some 20% of surgical patients with hydatid cysts died (Baronet et al 1994).

Phase 1: Epidemiological Approaches

Beginning in the 1990s the National Zoonoses and Food Hygiene Research Centre (NZFHRC) and the University of Guelph, with collaboration from researchers at CDC Atlanta and Salford University in England, initiated a series of epidemiological studies to determine rates of disease in animals and people, and identify risk factors which could – in theory – be manipulated to prevent the disease[1]. These risk factors related to human-dog interactions in the community, and open-air slaughtering along the banks of the Bishnumati River in Wards 19 and 20 in Kathmandu. Our work was based on the premise that many countries, ranging from Iceland and New Zealand to Chile and Cyprus, have successfully undertaken aggressive and intensive control programs based, or accompanied by, similar research programs (Gemmel et al 1996). These programs entailed both strict dog control measures and modernization and securing of slaughtering facilities.

The science which informed this work was normal, in the Kuhnian sense, that is, based on accepted epidemiological ways of thinking. Echinococcosis, that is, infection with the parasite regardless of species, is usually described in terms of its basic life-cycle between canids and other species (Figure 2). Despite rhetoric about "webs of causation", many epidemiological studies reduce their models to the common denominator of their statistical tools, and produce, at most, complicated models of disease causation (Krieger, 1994). Most are basically simplistic, such as that depicted in the linear causal model in Figure 3. These were the models that informed our early work in Nepal, which allowed us to identify risk factors for infection in people and animals, devise public health statements, and have no impact whatsoever on outcomes.

[1] This study, and other similar ones, can be found described at www.nesh.ca, in the "projects" section.

Figure 2. Life cycle of Echinococcus granulosus (inside dotted line)

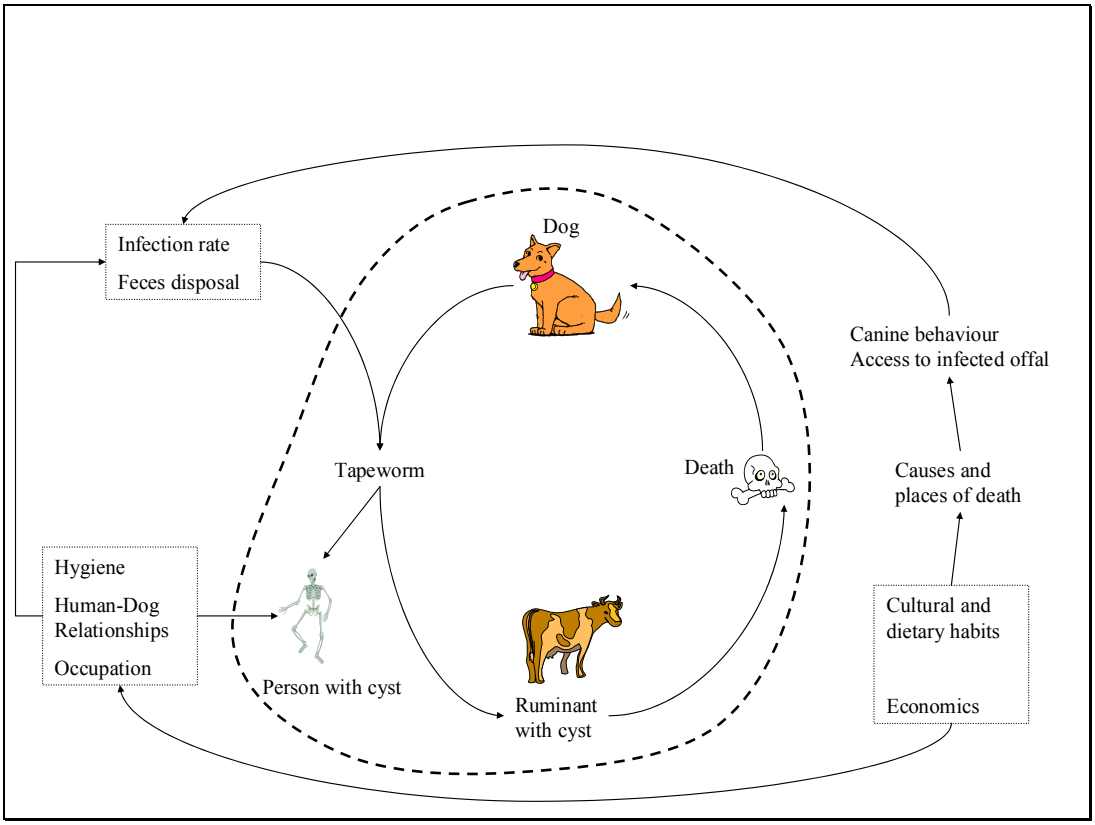
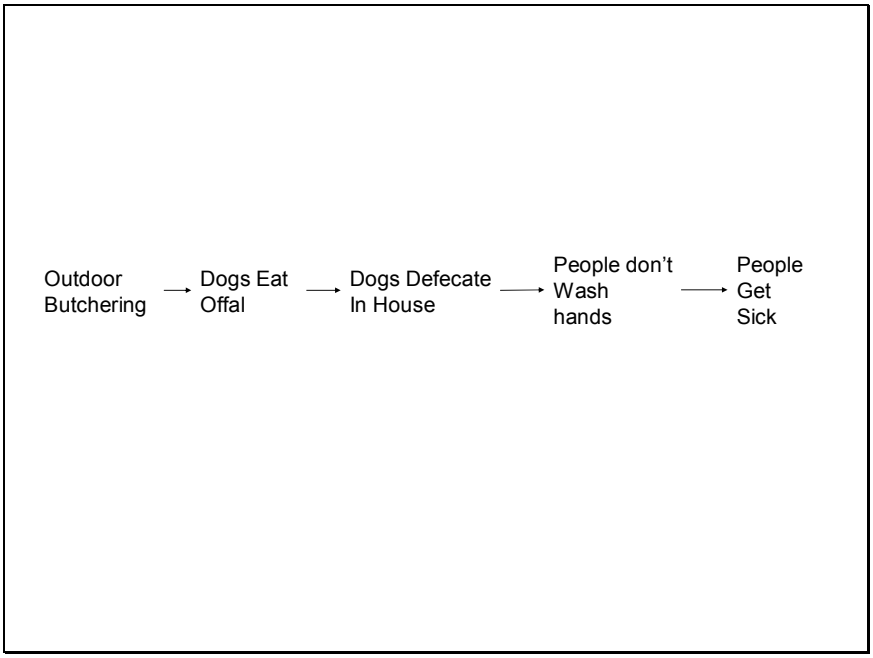


Figure 3. An epidemiological risk factor model of hydatid disease in Kathmandu



By the mid-1990s, we had gathered an impressive amount of information on infection rates in people and animals, dog behaviour and risk factors for acquiring infection (Baronet et al. 1994). Nevertheless, little had changed in the communities with whom we were working. Those solutions commonly promoted in other eradication programs – mass killing of stray dogs, restriction and strict control of dog ownership, building of secure, modern slaughterhouses – seemed unlikely to succeed in Nepal. Slaughtering was still done in the open air along the riverbank, amid piles of offal and manure through which dogs, pigs and children wandered at will (Figures 4 and 5). A survey of community members at the end of the project listed water quality, health, and waste generation and disposal, particularly from animal slaughtering, as being their most important, on-going concerns.

Figure 4. Slaughtering on Bishnumati Riverbank in Kathmandu, mid 1990s.

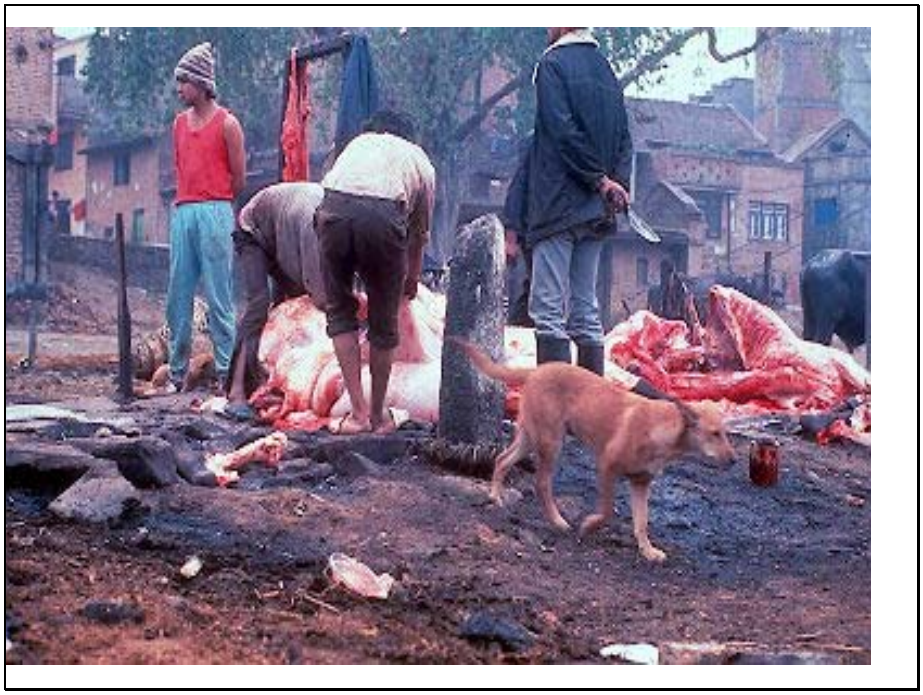
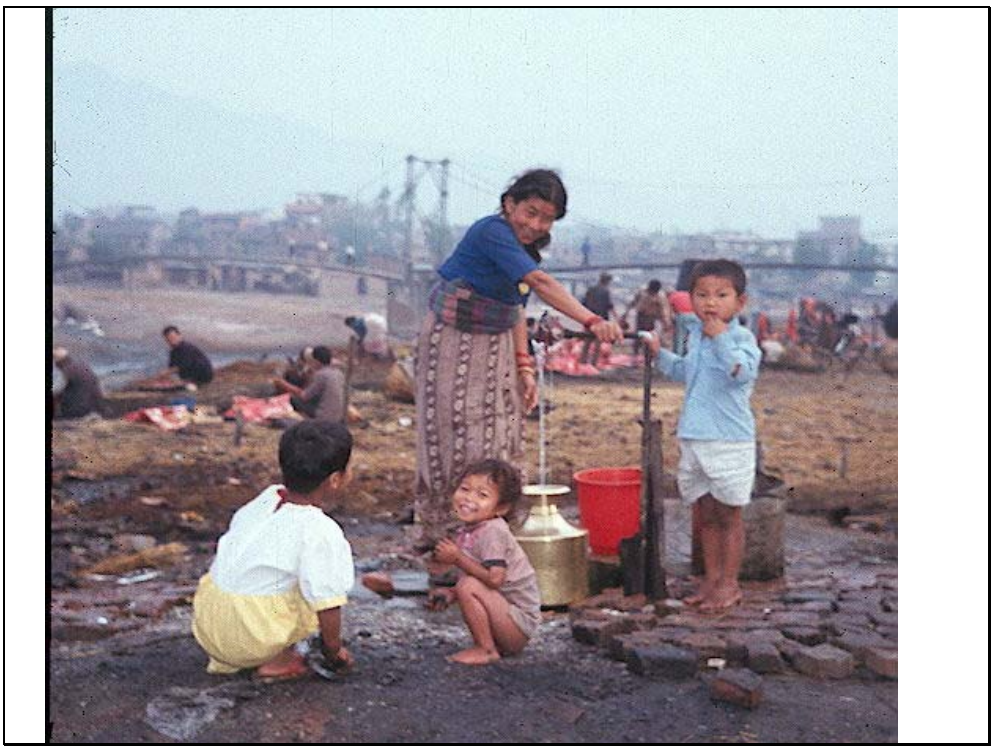
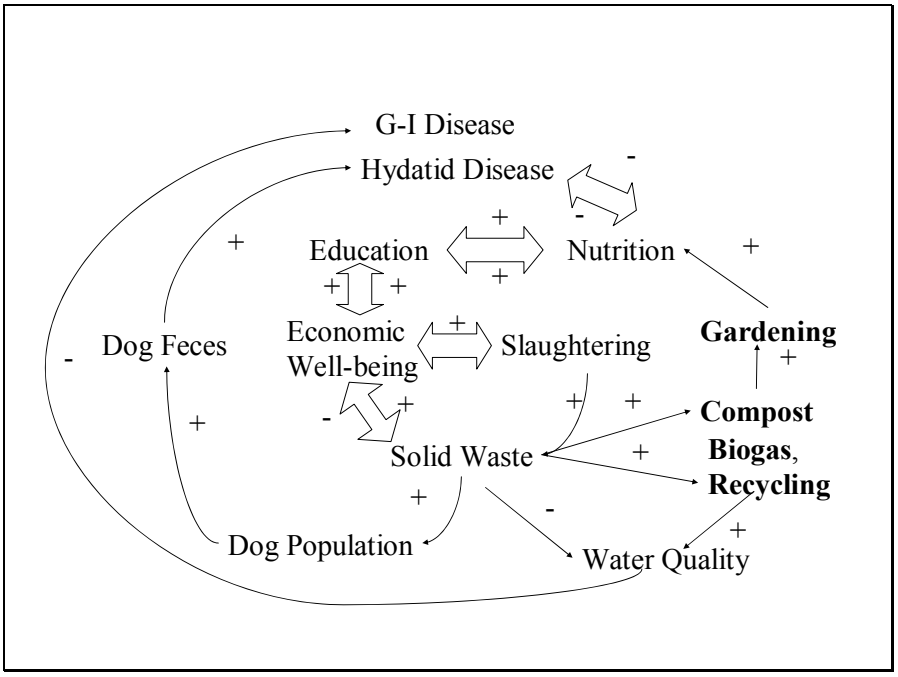


Figure 5. Drinking water and slaughtering on Bishnumati Riverbank in Kathmandu, mid 1990s



By the end of the first set of epidemiological studies, we proposed a more complex model (Figure 6), which we termed an ecosystem health model. This model, which was systemic, but assumed a single "correct" perspective, informed the beginnings of another set of studies. The model itself, one of several presented to professionals and scientific experts by one of the researchers, was useful in stimulating new ways of thinking. Several of the proposed strategies to "fix" the situation – such as composting and biogas generation – were in fact adopted by some of the more affluent slaughterhouse owners in the community. The model, however, omitted key elements of the situation – such as socio-economic, political and caste status, gender, and livelihoods. Since the overall eco-social community was in fact an emergent property of how local citizens went about their daily tasks, and since these citizens were not engaged in the processes of problem formulation and solution-seeking, these new models had minimal impact.

Figure 6. An ecosystem health model of hydatid disease in Kathmandu



Phase 2: Eco-systems Approaches

In 1998, the Social Action for Grassroots Unity and Networking (SAGUN) joined with NZFHRC, researchers from Guelph and a variety of community-based stakeholder groups to carry out a project on ecosystem approaches to health in the two urban wards of Kathmandu. Thus the focus of activity shifted from a specific parasite, the research team expanded to include the community members themselves, and the methods expanded to incorporate a variety of participatory and qualitative tools.

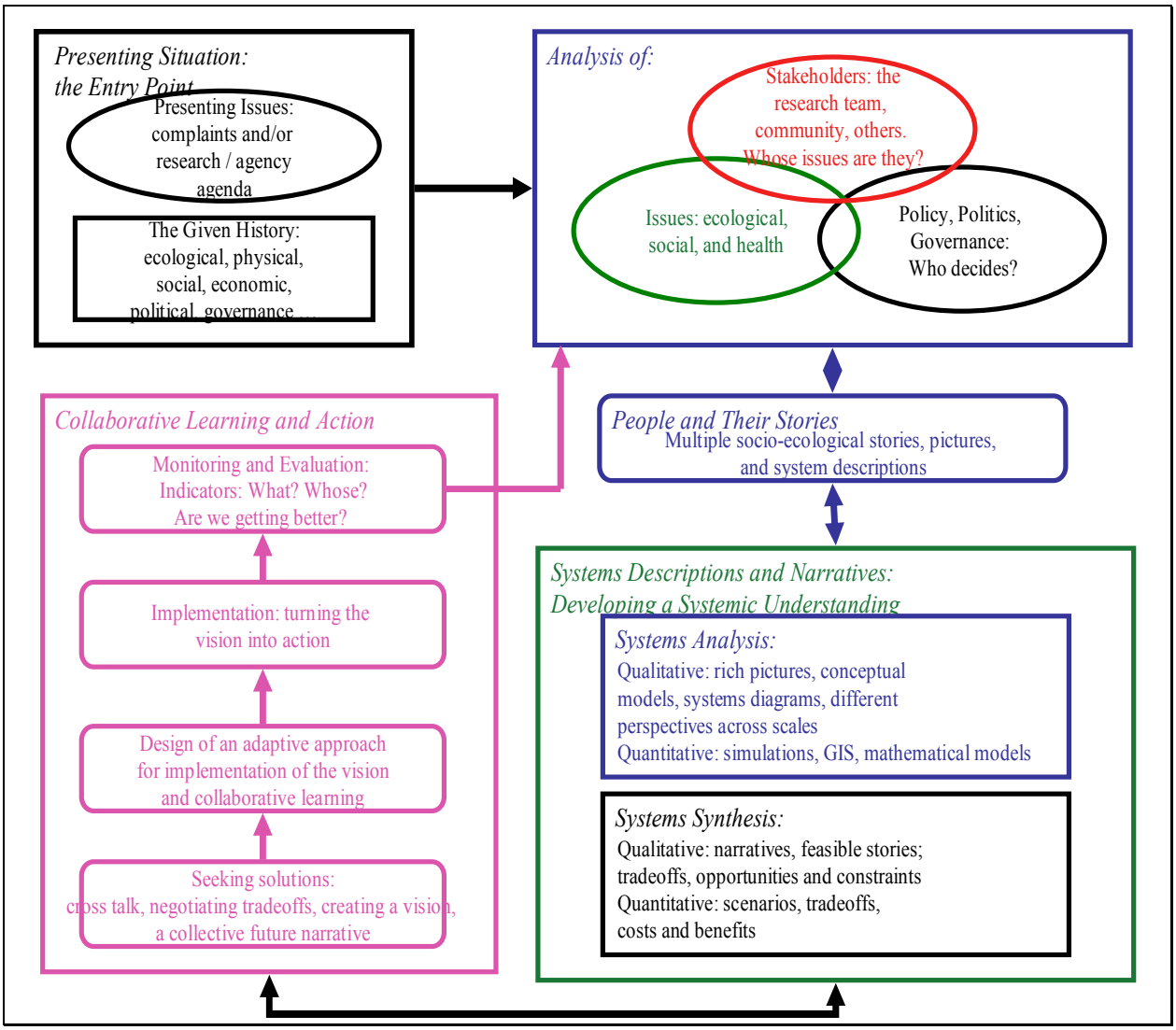
Details of this study are reported elsewhere (SAGUN et al, 2001; Neudorffer et al, 2004). The new project encompassed a wide range of investigative methods, reflecting both the ambitious goals of the researchers, and an emerging consensus among scholars in this field that methodological pluralism must be central to any new science for sustainability (Murray et al 2002). We used conventional, quantitative scientific methods including epidemiological surveys, water quality monitoring and a variety of health assessments. These were complemented with more qualitative tools, drawn from Participatory Action Research (PAR) and related fields such as participatory urban appraisal, gender analysis, semi-structured surveys, focus group discussions, appreciative inquiry, and stakeholder analysis.

Community researchers, hired and trained by the research team, and members of the local community, were key facilitators in such processes. This was to ensure the development of local capacity for participatory action and research through generation of awareness among people. Various stakeholder groups in the community developed action plans based on group narratives and priorities; these were implemented to varying

degrees. However, there was a sense that the collective narrative of the community was not being adequately understood or addressed, and that the multiple perspectives and methods left a sense of fragmentation.

Near the end of the project, the work was re-assessed using AMESH, an Adaptive Methodology for Ecosystem Sustainability and Health, first developed in the context of similar projects in Peru and Kenya (Waltner-Toews et al. 2002; Murray et al. 2002; Figure 7).

Figure 7. An Adaptive Methodology for Ecosystem Sustainability and Health (AMESH)



AMESH brings together critically reflective public participation with insights from Self-Organizing, Holarchic, Open Systems theories (Kay et al 1999). It calls for methodological pluralism and multi-scalar participation of stakeholders. Beginning with a problematic situation and a "given" history, AMESH then engages all legitimate

stakeholders to identify key issues and their policy and decision-making contexts; from this emerge narratives, which are then structured into systemic descriptions. These, finally, are used by decision-makers to choose a course of action, identify indicators, and implement correct actions. The methodology, which we have now applied in Nepal, Kenya, Peru and Canada is iterative and self-correcting, that is, adaptive.

In this paper, I will focus on only one aspect of this complex process – the changing models of reality we had to incorporate into our activities, and the critical point at which everything changed.

Systems descriptions: one scale, many perspectives

After the epidemiological studies, a full review of the situation, followed by a community-based workshop, led to the new initiative, the "Participatory Action Research Urban Eco-system Health Project", with a major leadership role taken on by SAGUN. What emerged from an intensive program of working with a wide variety of stakeholder groups in the community was a set of 'ecosystem stories' or 'ecosystem narratives', one for each stakeholder group. Describing how each stakeholder group perceived the interactions among themselves, other stakeholder groups, and the local eco-social system, these narratives were translated into a set of influence diagrams. Using a technique modified technique modified from the work of Thomas Gitau, who had initiated another AMESH project in Kenya (McDermott et al. 2001), these diagrams were able to identify a wide range of interactions within groups, as well as point to areas of potential conflict between groups.

Figure 8 is the Issues and Influences diagram for the Butcher Stakeholder group. The activities of this group – comprised of Wholesalers, Retailers and Butchers – are related to butchering and selling meat. The ecosystem health issues identified had to do with hygiene, waste management and water quality and quantity. The needs and concerns clearly varied by actor perspective even within this group.

Figure 8. Issues and influences in wards 19 and 20, Kathmandu, Butchers' version

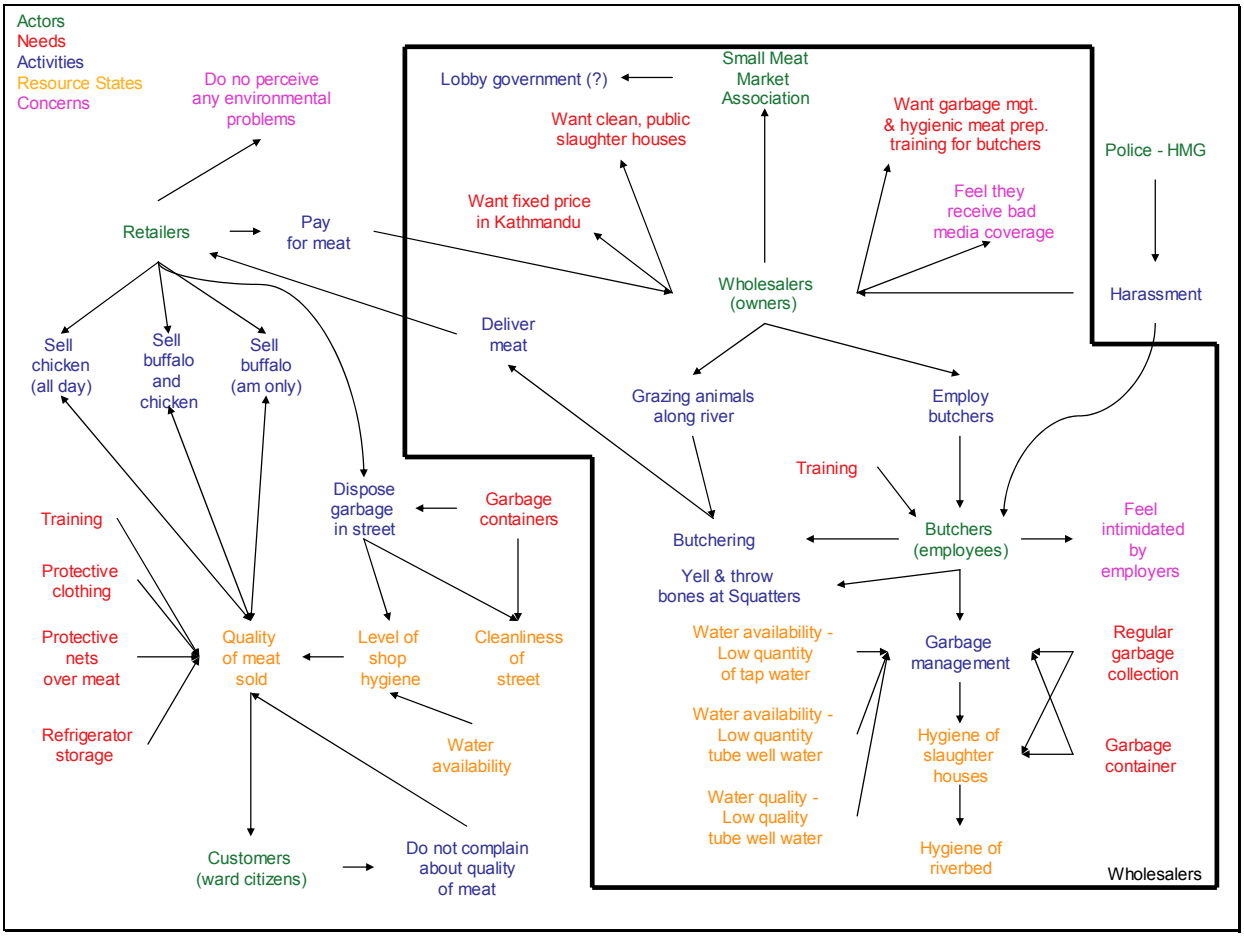
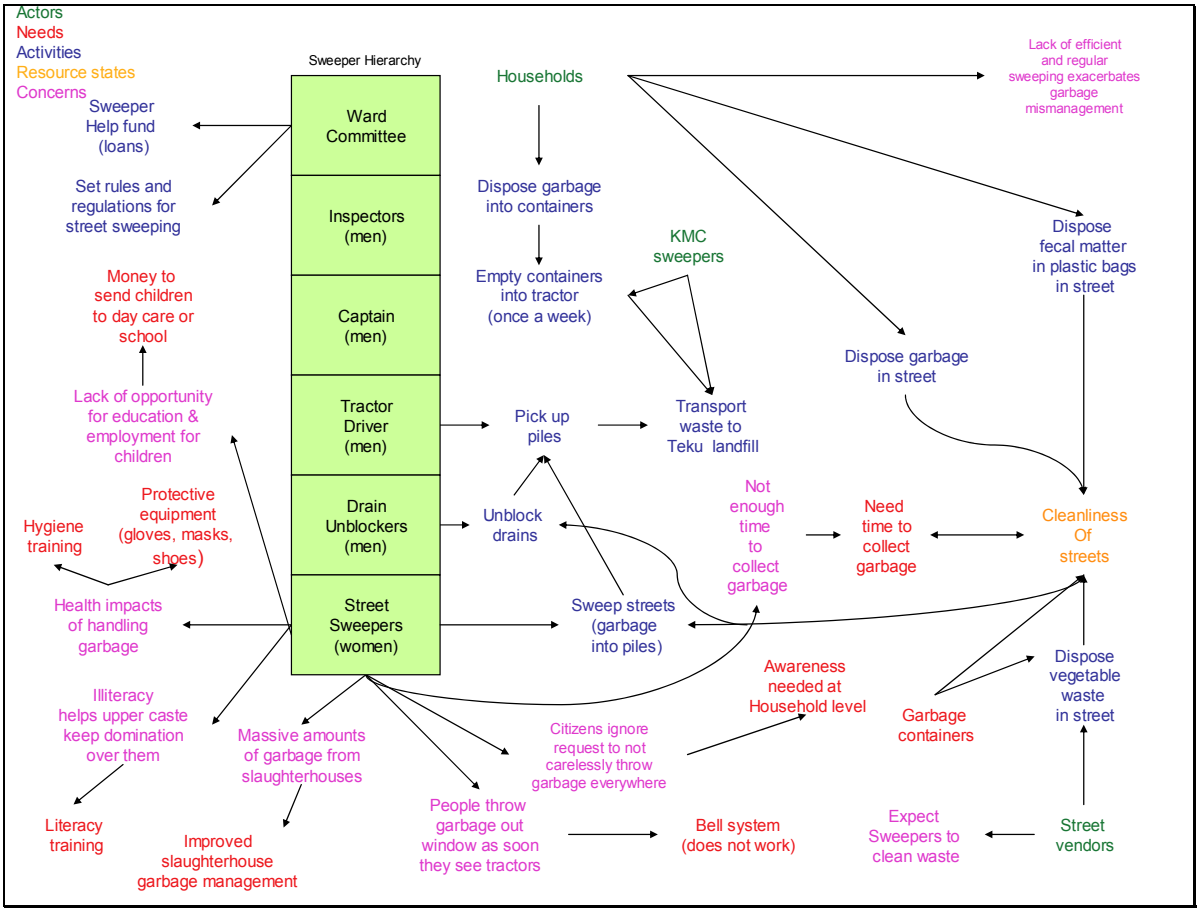


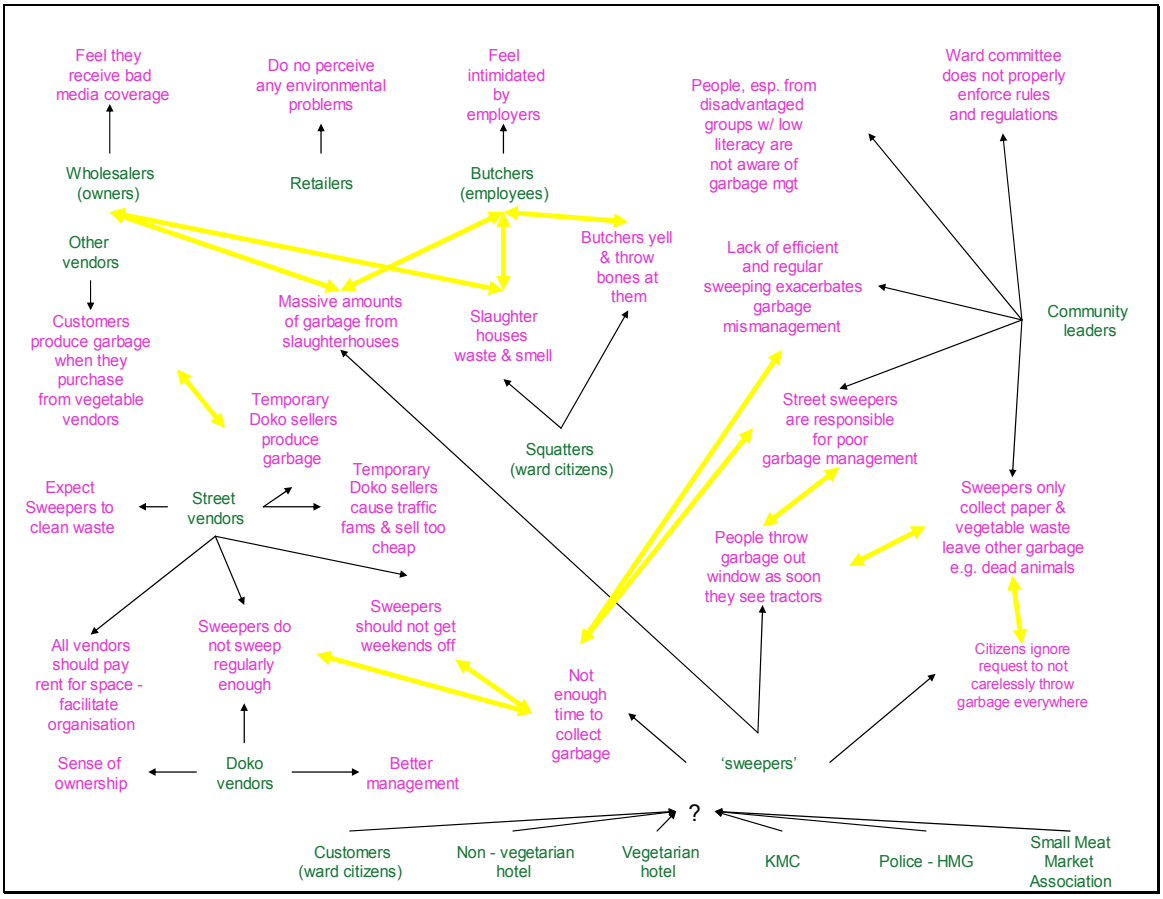
Figure 9 is the Issues and Influences diagram for the Sweeper Stakeholder group. Activities in this group were determined based on location in this power hierarchy, confounded by both caste and gender. The lowest on the hierarchy were poor, uneducated women of low caste.

Figure 9. Issues and influences in wards 19 and 20, Kathmandu, Sweepers version



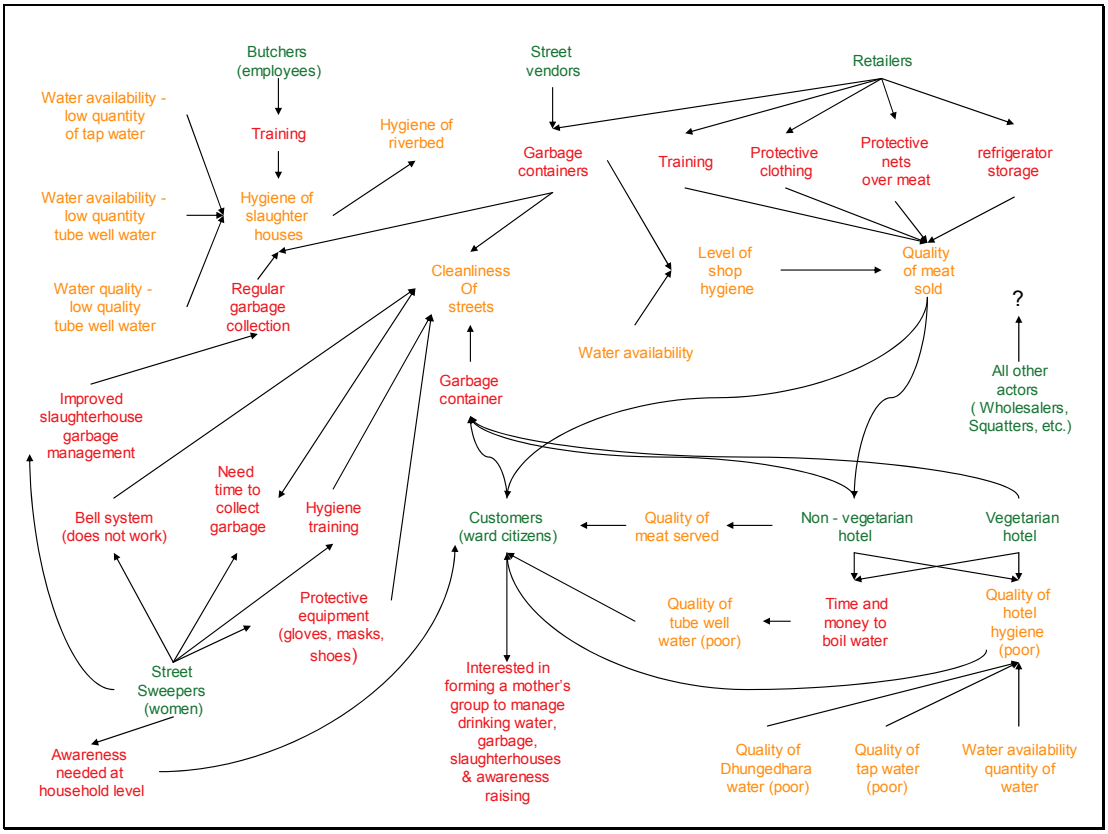
For the final workshop of the project, we brought these influence diagrams together in various ways, and presented them back to the community. Figure 10 depicts the concerns and perspectives of the various stakeholders of the food and waste system. This enabled the community to identify where there were strongly divergent views requiring negotiation of tradeoffs, future visions, and possible future actions.

Figure 10. Stakeholder concerns, food and waste system, wards 19 and 20, Kathmandu,



The same food and waste system can be seen as a set of expressed needs and how those needs were seen to relate to resource states, which were used as general indicators of ecosystem health (Figure 11).

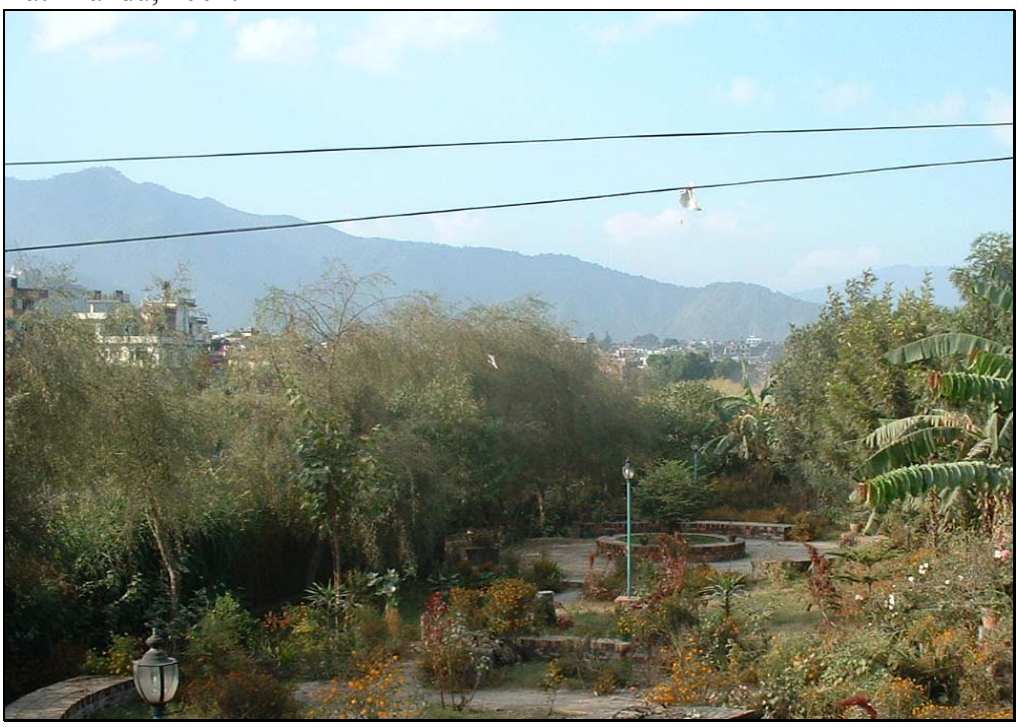
Figure 11. Stakeholder needs and resource states, wards 19 and 20, Kathmandu



Although these models were not made explicit until near the end of the project, it was clear that they reflected the mental models used by participants in telling their stories. Furthermore, by drawing on these stories, and through the process of civic engagement, the citizens of these communities completely transformed their neighbourhoods. Small scale slaughterhouses were built and butchers began to compost and recycle; both public and private gardens were planted along the river; public toilets were built; and a program to clean up local water sources was initiated. By 2001, the area had been completely transformed (Figures 12 and 13). Most importantly, some of the key actors in the community – the butchers – who generated employment, money and waste, emerged as a potent force for change and renewal.

Figure 12. Riverbank of Bishnumati River (same place as figures 1, 4 and 5), Kathmandu, 2001.

Figure 13. Riverbank of Bishnumati River (same place as figures 1,4 and 5), Kathmandu, 2001.



Systems descriptions: many scales, many perspectives

By the end of the project, it became clear that, while many issues could be dealt with by individuals, in households and in the neighbourhoods, some – relating to garbage collection and water supplies in particular – required much larger-scale commitments and engagements. In some cases, local volunteer clubs developed garbage collection and recycling programs in lieu of changes in city-wide garbage collection and disposal programs. These could be seen as organizational adaptive responses to local issues that emerged through a combination of improved knowledge and local "ownership". In other cases, local artesian wells were cleaned up, and cloth filters put on public taps, but it was clear that these were stop-gap measures until changes at the city or valley scale could be initiated. Presentation of multi-scale models to the communities and their leaders enabled us to identify the nature of these adaptive responses and scale issues. For instance, Figure 14 links various formal governance hierarchies with issues being addressed. Figure 15 raises questions about links between formal and informal governance structures which required further investigation. Some of these hierarchical issues were already being dealt with, by bringing together neighbourhood (ward) and including Kathmandu city bureaucrats in water management workshops, and by promoting national laws and regulations regarding animal slaughtering.

Figure 14. Hierarchies in Nepal

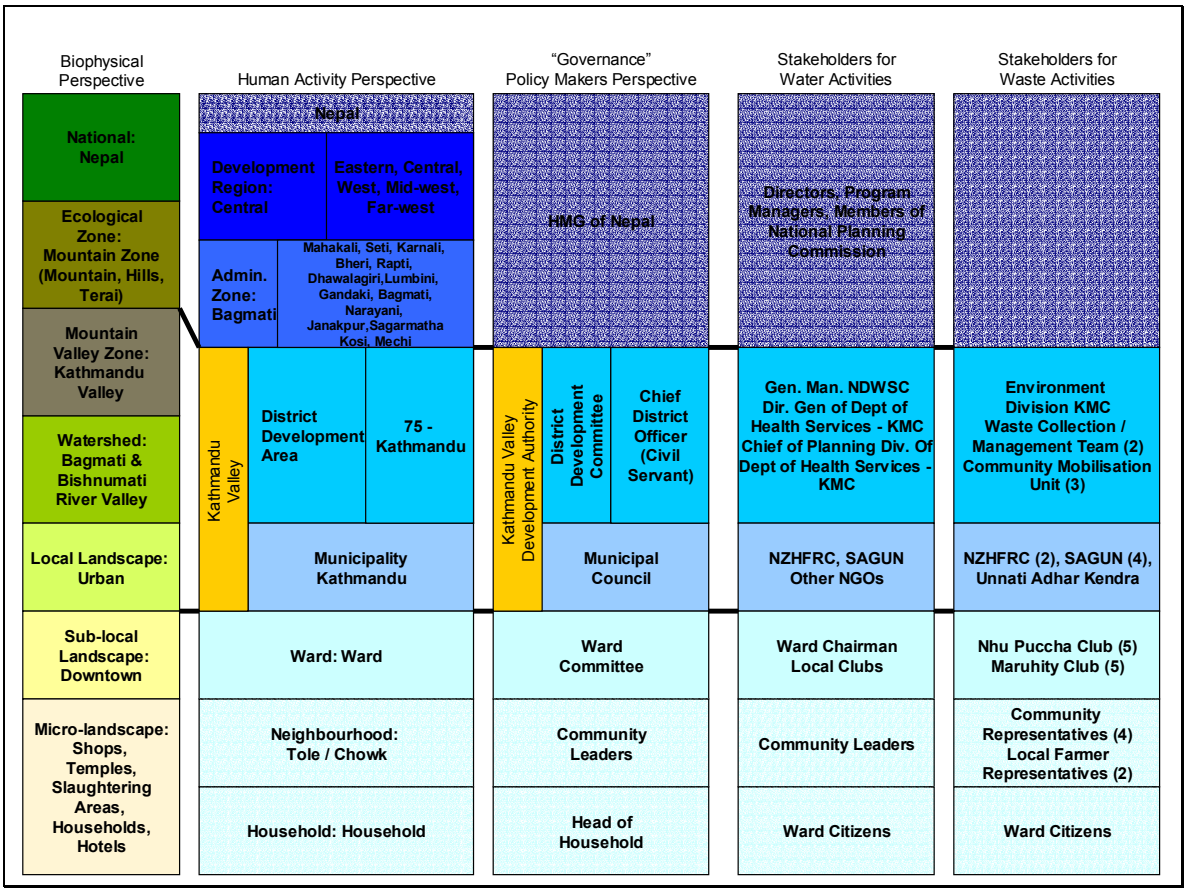
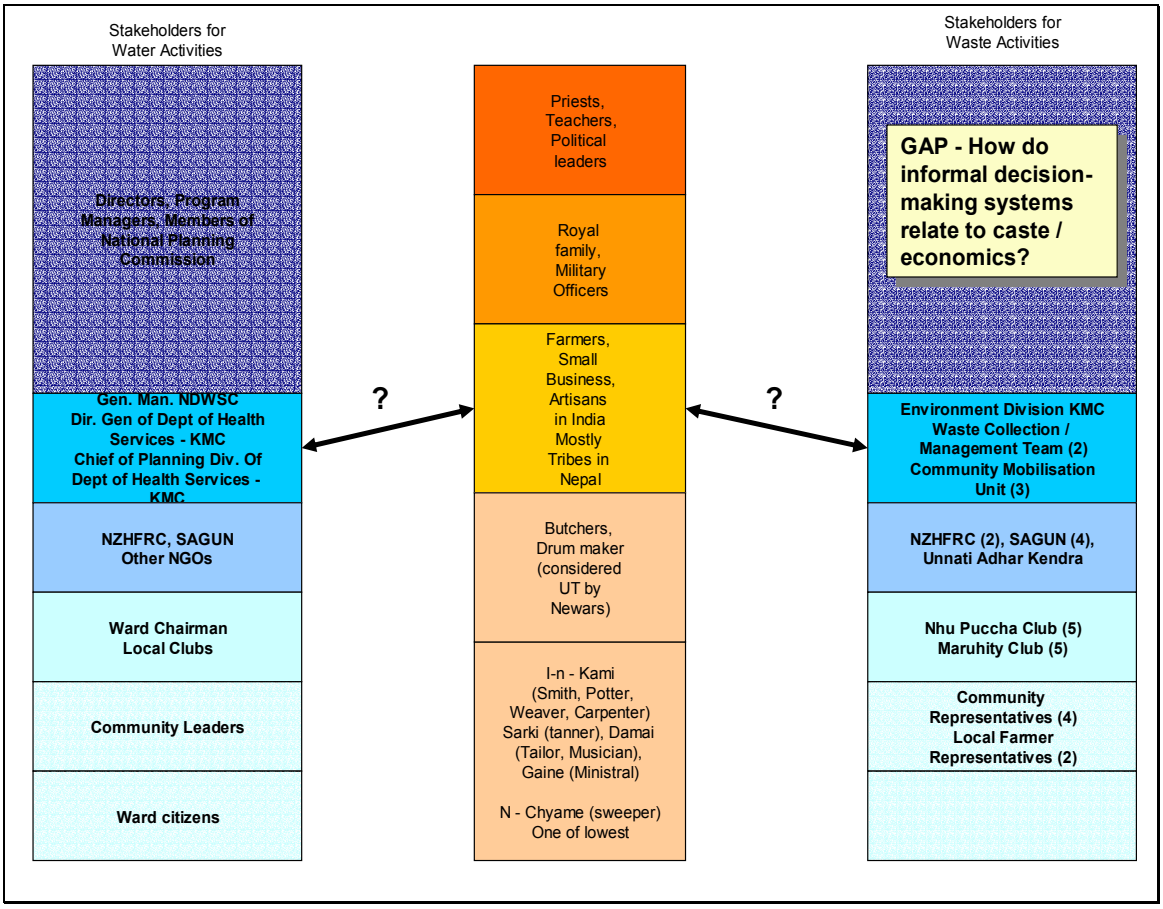


Figure 15. Relationships between formal and informal governance structures, Nepal.



The meaning of the models: a meta-narrative

One of the most useful ways to now stand back and view all of these multiple models is to incorporate them into a kind of meta-narrative, of the kind that are implicit in all scientific studies, and usually explicitly denied by scientists.

This narrative includes a cast of thousands of Newari, Tibetans, Indians and Bhutanese who have come to Kathmandu in the past few decades fleeing soil erosion, food and fuel shortages, rural community breakdown, and political instability. They bring with them food preferences and trading patterns, thus importing, for instance, goats from Tibet (where hydatid disease is common) into Kathmandu (where we don't think it has been).

Family and cultural traditions of butchering perhaps once sustainable in sparsely populated rural areas are brought into the very different, more crowded urban setting of Kathmandu. Butchers don't want to give up family traditions and become wage labourers in an animal killing factory. Hence a large Danish project which built a modern slaughterhouse near Kathmandu in the 1980s was largely unused.

Cow pats are slapped on the walls of buildings where they dry and are used for fuel. If these are not used, then more wood fuel is needed (to cook the offal or the food) from the already deforested countryside - carried down by young girls who are not then getting an education which would enable them to escape these traps. If cow pats are used as fuel, then valuable fertilizer is lost from the countryside. Streets are used for waste disposal, since the government simply cannot afford to maintain a European-style sewage disposal infrastructure.

One way to generate more money to solve this problem is to increase the carpet trade in response to high demands for these from Europe, Germany in particular. This uses vast amounts of water, making less available for public health purposes, and creates serious pollution problems of its own. Because the water system in Kathmandu is ancient and leaky, and because so much water is used to generate income (and money to pay for a better system) by the carpet and tourist businesses, riverbanks are used as public toilets and laundromats.

Groups of dogs – sources of rabies and echinococcosis - serve also as community-watch volunteers for places of worship and meditation. While our University of Guelph field researcher, Dominique Baronet, was in Kathmandu, members of the community where she was working noticed that some of the community dogs died. At the same time, thieves stole some artifacts from a local temple. Their explanation of these events went like this: Canadian woman comes into our neighborhood, injecting dogs with strange drugs. The dogs, who are our community police, die. The thieves move in. (Our version might be that dogs die all the time, but when they have fluorescent collars on, people notice them more; thieves are always on the lookout for portable gods to sell. The events were un-connected. Our version, however, did not determine their behaviour and was irrelevant to resolving the issue, however dearly we might have believed it to be true). Fortunately, Dominique had built up a lot of goodwill in the community and we could continue our work despite the suspicions. The bottom line is that people value their dogs for a whole complex of reasons, and getting rid of them - as was done in Cyprus and Iceland - will simply not work.

Rickshaw drivers, taking advantage of increased meat consumption by tourists and increased economic activity a small upper class, carry meat to market in the morning and tourists to temples in the evening. Streets intended for people on foot are now crowded with families on bicycles and motorcycles, and old vehicles burning fossil fuels, choking the air with pollutants.

The economic, cultural, and family bases of human-dog relations, butchering practices, and their many dependent occupations of small-scale meat transporters and butcher shops throughout the city, cannot simply be altered by decreeing that it should be so. Butchering and food hygiene practices depend not only on knowledge, but on the availability of clean water and affordable fuel and for cooking, thus competing directly with economically powerful activities such as the carpet industry, which use - and waste - huge amounts of water. Even if the dogs could all be treated with an anti-parasitic drug,

it is clear that the communities involved would still be left with serious public health, economic and environmental problems, many of which appear to be considerably more pressing than this particular parasite. Of all the places these communities could spend what little spare cash they might have, why would they want to spend it on an anti-parasitic drug or control program for dogs?

Changing butchering practices seemed to be an essential part of any strategy, but this involves major cultural and economic changes, and not only for butchers. The original program which built the large slaughterhouse assumed that Nepalese people could control the disease (and others) if they behaved like Danes - in fact, if they reconstructed their culture in the model of Denmark. Indeed, much of what is promoted as disease prevention world-wide is based on a science which assumes that its information is objective and globally true. Because this is actually false, the success of our disease control programs depend on the degree to which we could convince the Nepalese to become like Western countries. This explains, in part, why conventional programs to control echinococcosis in New Zealand have been much more successful among settlers of European descent than among the native Maori.

The ultimate effect of conventional public health programs is a narrowing of the cultural base, and a closing off of options for future adaptability to change. They tend, thus, to fly in the face of sustainable development. Just as genetic homogenization in the populations of plants and animals we use for agriculture is leading inevitably to global epidemics of animal and foodborne diseases, so this cultural smoothing, while solving the disease problems we are focused on, will result in massive public health problems down the road.

Actually, it was even worse than this, because the European and North American models of disease control depend on reducing the complexity of nature to fit the image we have created in our simplistic laboratory models. The implications of this for species extinction, soil erosion, disease epidemics and global climate change we are only now beginning to realize.

Conclusions

The multi-perspective, multi-scale combination of narratives and models might seem overwhelming and perhaps paralyzing to someone seeking global quantitative assessments. It is instructive to return to ground level, and listen to the story of a squatter from one of the wards.

“Nowadays situation of Ward 20 is spoiling. Everywhere there is garbage and waste. The local people are unaware hence they dispose garbage and other things everywhere in the street. Instead of disposing at appropriate places as well as disposing in to the Bishnumati River that is why playing role to make Bishnumati River polluted hence the people living near by are facing different kinds of problems. There are many educated people although they don’t come out to develop the ward. Perhaps they feel that this is only the business of KMC (Kathmandu City Council) but they don’t know that someone

can’t clap without two hands. Only efforts of KMC the Ward never enters towards development. In the developmental activities of the community people must take active participation.

Garbage that is left uncollected for an extended period of time creates an environment friendly to disease-causing micro-organisms, which can be transmitted to the surrounding community. Garbage causes water pollution and polluted water causes disease such as fever, jaundice, dysentery, cholera, diarrhoea, parasites and typhoid.

The garbage and waste around there may bring different kinds of diseases, which drag the Ward backwards not forward. The whole ward will suffer from diseases only after that the people become aware at that time it would become very late.

It is necessary to increase public health awareness, especially on how diseases are spread by garbage. A monthly program on appropriate management of garbage disposal should be held in the Ward. Similarly, containers should be placed in various areas within each Ward. Both Ward Committee Chairmen and members and the Ward residents themselves must ensure that the containers are picked up on a regular and reliable basis. Hence, the community people must united and step forward for the development of Ward. Community people must be provided education. If some one is disposing waste in the street, the person must be asked to dispose into container. If everybody steps forward, the Ward 20 itself moves into bright future, diseases free, clean and clear. “

By starting our system identification from the inside out, based on the priorities of the local stakeholders such as this squatter, street sweepers, businessmen and political leaders, we can begin to understand the meaning of integrated assessments. We cannot of course stop at the “local”; even in our cleaned up wards, we found waste floating into the area from upstream (Figure 16). This is why multi-scale engagements are essential. In on-going debate and adaptation across scales, we can incorporate the insights gained from our scientific models, and the concerns of the wider scientific and sustainable development community. This approach to urban agro-ecosystem assessment, then is not overwhelming, but sensible, reasonable, scientifically sound, and can lead directly to meaningful and convivial changes to the lives of the people with whom we are working.

Figure 16. The need for multi-scale assessments

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