

TOWARDS SUSTAINABLE RURAL SANITATION: THE ROLE OF THE UNIVERSITY IN PARTICIPATORY TECHNOLOGY DEVELOPMENT IN PAKISTAN

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ABSTRACT

While the provision of and access to clean water by the poor has been an important international focus in recent years, issues of sanitation are as yet not nearly as thoroughly analyzed. Evidence of the inadequacy of conventional approaches to sanitation is nevertheless rapidly emerging, as we discover that they are in themselves neither effective in improving health, nor sustainable and rarely accessible to rural populations in the South. The importance of developing socially, institutionally, economically and environmentally sustainable solutions for rural sanitation is therefore quickly becoming apparent. There are a number of challenges, however, in moving out of a conventional sanitation paradigm towards more innovative approaches. Technology development in sanitation has proven to be power-laden, with little room for maneuver within an engineering-based regime. There are, however, exceptions. Sustainable sanitation is an emerging field of research in the North that has shown promising results in addressing environmental issues, and may prove relevant in the South. This will require that the process of technology development be both re-conceptualized and contextualized, to ensure that technologies are not only effective and sustainable but equitable and empowering as well and in fact lead to a better quality of life for rural women, men and children.

This paper explores processes of innovation and technology-development in sustainable sanitation, through an analysis of a joint Pakistani-Norwegian research programme. We explore the proposition that institutions and actors with similar approaches, ontologies, epistemologies, and methodologies tend to band together in powered knowledge regimes, reinforcing each other, and preventing the development of alternative constellations, both within their institutions and with external actors. We also contend that, by identifying the underlying approaches of various institutions or actors, and the constitution of power relations, one can better understand how alternative framings might be constructed and new alliances formed, leading to the emergence of new regimes of knowledge-sharing and development, and thus new pathways toward sustainable development. Case data was obtained through observation of and participation in research and education proposal development, programme-planning meetings and stake-holder workshops in Norway, Nepal and Pakistan, during the period from January 2007 to June

2009. Based on this case, we argue that the University can play an important role in managing a new regime of technology-development and promoting social change, particularly where there is a strong policy-focus on participation and equity issues.

1. INTRODUCTION

Provision of and access to clean water by the poor has been an important international focus in recent years, most clearly defined in the Millennium Development Goals (MDGs). This has mobilized vast resources globally in the form of international forums, etc. Issues of sanitation, however, although mentioned as well in the MDGs, have only recently begun to be considered in any comprehensive manner, and are as yet not nearly as thoroughly analyzed as water supply and access. How sanitation systems develop, are managed, and influence health and the environment, is therefore poorly understood. Particularly rural sanitation issues have been neglected, with sanitation being considered either as a purely hygiene-practice issue or the construction of latrines. Concerns over the inadequacy of these conventional approaches to sanitation, however, are rapidly emerging, as we discover that they are neither effective in improving health, nor sustainable. The importance of developing socially, institutionally, economically and environmentally sustainable solutions in rural sanitation is quickly becoming apparent.

There are a number of challenges, however, in moving out of a conventional sanitation paradigm towards more innovative approaches. Technology development in sanitation has proven to be power-laden, with little room for maneuver within an engineering-based regime. There are, however, exceptions. Sustainable sanitation is an emerging field of research in the North that has shown some promising results in addressing environmental issues, and may prove relevant in the South. This will require, however, that the process of technology-development be re-conceptualized and refocused to ensure that technologies are not only effective and sustainable, but equitable and empowering as well, and in fact lead to a better quality of life for rural women, men and children. It will thus require a departure from existing hegemonic sanitation-framings, and the development of a new technology-regime, in order to re-frame the issues and shift the pathway of development toward a more sustainable sanitation. In particular, it requires a new look at the role that universities can play in linking

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research and development, not only in theory but in practice as well.

This paper explores processes of technology-development in sustainable sanitation through an analysis of a joint Pakistani-Norwegian research programme. We explore the proposition that institutions and actors with similar approaches tend to band together in powered knowledge-regimes, reinforcing each other, and preventing the development of alternative constellations both within their institutions and with external actors. We also contend that by identifying the underlying approaches of various institutions, or parts of institutions, or actors within institutions, and the constitution of power relations, one can better understand how alternative framings might be constructed and new alliances formed, leading to the emergence of new regimes of knowledge-sharing and development, and thus new pathways towards sustainable development.

Case data was obtained through observation of and participation in research and development proposal development, programme planning meetings and stakeholder workshops in Norway, Nepal and Pakistan, during the period from January 2007 to June 2009. As participants in the process, this posed particular challenges to the authors in reflecting over our own roles and interests in the program. On the other hand, it gives a unique insider-view of the way the programme was negotiated by the various actors involved.

We begin with a presentation of the case; how the programme in sustainable sanitation has evolved in Norway, Pakistan and Nepal. We then offer an introduction to competing paradigms in technology-development in sanitation, and how this has led to the need for a different kind of analysis of technology-processes, which would explore a range of issues, interests and power relations that are not normally apparent in conventional understandings of innovation and technology development. We then introduce the idea of technology-regimes and their transformation, focusing on four main areas, which we find important in understanding the ways actors relate to each other in technology regimes:

- Professional environments, incentives and networks;
- Approaches to analysis, and complexity self-

reflexivity;

- Understandings of technology, innovation, knowledge and participation;
- Views of development, equality and equity.

In doing this, we combine emerging perspectives in innovation and technology with development perspectives on power-relations, participation, action research, and equity so as to explore alternative ways of framing sanitation-issues in a new technology-development regime. By anchoring the discussion in a specific process of technology-development, in this case Norway and Pakistan, we gain insight into what re-framing of sanitation issues, and re-defining the roles of the actors involved could actually mean in practice. Based on this discussion, we argue that the university can play an important role in managing systems of technology-development and promoting social change, particularly where there is a strong policy focus on participation and equity issues.

2. THE CASE

The Norwegian University of Life Sciences (UMB), and COMSATS Institute of Information Technology (CIIT), Abbottabad, Pakistan, have been collaborating in the field of Environment and Development Studies since 2005. In September 2008, CIIT launched an MS programme in Sustainable Water, Sanitation, Health and Development, in collaboration with UMB and Tribhuvan University, Kathmandu, Nepal. Funded in part, by the Norwegian government¹, this is an interdisciplinary programme combining technical, ecological, institutional and socio-cultural perspectives. In addition to curriculum, students are required to complete a participatory, field-based research.

The impetus for the MSc programme came from researchers and PhD students at partner institutions in Pakistan and Nepal, who had studied sustainable sanitation at UMB in Norway. Recognizing the potential of this type of technology in their countries, they entered into discussions with UMB on how it might be promoted in their countries. The timely availability of Norwegian funding for the establishment of MS programmes provided a specific entry point for such collaboration.

The MS programme principles were laid down early; the programme was to be interdisciplinary and

1 Funding was provided under the NOMA Programme (Norad's Programme for Master's Studies).

innovative, and the research participatory and rural-based. Development of the programme involved choosing courses from highly different disciplines, and many of the courses were themselves interdisciplinary in nature, while some of the courses already existed at one or more of the institutions, and yet others were completely new. This process required intense negotiation by academics from all the institutions over not only the content of the courses, but also to decide which courses would be obligatory and which would be elective, and what the entry requirements would be for students coming from very different academic backgrounds.

In Pakistan, plans developed simultaneously for a comprehensive research programme, in which the MS students' research could be embedded so as to contribute to longer-term, strategic research in this area. A workshop was therefore held in March 2009 in Abbottabad, where NGOs and government officials involved in the areas of sanitation and health were invited to share their ideas on what kind of research would be useful to them as implementers and policy-makers. The participants clearly stressed the inadequacy of the existing approaches to rural sanitation and the need to find more sustainable solutions, particularly for the poorest community members. There was a keen interest on part of the NGOs in not only conducting participatory research, together with students and researchers, but also sending their staff, village activists and government counterparts to CIIT for short- and medium-term courses, where they could learn about more sustainable approaches to rural sanitation and health, as well as share their own experiences of the field.

Follow-up meetings with NGOs and policy-makers in Islamabad confirmed a high interest in developing a comprehensive education, research and training programme at CIIT, into which implementers could be integrated. A number of funding sources were identified, which would serve to strengthen the quality of the programme and provide additional scholarships². The stage was now set for this new configuration of actors to share their knowledge and develop new insights to and technologies for sustainable sanitation and health. Even with existing funding, the programme would be able to operate on a very limited scale, such that education and research would be conducted. Also, the NGOs were willing to

pay CIIT from their own budgets to send their staff and partners to the courses they requested, making the training economically sustainable. Preliminary results from student research, conducted together with villagers and NGOs, will be available within the first year in the form of result workshops. Longer-term results, of course, take more time, depending on the nature of the research conducted.

Thus, one year on from receiving funding to start an MS programme, an entirely new knowledge-sharing system had been established that links villagers, NGOs, government staff and policy-makers, and researchers and students from the South and the North, to conduct action-research in rural sanitation, health and development. Although this initiative is still quite young, it nevertheless represents an interesting case where it happened rather quickly and has received such broad-based support from both the universities and institutions involved in rural sanitation in Pakistan. It would therefore be interesting to examine closely the conditions under which this programme was established, which contributed to its apparent acceptance. By analyzing the process this far, we might also gain insight into whether this initiative might be sustainable institutionally, and contribute to positive social change in the communities, as well as farther-reaching changes within the universities in both Norway and Pakistan.

3. INNOVATION IN SANITATION: PARADIGMS IN TECHNOLOGY DEVELOPMENT

Sustainable sanitation³, is gaining ground in the North as an alternative to the shortcomings of conventional systems of sanitation, particularly in rural environments, but also more recently in urban settings. Langergraber and Muellegger (2005) see it as a 'way to solve global sanitation problems' through minimizing hygienic risks and protecting the environment. The sustainable sanitation 'movement' itself is global, with researchers, activists and policy-makers participating in a number of global forums⁴ to promote the approach in both policy and practice. According to Langergraber and Mueller (ibid), the sustainable sanitation paradigm 'is based on ecosystem approaches and the closure of material-flow cycles' where 'human excreta and water from households are recognized as a resource (not as waste), which should be made available for re-use'.

2 The NOMA programme provided only 5 scholarships, the remaining 20 were financed by CIIT in order to support the programme in its early stages.

3 Sometimes referred to as ecological sanitation, or EcoSan, depending on what one includes in the definition.

4 World Water Week.

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(p.435). It is a holistic, systematic approach, with a focus on ecologically and economically sound sanitation.

One of the key ideas in this approach is that technologies are considered as means to an end, and are only ecological in relation to the observed environment. Technologies could therefore range from latrines to natural filtration systems and biogas plants, depending on the natural, social and economic context. This is a significant break from an approach that focuses on the technologies themselves as inherently environmentally sound or not. Thus, those following a sustainable sanitation approach in this broader sense, are highly dependent on a detailed understanding of both the natural and social environment in order to design ecologically, economically and socially acceptable sanitation systems. It also implies that a new assessment of these aspects is necessary for each environment and a unique solution is developed, necessarily with the participation of all the stake-holders. This has, in fact, enormous implications for how sanitation systems are both conceived and promoted, since it breaks radically with the conventional focus on sanitation-hardware and on making small changes to existing systems to make them more environmentally friendly.

In addition, sanitation systems in developing countries have their own set of challenges, which can be quite different from those in the North. Langergraber and Muellegger (2005) note that while the main challenge in sanitation in the North is to limit negative environmental impacts, in the South the focus should be one of reducing health risks. This in turn implies an understanding of the link between hygiene and sanitation, which requires detailed knowledge of local hygiene practices and perceptions of health. In addition, there are significant challenges in the South in addressing the needs of the poor particularly in rural areas, who are often without access to basic public goods and services. There is thus a dimension of equity in the development sanitation systems in the South, which is less acute in the North, where public services are far more likely to reach the majority of the population.

Conventional theories of processes of innovation and environmental technology development offer limited insight into how new sanitation-systems, radically different from conventional systems can, in practice, be developed. The bulk of literature on environmental technology development has focused almost exclusively on innovation in terms of discrete

technologies, in the context of private firms, and realizing the importance of price as 'an efficient means of inducing technological and organizational innovation' (Berkhout 2002:1). Such analyses, however, have been unable to capture the significance of the complex social, political and economic systems in which technology development is actually embedded. Firms, for example, have to relate to wider markets, consumer demand, regulatory systems, infrastructural limitations when considering technological changes, but as, Smith et. al., note that they 'have little room for unilateral maneuver in relation to these factors' (2005:1491). The possibility of the rapid spread of technological innovation initiated through firms, therefore, is inherently limited. Also, there may be little incentive for private firms to take the lead in developing technologies accessible to the poor, without significant support from the public sector, which in many countries is not viable due to weak public institutions.

Alternatively, more recent literature has suggested a complete reframing of technology analysis away from firms, to focus on the shifts and transformations of larger technology-regimes (Kemp et al., 1998; Berkhout 2002; Smith et. al., 2005). Such analyses broaden the scope to consider the interaction of social, economic, political and institutional aspects of technology-development in either reinforcing or changing technology-regimes. *In this approach, issues of agency and power in the transformation of socio-technical regimes become central. Regimes are not comprised of static institutions linked together in relations of equality, but of institutional and individual actors who differ in the degree to which they can influence the direction of innovation within a regime.* Smith et. al. argue, therefore, that in order to consciously change regimes (purposive transformation), one must consider the ways in which the many actors who are members of the regimes negotiate with each other and exercise their influence over the pathways of innovation. This will require careful analysis of who the different actors are; what their interests are; what resources and competence they have at their disposal and which contexts they can influence change and in which ways. Through such an analysis, the complementarities of the actors, as well as possible competing agendas can be identified, and their power relations can be better understood.

Deconstructing and re-constructing technology regimes in this analysis will involve the examination of four sets of issues:

- Professional environments, incentives and networks;
- Approaches to analysis, self-reflexivity, and complexity;
- Views on technology, innovation, knowledge and participation;
- Views of development, equality and equity.

The choice of these four represents a synthesis from several distinct but relevant areas, including science studies, development studies, and ecological/environmental sanitation studies. In practice, these areas overlap and interconnect, reinforcing or disconnecting to form a web of relationships between actors in a technology regime. Thus, while we have organized the sections below according to these sets of issues, they are nevertheless not treated as completely separate; but are woven into the discussion whenever relevant. Since this analysis is concerned not only with a description of a regime but also the processes of change we need, as well as a way to conceptualize what we mean by regime change or change in the pathways of socio-technical development. Berkhout (2002:3) outlines three ways of conceiving change:

- Multiple, cumulative, often incremental changes that occur within regimes (no major shift in regime, but improved efficiency);
- Smooth re-orientation of prevailing trajectories (re-orientation in direction over time, but no change in the technologies and supporting institutions);
- Replacement of an incumbent system with a superior one.

It is the last example which describes a shift from one regime to another. According to Berkhout, 'Truly revolutionary innovations are likely to start small, and they will come to define through co-evolutionary processes a new regime for themselves' (Ibid). It is perhaps this type of regime shift that is occurring, within the sanitation regime in our case, to varying degrees and with varying success in the different contexts.

4. PROFESSIONAL ENVIRONMENTS, INCENTIVES AND NETWORKS

Sanitation technology has conventionally been placed firmly within the field of engineering and professionals are being trained in engineering and water and

sanitation positions being filled by engineers. This network has proven to be powerful, both nationally and internationally, and in terms of sanitation it has turned rather conservative. Alternative approaches to sanitation have struggled where they have tried to operate within this established professional sphere. Also, due to the hardware aspects of conventional sanitation, there is a network of contractors and suppliers which would prefer a continued focus on existing options. *It is clear in any case that these environments are ill-equipped to consider the complex and interdisciplinary issues which form the new paradigm in sustainable sanitation.*

In order to develop new approaches to sanitation, a shift out of mainstream engineering into new spaces has occurred, for example environmental engineering, environmental sciences, or multi-disciplinary centers of research and innovation. In Norway, environmentally conscious sanitation has developed in at least two separate research environments, each with its own regime of institutions and resources. In one environment⁵, the focus has remained within the engineering world, albeit environmental engineering. These efforts are highly commercialized, funded largely through research grants from private industries, but with an element of public funding from the research council. In this regime, the approach has remained one where sanitation innovation is concerned with producing increasingly more sophisticated hardware to address environmental concerns, mainly in the context of Norway.

The second environment⁶ in Norway has shifted its focus increasingly farther away from an engineering paradigm, and moving its center away from environmental engineering to both environmental sciences and development studies. *This does not mean that environmental engineering is not an important field in which to work, it is merely that it no longer lies in the center of the wheel. One of the spokes of an interdisciplinary approach to addressing sustainable sanitation is considering a myriad of aspects, such as development, health, environment, culture, socio-economic, politics and institutions.*

In many countries of the South, however, the development of water and sanitation systems remains firmly within the sphere of engineering, with environmental engineering securing a small space within that discipline. This is the case, for example, of Nepal, where the sustainable sanitation collaboration

5 Here we refer to the environmental sanitation work connected to NTNU and its partners.

6 Here we refer to the work at UMB and Bioforsk, in the Aas environ.

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is placed in a sub-section of the main engineering department at Tribhuvan University, where a few environmental engineers are located. In Pakistan, a different institutional approach has been taken. The programme is currently based in Environmental Sciences, is run by the Head of the Development Studies Department, in collaboration with the Department of Management Sciences and the Engineering Department. This is a radically different way of organizing research and education in sustainable sanitation. One important advantage of this arrangement is the fact that there is no established engineering field at the university working in sanitation that would resist a shift away from conventional approaches to sanitation, rather the engineering department at this campus focuses on electrical engineering. It could thus be considered as a process of 'niche formation', where there is a break with the existing institutional relationships. *In order for this to succeed, however, the university leadership must be highly committed to the idea of interdisciplinarity and to create incentives for departments to collaborate among established departments.*

As mentioned earlier, sanitation networks extend beyond university, as in government and NGOs. In particular, sectoral approaches to water and sanitation, health and hygiene, and environment are manifested in government departments and NGOs through the hiring of staff according to their professional background. For example, engineers in Pakistan receive their training from Civil Engineering Departments) and health staff from medical colleges. Integration between these fields has proven difficult; for instance it is quite common in NGOs in Pakistan that the health and hygiene programmes are staffed by health professionals, the water and sanitation are staffed by engineers, and the two programmes are run separately. Starting a sustainable sanitation programme is also a challenge for these professionals. What we do find at the national level, however, is an interest in the Ministry of Environment in exploring more environmentally friendly ways of approaching sanitation, although the impact of this at lower levels of government is limited.

Thus, in the case we are describing, we can see three sets of regimes, where institutions form networks, either on a disciplinary or sectoral basis (see Figure-1). First, the conventional engineering network (in yellow), second the sectoral networks in the field (yellow and purple) that reinforce their sectoral approaches through professional training and hiring, and, third, the emergence of a new network in

sustainable sanitation, which encompassed three university departments at UMB in Norway and three departments at CIIT in Pakistan (with connecting lines). This new network, however, is not in itself sufficient to change the way sanitation technology is developed. It must link with the actors involved in both the policy-making and implementation of sanitation at the village level, who as we see are still stuck in a sectoral approach. This will involve not only the forming of new networks, but gaining an understanding of the sometimes fundamental differences in approach between these factors, which made the break with conventional engineering necessary in the first place.

5. APPROACHES TO ANALYSIS AND APPRAISAL, COMPLEXITY AND UNCERTAINTY, AND REFLEXIVITY

How different environments view the tasks of appraisal and analysis is central in enabling academics from different disciplines, policy-makers, government staff, local NGOs and villagers to interact constructively. According to Stirling et al., (2007), there are fundamental differences in the ways in which certain actors or groups of actors frame issues that will affect the way they view the tasks of analysis and appraisal. Rather than being based on differences in disciplinary background, or quantitative vs. qualitative dichotomies, he suggests that there are cross-cutting issues which transcend these dichotomies. One of these is the extent to which analyses and appraisals 'open up' or 'close down' the scope of enquiry, analysis and policy-making (Stirling, 2005; Stirling, et al, 2007). According to Stirling, these involve quite different normative, substantive and instrumental understandings of the purpose of an appraisal or analysis, and will impact the way it is carried out as well. If, for example, the purpose of a technology process is either to provide policy-makers with clear, instrumental justification for policy-making, or to provide the single 'best option' to users, the role of the appraisal and analysis process 'lies in cutting through the messy, intractable and conflict-prone diversity of interests and perspectives to develop a clear, authoritative, prescriptive recommendation to inform decisions' (2005:228). Key characteristics of such an approach are that it is unitary and prescriptive, with a limited number of 'best options'.

If, however, the purpose of a technological process is to open up choices, as well as to ensure an understanding of the consequences of alternative framings on the results, the appraisal and analysis

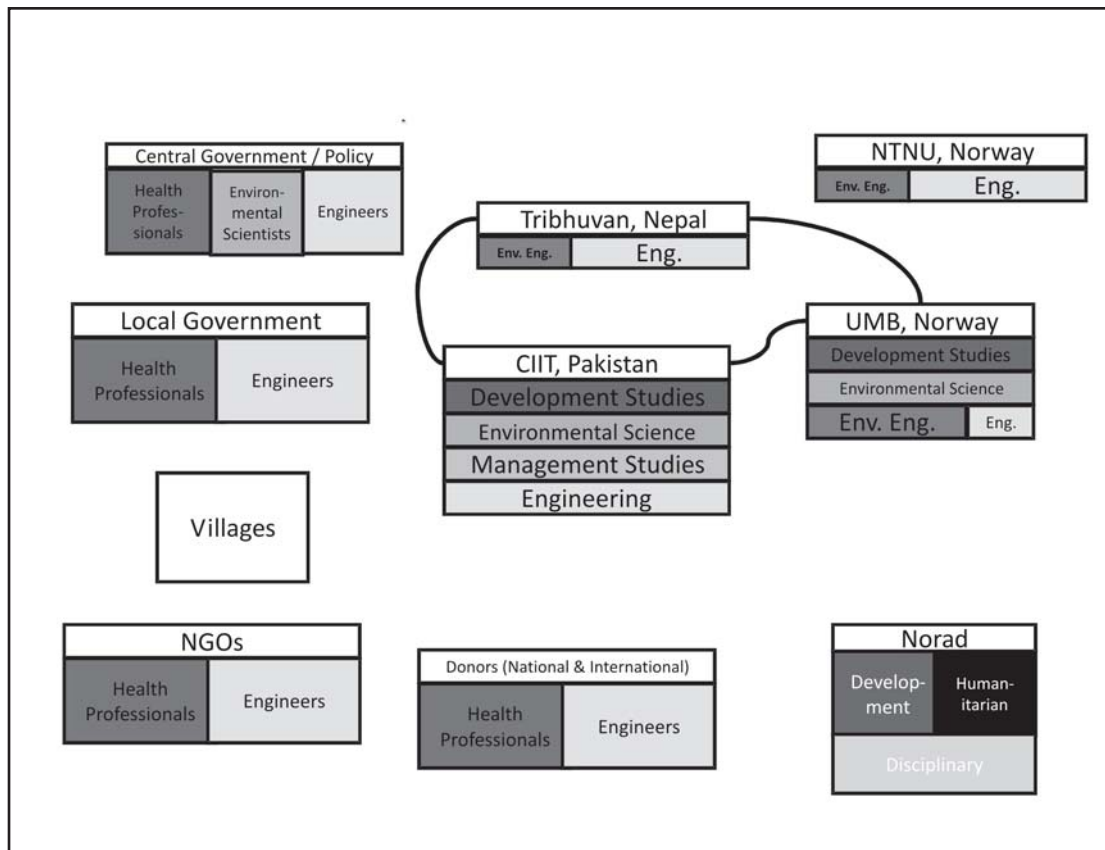


Figure - 1: Institutions and Actors in Sanitation in Pakistan, Norway and Nepal

process would focus to: ask alternative questions; addressing neglected issues, including marginalized perspectives, triangulate contending knowledge; test sensitivities to different methods; consider ignored uncertainties; examine different possibilities; and highlight new options (Ibid: 229). *In such an approach, the 'outputs' to policy-making would be 'plural and conditional' (Stirling, 2003), 'illuminating the potential for accommodating more diverse portfolios of social choice' (Stirling, 2005: 229).*

In our case, we can see how the academic actors in the new sustainable sanitation regime are promoting a clear 'opening-up' approach, which involves a broad appraisal and analysis based on the inherent complexity of designing socially, economically, institutionally, and ecologically sustainable sanitation systems. Since the success of such systems will be completely dependent on the development of contextually appropriate solutions, simplified, single-solution approaches would simply not be possible. This could be one explanation of how environmental engineers and scientists could ally relatively easily

with social scientists in the institutions involved in the collaboration. Environmental sciences recognize the inherent complexity and context-specific diversity of ecological processes, which, in some respects, is mirrored in the world of social science, where people and their social relations are complex and diverse as well. An 'opening-up' approach in itself, however, is not sufficient to comprise a strong, alternative technology regime, and needs to be combined with other aspects, that are presented here in the next two sections.

While the universities involved in the programme have a clear 'opening-up' approach to sustainable development, they will likely encounter challenges when engaging with other environments who may instead lie firmly within a closing down, prescriptive mode. This might include policy-makers faced with the need for clear, often sectoral direction, as well as donors and government staff who are conceptually located in a service-delivery/hardware mode of operation, with pressure to 'scale-up' interventions. Hence, it will be critical that the outcomes of an opening-up approach are made explicit in the process,

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in terms of both the development of innovative, appropriate and robust systems, but also the ways in which the inclusion of local women and men in a participatory technology development process is ensured for capacity-building in terms of the development of local competence in appraisal, analysis and deliberation over alternatives.

6. UNDERSTANDINGS OF TECHNOLOGY, INNOVATION, KNOWLEDGE AND PARTICIPATION

Another group of related issues revolves around how actors understand processes and concepts embedded in technology development. Starting with the idea of innovation, we argued above that innovation with a technological paradigm is considered as the domain of private-sector firms. Evidence from other sectors, however, shows us that innovation, in fact, occurs elsewhere as well. One well-known example of this is the research and innovation by small farmers in the South adapting and developing agricultural technologies, either on their own or in collaboration with agricultural researchers and extension agents⁷. Literature is filled with examples of how farmers have been innovative, in light of their own diverse needs, interests, and dynamic situations and most recently adaptation to climate change⁸.

In the field of sanitation, however, models of innovation development are still in their infancy. While there is evidence of innovation by villagers in collaboration with NGOs (Nyborg, et. al., 2009). This innovation is little known in conventional sanitation environments, and completely separate from the existing sanitation-technology regime led by government engineers and policy-makers. The question thus arises on how to include local innovation-processes in a broader technology-development regime. A closer look at the way technology itself is understood by different actors, and how this is linked to the contemporary views of knowledge and participation, will provide clues as to how a new regime may be constituted.

One of the fundamental shifts in the understanding of technology over the last 30 years has been the acknowledgement that technology is not merely the production of discrete 'things' but is in fact a 'process' embedded in socio-cultural, economic and institutional norms and practices through which discrete 'things' may or may not be developed.

However, despite the emergence of the field of science and technology studies in the 1970s and a plethora of anthropological work examining local knowledge-systems and their meeting with modernization processes, the view of technology-development as an embedded process has not managed to infiltrate the mainstream technology-development regime in sanitation. In Norway, for example, civil engineering educational programmes can exist side-by-side with society, technology and culture studies (e.g. at NTNU), but with not one course in the civil-engineering programme on social aspects of technology. At UMB, the social study of science and technology is conspicuously missing.

The lack of reflection over how science and technology relates to society puts conventional sanitation regimes at a disadvantage in understanding how local knowledge can, in fact, become an integral part of technology development, particularly in the South. In the current sanitation-regime, knowledge owned and practiced by scientists and government engineers is privileged over other types of knowledge (experience-based and socially and culturally embedded). In Pakistan, sanitation solutions are based on technologies developed by 'credible knowers,' (i.e. government engineers) and then transferred to local populations. If there are problems in the acceptance or use of such technologies, this is considered mainly the fault of the villagers, whose cultural practices hinder their learning of the 'correct' way to behave and use the new technology. While there have certainly been attempts to consider local preferences in technology development, the impact remains limited. As long as the mode of participation remains inherently consultative, and the view of technology as created by the 'knowers', (i.e. the university) and disseminated to 'users' (i.e. villagers) sanitation technology will remain firmly within a 'technology transfer' paradigm, with local knowledge valued only as an input in a process controlled by others.

There are, however, alternate views of knowledge and participation which have grown out of a mix of anthropological, feminist, development and participatory research-literature. Particularly influential has been Haraway's (1999) view of knowledge, where she rejects the myth of the objectivity of knowledge through her claim that all knowledge is situated and partial, embedded in social

7 For example Reij, Chris and Ann Waters-Bayer (2001)

8 See for example Lars Otto Næss (2005), Eriksen et al (2007).

position, place and time. *The idea of knowledge being both situated and partial implies that no one type of knowledge is able to supply a complete picture of a situation or condition, and must be complemented by other types of knowledge to offer a better picture of the world. Thus privileging one type of knowledge, like scientific knowledge, and excluding knowledge produced in other ways, would, in fact, prevent better accounts of the world (Fortmann 2008).* With such a view of the embeddedness of knowledge creation, the interaction of several types of knowledge throughout a process of technology-development becomes a prerequisite to creating sustainable solutions. Each 'knower' takes to the table his or her unique perspective and experience, whether it be generalized or localized. Participation is thus perhaps no longer the most useful term to describe this relationship. *Fortmann's (2008) concept of 'interdependent science' may offer a better way forward in understanding how conventional science and citizen science might interact.* For this to be possible, issues of unequal power in terms of resources, framing and with credible knowledge at different points in the process have to be addressed. In Pakistan, the way in which researchers and sanitation implementers approach and interact with villagers in the initial assessment phase, when the problems are being defined, will be particularly telling. 'Who will be included in initial assessments?', 'What type of data will be collected and discussed', and, 'How it will be analyzed and acted upon?' are all questions which will likely require serious negotiation between a diverse set of actors to determine whose knowledge is most when relevant, as well as whose voice will be heard at what point during the process of technology development.

Power relations between scientists and citizens are not the only power relations to be considered. Technology development in both Norway and Pakistan is mitigated by a variety of actors both in the process of development and its use, and becoming thoroughly embedded in social, political and economic institutions along the way of development. In the following section, we will consider, in particular, the role of development aid in sanitation-technology development in Pakistan.

7. VIEWS ON DEVELOPMENT, EQUITY AND EQUALITY

A fourth dimension, which we find important, is the way in which different actors may or may not consider

development, equity and equality in their understandings of technology-development processes for sustainable sanitation. In Norway, since sanitation systems already have near-complete coverage, equity issues are perhaps most relevant in terms of who should bear the burden (private vs. public) for a switch to more environmentally sound sanitation. In Pakistan, however, poor sanitation and the lack of sustainable solutions have a direct effect on rural development, and there are serious issues of unequal access to the limited sanitation technologies which might persist. Therefore, the ways in which actors relate to these issues will influence how they think about appropriate and sustainable solutions.

The development of conventional sanitation solutions on the basis of technical or engineering specifications and efficiency, combined with a focus on the provision of hardware and government contracts with private suppliers, has a propensity to define development in terms of infrastructural modernization, rather than those of health benefits, access or equity. Thus, capital intensive infrastructural investment takes precedence over low-cost solutions made with local materials, which although accessible to the poor, may be perceived as steps away from rather than towards development (Nawab and Nyborg 2009). In Pakistan, this view is quite common amongst both government technical officials and village elites, who view development as emulating the infrastructural achievements of the cities and the West (ibid).

If, however, development is viewed as improving the health and well-being of all⁹, then equal access to sustainable sanitation becomes an important criterion. In Pakistan, this also entails the involvement of development organizations into the institutional landscape, each with their own set of interests, aims and interpretations of rural development, and, in turn, sanitation technology. International and national NGOs, supported by donor funding, influence both government policy-making and local implementation of sanitation programmes. Rather than reflecting one view of development, however, they represent a range of views, influenced by many of the professional and disciplinary splits that can be seen both within universities and between government ministries and departments.

Also, there can be a difference in the underlying approach to development of the NGO, in terms of whether it focuses on service delivery, or social and

9 As in, for example, the MDGs

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political rights, and capacity building. The strength of these organizations is that they work directly with the communities, where they see the problems faced by local women, men and children first-hand. They are themselves, however, constrained in addressing these problems in several ways. They promote participatory development in principle, but nevertheless continue to deliver services and training based on a dissemination paradigm. This is particularly true in terms of sanitation technology. While they may have become better at interacting with communities on a more equal basis in some areas, they continue to come to the communities with finished technical solutions. Their staff carries on the scientific traditions from whence they came, for example, for water and sanitation programmes they recruit engineers, and for health and hygiene projects they recruit health staff. Both of these are trained in the design and delivery of technical solutions¹⁰. This can in fact result in different views of the nature of both knowledge and participation within the same organization.

In terms of equity and equality, the emphasis of development organizations on these issues opens for an alliance in a move towards improved access by the poor to sustainable sanitation solutions. In fact, in Pakistan, there has been quite a lot of NGO activity to support improving sanitation systems, and the introduction of CLTS has increased the focus on motivating local communities to address their sanitation problems such that they are low-cost and accessible to the poor. Despite a good degree of innovation, however, they have expressed the need to the development of more sustainable solutions, as their locally developed solutions are not able to fully address the environmental and institutional needs of these rapidly growing rural communities, particularly in schools and other public spaces.

Collaborating with the university in the development of more sustainable technologies is thus of great interest to these organizations. The nature of this collaboration could take two distinct pathways, depending on the way views of knowledge and technology coincide with views of equity, equality and the nature of development. In one scenario, where equity is defined as equal access to improved technology and the organization has a focus on service delivery, improved sanitation could merely involve the transfer of finished technology having a certain amount of local

involvement in construction and testing. However, in another scenario where the development organization is more concerned with equality of voice and equity in participation, technology development could be seen as a process through which members of the community engage with scientists to develop a new, appropriate technology on a more equal basis. *It is, of course, the second scenario towards which the sustainable sanitation programme in Pakistan is trying to move.*

8. RE-DEFINING ROLES WITHIN A NEW SUSTAINABLE TECHNOLOGY REGIME

The previous sections explored sets of issues which have been shown to be important when considering how the different actors working in sanitation technology relate to one another in the practice of technology development. It has been both a reflection of what has happened so far in the process, as well as a reflection over what may be found important to consider in the programme as it develops further. Returning to the idea of the creation of a new technology regime, or at least to what Kemp, et. al., (1998) term niche formation, we can then pose the question, 'How does one successfully form a niche, and what does one have to be aware of in order to ensure that the process is not co-opted?' Both Smith et al., (2005) and Kemp et al. (1998) cite several conditions which are necessary to ensure that transitions to new technology regimes are successful. Kemp et al, for example, warn against the inclusion of actors with vested interests in competing technologies, since they may, in fact, slow down or even stop the niche from developing (p.191). In our case, it is not possible to completely close out competing actors, as we will meet many actors, particularly practitioners, who still lie firmly within conventional engineering, health, or service delivery traditions. We can, however, being aware of the particular issues discussed above, develop strategies on how to promote a better understanding of sustainable sanitation amongst conventional actors.

Smith's discussion of the 'purposive transitions' of regimes goes further by identifying three arenas where attention to power and agency particularly matters: the ways in which membership networks are formed, how resources are distributed amongst these members, and the degree to which visions and expectations are shared. All three aspects are

10 As described by NGO workshop participants themselves

important, and have been touched upon in various ways in our analysis above. We would, however, like to examine more closely the implications of the third arena, shared visions and expectations, on the development of a new technology regime. As Smith et al., State, 'different core members will have different ideas and shared narratives bearing on regime-development and technology appraisal'. This is also clear in our case, as we have seen above how different actors had different understandings of and approaches to ideas of knowledge, participation, technology, development and equality. In forming a new regime, the ability to drive forth, amongst a diverse set of actors, a common vision and understanding of sustainable sanitation and all of its complexity is a key-factor for the ability to develop and sustain a new technology regime. This task is not of 'control', but of having 'legitimate authority to push change through, or, the resources available to build consent, to raise informed dissent, or even to block change' (2005:1508). Who should take the lead in such an endeavour? We have already discussed the limitations of private industry in leading environmentally friendly technology development for the poor. Public policy-makers as facilitators has also been suggested, 'to ensure that the processes of co-evolution of technology supply and demand lead to desirable outcomes' (Kemp et al., 1998:191). While this could be a possibility in the future, the government sector in Pakistan currently remains too sectorally focused and embedded in competing political interests so much so that it may not be able to live up to such a challenge in the short-term (Nawab and Nyborg, 2009).

9. CONCLUSION

In our case, it is the university sector that has taken upon the role of both guiding and managing a new technology regime in sustainable sanitation. As we discussed earlier, however, it is a group of particular actors, with particular interests and backgrounds, at the universities involved that have taken this initiative. Also, while the university sector can certainly suffer from lack of funds and capacity, both in the North and the South, they have nevertheless several important attributes that could support their ability to manage a new regime in sustainable sanitation since:

- As a public institution, it is not excused as private firms might be, from accountability to public policy i.e. poverty goals, etc. (Leach, Scoones and Wynne 2005)
- Its business is not only research, but education

and training as well (unlike NGOs, private business and government). Therefore, lessons learned from research feed directly back into education and training and visa versa.

- It can 'open-up' the field, and offer comprehensive analyses of both research processes and outcomes, and address broader issues of complexity and interdisciplinarity, but still make sense of the 'messy' data.
- It can respond to the need for competence building in the art of reflective thinking and practice, as well as meta-thinking.
- Since universities are permanent institutions, they will continue to have a mandate for education and research in the long run.

While in this case the university may be an appropriate manager for developing a new technology regime in sustainable sanitation, there may be other institutions more adept in other fields of technology or development. Nevertheless, there may be an untapped potential in using universities as hubs of knowledge networks, innovation and social change, both in the North and South. This has been recognized by UNESCO, who has recently published 'Higher Education: New Challenges and Emerging Roles for Human and Social Development, the third volume of a series specifically devoted to examining the social commitment of universities (GUNI 2008). There are also a number of innovative grass-roots initiatives, such as Earth University in Costa Rica, and Brighton University, UK, who foster close interaction with local communities as an integral part of their education and research programmes. In our case of sustainable sanitation in Pakistan, we see the emergence of a new technology regime as an opportunity to forge new alliances between the public and the private, citizens and government, which, if followed closely, could contribute to new and better pathways towards sustainable development in rural Pakistan.

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