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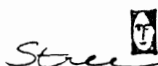
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Gendered Waters, Poisoned Wells:  
Political Ecology of the  
Arsenic Crisis in Bangladesh

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Bangladesh is often associated with monsoonal floods and an overabundance of water. However, it is also currently facing a severe drinking water crisis. Perhaps this is difficult to imagine in a deltaic, riverine country, but scarcity of safe potable water for millions of rural citizens of Bangladesh has become a catastrophic problem. This is due to the contamination of groundwater sources, providing drinking water to up to 70 million rural people, by naturally occurring arsenic. Currently over 35 million are directly exposed to arsenic poisoning (Ahmed and Ahmed 2002). Arsenic contamination of drinking water emerged as an issue due to widespread usage of groundwater sources in recent decades. Smith et al (2000) writing in the World Health Organization (WHO) Bulletin, have stated that this presents the largest mass poisoning of a people in history. The lack of alternative drinking water options and the alarming rates of morbidity and mortality from arsenicosis (arsenic poisoning) have prompted the government and international donors to address the problem comprehensively. The challenges from the arsenic contamination of groundwater (often called the arsenic crisis) form one of the biggest water-resource concerns in the country, as a short-term survival issue and as a

long-term water management and sustainable development problem.<sup>1</sup>

Shifts in focus from 'productive' water vis-à-vis irrigation and flood control to 'domestic' water concerns have risen with increased attention to arsenic contamination. However, this does not mean that the dominant water-resource management discourse and planning are no longer on irrigation and flood control, as they still are top priorities of the Bangladesh state. The arsenic crisis has drawn public attention to domestic water issues and women's water concerns.<sup>2</sup> Women have recently prominently featured in water discourses around arsenic mitigation. Whether or not women are playing a role in decision-making on how arsenic mitigation policies and practices should proceed is a different matter. Similarly, to what extent different groups of women are affected differentially by the arsenic crisis is also not fully addressed.

In the predominantly patriarchal setting of rural Bangladesh, the access to and control over resources, as well as the social construction of gendered rights, responsibilities and roles, complicate the ways by which men and women's livelihoods and lives are impacted by water scarcity and stress. Gender divisions of labour largely construct domestic water procurement and household water management to be performed by women, while irrigation water management is generally undertaken by men. It is rare for men to participate in daily drinking water procuring activities, where culturally appropriate notions of femininity and masculinity appear to be reinforced through relations with water.<sup>3</sup> Scarcity of potable water can thus considerably burden the daily responsibilities of women, and challenge their fulfilment of socio-culturally defined gender roles; illness resulting from consuming contaminated water can also considerably add a burden to their productive and reproductive responsibilities.

*Political Ecology, Gender and Water: Debates and Approaches*

Political ecology provides a useful analytical framework to study socio-ecological relationships, especially in water management and

related impacts. This perspective emphasizes the importance of history, role of politics, social relations of production, international economic structures, and the relationship between capitalist development and ecological changes (Redclift 1993; Sneddon 2000). Political ecology is a broad body of theoretical perspectives that connect human/cultural ecology with political economy, and aims to link local processes with larger social structures and political economic processes (Blaikie 1985; Blaikie and Brookfield 1987; D. Moore 1993; Peet and Watts 1996; Bryant 1998). Political ecologists have demonstrated how the poor suffer the most from environmental degradation that is largely caused by broader political economic processes (Blaikie 1985; Blaikie and Brookfield 1987). Feminist political ecology advocates that struggles over nature often reflect gendered relations over power at multiple scales (Rocheleau et al 1996; Carney 1993). Feminist political ecologists argue that gender is a critical variable in environmental analysis, whereby attention is given to gendered differences in knowledge, rights, access, control, and organization vis-à-vis the environment. The focus in political ecology literature has predominantly been on land and forest resources; it has not engaged adequately with water resources or the complexities of hydro-social cycles (Swyngedouw 1999). Water as a natural resource is a more difficult resource to study because of its fluid nature and challenges in containment and quantification (Bakker 2003a,b). A political ecology of water would thus engage with issues of modernity, history, development discourses, movements, state-donor-NGO relations, and issues of power in understanding environmental change in multiscale analyses (Derman and Ferguson 2000). Recent water-resource management discourses have generally been situated within broader debates about sustainable development and sustainability (W. M. Adams 1990; Lélé 1991; O'Riordan 1993).

In the water sector, there has thus been a shift from state-led, technocratic water-resource management programmes to an increase of 'participatory community water-resource management' projects in many parts of the world (Ahluwalia 1997; Mehta 1997; Agarwal 2000). The Bangladesh state has also recently taken up such

discourses and incorporated them in official water policies, discursively moving away from former technocratic, sectorally driven approaches to give more attention to broader social and environmental issues, as reflected in the National Water Policy (Government of Bangladesh 1999) and the National Water Management Plan (Government of Bangladesh 2001). Gender and irrigation studies conducted in Bangladesh point out that targeting women in so-called participatory community irrigation projects resulted in overall loss of social status for many women compared to men, although it increased women's overall income earnings (Jordans and Zwartveen 1997). However, looking at both structure and agency of women provide insights into how livelihood strategies related to water are negotiated (Jackson 1998). Such ideas need further analysis and empirical grounding to explain the conflictual as well as cooperative gender relations of productivity and well being (Crow and Sultana 2002).

Gender and material inequalities intersect to influence water deprivation and water security in various ways (*ibid*). Different modes of access to water (private, public, common property resource, market) are affected by social and gender relations which can lead to water security or water deprivation (in terms of quantity, quality, reliability and timing). Protecting poor men and women's water rights are especially important in advancing rural development through irrigation projects during times of water scarcity (van Koppen 1999). Similar needs exist to protect the poor in ensuring drinking water supplies (Devasia 1998; Regmi and Fawcett 1999). Both academic scholars and development practitioners have flagged a better understanding of poverty-water-livelihood linkages as areas of further research. Arguments have also been made that drinking water policies, despite goals of sustainability or equity, often tend to increase inequities between people, whereby gender inequalities are often reinforced (Joshi et al 2003).

This brings up the issue of how 'gender' is actually understood in water management and development discourses and practice. For example, Cleaver (2000) and Jackson (1993b: 649) argue that understanding gender issues in natural resource management involves

recognizing the changing and negotiated nature of gender relations, with an emphasis on meanings of exclusion and inclusion in decision-making, for both men and women.<sup>4</sup> The focus should be on how gender is produced through daily practices, technologies, and customs, in brief, its socialization. For instance, irrigation versus domestic/drinking water management produces discourses and practices that naturalize gender differences where women are not usually seen as irrigators and men do not participate in daily drinking water procurement. Gender differentials in environmental expertise and knowledge should be seen to be related to experience derived from the gender division of labour and not to any inherent biological difference between men and women (Agarwal 1992; Joekes et al. 1995; Jewitt, 2000). Such arguments take a historical materialist approach to gender and environment relations, in contrast to ecofeminist theories that essentialize women and nature relationships (Shiva 1989; Mies and Shiva 1993). Indeed, it could be argued that rural women in Bangladesh are not inherently closer to nature, but rather that nature (such as poisonous arsenic-contaminated water) and women may be antithetical.

Moreover, the 'gender and water' literature does not adequately deal with the role of the state and other powerful agents of development. Analyses of institutions at multiple scales, especially the coordinating and governing role of the state, are important in a feminist political ecology perspective (Crow and Sultana 2002). States structure social priorities in many ways, and the stronger representation by government of the rich, powerful and male may deform spaces of power in their direction (Elson 1995). Focus on the broader political economy of decision-making and management of water can assist in better understanding water-society relations at multiple scales. Similarly, how community-state linkages play out through local water-resource management practices are also important to decipher. In addition, further research is also needed on how discourses shape and reinforce certain notions of gender within broader development discourses through water management policies and projects. Lastly, questions of spatiality and agency of

nature have not been addressed adequately in much of the literature on gender and environment/water. These are areas where a feminist political ecology approach can make critical and useful contributions.

### *The Arsenic Crisis in Bangladesh*

The arsenic crisis stems from the fact that Bangladesh is predominantly in a deltaic landscape where arsenic (a heavy, carcinogenic metal) occurs naturally in the aquifer sediments.<sup>5</sup> However, the release mechanism of the arsenic in sediment compounds into groundwater sources is still being debated.<sup>6</sup> While arsenic's presence in groundwater drinking supplies was detected as early as 1993, for years this was not heeded to be a problem, until large numbers of patients with arsenic poisoning symptoms emerged in recent years.<sup>7</sup> The arsenic crisis is thus a relatively recent phenomenon, one that is rapidly unfolding and playing out in the country at the moment. This is primarily a result of the fact that millions of Bangladeshis now drink water from hand-pumps (tubewells) that pump up groundwater.<sup>8</sup> Government agencies, along with international donors and NGOs, undertook sampling of tubewells in several parts of the country in the late 1990s and detected that the arsenic levels in over 50 percent of the tested water sources were much higher than permissible levels (that are at 0.05 micrograms/litre by Bangladeshi standards, which are more lax than World Health Organization's standards of allowable levels at 0.01 micrograms/litre). Arsenic occurs mostly in the shallow aquifers (between 10-70 m below surface), where the vast majority of the drinking water tubewells access groundwater. High levels of arsenic contamination have shown up in drinking water in 59 of the 64 districts in the country. (Ahmad et al 1997; Paul and De 2000; Alam et al 2002; Hossain 2002; WSP 2002; Kinley and Hossain 2003).

What is ironic is that the majority of rural people in Bangladesh now consume groundwater after decades of campaigning by the state, NGOs and donors against drinking surface water, which was

contaminated with bacteriological pathogens and resulted in high morbidity and mortality rates in the past. Large-scale campaigns and habit-changing endeavours were undertaken since the 1960s to encourage people to switch to tubewells providing groundwater for consumption. Championed by international donor agencies and development NGOs, state subsidies for tubewells assisted this process, which was also supported by the private sector mass-producing the tubewells and pumps to make them more affordable over time. As a result, there are now an estimated 10 million tubewells throughout the country, both public and privately owned. State-installed tubewells are generally seen in public spaces (such as bazars, mosques, and schools), while there are considerably many more privately-owned tubewells throughout the countryside. Since water provision in rural areas is not centralized (only few urban centres have centralized, monitorable municipal water provision), the dramatic proliferation of millions of tubewells scattered throughout the landscape has made addressing the arsenic crisis that much more difficult.

As there are no clear groundwater access/usage laws and rules in Bangladesh, groundwater is effectively an open access resource for exploitation and access by anyone with the technology to extract it (Sadeque 2000). As a result, the growth of tubewells, for both irrigation and drinking water purposes, has been quite profound in rural areas in the last couple of decades. The convenience of tubewells, as well as the status symbol associated with it, made it a popular water supply system in rural areas. It has particularly been favoured by women, whose drudgery in procuring water was lessened with increasing numbers of tubewells in villages (Caldwell et al 2003a, 2003b). While many poorer households without their own tubewells still consume contaminated surface water, the majority of the people in Bangladesh were thought to have been consuming 'safe' groundwater for the last decade or so. This was seen as a big development stride and public health success for a country plagued with chronic poverty and inadequate livelihood resources for its growing population. However, claims that 97 percent of Bangladeshis had access to 'safe' water have become questionable in the light of

the present arsenic contamination of drinking water sources, as the water is no longer 'safe' for consumption.

Present statistics indicate that there are over 35 million people consuming arsenic contaminated water and there are over 20,000 arsenicosis patients.<sup>9</sup> This is likely to be the tip of the iceberg as more areas are screened for arsenic contamination and patients identified. As clinical manifestations of arsenicosis can take up to 10-15 years to appear, increasing numbers of patients will materialize as people continue to consume poisoned water because of a lack of alternative options (Karim 2000; Ahmed and Ahmed 2002). Arsenicosis largely manifests first in the form of skin lesions and marks, often followed by gangrene and amputations; cancers of the kidney and liver, as well as heart failure, are common causes of death. Over 70 million people are estimated to be at risk of exposure (Smith et al 2000; Ahmed and Ahmed 2002), and this figure is likely to rise. Very few households can afford existing expensive filtering technologies, and alternative water sources (such as traditional surface water sources) have dried up, been land-filled, or polluted. What is also disturbing is the fact that irrigation water in many parts of the country has also been found to be contaminated and arsenic is slowly making its way into the food chain. Studies being conducted on arsenic levels in rice, milk, and vegetables show that alarmingly high levels are present in many staples that Bangladeshis consume (Alam et al 2003; Meharg and Rahman 2003).

Accusations of blame for the catastrophe to international donors (such as UNICEF) and the Bangladesh state for promoting usage of tubewells often oversimplify issues. Such arguments often overlook the complex factors that have gone into and continue to create the present conditions of the arsenic crisis that occur at multiple scales. For instance, reductions in infant mortality from water-borne diseases occurred with switching over from consuming surface water to groundwater, largely due to support from donors such as UNICEF and state intervention. Historical contexts within which tubewells were promoted thus have to be acknowledged. However, better and more systematic monitoring of water quality should

have been pursued by these very institutions, which could have averted such a calamity. Recently, an international court case was brought by NGOs on behalf of arsenic victims against the British Geological Survey for not testing for arsenic in a national hydrochemical baseline survey that it conducted for the Bangladesh government in 1992, leading the public to believe the water was safe for consumption. The court case, numerous national and international conferences, and sustained media coverage over recent years have raised international awareness of the arsenic crisis in Bangladesh.<sup>10</sup> However, it is also interesting to note that the capital city Dhaka, the premier site of social, economic and political power in the country, sits on a geological formation that is not contaminated with arsenic. Had Dhaka's water supply been contaminated with arsenic levels as are found in other areas, it can be speculated that action would perhaps have been more swift and decisive than what it has been.

The Bangladesh state's largest effort to address the crisis has been the Bangladesh Arsenic Mitigation and Water Supply Project (BAMWSP), embarked upon in 1998 with \$44 million World Bank funding. The goals of BAMWSP were to screen and identify contaminated tubewells, provide alternative drinking water options and identify arsenicosis victims (WSP 2002). This project has had a poor performance thus far and has had to be redesigned.<sup>11</sup> In the meantime, other donors and innumerable NGOs have jumped in and started addressing the problems in their project sites in various ways. As such, there is a lack of coordination of the efforts in tackling this enormous crisis. To address this concern, the government has drafted the National Arsenic Policy (Government of Bangladesh 2003) with the goal to coordinate efforts of all actors and stakeholders, and to channel funds in the most efficient manner. The National Arsenic Policy has its promoters and critics.<sup>12</sup> Further analyses of the roles of the state, NGOs, donors and other development actors in addressing the arsenic crisis through policy and institutional analyses are needed to understand the processes and politics involved in arsenic crisis management.

One of the immediate outcomes of the arsenic crisis has been widespread panic, with considerable social implications. Fears of what the source of the problem was and what would happen next caused considerable alarm among people; many attributed it to the punishment from God for past sins (Chakraborti et al 2002). Until awareness campaigns started recently, superstition ruled, and still is a factor today. In many rural areas where arsenic contamination is very acute with large numbers of arsenicosis victims, people have been shunned or ostracized (*New York Times*, 11 October 1998; Jakariya 2003). Studies have found that social and economic loss for people in arsenic areas are severe and rapidly worsening (Ahmed 2002). Poorer households have been found to have higher percentages of morbidity and mortality from arsenicosis (Chakraborti et al 2002). Poorer households generally have fewer resources to cope with such adversities, such as dealing with exorbitant health care costs as well as loss of income due to illness. They also tend to have less nutritional intake and are more vulnerable to arsenicosis; this is particularly evident for poor women, as they generally tend to eat last and get the least amounts of food in the household. The overall subordinate status of women in society in general results in their having less voice and resources in responding to the situation. While both men and women in a household may be exposed to arsenicosis and fall ill, the experiences of suffering are gendered: the gendered division of labour increases women's daily burdens in looking after the ill while continuing with daily domestic tasks (such as fetching drinking water) even if they themselves are ill; men are likely to lose productive labour time and earnings, which can adversely impact the household's overall economic resources. Wealthier women may be able to draw on other resources or labour to assist them to help with domestic tasks, while poorer women may not be able to; similar analogies can be made for wealthier men, who can rely on savings or social networks to help in economic survival. Thus gender and class intersect to co-produce the burdens and sufferings from the arsenic crisis.

Other related gender issues are that women afflicted with skin

lesions (the first visible symptoms of arsenicosis) have been treated as contagious and often divorced or denied marriage. This is particularly significant, given the wide practice of dowry in marriages in the rural areas, where arsenicosis can reduce a girl's marriageability, increase her dowry, or make her totally unacceptable (and thereby increase the family's burden and directly feed into the insidious social stigmatization of having female children in a family). Furthermore, women are also less likely to afford and get medical attention for health manifestations of arsenic poisoning, or be willing to be examined and thus be socially marked. There have also been reports of increased pregnancy complications and still births among arsenicosis sufferers. Recent media campaigns (undertaken by the state and NGOs) to inform people of the source and nature of the problem have sensitized many people, but tensions still prevail. Overall, loss of economic productivity and earning capacity from arsenicosis-related problems and deaths, as well as hardship in procuring water from distant wells that are not contaminated and looking after ill family members, is reported to have led to overall social hardship and increased poverty in many areas (Ahmed 2002).

What needs to be kept in mind is that water rights are not always secure and can change with alterations in conditions within which water is available—in other words, water rights can become contentious in the light of the scarcity produced by arsenic contamination of drinking water sources. This scarcity is both naturally produced, in that it originates in aquifer sediments, and socially produced, in that rules of access and usage determine who has rights to which sources of water. As such, certain groups may feel the burdens of the scarcity of water more unevenly than others. It depends on the negotiations and strategies they can deploy to claim and obtain water within systems of legal pluralism: 'Government, religious, and customary laws, development project rules, and unwritten local norms may all address who should receive water, from which sources, for what purpose' (Bruns and

Meinzen-Dick 2000: 25). During times of crisis and water scarcity, such water rights and claims can break down or come under stress. This is being observed in arsenic-acute areas, where women's claims and rights to water sources have come under stress. While Islamic and traditional values for many require sharing of resources in times of need, the arsenic crisis seems to be challenging upholding such values in several places. For poorer and marginalized households, water access and usage has to be negotiated and often good relations maintained with wealthier households who own or control safer water sources. For instance, free labour may have to be offered by poorer women in exchange for safe water. There is also an age differential here, as younger women and daughters-in-law are often made to fetch drinking water each day for the entire household. Negotiating the time, distances, physical labour, and amount of water taken thus reflect unequal access to and usage of water resources, unequal power relations, and can lead to conflicts over fewer and fewer safe water sources.

The spatial distribution of social implications from arsenic contamination has not been adequately studied thus far. There is high spatial variability of arsenic contamination not only vertically but also horizontally: wells within very short distances can show dramatic differences in contamination levels.<sup>13</sup> Hydrogeology is thus seen to play a critical role in both the natural and social aspects of this crisis. This spatial heterogeneity results in confusion about which tubewells to use, as well as pressures on the ones that have been identified to be safe. Government efforts at identifying and marking contaminated tubewells have been to paint them red and paint uncontaminated tubewells green. Many places have a high concentration of red tubewells, placing greater pressure on the green tubewells (which are usually the deep tubewells tapping aquifers levels below the contaminated layer). Wealthier households are able to afford expensive deep tubewells and also to engage in politics over access to water from their wells. Since women and children are generally responsible for procuring drinking water,



this places extra burden on their time and energy in order to fetch water from fewer sources; if distances are too far or troublesome, they are likely to procure water from nearby tubewells, even if contaminated (BRAC 2000; Jakariya 2003). Foregoing safe water has to be seen within the context of the multiple demands of productive and reproductive duties and responsibilities of women. Thus it is seen that social differences interact with the spatial variability of arsenic contamination to produce spaces of power of some over others who require access to water. Spaces of hardship are also created for others who lack access to safe water. As a result, spatial inequalities are observed to be exacerbated with arsenic contamination of groundwater sources. The technology of tubewell usage thus produces differences within the category of 'women' (often homogenized within development literatures, as mentioned earlier) according to differences among women with respect to negotiating power, knowledge, rights, resources, and location.

The spatiality of arsenic contamination also manifests itself in the social realm in varying degrees in terms of perceptions and approaches to addressing the problem. A study by BRAC, a leading NGO in Bangladesh, found that variables such as relative economic condition and mobility of the population influenced responses to different mitigative strategies in different arsenic affected villages (Jakariya 2003). The study also found wide variations between and within communities in the perceptions of the arsenic problem as well as acceptance of alternative options and initiatives to take steps to address the problems. The general preference in this study population was to switch to deep tubewells and expect the government to deliver options. It was also found that communities took initiatives to procure arsenic-free water when projects were started, or when awareness campaigns were prominent, and then reversed to consuming arsenic-contaminated water over time. Often this was attributed to lack of labour power, time or difficulty in procuring arsenic-free water (ibid). Furthermore, in 'community' based water projects, wealthier households generally tend to prefer such options as they

can exercise their clout in project siting (by offering land) and project management (by having greater say in a community decision-making forum).<sup>14</sup>

In another study, Caldwell et al (2003b) found that three-quarters of the women interviewed in arsenic-affected areas preferred switching to deep tubewells rather than procure surface water when their tubewells were found to be contaminated. Surface water was not preferred due to burdens in carrying and boiling/treating the water for usage. Certainly, the availability and accessibility of (uncontaminated) deep tubewells has to be factored into such decision-making in different places. Jakariya's (2003) study indicated that when negotiating water usage from few deep tubewells is troublesome or too much work is involved in procuring the water, people often resort to consuming surface water or contaminated shallow tubewell water that is more accessible.

As arsenic-contaminated water does not look, smell or taste different from uncontaminated water, many people have expressed scepticism about warnings (especially in areas where arsenicosis manifestations are low or water contamination levels are low). This scepticism is not surprising, given that for decades, campaigns to switch people over to drinking groundwater were now suddenly being contradicted by the same authorities. Despite attempts by various organizations in trying out options for providing water, poorer households are often left with very few options but to continue to consume unsafe water, as time, energy and costs involved in availing safe water is prohibitive in the context of their livelihoods and resources. Similarly, while arsenic-contaminated water can be used for washing, bathing and other domestic purposes besides consumption, there remain vast misperceptions and fear in many areas of the country about using 'poisoned water' from erstwhile-safe tubewells. The messages sent about appropriate usage of 'red' tubewell water need to be further strengthened so as not to increase women's burdens of provision of different types of domestic water (Caldwell et al 2003b).

The temporal dimension of the contamination also needs to be

considered. Some areas have shown seasonal variation in contamination levels, leading to some confusion for local people on using tubewells. Similarly, there have been concerns about the temporal nature of the 'green' status of a tubewell, where erstwhile green tubewells have had to be painted red over time as higher contamination levels were detected upon repeat testing. Other areas where testing is not repeated or the situation not monitored, people often return to using contaminated tubewells for lack of suitable alternative options. Lastly, in areas where arsenic contamination is acute, fears of prolonged use of safer deep tubewells leading to their contamination have led to restrictions on their use by their owners (fears of it being only a matter of time till arsenic contaminates the tubewell and over-use would accelerate the process). Such factors influence the politics over water that is seen in many arsenic-affected areas.

Many development projects and NGOs are trying to increase public awareness in order to address this massive water supply and public health problem (Alam et al 2002; Caldwell et al 2003b; Hadi 2003; NAISU nd). In a study of the effects and outcomes of arsenic-awareness campaigns, it was found that there is considerable gender gap in knowledge about arsenic contamination, transmission and mitigation (Hadi 2003). While this is likely to be related to lower literacy rate among women and their lower participation in public spaces in general in rural areas, it was more specifically seen to be correlated to land ownership, family income source and exposure to media. Awareness campaigns are often found to be effective in reducing gender and class gaps in knowledge about arsenic contamination and poisoning, and can thereby attempt to change perception and behaviour in dealing with water with respect to the crisis. However, the poorest segments of the society, with lower levels of education, literacy and official involvements, are often harder to reach in such awareness campaigns. Furthermore, advocating increasing the intake of nutritious food to reduce vulnerability to arsenicosis is likely to have little effect for the vast majority who suffer from chronic poverty and undernourishment.

Similarly, advocating abstaining from consuming contaminated water without alternative water provisions that are viable and acceptable is unlikely to help the situation.

In addition to awareness campaigns, one major thrust of current strategies to address the arsenic crisis has been to examine the implementation of different arsenic-removal technologies as well as alternate water provision options in some project areas (such as drilling deeper tubewells, rainwater harvesting, pond sand filters and community piped water supply systems).<sup>15</sup> While some options involve private/individual investments (drilling deep tubewells on one's own homestead, or purchasing water filters, which wealthier households can undertake), others involve community institutions and collective action (pond sand filters, piped water systems). Many existing development projects have incorporated various versions of the alternative water provision approaches, with mixed results. For example, some projects involve providing water filtration technologies (which can be quite expensive for poor households); efforts are being made to provide more affordable and locally-produced filters. Reviving indigenous dugwells are also being attempted in some sites. Others promote switching to deeper tubewells that are uncontaminated (Van Geen et al 2002; Caldwell et al 2003b). However, concerns have been raised that mass switching to deep tubewells may encourage unregulated and improper well drilling, exposing deeper aquifers to arsenic contamination from shallow aquifers. Other mitigative attempts such as various forms of community piped water systems, pond sand filters, or rainwater harvesting have been successful for short durations of time and others collapsed after project completion (Anstiss et al 2001; Jakariya 2003). Many policy makers and scholars are advocating returning to surface water solutions, and see this calamity as an opportunity to jumpstart development of surface waters of the country. The arsenic debate thus has to be understood in the context of the long-standing groundwater versus surface water debate in the country (Kranzlin 2000). For these various mitigative approaches, the concerns often raised are the costs of ownership, costs of construction and

low quantity of water available, taste/smell of the water, bacteriological contamination of the water, arsenic sludge disposal, or distance/access issues. Ultimately, alternative water options have to be affordable, viable and acceptable for people to be able to switch from tubewell water usage.

### *Conclusion*

In conclusion, I would like to reflect on how the academic and policy debates and approaches can be brought to bear on the arsenic crisis in Bangladesh, and how we might better understand the processes and issues involved from a gender perspective. In doing so, I also raise questions for further research and dialogue. Firstly, water-resource management needs to be recognized less as a technocratic issue and more as a socio-ecological and political one. The dominance of engineering and 'economistic' approaches should give way to more interdisciplinary focus and research. A more engaging conversation between the largely technocratic/'managerialistic' water-resource management literature with literatures on political ecology and feminist theories is likely to prove useful in raising interesting questions for enriched understandings of water-society relations and changing waterscapes. Bridging the theoretical/academic literatures with the more applied/policy oriented literatures is thus important.

Moreover, while gender mainstreaming in water resources management has been gaining favour in development discourses globally, it is not clear that it has been altering practices on the ground sufficiently. For instance, 'gender' is often reduced to mean 'women' and not seen as the social relational term that it is. Similarly, 'community' and 'household' are often seen to be homogeneous entities and not treated as differentiated units where members have different powers, goals, roles, and interests. However it has become common to include community-based water management in much policy rhetoric without adequate attention to problematizing such terms. While scholars have made these arguments in academic

and policy literatures, it does not appear to have translated to practices on the ground. As such, issues of gender division of labour, literacy rates, social norms and exclusions which often lead to lower presence of different categories of women compared to men in community fora (e.g., water-users associations) are not sufficiently analysed. Greater attention needs to be drawn to women's rights, access to economic opportunities, and bargaining power in understanding gender-water relations (Agarwal 2001). Gender analysis also has to incorporate intersectional analysis, to focus on how gender operates within other social axes of difference in relation to water. Arsenic mitigation policies and approaches will benefit from addressing such concerns.

It is often noted that women's role in water-resource management is generally high, but their role in policy-making and decision-making at multiple scales is low compared to men. Participation of women, from different social backgrounds and locations, is thus needed at different levels to ensure proper consultation and distribution of benefits. Training, legislation, and policy changes need to support gender approaches in addition to increasing the number of women in relation to men at different levels of power (Tortajada 1998; Turton et al 2001). Of course such participation has to take into account the concerns raised earlier about multiple axes of difference that operate in conjunction with gender differences. Similarly, it is important to ensure that participation in local projects does not result in gross increases in workloads and burdens for the poor. Furthermore, it should be recognized that women's interests in water are not just for drinking and domestic water but for productive water as well (as often women have homestead/kitchen gardens, participate as farmers, as well as raise poultry and livestock). Women's involvement in community drinking water projects needs to be complemented with addressing other water needs, as water scarcity and deprivation can have profound effects on poverty and livelihood strategies in multiple ways. As such, drinking water issues should be viewed as broader societal concerns and men's roles in drinking water management, provision, decision-

making and politics also have to be assessed. Fundamentally, it needs to be recognized that struggles over water are basically struggles over power and livelihood.

While sustainability, equality and efficiency are common development goals, greater gender sensitivity is likely to increase the chance of attaining such goals in water projects. A gender approach looks at issues of embedded power relations and hierarchies in society, and can better inform water projects as they are conceptualized and implemented. Similarly, while many water-resource management projects have articulated goals of 'empowerment' through participation in projects, it is not clear that that is possible without broader social changes (practical versus strategic gender needs need to be recognized; c.f. Moser 1993). As a result, projects can contribute to increasing inequality and discrimination by reinforcing gender hierarchies if such concerns are not adequately taken into account (Agarwal 2003). Similarly, changes in broader development paradigms, reflecting neoliberal globalization, have tended to encourage privatization of water management and water delivery. Often this is couched within discourses of participatory development and decentralization. Such shifts need to be carefully analysed for their gender implications and the way they affect the poor. While some argue that water is a basic human right (Gleick 1999), increasing focus on privatization is likely to exclude the poor and already-marginalized, and thus not to ensure water as a basic right for all. What privatization of water resources means for goals of socio-ecological sustainability and social equity are also contested (Page 2003).<sup>16</sup>

Present trends in water-resource management with respect to the arsenic crisis raise the concern whether discourses of sustainable development and participatory community-based development mobilized to formulate new projects, such as 'participatory community-based arsenic mitigation projects', that can problematically idealize community, might actually increase class and gender inequalities and exacerbate social struggles and conflicts over water. Community water management projects in rural villages can play into the

existing unequal power relations and conflictual relations over water, which can lead to further marginalization of the poor, especially women in relation to men, in decision-making within water user groups and benefiting from new policies. In what ways and how mitigative measures are participatory are often not adequately documented. It is important to look at what conditions are conducive to collective action and how benefits are distributed (i.e., to what extent 'community' projects are inherently preferred or viable and whether organizational and institutional capacities exist on the ground). Discourses such as 'participatory', 'sustainable' and 'community' in water resources management projects appear to be largely unquestioned by the state, donors, and NGOs, thereby creating a disjoint between rhetoric and practice. Perhaps the assumptions of such development discourses that shape water management policies and practices need to be held up to greater scrutiny and reflection on what such terms actually mean on the ground.

Furthermore, the arsenic crisis needs to be seen as a broader socio-ecological crisis rather than as one of only drinking water provision or public health management. Indeed, it could be argued that the arsenic crisis poses as the largest development challenge in Bangladesh today. As such, viewing the arsenic crisis as a natural disaster (i.e., produced by nature) obscures the fact that it is simultaneously a social and institutional crisis. In other words, the nature-society binary is actually dialectical, where each is implicated within the other: institutional discourses and practices, social change and ecological transformations are co-constitutive of each other. Approaching the arsenic crisis in such a way would draw attention away from largely technocratic interventions to one that is more holistic and comprehensive.

Successes and failures in addressing the arsenic crisis also have to be seen in the contexts of larger development constraints, politics and processes of social change in Bangladesh. General opinion appears to be that mitigation programmes need to gear up more in terms of coordination and implementation in order to handle the rapidly unfolding disaster. The state can play the role of provider

as well as regulator of arsenic mitigation plans, where the private sector and NGOs can play an important and coordinated role in delivering options and solutions. As such, the Bangladesh state's institutional capacity and ability to coordinate across scales in managing development comes into focus in managing the drinking water crisis, as do the capacities of other development actors. Indeed, the arsenic crisis is seen as a way to test run the effectiveness and functioning of local government bodies as the state deliberates greater decentralized governance (Ahmed and Ahmed 2002). To what extent this will be successful is unknown. But the arsenic crisis may offer an opportunity to enhance the processes of transforming the state towards being more effective, accountable, transparent, and inclusive.

Furthermore, years of relentless exploitation of groundwater for irrigation and drinking water provision have to be seen in the context of national goals and policies on development and addressed as such. Broader watershed management also comes into the picture, as reduction in surface water is likely to exacerbate drinking water shortages in the light of the arsenic crisis. India's mega-project of linking major international rivers will deprive downstream Bangladesh of river water, and thus reduce surface water sources available for use. This may exacerbate the arsenic crisis and drinking water shortages. The larger political ecology of development and water sharing in South Asia thus becomes a part of the discussion. Hence a multiscalar and multi-disciplinary approach to understanding and addressing the arsenic crisis is necessary. Political ecology provides such a critical perspective to understand how extra-local and local socio-ecological changes are linked.

Finally, the question arises whether or not new crises in water-resource management can open up spaces for renewed critical dialogue and enable more gender equitable outcomes. Factors that could be contemplated include investigating what options exist to facilitate dialogical processes, forms of resistance and cooperation, new knowledge creation, and opportunities for women's collectives/movements to bring about shifts in gender ideology and social

oppression. In other words, can crisis situations be turned into situations of opportunity and change? This is likely to be possible with immense and coordinated efforts across sites and scales by various development actors and agents, so that crafting solutions involve working together in meaningful, accountable, transparent and egalitarian ways. This will perhaps take some time in order to work as the issues of historical relations, systems of patriarchy, developmental constraints, and the overall socio-political situation operate within the context of changing ecological conditions of arsenic contamination. But one must hope that endeavours to provide adequate safe drinking water in the course of addressing such a national calamity create spaces for critical reflection on and attempts to change gender and power relations over water.

#### NOTES

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<sup>1</sup> I use the term 'arsenic crisis' in quotes both because I want to use a commonly used phrase that encapsulates the multifaceted nature of the crisis as well as to raise questions about what/who the crisis is for (e.g. crisis of the state, for development, for water resources management, for livelihoods, of gendered rights, etc.).

<sup>2</sup> Cleaver and Elson (1995), however, argue that the distinction between 'productive' and 'domestic' water is a false dichotomy as they are intertwined. However, it could be argued that state institutions and ideologies that favour water provision for the agricultural sector, often construed as a male domain, affect the priorities placed on provision of drinking water, generally construed as female responsibilities.

<sup>3</sup> Such cultural constructions of gender responsibilities are naturalized even through artwork and folk songs in Bangladesh, thereby reinforcing gender divisions of labour and duties.

<sup>4</sup> Coates (1999: 2) further argues that 'race, ethnicity, age, culture, tradition, religion and an individual's "position" (wealth, status) also assist to differentiate the experience of being a man or a women within a particular society. Therefore gender identity and gender roles are the result of learned behaviour and, given the right impetus and motivation, can change.' Similarly, social constructions of femininity and masculinity that are mapped onto female and male bodies need to be scrutinized and not taken as a given or permanent.

<sup>5</sup> Information for this section is based on field research carried out in Bangladesh in 2003. Interviews were conducted with senior and project officials as well as scholars of the following institutions: NGO Forum for Drinking Water and Sanitation, Bangladesh Rural Advancement Committee (BRAC), Dhaka Community Hospital, Dhaka Ahsania Mission, Department of Public Health and Engineering (DPHE), Ministry of Environment and Forest, Bangladesh Arsenic Mitigation and Water Supply Project (BAMWSP), Local Government Engineering Division (LGED), Bangladesh Water Development Board (BWDB), Water Resources Planning Organization (WARPO), UNICEF, World Bank, British Department for International Development (DFID), Canadian International Development Agency (CIDA), OCETA, World Health Organization (WHO), Swiss Agency for Development and Cooperation (SDC), DANIDA/DPHE project, UNDP/DPHE project,

International Development Enterprises (IDE), WaterAid, Asia Arsenic Network, Bangladesh University of Engineering and Technology (BUET), and Dhaka University.

<sup>6</sup> Similar arsenic contamination of groundwater is also seen in the state of West Bengal in India, just west of Bangladesh, which is geologically similar and a part of the Ganges delta. In Bangladesh, arsenic has been found in high concentrations in the south, west and central parts of the country, primarily in areas close to rivers.

<sup>7</sup> Arsenic is generally thought to have been released into aquifers from overdrawing of groundwater for irrigation in the last few decades. This is still a contested thesis and scientists are looking into the causes of the high concentrations of arsenic in groundwater sources. The two main contending theses are whether or not arsenic is released via oxidation or reduction mechanisms, with the latter hypotheses having more popularity and credence as it ascribes the arsenic contamination to natural delta processes and not to oxidation through irrigation (which would place it squarely in the T anthropogenic domain with considerable political ramifications, both within the country and in neighbouring India). (For further details see Nickson et al 1998; Anawar et al 2001; Ahmed and Ahmed 2002; Alam et al 2002; Burgess et al 2002; Cuthbert et al 2002; C. F. Harvey et al 2002; Anawar et al 2003; Khan et al 2003).

<sup>8</sup> Tubewells can be shallow or deep depending on the depth of the borehole into the aquifer. Deep tubewells are much more costly than shallow tubewells (nearly ten times more costly, well beyond the means of majority of the rural poor). Shallow tubewells generally go 20-30 m underground, are relatively affordable and easy to instal, and are more common in rural areas.

<sup>9</sup> Such statistics do not capture the millions who are not registered, have been misdiagnosed, have not been officially diagnosed and identified yet, or have already died.

<sup>10</sup> See Arsenic Crisis Information Center for further details at <http://bicn.com/acic/> as well as national information sources such as the NGOs Arsenic Information and Support Unit (NAISU) at <http://www.naisu.info/>

<sup>11</sup> Some of the concerns regarding this have been the level of involvement

of the Department of Public Health and Engineering (DPHE), validity of the test results generated, delivery of targeted outputs and coordination between different actors. There have also been some concerns raised about the effectiveness of the field test kits used and the level of training of fieldworkers mobilized to test water in rural areas (Rahman et al 2002).

<sup>12</sup> Critiques have been made that, while the policy is useful in coordinating activities and bringing the issue under national purview, it is rigid in its recommendations of implementation ideas. Others have raised the concern that while the arsenic crisis is a national disaster, its mitigation should fall under the existing National Drinking Water and Sanitation Policy and that a separate policy is not necessary beyond calming public panic and outcry at slow government response.

<sup>13</sup> The variability of contamination levels comes from minor soil differences and differences in Ice Age soil deposits (Caldwell et al 2003b).

<sup>14</sup> In some project areas, the wealthier and more powerful households expressed unwillingness to go to a safer water source located in a poorer household's *bari* or land, as that would indicate a loss of 'social status'. This highlights the class stratification of rural Bangladeshi society, where perceived notions of 'social status' apparently belong only to wealthier or politically connected households.

<sup>15</sup> The government finally concluded its lengthy testing and evaluation of various filtration technologies in early 2004 and approved a few for national promotion or replication. However, many different kinds of methods have been used by various organizations in project sites on a trial basis the last few years (e.g. Three Kolshi, Safi, Alcan). Some of the concerns that have been raised involve what to do with the arsenic sludge after filtration, which would end up going back into the environment if not properly handled.

<sup>16</sup> Some authors have further argued that global commodification and privatization of water actually undermine women's values of water and exclude women's water rights (Shiva 1998).

## REFERENCES

- Adams, W.M., 1990. *Green development: environment and sustainability in the third world*. London: Routledge.
- Agarwal, A. and C. Gibson, 2001. *Communities and the Environment: Ethnicity, Gender, and the State in Community-based Conservation*. New Brunswick: Rutgers University Press.
- Agarwal, B., 1992. "The gender and environment debate: lessons from India" *Feminist Studies* 18: 119-57.
- Agarwal, B., 1994. *A Field of One's Own: Gender and Land Rights in South Asia*. Cambridge: Cambridge University Press.
- Agarwal, B., 2000. "Conceptualizing Environmental Collective Action: Why Gender Matters". *Cambridge Journal of Economics* 24(3): 283-310.
- Agarwal, B., 2001. "Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework". *World Development* 29(10): 1623-1648.
- Agarwal, B., 2003. "Gender inequality, cooperation, and environmental sustainability". In *Inequality, Collective Action and Environmental Sustainability*, J-M. Baland, S. Bowles and P. Bardhan (eds.). Russell Sage: New York.
- Ahluwalia, M., 1997. "Representing communities: The case of a community-based watershed management project in Rajasthan, India". *IDS Bulletin* 28(4): 23-34.
- Ahmad, S. K. A., G. Uddin, M. D. A. Halim, D. Bandaranayake, A. W. Khan, and S. K. A. Hadi, 1997. "Arsenic contamination in ground water and arsenicosis in Bangladesh." *International Journal of Environmental Health Research* 7(4): 271-276.
- Ahmed, C. M., 2002. "Impact of Arsenic on the Rural Poor in Bangladesh". In *Bangladesh Environment 2002*, F. M. Ahmed, S. Tanveer and A.B.M. Badruzzaman (eds). BAPA: Bangladesh. pp. 154-160.
- Ahmed, F. M. and C. M. Ahmed (eds), 2002. *Arsenic Mitigation in Bangladesh*. An Outcome of the International Workshop on Arsenic Mitigation in Bangladesh, 14-16 January 2002. Local Government Division, Ministry of LGRD and Cooperatives, Government of Bangladesh.
- Alam, M. G. M., E. T. Snow, and A. Tanaka, 2003. "Arsenic and heavy metal contamination of vegetables grown in Samta village, Bangladesh." *Science of the Total Environment* 308(1-3): 83-96.
- Alam, M. G. M., M. Westbrooke, G. Allinson, F. Stagnitti, and A. Tanaka, 2002. "Arsenic contamination in Bangladesh groundwater: A major environmental and social disaster." *International Journal of Environmental Health Research* 12(3): 236-253.
- Anawar, H. M., S. Safiullah, S. M. Tareq, J. Akai, and K. M. G. Mostofa, 2001. "Arsenic poisoning in groundwater: Health risk and geochemical sources in Bangladesh." *Environment International* 27(7): 597-604.
- Anawar, H. M., T. Yoshioka, T. Ishizuka, S. Safiullah, K. Kato, J. Akai, K. Komaki, and H. Terao, 2003. "Geochemical occurrence of arsenic in groundwater of Bangladesh: Sources and mobilization processes." *Journal of Geochemical Exploration* 77(2-3): 109-131.
- Anstiss, R., M. Arewgoda, M. Ahmed, S. Islam, and A. W. Khan, 2001. "A sustainable community-based arsenic mitigation pilot project in Bangladesh." *International Journal of Environmental Health Research* 11(3): 267-274.
- Bakker, K., 2003. "A political ecology of water privatization". *Studies in Political Economy* 70.
- Bardhan, P., 2001. "Water Community: An empirical analysis of cooperation on irrigation in South India." In *Communities and markets in economic development*, M. Aoki and Y. Hayami (eds). Oxford: Oxford University Press. Pp. 247-264.
- Blaikie, P., 1985. *The Political Economy of Soil Erosion in Developing Countries*. New York: Longman.
- Blaikie, P. and H. C. Brookfield, 1987. *Land degradation and society*. New York: Methuen Press.
- BRAC, 2000. "Combating a deadly menace: early experience with a community-based arsenic mitigation project in Bangladesh." *BRAC Research Monograph Series No. 16*. BRAC Research and Evaluation Division: Dhaka, Bangladesh.
- Bruns, B.R. and R. S. Meinzen-Dick (eds), 2000. *Negotiating Water Rights*. New Delhi: Vistaar Publishers.
- Bryant, R. L., 1998. "Power, knowledge and political ecology in the third world: A review". *Progress in Physical Geography* 22(1): 79-94.
- Bryant, R. L. and S. Bailey, 1997. *Third World political ecology*. New York: Routledge.
- Burgess, W. G., M. Burren, J. Perrin, and K. M. Ahmed, 2002. "Constraints on sustainable development of arsenic-bearing aquifers in southern Bangladesh. Part 1: A conceptual model of arsenic in the aquifer." *Geological Society Special Publication* 193: 145-163.
- Caldwell, B. K., J. C. Caldwell, S. N. Mitra, and W. Smith, 2003a. "Tubewells and arsenic in Bangladesh: Challenging a public health success story." *International Journal of Population Geography* 9(1): 23-38.
- Caldwell, B. K., W. Smith, J. C. Caldwell, and S. N. Mitra, 2003b. "Searching for an optimum solution to the Bangladesh arsenic crisis." *Social Science and Medicine* 56(10): 2089-2096.
- Carney, J., 1993. *Converting the Wetlands, Engendering the Environment: the Intersection of Gender with Agrarian Change in the Gambia*. *Economic Geography* 69(4): 329-348.
- Chakraborti, D., M.M. Rahman, K. Paul, U.K. Chowdhury, M.K. Sengupta, D. Lodhi, C.R. Chanda, K.C. Saha, and S.C. Mukherjee, 2002. "Arsenic calamity in the Indian subcontinent - What lessons have been learned?" *Talanta* 58: 3-22.
- Chambers, R. and G. R. Conway, 1992. "Sustainable rural livelihoods: Practical concepts for the 21st century". *Institute of Development Studies Discussion Paper* 296. London: IDS.



- Chambers, R., 1997. *Whose Reality Counts? Putting the First Last*. Great Britain: The Bath Press.
- Cleaver, F., 2000. "Analysing gender roles in community natural resource management: Negotiation, lifecourses and social inclusion." *IDS Bulletin* 31(2): 60-67.
- Cleaver, F., 2003. "Bearers, Buyers and Bureaucrats: the Missing Social World in Gender and Water". Paper prepared for the International Workshop *Feminist Fables and Gender Myths: Repositioning Gender in Development Policy and Practice*, Institute of Development Studies, Sussex, 2-4 July 2003.
- Cleaver, F. and D. Elson, 1995. *Women and Water Resources: Continued Marginalisation and New Policies*. In The Gatekeeper Series of International Institute for Environment and Development's Sustainable Agriculture Programme, no. 49, p. 3-16.
- Cleaver, F. and K. Jobs, 1996. "Donor policies and gender in the water and sanitation sector." *Natural Resource Forum* 20(2): 111-116.
- Coates, S., 1999. "A gender and development approach to water, sanitation and hygiene programmes". *WaterAid Briefing Paper*, WaterAid: UK.
- Cornwall, A., 2000. "Making a difference? Gender and participatory development". *IDS Discussion Paper #378*. Institute of Development Studies: UK.
- Crow, B. and F. Sultana, 2002. "Gender, Class and Access to Water: Three Cases in a Poor and Crowded Delta". *Society and Natural Resources* 15 (8) pp.709-724.
- Cuthbert, M. O., W. G. Burgess, and L. Connell, 2002. "Constraints on sustainable development of arsenic-bearing aquifers in southern Bangladesh. Part 2: Preliminary models of arsenic variability in pumped groundwater." *Geological Society Special Publication* 193: 165-179.
- Derman, B. and A. Ferguson, 2000. "The Value of Water: Political Ecology and Water Reform in Southern Africa". Paper Prepared for the *Panel on Political Ecology for the Annual Meetings of the American Anthropological Association*, San Francisco, November 15-19, 2000.
- Devasia, L., 1998. "Safe drinking water and its acquisition: Rural women's participation in water management in Maharashtra, India." *International Journal of Water Resources Development* 14(4): 537-546.
- Doyle, T., 1998. "Sustainable development and Agenda 21: the secular bible of global free markets and pluralist democracy". *Third World Quarterly - Journal of Emerging Areas* 19(4): 771-786.
- Elson, D., 1995. *Male bias in the development process*. (2nd edn). Manchester: Manchester University Press.
- Gleick, P. H., 1998. "The human right to water". *Water Policy* 1: 487-503.
- Guijt, I. and Shah, M. (eds), 1998. *The Myth of Community: Gender Issues in Participatory Development*. London: Intermediate Technology Publications.
- Hadi, A., 2003. "Fighting arsenic at the grassroots: experience of BRAC's community awareness initiative in Bangladesh." *Health Policy and Planning* 18(1): 93-100.
- Harvey, C. F., W. Yu, M. A. Ali, J. Jay, R. Beckie, V. Niedan, D. Brabander, P. M. Oates, K. N. Ashfaq, S. Islam, H. F. Hemond, M. F. Ahmed, C. H. Swartz, A. B. M. Badruzzaman, and N. Keon-Blute, 2002. "Arsenic mobility and groundwater extraction in Bangladesh." *Science* 298(5598): 1602-1606.
- Hoque, B. A., S. A. Ahmed, S. Shafique, M. Rahman, G. Morshed, T. Chowdhury, M. M. Rahman, F. H. Kahn, M. Shahjahan, M. Begum, M. M. Hoque, A. A. Mahmood, M. Quadiruzzaman, and F. Khan, 2000. "Recommendations for water supply in arsenic mitigation: A case study from Bangladesh." *Public Health* 114(6): 488-494.
- Hossain, M. A., 2002. "Arsenic contamination in drinking water and environmental threats: Mitigation perspectives in Bangladesh." *Regional Development Dialogue* 23(1): 83-108.
- Jackson, C., 1993a. *Doing What Comes Naturally? Women and Environment in Development*. *World Development* 21(12): 1947-1963.
- Jackson C., 1993b. "Environmentalisms and gender interests in the Third World." *Development & Change* 24(4): 649-677.
- Jackson, C., 1998. *Gender, irrigation and environment: Arguing for agency*. *Agriculture and Human Values* 15(4):313-324.
- Jahan, R., 1995. *The Elusive Agenda: Mainstreaming Women in Development*, Zed Books: London.
- Jakariya, M., 2003. *The use of alternative safe water option to mitigate the Arsenic problem in Bangladesh: community perspective*. BRAC Research Monograph Series No. 24. BRAC Research and Evaluation Division: Dhaka, Bangladesh.
- Jewitt, S., 2000. "Unequal knowledges in Jharkand, India: De-romanticizing women's agroecological expertise". *Development and Change* 31: 961-985.
- Joekes, S., M. Leach, and C. Green (eds), 1995. "Gender relations and environmental change". *IDS Bulletin* 26, 1-95 (special edition). Institute of Development Studies, U.K.
- Jordans, E. and M. Zwarteveen, 1997. *A Well of One's Own: Gender Analysis of an Irrigation Program in Bangladesh*. Grameen Krishi Foundation and International Irrigation Management Institute, Colombo.
- Joshi, D., M. Loyd and B. Fawcett, 2003. "Voices from below". Paper presented at the *Alternative Water Forum*, University of Bradford, UK, May 2003.
- Kabeer, N., 1994. *Reversed Realities: Gender Hierarchies in Development Thought*. London: Verso.
- Kapoor, I., 2001. "Towards participatory environmental management?" *Journal of Environmental Management* 63: 269-279.
- Karim, M. M., 2000. "Arsenic in groundwater and health problems in Bangladesh." *Water Research* 34(1): 304-310.
- Khan, A. A., M. A. Hoque, S. Hoque, S. M. I. Huq, and K. Q. Kibria, 2003. "Evidence of bacterial activity in the release of arsenic - A case study from the Bengal delta of Bangladesh." *Journal of the Geological Society of India* 61(2): 209-214.
- Kinley, D. H. and Z. Hossain, 2003. "Bangladesh, desperately seeking solutions." *World Watch* 16(1): 22-27.

- Kranzlin, I., 2000. "Pond management in rural Bangladesh: Problems and possibilities in the context of the water supply crisis." *Natural Resources Forum* 24(3): 211-223.
- Leach, M., R. Mearns, and I. Scoones, 1997. "Challenges to community-based sustainable development: dynamics, entitlements, institutions". *IDS Bulletin* 28 (4): 1-14.
- Lélé, S., 1991. "Sustainable Development: A Critical Review". *World Development* 19 (6): 607-621.
- Marchand, M. and J. Parpart (eds), 1995. *Feminism/Postmodernism/Development*. New York: Routledge.
- McCully, P., 1996. *Silenced Rivers: The Ecology and Politics of Large Dams*. London: Zed Books.
- Meharg, A. A. and M. Rahman, 2003. "Arsenic contamination of Bangladesh paddy field soils: Implications for rice contribution to arsenic consumption." *Environmental Science and Technology* 37(2): 229-234.
- Mehta, L., 1997. "Social difference and water resources management: Insights from Kutch, India". *IDS Bulletin* 28(4): 79-88.
- Meinzen-Dick, R. (ed), 2001. "Multiple Uses of Water in Irrigated Areas". *Irrigation and Drainage Systems* 15 (2) Special Volume.
- Meinzen-Dick, R. and M. Zwarteveen, 1998. "Gendered participation in water management: Issues and illustrations from water users' associations in South Asia." *Agriculture and Human Values* 15: 337-345.
- Mies, M. and V. Shiva, 1993. *Ecofeminism*. London: Zed Books.
- Mohanty, C., 1991. "Introduction: Cartographies of struggle". In *Third World Women and the Politics of Feminism*, C.T. Mohanty, A. Russo and L. Torres (eds). Indiana University Press: Bloomington. Pp. 1-47.
- Moore, D., 1993. "Contesting Terrain in Zimbabwe's Eastern Highlands: Political Ecology, Ethnography, and Peasant Resource Struggles". *Economic Geography* 69(4): 380-401.
- Moser, C., 1993. *Gender Planning and Development: Theory, Practice and Training*. London: Routledge
- Mosse, D., 1997. "The symbolic making of a common property resource: History, ecology and locality in a tank-irrigated landscape in South India". *Development and Change*, 28: 467-504.
- NAISU Arsenic Bulletin. Multiple years. Publication of the NGOs Arsenic Information and Support Unit, available at <http://www.naisu.info/>
- National Arsenic Policy, 2003. *Draft*. Government of Bangladesh.
- National Water Management Plan, 2001. *Draft*. Bangladesh Water Development Board, Government of Bangladesh.
- National Water Policy, 1999. *Final Version*. Ministry of Water Resources, Government of Bangladesh.
- Nelson, N. and S. Wright, 1995. *Power and participatory development: Theory and practice*. Intermediate Technology Publications: UK.
- New York Times*, 11/10/98, "New Bangladesh disaster: Wells that pump poison", front page.
- Nickson, R., J. McArthur, W. Burgess, K. M. Ahmed, P. Ravenscroft, and M. Rahman, 1998. "Arsenic poisoning of Bangladesh groundwater". *Nature*, 395 (24 September).
- O' Riordan, T., 1993. "The politics of sustainability". In *Sustainable environmental economics and management: Principles and practice*, R. K. Turner (ed). London: Belhaven. Pp. 37-69.
- Page, B., 2003. "Communities as the agents of commodification: the Kumbo Water Authority in Northwest Cameroon". *Geoforum* 34: 483-498.
- Parpart, J. L. and M. H. Marchand, 1995. "Exploding the Canon: An Introduction/Conclusion". In *Feminism, Postmodernism, Development*, M. Marchand and J. L. Parpart (eds). Routledge: New York. Pp. 1-22.
- Paul, B. K., and S. De, 2000. "Arsenic poisoning in Bangladesh: A geographic analysis." *Journal of the American Water Resources Association* 36(4): 799-809.
- Peet, R., and M. Watts (eds), 1996. *Liberation ecologies: Environment, development, social movements*. New York: Routledge.
- Rahman, M. M., D. Lodh, C. R. Chanda, S. Roy, Md Selim, Q. Quamruzzaman, A. H. Milton, S. M. Shahidullah, R. M. Tofizur, D. Chakraborti, D. Mukherjee, M. K. Sengupta, and U. K. Chowdhury, 2002. "Effectiveness and reliability of arsenic field testing kits: Are the million dollar screening projects effective or not?" *Environmental Science and Technology* 36(24): 5385-5394.
- Redclift, M., 1993. "Sustainable development: concepts, contradictions, and conflicts". In *Food for the Future: Conditions and contradictions of sustainability*, P. Allen (ed). J. Wiley & Sons: New York. Pp.169-192.
- Regmi, S.C., and B. Fawcett, 1999. "Integrating gender needs into drinking-water projects in Nepal." *Gender and Development* 7(3): 62-72.
- Rico, M.N., 1998. "Women in water-related processes in Latin America: Current situation and research and policy proposals." *International Journal of Water Resources Development* 14(4): 461-471.
- Rocheleau, D., B. Thomas-Slayer, and E. Wangari (eds), 1996. *Feminist political ecology: Global issues and local experiences*. New York: Routledge.
- Sadeque, S. Z., 2000. "Nature's bounty or scarce commodity: Competition and consensus over groundwater use in rural Bangladesh." In *Negotiating Water Rights*, B.R. Bruns and R. S. Meinzen-Dick (eds). New Delhi: Vistaar Publishers. Pp. 269-291.
- Shiva, V., 1989. *Staying Alive: women, ecology and development*. London: Zed Books.
- Shiva, V., 1998. "Women's water rights". *Waterlines* 17(1): 9-11.
- Smith, A. H., E. O. Lingas, and M. Rahman, 2000. "Contamination of drinking-water by arsenic in Bangladesh: A public health emergency." *Bulletin of the World Health Organization* 78(9): 1093-1103. Available at: <http://www.who.int/bulletin/pdf/2000/issue9/bu0751.pdf>
- Sneddon, C.S., 2000. "Sustainability in ecological economics, ecology and livelihoods: A review". *Progress in Human Geography* 24( 4) : 521-549.

- Stott, P. and S. Sullivan, 2000. *Political Ecology: Science, Myth and Power*. Arnold: UK.
- Swyngedouw, E., 1999. "Modernity and Hybridity: Nature, Regeneracionismo, and the Production of the Spanish Waterscape, 1890-1930". *Annals of the Association of American Geographers* 89: 443-465.
- Tortajada, C., 1998. "Contribution of women to the planning and management of water resources in Latin America." *International Journal of Water Resources Development* 14(4): 451-459.
- Turton, A. R., B. Schreiner, and J. Leestemaker, 2001. "Feminization as a critical component of the changing hydrosocial contract." *Water Science and Technology* 43(4): 155-163.
- Van Geen, A., Y. Zheng, I. Hussain, K. M. Ahmed, A. Gelman, M. Stute, J. Simpson, S. Wallace, C. Small, F. Parvez, V. Slavkovich, N. J. Lolacono, M. Becker, Z. Cheng, H. Momotaj, M. Shahnewaz, A. Ali Seddique, J. H. Graziano, H. Ahsan, A. H. Horneman, and R. K. Dhar, 2002. "Promotion of well-switching to mitigate the current arsenic crisis in Bangladesh." *Bulletin of the World Health Organization* 80(9): 732-737.
- Van Koppen, B., 1999. "Sharing the Last Drop: Water Scarcity, Irrigation and Gendered Poverty Eradication". *IIED Gatekeeper Series*, No. 85. International Institute for Environment and Development: UK.
- Van Koppen, B. and S. Mahmud, 1996. *Women and Water-Pumps in Bangladesh, The Impact of Participation in irrigation groups on Women's Status*. London: IT Publications.
- Veron, R., 2001. "The 'new' Kerala model: lessons for sustainable development" *World Development* v. 29 no.4, p. 601-17.
- Visvanathan, N., L. Duggan, L. Nisonoff, and J. Wiegersma (eds), 1997. *The Women, Gender and Development Reader*. London: Zed Books.
- WCED, 1987. *Our Common Future*. World Commission on Environment and Development. Oxford: Oxford University Press.
- WSP, 2002. "Fighting Arsenic, listening to rural communities: findings from a study on willingness to pay for Arsenic-free, safe drinking water in rural Bangladesh". *FieldNote*, Water and Sanitation Program – South Asia. Dhaka, Bangladesh.
- Zimmerer, K.S., 2000. "Rescaling irrigation in Latin America: the cultural images and political ecology of water resources". *Ecumene* 7 (2): 150-175.