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Poisons, pragmatic governance and deliberative democracy: the arsenic crisis in Bangladesh

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Abstract

The paper applies some of the principles of pragmatism to the environmental health crisis of arsenic pollution in the groundwater of Bangladesh. This hazard affects between 28 and 57 million people and it has been called “the largest mass poisoning of a population in history”. Such hyperbole aside, the authors consider the dysfunctional nature of central and local government in Bangladesh, which at all levels can be said to have failed water consumers. This leads to a discussion of the nature of governance generally, particularly with regard to two principles derived from the pragmatism of John Dewey: first, an orientation to political action through local, community-based experimentation; and, second, a conviction that participatory democracy draws its strength from the beliefs and attitudes distributed in social networks. The paper then assesses a number of interventions, for instance the World Bank’s large-scale Bangladesh Arsenic Mitigation Water Supply Project which has faced administrative problems since its inception in 1997 and was very slow to find its feet. NGOs with a stake in arsenic mitigation are also highlighted, particularly for their role in the so-called franchise state. It is argued that a number of conditions of inertia and resistance explain the sluggish response to the arsenic hazard. Indeterminacy about the science and technology of arsenic is one factor, and another is the distribution of power at the local level. The paper argues that future policies and projects would do well to consider deliberative democracy in guises appropriate to rural Bangladesh. This must include better information availability and opportunities for participation at the village level, for instance in civic science. The overall conclusion is that pragmatic principles are helpful in promoting community-focused mitigation measures but that accountability is essential if policies are to avoid problems of local power, patronage and clientelism.

Keywords: arsenic; water; environmental health; South Asia; Bangladesh; governance; pragmatism

“Arsenic is a metalloid whose name conjures up images of murder” (Oremland and Stolz, 2003, p. 939).

1. Introduction

With its vast, intersecting problems of poverty and environmental vulnerability, and a limited administrative capacity, the government of Bangladesh has struggled to formulate and implement a national water policy. This failure has been so comprehensive that Geof Wood (1999, p. 734) has commented acidly that “policy towards water is too important to be left only to those traditionally in charge of it”. The legitimacy of the elected government itself is perhaps questionable when there is such neglect of both the national interest and the interests of water users and consumers, but some argue that the recent reshaping of environmental sovereignty in Bangladesh into a new form shared between local politicians, NGOs and the aid industry means that we must reassess governance in terms of an ethics of distributed responsibility (Wood, 1997).

Water is a well-known hazard in Bangladesh, with riverine floods causing annual disruption and death, but this paper will investigate a different aspect of water policy and practice. Pollution by one of the trace elements in the groundwater has caused a major environmental health emergency. This started in a low-key fashion.

“About six or seven years ago blisters developed on my whole body and there was a lot of itching. A few months later, these blisters turned into black spots on my hands and legs. They itched and there was some pain. A few years later, these black spots became hard and rough. Now they have turned into sores” (In-depth interview, Basiapara village, 2001).

The experience of this patient is now a common one across Bangladesh, due to chronic arsenic poisoning. So far, 38,380 people have been diagnosed as having arsenicosis (BAMWSP, 2004a) but the expectation is that the figure will rise to two million as patients present with a complex variety of symptoms, including internal cancers (Yu et al., 2003). Estimates of the total number at risk vary from 28 to 57 million (BGS and DPHE, 2001) of the 100 million who drink water from tubewells, spread across most districts except for the eastern hills.¹ A national screening programme, mainly undertaken by the Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP), but with inputs also from UNICEF, DANIDA, WorldVision, the Watsan Partnership Project, and the Asia Arsenic Network, in 270 thanas, has found that water in 29.12 per cent of the 4.9 million tubewells

tested was polluted to unsafe levels. The most challenged district is Chandpur, near the mouth of the Ganges, which has serious pollution of 93.00 per cent of its tubewells, with some thanas up to 98.62 per cent.

This poisoning is the result of complex geochemical interactions in the Holocene sediments that comprise much of the surface layers of the deltas of the Ganges, Brahmaputra, Meghna and other rivers, and therefore West Bengal is affected as well as Bangladesh. Generally speaking, the aquifers to a depth of 100 metres are more polluted than those at depths greater than 200 metres, by an order of magnitude. Drinking water is extracted through small diameter metal or PVC pipes and the concentration of arsenic depends upon this depth but also upon horizontal variations in space. As we have noted, there is a regional component to this, but there are also micro-scale differences, sometimes between tubewells sunk within metres of each other.

It is important to mention that the conjoined deltas of the Bay of Bengal are not alone in exhibiting this environmental health emergency. The arsenic poisoning of groundwater is also a serious issue in other parts of South Asia, and also in Taiwan, Argentina, Chile, western China and even the United States. What is exceptional in Bangladesh is the weak response of its hollowed out and inefficient state. Other countries also have problems with corruption and dysfunctional governance but it is interesting to note that West Bengal, with a very similar set of geochemical groundwater conditions, has managed to mount a more effective response due to the committed stance of its state government.

As we will see, the weight of indeterminacy in the science and technology surrounding the arsenic pollution in Bangladesh is significant (Atkins et al., 2006a). Reaching agreement about an appropriate framework of policy has, as a result, proved to be difficult, exacerbated by political and bureaucratic problems with delivery. We propose a mode of enquiry that owes much to the pragmatism of John Dewey (1859-1952) and to the recent turn to “environmental pragmatism” initiated in the path-breaking book of Light and Katz (1996). Pragmatism, divided by some into the palaeo-pragmatism of Dewey, Peirce and James, and the recent, neo-pragmatism of Rorty, is a vast and complex enterprise.² For our purposes, it yields two practical principles that will inform our discussion.

First, there is the primacy of action and practice. The process of knowing is seen by Dewey as a transaction (Sleeper, 1986); “truth” is constituted in social procedure and theory is collapsed into practice. The judgment of progress is thus only meaningful as a review of practical “experimentation”, which may take various forms, including activities as diverse as science and democracy. According to

William James, “the significance of an idea is in the way it directs new observation and new experience” (Barbalet, 2004, p. 338). Experimentation leads to a balanced sensitivity to both hope and failure, without the bitterness, guilt or violent anger that has accompanied the assessment of negative outcomes in some ideologies.

Pragmatism has a keen sensitivity to context, as one would expect with a philosophy that has a relational ontology. Lived experience is prioritized over idealism and this leads to a refreshed view of empiricism, not as naive positivism but as a goal-orientated radical project seeking to engage with the world. Valuable though they are, pragmatism is not content with investigations of the conflicting interests at stake in a situation such as the arsenic poisoning in Bangladesh, nor with representational or discursive analytical strategies (Baert, 2003). There is an urge for practical engagement: for instance, the profound influence that Dewey has had upon American educational theory. William James, in particular, spoke of the ‘cash value’ of theories in terms of their practical consequences.

Second, concerns for conflict resolution and for community values make pragmatism a natural contributor to environmental debates (Rosenthal and Buchholz, 1996). The aim is not to develop universal ethical principles but to find a situationist and interactionist approach, even though this rarely yields certainties or argumentative closure (Bénatouïl, 1999). Because knowledge is active and agency is conceived as a network of beliefs and attitudes, the associated politics are likely to be participatory. Deliberative democracy through citizenship, particularly as conceived by Jürgen Habermas, is consonant with pragmatism. Community politics are essential to encourage participation in achieving environmental goals because they convey a sense of ownership and practical engagement. Although not a pragmatist himself, Habermas is willing to acknowledge a debt to Peirce, James, Dewey and Mead, the best known of the “classical” pragmatists: “I have relied on this American version of the theory of praxis when the problem arises of compensating for the weakness of Marxism with respect to democratic theory” (Habermas, cited in Aboulafia 2002, p. 2). He also shares with them the view that rationality requires dialogue and “communicative action” and Ingram (2002, p. 83) argues that Habermas learned from them that “knowledge is something acquired by persons in reasoning together”. As a result he has, throughout his philosophical output, suggested that “not bureaucratic hierarchy but participatory democracy is the best framework for problem-solving”.

Bearing these principles in mind, we will begin the paper with a brief analysis of the key issues of Bangladeshi governance, drawing on the literature which suggests that development has stalled because of poor administration, corruption and lack of accountability. Second, we narrate an

historical geography of arsenic poisoning in Bangladesh and look at responses to it at various levels, with special reference to the World Bank's BAMWSP. This is followed by an interlude in which we reflect on the need fully to grasp the indeterminacy of the associated science and technology if policies are to be acceptable and successfully implemented. The focus then shifts to the possibilities for democracy to provide a way forward, through the concepts of affected publics, deliberation and participation. Our conclusions raise certain pragmatic issues, including a recapitulation on ethics and distributed responsibility, one of the most important considerations arising from the arsenic crisis.

2. Circuits of governance in Bangladesh

The trope of illness often informs our metonymic image of Bangladesh. The social and moral decay implicit in that country's position at the top of the world's league table of corruption (Transparency International, 2005) is now paralleled by the new environmental sickness of arsenic, a health scandal on a global scale and even potentially "the end of a civilization" in the absurdly lurid words of one writer (Anwar, 2000). In this extreme view, curing the diseased bodies may require curing Bangladesh's dysfunctional system of governance because mobilizing resources and empowering energies at the local level are essential for both. There is little sign of either happening so far, and even the symbolic closure that all of us seek for our illnesses is absent (Herzfeld, 1986). There is no clinical cure presently available for chronic arsenic poisoning and most patients have been deprived even of a prompt, accurate and sympathetic diagnosis (Hassan et al., 2004, 2005). Government policy has been slow in the making and even slower in the implementation, to the extent that the Dhaka Declaration of 2002, by the members of a major international conference on arsenic, noted that "no significant achievement [has] been reached so far regarding the supply of arsenic free safe water to the people of Bangladesh" (Quamruzzaman et al., 2002).

Democracy in Bangladesh is a relatively recent phenomenon. Independence was achieved in 1971 but the present parliamentary system only took shape in 1991. The continuing enthusiasm of the electorate is shown by their 75 per cent turn out in the General Election of 2001, but there is still much to learn about the *modus operandi* most suitable for policy-making, local government and the exercise of human rights. The deeply antagonistic relations between the two major political parties (Bangladesh Nationalist Party and Awami League) has made peaceful and productive dialogue very difficult, so that even basic institutions such as the civil service and universities have become politicized to the point of breakdown. Most serious of all is the failure of parliament to act as a forum

for the debate of major political issues, coupled with the absence of devolved power in any meaningful form at the local level.

The World Bank's 2002 publication, *Taming Leviathan*, is a devastating and timely critique of Bangladeshi governance. It finds, first, a pervasive patronage and clientelism that rewards loyalty rather than efficiency and which is self-serving rather than addressing public agendas. This self-interest reproduces itself at all levels and results, for instance, in a lack of cooperation between ministries or agencies that should consult and have common programmes (Wood, 1999). Second, there are interest groups that have captured aspects of political decision-making and implementation, some of whom go beyond lobbying and the manipulation of social capital into the darker realms of intimidation. Virtually every proposal for reform encounters opposition from those who stand to lose power, status or opportunities for corrupt practices. These people are few in number but well organized and influential, whereas the masses who would benefit from change are a largely silent majority. In order to circumvent this dysfunctional and rotten polity, donors have for the last two decades been busy supporting NGOs as an alternative circuit of development delivery. But, according to *Taming Leviathan*, the NGOs have also failed to optimize governance, having had little impact on crucial needs such as strengthening the rule of law and supporting advocacy groups. The authors argue that:

“to succeed, reform must benefit all the stakeholders whose cooperation is needed. Because reformers have generally adopted a technocratic approach, and largely ignored the way incentives play out, the record of institution building is mixed – with few real successes and many setbacks to learn from. Effective incentives linked to real accountability are the key to better public sector performance” (World Bank 2002, p. ii).

There are 257 registered NGOs providing arsenic mitigation services in Bangladesh and these go some way to fill the gap left by state incapacity³; but they and the more general health NGOs operate in only about half of the country's village communities (Kaufmann, 2001). If there ever was a honeymoon between the rural poor and these NGOs, it is certainly over. Respondents in our field area in Ghona Union of Satkhira District are bitterly critical of a narrow NGO focus on micro-credit to the exclusion of effective arsenic remediation (Hassan, 2003), and there are more general criticisms of their competitiveness and weak accountability (Hashemi, 1996; Karim, 1996; Haque, 2002). Some of the larger NGOs, such as BRAC, Proshika and the Grameen Bank, have grown in size and mustered influence to match an industrial corporation or a government ministry, but their structural

faults, their stress upon professionalization, and a didactic style of relationship with the poor, has taken them further from invigorating the institutions of civil society (White, 1999; Ahmad, 2002). It is perhaps not surprising that NGOs in Bangladesh reflect both the problems and the hope of the broader society (Mercer, 2002).

Beyond the rarified political spaces of Dhaka there is significant physical and psychological distance between the thana level of administration and the villages (World Bank, 2002). This poses presently insurmountable difficulties for the efficient and timely application of policy. Also, union parishads and their chairmen are not seen by the people as either impartial decision-makers or as capable of providing adequate local services and the unelected gram sarkar introduced at village level in 2003 is seen by many as a cynical ploy by the governing party to bolster its influence in the countryside.⁴ There are no satisfactory mechanisms of redress for their partiality and inaction, and civil society is generally so weak that everyone must seek a patron in order to survive. Corruption and clientelism, although they are judged by outsiders in a moral light, are in reality coping mechanisms in a society where economic, social, political and environmental hazards are ever-present.

Barenstein (1994; 2000, p. 1) rearticulates the current wisdom that socio-economic poverty in Bangladesh is exacerbated by ineffective local governance. He claims that the life chances of the excluded majority will not improve unless they are brought into governance, “starting by the control of their immediate institutional surroundings and fair access to common assets and basic services, that is, by transforming the local power structures”. Barenstein’s account stands out because of his pragmatic advocacy of negotiation with local power brokers, whom he calls “tropical robber barons”, with a view to reaching their clients, the rural poor. This is because there is no evidence that clientelism is likely to decline in the near future; indeed, in the 1990s there was a trend away from traditional autonomous village or union-level power bases towards politicization vertically through national party hierarchies, with a ratcheting up of voter persuasion, including organized and widespread intimidation. As Dewey observed, such social facts are both “obstacles and resources” (Bohman, 2004, p. 37), and Platteau (2004) has argued that, while we must acknowledge the degree to which elites can hijack the benefits of community development aid, they often have tacit local support from poor and marginalized groups and so cannot easily be dethroned. Instead, Platteau argues for a series of measures that work within the *status quo* of distributed power but add layers of accountability that are a learning experience for all concerned.

A further constraint in the governance of Bangladesh is its weak capacity at the centre. Rammelt and Boes (2004, p. 308) assert that there is a general “weakness of governmental bodies in

solving problems within a reasonable time”. Despite the employment of large numbers of civil servants and agency staff, there has been insufficient investment in technical and managerial skills and the Department of Public Health Engineering, initially charged with solving the arsenic problem, is said to have been hopelessly out of its depth (Patel, 2001). Some institutional capacity was established through the BAMWSP funded by the World Bank from 1998 to 2006 but, generally speaking, centrally coordinated governmentality has largely failed and responsibility for arsenic remediation has been devolved *ad hoc* to a combination of NGOs and overseas donor agencies, who operate in a balkanized patchwork of client spaces that bear a startling resemblance to colonial territoriality (Figure 1).⁵ What has happened here amounts to an unbundling of sovereignty that can be seen, either as an incapable and reluctant state shifting its responsibility to more willing franchises, or, more generously, as the state “joining with non-state actors in ambitious experiments seeking to address problems...through multi-party collaborative governance arrangements” (Karkkainen, 2004). Either way, Bangladesh has now become a unique multiperspectival polity in the sense of Ruggie (2000) and Bohman (2004).

< Figure 1 here >

Steinberg (2003) proposes a spheres of influence model of environmental policy-making that transcends simplistic explanations of success or failure based upon corruption, class/caste/tribal conflict, elite strategies, or exploitation by multinationals. He prefers to note the successes of environmental movements in some countries derived from links between an international sphere of information and activism and a domestic sphere. In his opinion, it is the indigenous groups who are best able to forge such links and who achieve the most impressive outcomes. In Bangladesh there is some evidence to support this. The Bangladesh Environmental Lawyers’ Association was founded in 1991 and has been successful in opposing a range of environmental violations. In 2003 they were elected to the United Nations Environment Programme’s Global 500 roll of honour for their work in public interest environmental litigation. Their 38 key cases have included industrial pollution, compensation for development projects and, recently, the arsenic pollution of groundwater. Through the Bangladesh Environmental Lawyers’ Association’s international contacts, a case was brought in 2002 in the High Court in London against the Natural Environment Research Council, alleging negligence by its subsidiary, the British Geological Survey, which in 1992 had produced a report on water quality in certain regions but had not tested for arsenic (Davies and Exley, 1992). Atkins et al.

(2006b) discuss the case, which reached the House of Lords in 2006.⁶ For Bangladesh, it adds a new dimension to its spatialities of governance. Mason (2005) suggests that use of the law in this way amounts to a new accountability of environmental responsibility across borders, but, while most international environmental litigation has been at the level of state parties, the arsenic crisis shows the effective absence of a state. The government has neither been sued for negligence in its trusteeship of the common resource of water, nor has it been active in seeking redress on behalf of its consumer citizens for the damage caused by arsenic poisoning. It has played Banquo, a ghostly presence threatening from the wings but having no tangible form or impact. This can be seen as an instance of what Karkkainen (2004) calls post-sovereign environmental governance, reassigning powers and responsibilities to non-state actors. In the absence of governmental capacity and collective political will, the duty of holding to account cross-boundary polluters and others causing environmental damage falls to a kaleidoscope of voluntary and professional activists, operating without coordination and frequently conflicting in their goals.

Ethically we would argue that there has been an absence of a duty of care to water consumers. We dismiss Mythen's (2004, p. 35) gloomy assessment that in risk societies "the responsibility for establishing harm rests with the victim" but we do acknowledge that the restructuring of sovereignty in Bangladesh into a hybrid of multiperspectival governance has been at the expense of a precautionary outlook and to the detriment of consumers' interests. In the absence of clear leadership from either the government or the NGOs, society's first reaction has been to construct a tableau of dangerousness that has been used to justify driving sufferers into marginal social spaces and excluding them from many activities, on the entirely false premise that arsenicosis is a contagious disease (Hassan et al., 2005). This has been one of the most alarming aspects of the arsenic crisis.

3. Arsenic poisoning: policies and projects

"The global response to the arsenic crisis in the Bengal Delta has been marked by staggering inertia" (Meharg, 2004, p. 19).

Although the presence of arsenic in groundwater was known about in West Bengal in the 1980s, it was not until large-scale testing in the 1990s that it came to light in Bangladesh (Table 1). The Kolkata Conference of 1995 was a turning point for Bengal as a whole, with general acceptance emerging that environmental health was threatened across a vast area. Soon afterwards the World Health Organization declared a major emergency and the issue took on the profile of a global crisis.

< Table 1 here >

The hazard itself had its origins decades ago with the tapping of aquifers that had arsenic naturally present. Millions of simple, hand-pump tubewells have since been sunk into the soft deltaic sediments with the intention of providing an alternative to the microbe-abundant surface ponds and dug wells that were used traditionally in rural areas. Infant deaths from diarrhoeal and other water-borne diseases were at a peak in 1972 when the UNICEF agreed to help with funding for drilling tubewells. In addition to their life-saving capacity, these tubewells, usually located in or close to household compounds, were also very convenient, especially for women, who are the customary drawers of domestic water supplies. The discovery of the vast scale of the arsenic pollution about ten years ago created a situation incompatible with the previous relationship between rural people and their groundwater. Faith in yet another aid project was shattered,⁷ along with trust in one of the most important of unmediated 'natural' resources. Since then the government has been very slow, for a number of reasons, in gearing itself up for the nationwide programme that is clearly necessary to mitigate what has been called 'the largest mass poisoning of a population in history' (Smith et al., 2000, p. 1093).

A new National Water Management Plan was approved in March 2004, with a subsidiary National Policy for Arsenic Mitigation, which empowers and mandates the government to "facilitate availability of safe and affordable drinking water supplies through various means" and enunciates the policy that "access to safe water for drinking and cooking shall be ensured through implementation of alternative water supply options in all arsenic affected areas. All arsenicosis cases shall be diagnosed and brought under an effective management system". There are sections in this document on well-screening, identification and management of patients, mitigation, research, awareness-raising, and alternative, safe supplies. Potentially the most significant move is "towards decentralized planning and delivery of safe water options and health services through the grass root level local government institutions" but, whether this is a genuine move to empower the grassroots, or a fig leaf to cover the government's embarrassment at its own incapacity, remains to be seen. The associated "Implementation Plan for Arsenic Mitigation in Bangladesh" initiates an ambitious "Emergency Water Supply Programme in Severely Arsenic Affected Areas", which aims to ensure at least one secure source of safe water "within a reasonable distance on an emergency basis" per 50 families. This is to be completed within one year of the screening of wells in villages where more than 80 per

cent of the tubewells are contaminated (BAMWSP, 2004b). Awareness-raising is targeted at villages where more than 20 per cent of TW are contaminated. The new, emergency water sources will be provided free of charge by the government but the cost of operation and maintenance is a community responsibility.

A funding framework for this mitigation strategy had been provided years before, in 1997, when the World Bank invested \$44.4 million in the establishment of the BAMWSP (Table 1), principally to complete the emergency nationwide testing of all tubewells in Bangladesh. This was to become the world's largest water monitoring project (Khouri and Chowdhury, 1999). Second, there were to be rapid health surveys to identify arsenicosis sufferers and refer them to the health services. Third, the foundation of a National Arsenic Mitigation Information Centre was to plug the yawning knowledge and information gaps that were hampering the implementation of policy.

Progress with the BAMWSP was very slow at first and the World Bank is reported to have considered withdrawing its investment because of resistance and institutional inertia within the government (Anon., 2005). By 2001 water testing and patient diagnosis had taken place in only 30 thanas and only \$2 million of the total had by then been disbursed.⁸ From the outset there is said to have been the lack of a clear strategic plan and an absence of government leadership to coordinate activities and provide momentum (Kaufmann et al., 2001), but the absence of an effective top-down blueprint may be a blessing in disguise because “each of the 60,000 villages suspected of being at risk was likely to require a tailor-made solution” (World Bank, 2000, p. 3). The lateral spatial indeterminacy of the pollution is extraordinarily destabilizing for planners used to allocating funds to regions, especially when it is difficult to predict the level of poisoning in wells even a few metres apart (Hassan et al., 2003).

After a restructuring of the BAMWSP following its mid-term review in 2001, it seems that the World Bank now views the solutions to the arsenic crisis as likely to arise from a series of pragmatic “learning by doing” projects that might take ten to fifteen years to cover the country with sustainable options (World Bank, 2002). These options will be derived from experimental pilot projects mounted “to determine the best methods to raise community awareness, set up local organizations, determine procedures and guidelines for these community-based organizations to ensure transparency and accountability, help communities identify their needs, and come up with a feasible proposal”. Growing evidence suggests that, if these projects are to be successful, they must be fully committed to engaging with water consumers in a participative conversation about: (a) risks and health consequences; (b) mitigation alternatives; (c) location and maintenance of facilities; and, (d) cost and

quality control. Everyone consumes water, so every member of the community has a stake in this debate.

As already noted, the BAMWSP was charged with a major emergency screening programme but by the end of 2004 only 4.95 million tubewells had been tested for the first time, less than half of the total number (BAMWSP, 2004a). One reason for the delay was the need to train a small army of field workers. Overall, 54,000 people, the vast majority of whom have only basic educational qualifications, have been trained to use field testing kits. The results of the testing of every tubewell in a thana are used to plan the next phase. As noted above, if more than 80 per cent in an area are contaminated, an emergency mitigation procedure is triggered, in which alternative safe water sources are provided. By mid-2005 the BAMWSP had developed mitigation measures under about 3,000 Community Action Plans in 35 thanas and, under the emergency hot spot programme, in a further 29 thanas (Table 2) (BAMWSP, 2005). In addition, the BAMWSP has trained 2,330 doctors and 12,590 health workers in the diagnosis of arsenicosis symptoms, but its commitment to awareness programmes has been disappointing; by late 2004 only six thanas had been targeted.⁹

< Table 2 here >

As we will see later, well-switching to the use of less contaminated tubewells and the sinking of community-based deep tubewells both have their problems in terms of access. In the opinion of the World Bank itself, these small-scale mitigation measures of the BAMWSP “actually represent a step backwards in terms of service delivery in Bangladesh because the rural population has become accustomed to the high service level associated with the privately-owned hand pumps in their yards” (World Bank, 2004, p. 1). Something better is needed and the usual preference stated by the consumers is for piped water (Hoque et al., 2004) because of its convenience. There are already 100 or so experimental piped water systems in rural Bangladesh, mostly provided by the Department of Public Health Engineering, and experience indicates that, for nucleated villages with 200-300 households or more, this is likely to be a more cost-effective solution than the use of home-based treatment systems (World Bank, 2003). The BAMWSP is planning pilot piped schemes in 30 villages, with half of the capital costs met centrally, 30-40 per cent from private enterprise, who would maintain the networks, and 10-20 per cent from the consumers. Using the contingent valuation method, Ahmad et al. (2002; 2005) found that rural people’s willingness to pay for piped water was directly dependent upon their knowledge of arsenic and their level of concern. Educational status was

also a determinant. Their conclusions, from a carefully designed survey of 2,900 households in three areas, are that convenience is important, but that families in contaminated areas were willing to pay only up to 0.2 per cent of their household income for arsenic-free, piped water.

The new Bangladesh Water Supply Programme Project was launched in June 2005.¹⁰ This is backed by a further \$40 million of World Bank funding and will build on lessons learned by the BAMWSP. Four hundred and fifty large villages will be given piped water in a pilot scheme. The cost will be shared in a Water Users' Association between grant money (50 per cent), a local sponsor (NGOs, cooperatives, water companies), and the consumers. The sponsors will operate local systems for fifteen years in agreement with the WUA and the union parishad. The choice of the end point of the pipes will be threefold: individual or shared standpipes, or household taps, depending on affordability for each household. Water quality will be the responsibility of the Department of Public Health Engineering. Two hundred smaller villages in hot spot thanas will receive deep tubewells, dug wells and pond sand filters. Union and Ward Arsenic Committees will be formed with the task of raising awareness and developing a Community Action Plan with details of mitigation measures, and the project document explicitly states one of its objectives as an increasing sense of local ownership, thereby acting as a catalyst for political decentralization. Each community must pay for 10 per cent of costs and women and vulnerable groups must make up at least 30 per cent of the membership of the Ward Arsenic Committee. The Bangladesh Water Supply Programme Project will pioneer a credit market for piped water systems in order to convince local banks of the demand for, and viability of, this type of long-term loan. This is a key point because poor households will not otherwise be able to afford the connection fee and water charges. No doubt the World Bank is counting on people's increasing familiarity with micro-credit due to the activities of the Grameen Bank and other NGOs, although we should note that this has been heavily criticized (Mallick, 2002).

To date, NGOs have been involved with arsenic in one of two ways. Either they have been working independently with funding from foreign donors, or they have been surrogates, locally delivering certain aspects of government policy. With UNICEF funding, and the technical and logistical help of the Department of Public Health Engineering and BRAC, tubewells in 43 thanas have been screened. BRAC employs local women as village health workers to operate field testing kits, identify arsenicosis patients, and raise awareness, the hope being that communities will listen to their own members (Patel, 2001). Other NGOs have been involved in a smaller way, such as the Dhaka Community Hospital and World Vision, and funding has come from DANIDA and Britain's Department for International Development. By far the largest screening effort, however, has been by

the BAMWSP, working with small NGOs, and they have checked tubewells in 190 thanas. NGOs have been innovators in mitigation options, trying rainwater harvesting, dug wells, pond sand filters and some of the chemical treatment methods, but none of these seem to be as popular with consumers as deep tubewells and piped water.

One final pragmatic point to make in this section is that an estimated death rate of 9,136 people a year along with 174,174 disability-adjusted life years (Lokuge et al., 2004) from arsenicosis in Bangladesh must be set against an estimated annual saving of approximately 5,500 diarrhoea-related deaths by the use of bacteria-free ground water. This begs the question whether making policy with regard to arsenic *in isolation* is both wasteful and misguided. The arsenic problem is better seen in the round, as just one amongst the many environmental and general health challenges facing poor Bangladeshis. The fact that people continue to drink from red-marked tubewells shows clearly that they perceive this as just one of the problems of their daily lives and often not the principal risk they face. Related to this is the thought that the government and donors should pay more attention to the general sanitary and nutritional environment of the afflicted people, rather than to expensive technological solutions such as chemical means of removing arsenic in water once it has reached the household.

4. Technological indeterminacy and affected publics

Geof Wood (1999) argues that water resource “experts” have often in the past had “limited perceptions” of the implications of their proposals for livelihoods. As a result, the imposition of hi-tech solutions with regard to water policy has occasionally proved to be disastrous in the Bangladesh setting. The Flood Action Programme (1989-95), for instance, is a notorious example of a hard engineering solution intended to tame nature. It failed, in its first incarnation at least, to take account of its affected publics – a term introduced by Dewey (1927) to finesse the notion of accountability within democracy. At the other end of the technological spectrum, the production of arsenic by a quarter of the country’s tubewells, is evidence of what Giddens (1991) has called the “dark side of modernity”, and it is typical of the technologies in Beck’s “risk society”, having global reach, even to poor rural societies (Beck 1992; 1999).¹¹

In their paper on arsenic mitigation strategies and policies, Alaerts and Khouri (2004) argue that it is essential from the outset to recognize the indeterminacy of the science and technology associated with the arsenic crisis. We agree, and if all the stakeholders can assimilate this point, a set

of pragmatic solutions will become possible; but pretence about the knowability of the problem is counterproductive. The best illustration of this is the safety limit for arsenic ingestion. The threshold is set by the World Health Organization and the United States Environmental Protection Agency at 0.01 mg/l but by the Bangladeshi authorities at a more lenient 0.05 mg/l. There is a complex history behind this, which is discussed by Smith and Smith (2004), but for our purposes we have to ask whether the precautionary principle should be applied and therefore the more stringent limit enforced. It is certainly true that some writers argue that long-term exposure at 0.05 mg/l is likely to lead to morbidity, particularly the risk of cancer, but the Smiths remind us that this must be weighed against the present inability of the government to provide alternative sources of clean water to replace the millions of wells that would have to be taken out of service. In reality, they suggest, a strict limit would not be applied and there is a likelihood that there would be no protection at all in many areas. Their pragmatic judgment is that it is better, for an interim period at least, to have a standard that has some realistic chance of application and cuts waterborne disease, and we would add that accountability for such a decision must come at the local level.

Another example of indeterminacy is the spatial complexity of the arsenic pollution. We have shown (Hassan et al., 2003) that this risk can be mapped but predictive interpolation is problematic because of significant variations between neighbouring wells, sometimes close together. Three dimensional modelling can help here, taking into account the depth of the aquifers tapped, and the detailed work of the BMWSP's Deep Aquifer Characterization and Mapping Programme in Chandpur District will give us a good starting point for understanding the complexity.¹² Van Geen, Zheng et al (2003) make a valid point when they argue that setting a national minimum drilling depth for new wells, as had been contemplated, would be inappropriate because circumstances vary so much with each tubewell. The more research that is done on arsenic in Bangladesh, the more one realizes that blanket policies for mitigation are unsuited to a complex reality.¹³

The implications of complexity are felt by water consumers, yet many of them are unaware of their situation. Apart from the poor circulation of information about risks in consuming contaminated water and the symptoms of the resulting disease, there is also surprisingly little debate or publicly-expressed anger. This is probably because Bangladesh presently fails all of the tests of deliberative democracy set by Festenstein (2004, p. 295), who argues pragmatically, first, that those taking part in debate "are under obligation to offer arguments persuasive to all other participants". In contrast, the country's politics are confrontational and violence is frequently an instrument of first resort, such as the frequent hartals (general strikes) that are enforced against the will of the public.

Second, he suggests that what matters is the force of the better argument rather than bargaining power; but in Bangladesh it is networked influence that settles issues, not open debate. Third, he indicates that acceptable policies should be achieved by compromise – in reality the programme formulated in isolation by one party is consigned to the dustbin when they lose a general election. As a result, the country is deprived of the process of public discussion, and the state not only evades its responsibility to achieve the best possible judgments, but there is a reduced chance that policies will be accepted and laws obeyed.

Two problems with encouraging the circulation of information are that our knowledge of the social science of arsenic in Bangladesh is very thin and that some of the science is controversial (Hanchett 2004). In view of this, it is surprising that the World Bank has committed over \$80 million without much depth of information about the technological and logistical systems that will best match the realities of situated power and knowledge in the field. Hassan (2003) has shown that intimate local awareness coupled with several months of fieldwork can yield significant dividends in understanding the issues in one union from both the ethnographic and technical points of view, and we suggest further research of this nature into the socio-economic context of arsenic pollution. Without understandings of the impact of arsenic on people's lives and livelihoods, and how arsenicosis is perceived, we feel that policies will founder on the Scylla of indifference, fear, prejudice and other negative emotions that have been identified as hindering appropriate community and public health responses (Hassan et al., 2005).

With regard to practical methodologies of enquiry, Rosenboom's (2004) close study of fifteen thanas is a balanced, reflective and careful analysis and provides guidance for other countries in the region seeking a model. But we need to go further and push the epistemological boundaries, to experiment with new modes of enquiry and to forge much closer ties between the geoscience and the social science of arsenic. This will only be possible, however, if relevant funders can be found. If reception theory were applied to the development industry, we would probably find that at present international donors and their client governments or NGOs are captured more by headlines concerning ongoing health crises such as HIV/AIDS or by immediate environmental disasters like an earthquake or a tsunami, than they are by every-day and low profile basic needs such as water and sanitation, which find it difficult to compete for attention and for cash. This means that learning from emergencies such as arsenic poisoning in Bangladesh is problematic because the events tend to unfold more quickly than the response. Only with a good knowledge base and a strong form of grassroots

self-help is it conceivable that solutions can be rolled out speedily and appropriately for local circumstances and be made to stick.

5. Deliberative democracy?

Dewey's idea that democracy is "an experimental form of practical enquiry" means that it is well suited to problem-solving (Bohman, 2004, p. 28). Dewey also argued that democracy should not be tied solely to formal institutions and that it might derive strength and inspiration from the decentring tendency of multiple publics. What form should this take for the nascent, fragile democracy of Bangladesh? We will make four points here.

First, pragmatism has much in common with participatory action research (Reason and Bradbury, 2001). According to Peter Reason, this involves "building democratic, participative, pluralist communities of inquiry" (Reason, 2003). In terms of data collection and the communication of risk/health messages, the available methods used are many and varied, the object being to involve local people at every stage, taking into account what Hardin (2003) calls their street level epistemology, rather than regarding them as the passive objects of an arm's length study (Chambers, 1983). Qualitative approaches are common but in our opinion there is room also for advanced technologies if they serve a purpose. Thus, we propose a system of participatory Geographical Information Systems at the level of the union or the thana that would record arsenic data and would be public property, with civic rights of access (Hassan, 2005). Particularly important would be access to any risk maps that might be produced, informing householders of pollution generally in their area.¹⁴ Such a system would be labour- and skill-intensive, expensive and in constant need of updating, but information-sharing is a crucial weapon in the armoury of democracy and one can imagine a participatory GIS being extended to other aspects of poverty and vulnerability mapping, resource inventory, and the planning and monitoring of local service delivery.¹⁵

Second, to pragmatists "all problems are problems of conduct and all judgments are implicitly judgments of value" (Barker, 2004, p. 447). Therefore pragmatism privileges ethics – in the human-centred sense of taking an interest in environmental ethics from the point of view of 'the environment as the location of human community' (Light, 2002), rather than the non-human value theory of many modern environmental ethicists. In this context, we feel it is important that each individual tubewell owner should be informed of the level of pollution of their water, although the results will be upsetting for the 30 per cent whose tubewells are unsafe, many of whom invested a lot

in drilling, and explaining the safety implications will be time-consuming. But there is an ethical dimension here that cannot be ignored. Testing water is not a purely scientific exercise; it is, or should be, a joint enterprise between the owner and the investigator and the latter must forfeit exclusive intellectual property rights over the data. In addition to these rights of the individual, there are, in our opinion, rights of the community over databases and resulting analyses. Hoque et al. (2000) have expressed similar views as a result of their action research in Manikganj.

Third, we follow Bäckstrand (2003), who formulates a persuasive argument for what she calls “civic science”. This comprises several elements. There is civic science as participation in which the public is engaged, as individuals and through civil society, in participatory technology assessment and other means of inclusive/democratic environmental risk management. In Hajer’s (1995) account of ecological modernization, he posits an institutionalized type of “societal inquiry”, which would provide a forum for the balanced presentation of views and the degree of ownership of the process that is necessary for participation. We don’t think that large-scale formal events would be appropriate in rural Bangladesh, but Kar (2003) has shown that an equivalent community-based and self-motivated method of investigating and improving sanitation has been very successful. In the words of Leach and Scoones (2003, p. 12), it is “citizenship as practised engagement through emergent social solidarities”. In this sense, citizenship is not a static phenomenon but rather a learning process that reveals and enhances capabilities (Merrifield, 2002).

Bäckstrand suggests that improved communication is one pay-off from civic science. In a situation where levels of information about arsenic poisoning are generally very poor, it makes sense for the various providers of mitigation to consider public education, transparency and technological accountability. This is very far from being straightforward because, as Alaerts and Khouri (2004) indicate, there is a fine balance to be struck in public health messages between, on the one hand, blunt descriptions of a crisis that may cause alarm and panic and, on the other hand, emollient statements that encourage complacency or even denial. These writers favour the encouragement of dialogue between water consumers and official or NGO information providers. Public hearings are one suitable forum, backed up with advertisements on radio and television, village-level dramatizations, and various other activities. What matters here is understanding and trust, and there is space for both to be built in a spirit of pragmatic experimentation rather than in the top-down, programmatic fashion that has failed in the past. This would leave flexibility for the incorporation of local knowledges and contingent socio-economic circumstances. Inevitably in Bangladesh, where civil society is much stronger in some districts than others, responses to participation will vary. Under conditions where

there has been widespread political intimidation, for instance, or the elite capture of development projects, it is difficult to see how participative science could work. However, these conditions are not universal and the BAMWSP has made a start on an institutional make-over with their use of community-based organizations such as water users' associations.

A key here is public information. Government campaigns on the television have been instrumental in raising awareness in recent years (APSU, 2003), even in areas not seriously affected by the crisis. But there are hard-to-reach groups among the poor, the non-literate, and the socially marginalized, for whom information has to be carefully and sensitively tailored. Also women, especially rural housewives, whose mobility and voice are culturally constrained, are less likely than the average to have access to arsenic-related information, yet they bear the burden of water collection. Overall these characteristics matter because they are correlates of whether families are willing and able to change to safe water supplies upon receipt of a message that their own source is contaminated.

In the spirit of Dewey, McAfee (2004, p. 53) notes that “public deliberations usually spend a great deal of time developing a public picture of what a problem is”. In other words, deliberative democracy cannot proceed without everyone understanding where they stand in relation to an issue and what their interests are vis à vis others and the community at large (Figuroa et al., 2002). No information means no calculation, no interest, no deliberation and no action. It is only through deliberation that we hear the views of others and therefore make the kind of contingent decisions that in aggregate make for consensus (Smith, 2003). Deliberative democracy therefore seeks to transcend self-interest as the sole ground for politics and replace it with inclusive public reason (Bohman and Rehg, 1997; Dryzek, 2000; 2004; Baber, 2004).

There is some evidence at the village level in Bangladesh that there is scope for self-motivated enquiry and demand for appropriate solutions. Duynes (2004), for instance, discusses at length examples of community-led water management initiatives that belie the stereotypical image of hopelessness at the grassroots, and Hoque et al. (2000) suggest that the village Watsan Committees formed with UNICEF funding by local NGOs offer opportunities for strengthening institutions at the local level. They found positive signs of participation, especially as a result of work by women volunteers who held courtyard meetings and encouraged their fellow villagers to take the Watsan messages seriously. Not all Watsan village-level committees are necessarily active but the government was sufficiently impressed by the results of the UNICEF initiative that in 2002 it set up a framework for the establishment of further Watsan Committees at union, thana and district levels.¹⁶

There are more examples of successful participatory projects on arsenic. One is a Swiss Development Corporation project in north west Bangladesh, which Hanchett (2004) reports upon favourably. As an explicit objective, this initiative seeks to empower local decision-making. What the literature is lacking, however, is accounts of action research at the frontier of participation. We are not aware of any participatory GIS, as we have outlined above, nor does Bangladesh yet have post-structural participatory methods as discussed by Cameron and Gibson (2005). The latter would be especially interesting because this approach enables novel understandings of the subjectivity of respondents, for instance through their embodied practices.

Our advocacy of participation is certainly not starry-eyed. It would be foolish and dishonest, for instance, to claim that all types of poor, rural people would benefit. As Wood (2003) points out, poverty is heterogeneous and the capacity for self-help action is extremely varied. Also, since illiteracy in the country is 58.9 per cent overall, and 68.6 per cent for women, there is a possibility of false consciousness, where, without the benefit of a process of a Freireian-style conscientization, people may not be fully informed about their interests in the national and global context of environmental responsibility. Outside the realms of ‘participation’, some people may require the continued mediation of others in their family or neighbourhood in order to make their voices heard, for instance women in the highly conservative setting of rural Bangladesh. An example of this point is the well-switching advocated by writers such as van Geen et al. (2002). In Satkhira District, Hassan (2003) found that, in contrast to these authors’ optimism, access to water from public deep tubewells was being denied to arsenicosis sufferers. These tubewells are looked after by paid custodians who, in many cases, use this position as a lever of power within the community, choosing who to include or exclude. Thus the people who need pure water most are often being denied access and are thrown back on their own contaminated shallow tubewells, with the seemingly inevitable result that their health will suffer in the long-term. Bearak (1998) found similar problems of micro-scale conflict, with one of his respondents declaring that “If I die, I will die, but I will not go to fetch water from another man’s house”.

We are also conscious of the recent criticisms of participatory research. The Panglossian bubble of participatory social science fieldwork was burst by Cooke and Kothari (2001) in their book, *Participation: the new tyranny*. They and their contributors found an over-romanticized view of indigenous knowledge amongst participation activists, and, as Cameron and Gibson (2005) remind us, these so-called “authentic” local understandings are in fact multiply produced and cannot be guaranteed to be positively transformative. This scepticism is echoed by Richard Rorty (1979), who is

dismissive of participative democracy, which he claims is vaguely defined and ineffective in achieving reform (Green, 2004). He prefers instead campaigns linked to specific ends. Certainly one can see in Bangladesh that the government has tended to use participation as a means of consultation or persuasion, rather than as a means of agenda-setting or empowerment (Wood, 1999). They have been reluctant so far to devolve budgets and decision-making to local officials, let alone to the grass roots, and have generally not encouraged civic maturity.

Fourth, time and latency are elements of the arsenic story that have been neglected. One could argue, for instance, as does Daniel Deudney (1998), that it is important to consider affected publics in intergenerational terms, so that an environmental harm present now raises issues of responsibility with regard to future consumers of water, and also future farmers of soil that is now being contaminated with arsenic-laced irrigation water (Hossain, 2006). More broadly, we can see both hazards and resources as subspecies of latency. They present us with threats and opportunities that may or not be fulfilled. Some hazards, such as the riverine floods of Bangladesh, are both familiar and predictable. By contrast, arsenic poisoning is insidious, quotidian and, according to the BGS/NERC, nothing about it seems to have been foreseen or foreseeable. Even now, its full extent and import remain unclear. Heidegger (1962, p. 231) summed up the principle well:

“when something threatening brings itself close, anxiety does not ‘see’ a definite ‘here’ or ‘yonder’ from which it comes...That which threatens cannot bring itself close from a definite direction...it is already ‘there’, and yet nowhere; it is so close that it is oppressive and stifles one’s breath, and yet it is nowhere...What oppresses us is not this or that, nor is it the summation of everything present-at-hand; it is rather the possibility of the ready-to-hand; that is to say it is the world itself”.

In a sense this point relates to trust and risk-taking. The credibility of the arsenic testing agencies is insecure in the minds of many people. When told that their water source is contaminated, some villagers ignore the information because no-one in their family or neighbourhood is visibly unwell. The concept of latency requires careful discussion with those whose lives are constantly impinged by imminent risk and who apparently discount the saving of lives as little as ten years into the future (Poulos and Whittington, 2000). It seems that delays before symptoms of arsenicosis appear are as difficult for them to take seriously as the link between cigarettes and lung cancer was for

western smokers in the 1950s and 1960s. The addiction in the case of tubewell water is convenience, and any associated risks may therefore seem to some to be well worth taking.

6. Conclusion

We see the problem of arsenic pollution as a microcosm of the wider challenge of Bangladeshi governance, for instance as illuminated in several publications by Geof Wood, most notably his account of ‘prisoners and escapees’ (Wood, 2000). Here he convincingly demonstrates that the country’s widespread administrative failure is institutional rather than organizational, and he suggests a look into the deep structures of society for explanations and solutions. The sluggishness of governmental response to groundwater pollution is not surprising in such an analysis. It is not necessarily a function of the special characteristics of geological strata or of the scale of the chemical hazard but rather due to the obstinate strength of what might be termed ‘unsocial’ capital in the mal-performance of the state. Wood argues that the Bangladeshi polity needs a change in the centre of gravity from government to governance, with a greater emphasis upon the determinants of state practice.

Both the study of the arsenic problem and attempts to find solutions must in our view be community-focused experiments. As Cutchin (1999, p. 271) remarks, “we cannot discover most of the answers without entering into place and observing and asking the community members to tell us their stories”. This means a central emphasis on participation, civic science and deliberative democracy at the local level. Our fieldwork also suggests that community awareness of the issues is essential if participatory action research is to meet its objectives.

There are times when local elites can hamper or prevent change and, according to Mansuri and Rao (2004), the success of community-based initiatives depends upon a number of factors: an enabling institutional environment; a committed approach by donors that is sensitive to local power structures; and the accountability of community and project leaders to their constituents and clients. Incrementalism is the best way forward in the light of all three of these factors but this should not be a vulgar pragmatism of either utilitarianism or expediency but rather a critical pragmatism that recognizes multiple viewpoints and interests and tries to negotiate a path of maximum hope (Rorty, 1999).¹⁷ Transparency and accountability, for instance, can be facilitated by journalism, but long-term openness requires vigilance and pressure from local activism, and national campaign groups and policy think tanks (Wood, 2000).

NGOs represent a widely distributed alternative circuit of governance, and, *faute de mieux*, there is no doubt that they must be involved in providing analytical and mitigation services. But it seems that NGOs have also become part of problem in some areas, working to alien agendas with resources that are stretched beyond capacity to meet local needs for inexpensive, safe water. What is needed is a more sophisticated response to the arsenic crisis, starting with support from the larger NGOs for an increased intensity of litigation, along the lines of the Bangladesh Environmental Lawyers' Association, and also a substantial boost for the creation of a collective self-awareness that is clearly lacking for arsenic and several other environmental health issues.

In November 2004 the Ministry of Health and Family Welfare declared that “a viable, long-term solution to Bangladesh’s arsenic problem is not yet in sight” (MOHFW, 2004, p. 5). These remarks on the failure of other ministries left the authors themselves in the clear but ignored the progress that is now being made by the restructured BAMWSP and the laudable aims of the nascent Bangladesh Water Supply Programme Project. Whether water consumers gain in the long term remains to be seen but, contrary to the unfortunately negative image of Bangladesh, there is plenty of evidence of self-help. Coupled with outside support for expensive projects such as the provision of deep wells and piped water schemes, this gives cause for optimism.

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Footnotes

¹ The size of these estimates depends on which safety threshold is considered appropriate, the Bangladeshi or the World Health Organization limit.

² As yet, there is no comprehensive account of the implications of pragmatism in geography, but see Proctor (1998).

³ Voluntary Health Services Society's *Directory of health NGOs in Bangladesh, 2000-2001*, cited in <w3.whosea.org/en/Section1257/Section1259_5044.htm> (accessed: 18/3/06).

⁴ There are 507 thanas (formerly known as upazilas) and 4484 unions, the lowest level of administration. The union parishad is a representative committee with certain administrative powers. The gram sarkar is a committee of fifteen members nominated by the government and represents a parallel authority to the union parishad. Its declared intent was to give villagers a greater say in their own development. There was confusion from the outset about their division of responsibilities and much political dispute. In 2005 the gram sarkar was declared unconstitutional by the Supreme Court.

⁵ At the national level, the Local Government Division's Arsenic Policy Support Unit has responsibility for coordinating the various screening and mitigation programmes; the Inter-Ministerial Task Force and Secretaries' Committee guides the multi-sector response; and the Arsenic Donor Coordination Unit guides development partners' responses.

⁶ The appeal was dismissed (House of Lords, 2006).

⁷ Respondents in our field area claimed that Department of Public Health Engineering officials have been taking money (Tk4,500) as part payment from each family wishing to have a deep tubewell. They issue only hand-written receipts, without any official signature or stamp. No date is arranged for sinking the well and the people worry that this might be a scam.

⁸ In May 2003 still only 31.3 per cent of the project funds had been spent (BAMWSP, 2003).

⁹ 35 more will be included in phase II and 147 in phase III.

¹⁰ Implementation is by the Ministry of Local Government, Rural Development & Cooperatives.

¹¹ This does not mean that we are Luddites. On the contrary, we acknowledge that tubewells have brought benefits to Bangladesh and other developing countries but, like all technologies, they have the potential for harm if not properly applied.

¹² This uses isotope analysis to measure the age of the water and so distinguish between the Pleistocene and Holocene aquifers.

¹³ But there are underlying controls on arsenic distribution that can guide remediation.

¹⁴ But see comments about problems with these risk maps in Atkins et al. 2006a.

¹⁵ For more on participatory GIS, see the Community Mapping, PPGIS, PGIS, CiGIS and P3DM Virtual Library, <www.iapad.org/bibliography.htm>, and the bibliography at <www.urisa.org/PPGIS/2003/papers/ppgis_bibliography.pdf> (both accessed: 18/3/06).

¹⁶ This 'Rural Sanitation, Hygiene and Water Supply Project' is presently operating in 37 thanas.

¹⁷ For a helpful account of the vulgar pragmatism of cost benefit analysis, see Farber (1999).