7.1 Introduction

One of the key aims of this research is to formulate a more effective, sustainable and politically feasible pollution management approach for the Buriganga River. This was pursued through several avenues, including the analysis of river and waste water quality; the assessment of the existing river pollution control system; and the economic analysis of three alternative policies for water pollution management in the Buriganga River. The preceding chapters show that there are a range of pollution control measures available for the policy makers in Bangladesh to choose from. Nevertheless, it is important to identify an appropriate blend of instruments in order to address the specific pollution control problem in the Buriganga River. This task depends on the nature of the pollution problem and its causes, as well as on practical issues surrounding it, such as institutional capacity and acceptability to stakeholders. Moreover, it is important to take into account a set of criteria, including cost-effectiveness and administrative feasibility, in the process of selecting the instruments and developing an integrated management framework (Bernstein 1997).

One could draw on international experience in river pollution management in order to propose an adequate management framework for the pollution problem of the Buriganga River. It would be useful to look into the experiences with pollution management approaches in some of those rivers in order to devise appropriate policy instruments for the Buriganga River. Thereby this chapter offers findings from case studies on six prominent examples from selected countries where various pollution control measures have been applied to management of river water quality. Moreover, based on the findings communicated earlier in this thesis, and the lessons from the experience of river pollution management in other countries, this chapter aims at proposing a conceptual framework of an integrated pollution management system for the Buriganga River. The chapter also
identifies and discusses a set of policies to be implemented in order to move towards a system of integrated pollution management in Bangladesh context.

7.2 International experience on application of river pollution control measures

It is important to understand how the various policy measures (as discussed in the preceding chapters) are applied in practice specifically for the purpose of river pollution control. The examples have been drawn from both developed and developing countries including USA, Australia, China and India. The experiences from these examples provide insight about the performance and the difficulties encountered during implementation of various policy approaches across diverse countries.

7.2.1 Tradable permits for Fox River, Wisconsin, USA

The concentrated location of paper and pulp mills and other industries along the lower Fox River, located in north eastern Wisconsin in USA, has been attributed as the main source of pollution in this river. Public debate began on the issue of contamination as early as 1923, but no substantial effort was invested to improve the river water quality until 1972 when the federal Clean Water Act was passed. Since then several initiatives have been taken to clean up this river but problems continued to exist. In 1981 the state of Wisconsin initiated a system of tradable BOD permits on this river to address the pollution problem (Tietenberg 1986). The permit scheme targeted to cover 10 paper and pulp mills and four municipal waste treatment plants that were discharging pollutants within a 22 mile (35.2 km) segment of the lower Fox River. The specific problem, which led to the establishment of the permit scheme was that DO standards were not being reached at two critical points, even though the discharges were in compliance with the standards (Hahn 1989; James 1999). A study conducted by Tietenberg (1986) showed that traditional direct regulatory system would incur 40 per cent higher control costs for pollution abatement compared to emissions trading system for the river and the potential annual savings from a tradable permit scheme was estimated at US$ 6.7 million.

Despite having this potential, James (1999) reported that in this scheme (currently not in operation), only a single trade took place where a paper mill shifted its treatment activities to a municipal wastewater treatment facility. Howe (1994) argued that there
were certain conditions which had to be fulfilled for satisfactory permit trading. Those included: (1) a fairly large number of participants; (2) independent arm’s-length relationships\(^1\) between permit buyers and sellers; and (3) significant abatement cost differences among the polluters. However, adequate number of trading did not take place apparently because those requirements for the Fox River trading system were not met, which ultimately caused the market to be very small. In addition, and according to the rules of the scheme, the newly entered firms within the scheme had to continue to meet more stringent environmental requirements than old firms (pre-existing), and firms had to meet specified technological standards before trading was allowed (Hahn 1989). Further, Bernstein (1993) observed that additional administrative formalities increased the cost of trading, which consequently hindered the pollution causing agents from participating. Consequently, because of the inflexible regulations and high transactions costs, the experience with marketable permits in water pollution control has not produced impressive results for this river.

7.2.2 Stakeholder participation for San Antonio River, Texas, USA

The Clean River Program (CRP) implemented by the San Antonio River Authority (SARA), which was formed in 1937 by the Texas legislature is a key player in the conservation of the San Antonio River water. The CRP primarily aims to function on basic monitoring needed both spatially and temporally to identify water quality issues and changes in the river basin. Data collected by the CRP is officially used by the Texas Commission on Environmental Quality (TCEQ) to determine impairments to this river. However, the uniqueness of this program is the creation of a partnership among the state, local agencies and the public. Since the CRP places great emphasis on public outreach, the water quality data of this river is readily available and documented for the public from both the TCEQ and SARA’s website. These data are widely used by other agencies, programs, consultants, municipalities, students and the general public. There are reports that the data have been used to: determine impairments to water bodies; determine sewage leaks or overflows; support the in-stream Flows Study of the Lower San Antonio

\(^{1}\) This term describes a form of transaction between two related or affiliated parties to avoid a conflict of interest, which reflects a market value and is performed within commercially reasonable terms and conditions.
River; support studies on Total Maximum Daily Load (TMDL) of pollutants; inform City officials of current water quality conditions and water quality modelling (SARA 2008).

Moreover, the water quality information on the San Antonio River basin is regularly provided to the public through SARA’s quarterly community newsletter, *River Reach*. Created in 2003, the newsletter also features water quality related community events that are hosted and/or sponsored by SARA. The newsletter is distributed by mail to stakeholders throughout South Central Texas. It is also distributed in person throughout the area at school functions, community events and public meetings. San Antonio River Authority (SARA) has also formed an Environmental Advisory Committee, which is made up of stakeholders from various geographical areas within the river basin who represent a variety of personal and professional interests. The committee meets on a regular basis and provides direct input to the program by identifying and addressing the environmental strengths and weaknesses within the San Antonio River Basin. Furthermore, through the implementation of River Walk Project, SARA is also working in partnership with different community groups such as Paseo del Rio Association, Downtown Alliance of San Antonio, Hotel Motel Association and the Tourism Council to identify problem areas, recommend solutions and to develop Best Management Practices which incorporate building public awareness and running education campaigns to reduce pollution loading in the San Antonio River (SARA 2009). This is how SARA has set a classic example in promoting public participation and has encouraged a coordinated effort for the protection of this river.

7.2.3 Salinity trading scheme for Hunter River, Australia

The Hunter River salinity trading scheme in the state of New South Wales (NSW) in Australia was formally introduced in 2002 with a new legislation, following the success of a pilot scheme from 1995 to 2002 (Kraemar *et al.* 2004). The scheme was established to resolve longstanding and frequently hostile conflicts between local community and coal mining and power generation operators over the ill effects caused by saline water discharges into the Hunter River. The scheme was originally developed from the existing salt discharge licensing regime, which specified the discharge points, the maximum amount of discharge and monitoring and reporting requirements (Kraemar *et al.* 2004). The scheme permits each participant to discharge a certain percentage of the total
allowable salt load and these are calculated in terms of conductivity levels (Henderson and Norris 2008). Currently, discharges are only permitted when the flow in the river is high, and ‘real time monitoring is used to ensure that the target salt concentration for each 24-hour block of water is not exceeded’ (Henderson and Norris 2008, p. 115). Initially credits were grandfathered to license holders in the catchment, but at present anyone is able to buy credits using 24-hour online credit exchange facility. Credits are valid for 10 years, and every two years 20 percent of the credits expire. These credits can be reallocated through public auction, which permits new enterprises to enter the market (Henderson and Norris 2008).

This trading scheme is considered successful, as industrial discharges no longer cause salinity targets to be exceeded, and average salinity has halved despite the drier weather, which in the past was associated with higher salinity (Smith 2005). Moreover, the scheme is relatively cheap to run and is estimated to have saved between $30 and $50 million in infrastructure costs (NSW-EPA 2001a). Further, it has enabled at least four new coal mines to generate an additional production worth $1.4 billion per year, without causing further damage to the river water quality (DEC-NSW 2006). Kraemer et al. (2004) have identified some factors underlying the success of the Hunter River salinity trading scheme. Firstly, data collected over a long period provided a good understanding of the river's behaviour. Secondly, the local community was extensively consulted with and the seven year pilot project (1995-2002) was thoroughly studied before the scheme was formally established through legislation. Further, the NSW-Environment Protection Authority (EPA) believed that the new regulations would safeguard the continuity of the scheme, which would encourage investors to undertake long term plans (NSW-EPA 2001a). Finally, NSW-EPA (2003) pointed that the scheme is ‘sustained by real time data and trading with continuous measurements of river flow and salinity, modeling expertise as well as the online daily River Register and Credit Trading’ (Kraemer et al. 2004, p.17).

7.2.4 Political resolution for Parramatta River, Australia

The upper reaches of the Parramatta River experienced severe water pollution from the late 1950s to the late 1970s which was primarily caused by industrial effluent, sewage and septic tank discharges (SPCC 1985). However, Powell (1987) indicated that as far back as 1930s people were being affected by the pollution of the river and since then
articles on the state of the river regularly appeared in the press. Local residents started complaining to the councils regarding the pollution, although very little was done in the beginning. Eventually, as the public concern and the number of complains increased in the next two decades, the office of the Director General of Public Health (DGPH) started testing and reporting the quality of river water (DGPH 1963). The government recognition concerning water pollution in the Parramatta River initiated a political action through parliamentary debates in late 1960s. Simultaneously, water sample collection and assessment rate increased over the decades, which helped to establish a body of knowledge on this river (Staib 1997).

At the government level, a number of inquiries were initiated in response to growing public and political concern. The high powered Senate inquiry report (SSC 1970) revealed that the pollution occurred because of ineffective pricing system, piecemeal administrative approach and poor methods of abatement. To harness the lessons learned from the Parramatta River experience, recommendations were made to develop a national policy, a national body, allocation of public fund, comprehensive approach and systematic assessment of the problem to address the issue. In another inquiry (Barton 1970) suggestions were made to issue licenses for discharges and to form a powerful authority to control the pollution. These influenced state legislators to enact the Clean Water Act and to introduce penalties for non-compliance; however, the initial Act was amended with further stringent regulations.

The State Pollution Control Commission (SPCC) with increased responsibility and number of staff started administering the amended legislation in 1974 through higher penalties for pollution. As a result, by the late 1970s they identified most of the pollution sources to Parramatta River, which were either stopped or regulated by issuing licenses (Staib 1997). Licenses enabled to practice control over both the quantity and the quality of the discharges. Moreover, a significant amount of the discharges were redirected to the Water Board Sewers, whence forth it was released into the ocean via treatment plants (SPCC 1985). Consequently, the DO saturation levels in the Parramatta River increased from 30 percent in the early 1960s to 100 percent by the late 1970s. Therefore, this example illustrates that the active public concern and political action could become influential during the process of solving water pollution problems. That is why the case of
the Parramatta River has been recognised as a political resolution rather than a simple solution (Staib 1997).

### 7.2.5 Integrated pollution control for Huangpu River, China

Since the late 1970s, pollution from domestic, industrial and agricultural activities has led to serious deterioration of water quality in the Huangpu River, which flows through the down-town Shanghai in China (Yang et al. 2007). The two main forms of water-borne pollutants of concern—heavy metals and organic substances—were being discharged directly or through urban sewers, mostly untreated or partially treated. Subsequently, from the late 1970s to the early 1980s, environmental legislation and standards were set for ambient water quality and effluent, and institutions were created for enforcement. In 1982, a general survey of pollution sources, ambient water quality and hydrology of the major water bodies was carried out. Accordingly, Shanghai Environmental Protection Bureau (EPB) identified the control of heavy metal pollution as a priority and by the early 1980s, they centralised all the scattered electroplating enterprises (which were responsible for the pollution) into just a few locations to treat their wastes on-site with combined treatment methods. Consequently, more than 95 percent reduction in heavy metals concentration has been achieved since the mid 1980s (Zhang 1997).

Furthermore, the Shanghai Municipal Government provided much attention since 1979 to the integrated approach for pollution control in the Huangpu River through a combination of both engineering and non-engineering measures. As a part of this approach, the Huangpu River pollution control plan was formulated in the mid 1980s and subsequently financial resources were gathered from both local and international sources to initiate major investment projects to target pollution control in this river. The major engineering projects included infrastructure development for the new water supply intake; centralised treatment at industrial parks; large combined sewerage collection and treatment systems; and disposal of wastewater (after treatment) to the estuary of the Yangtze River (Zhang 1997). The implementation of some of the projects (such as the second potable water resource protection project) is still underway. Simultaneously, non-engineering measures such as laws, policies and management were also adopted to strengthen institutions and regulatory measures, which include (Zhang 1997, p.337-339):
• The establishment of a special office, the Office for the Protection of Shanghai Huangpu River Source, under the Shanghai EPB, with specific responsibility for the management and enforcement of pollution control in the upper reaches of Huangpu River.

• The enforcement of the waste discharge permit system, based on control of waste loading, so as to limit the total amount of waste discharged to the natural system.

• The adoption of pollution trading system that ensures there is always excess assimilative capacity in the river.

• The promotion of waste minimisation and the use of cleaner technology practices at pollution sources.

These combined measures have resulted in a positive impact by increasing the DO levels within the City section of the river from 1 mg/L (before any interception) to 3 mg/L (Yang et al. 2007), which has already fulfilled the near term target. This sign of improvement indicates the apparent success of the integrated approach for the Huangpu River, though more needs to be achieved for the water quality to reach the desired level (long term target).

7.2.6 Action plan for Ganga River, India

An action plan, popularly known as the Ganga Action Plan (GAP) was launched by the Government of India in April 1985 for the purpose of reducing pollution in the Ganga River and to better the water quality level suitable for bathing (DO>5 mg/L and BOD<3 mg/L). The Government of India formed the Central Ganga Authority (CGA) under the chairmanship of the then Prime Minister to administer the implementation of the GAP and to formulate policies and programs. The government also established the Ganga Project Directorate (GPD) under the Ministry of Environment and Forests to carry out the projects under the management and supervision of the CGA. Later, both CGA and GPD were abolished and were renamed as the National River Conservation Authority (NRCA) in 1995 and National River Conservation Directorate (NRCD) respectively in 1994. Subsequently, the formation of GAP opened the option to clearly demarcate the responsibilities for pollution of the Ganga River (Sharma 1997; Jaiswal 2007; NGRBA 2010).
The main target of the GAP was to regulate all municipal and industrial wastes that cause pollution in the Ganga River. In order to achieve the target, various engineering and technical schemes were undertaken, which include interception and diversion of wastewater, low cost sanitation, sewage treatment plants, electric crematoria and river front development. Heavily polluting industries were also identified (55 out of 68) and forced to comply with and install effluent treatment plants under the Water Prevention and Control of Pollution Act 1974 and the Environment Protection Act 1986 (Sharma 1997). Legal proceedings were taken against the remaining industries which were shut down for non-compliance. Furthermore, the GAP also put great emphasis on wide and diverse activities for pollution control which included, applied research, public awareness and participation, alternative technology development for effluent treatment and operation and maintenance for pollution mitigation.

However, the GAP project was criticised for the slow pace of developing the required infrastructure to control river pollution (CAGI 2000; Jaiswal 2007). The activities of many of the schemes in their first phase were either impaired or totally closed due to technical design flaws, difficulties in land acquisition for treatment plants, mismanagement of contract, inadequate maintenance and lack of serious attitude of the state governments and the implementing agencies. Shortage of funds also forced the NRCD to abandon the crucial activity of monitoring the water quality of the Ganga River since September 1999 (CAGI 2000).

A high powered Public Accounts Committee (PAC) was formed by the government to audit such a mass oriented program as GAP and they observed that a crucial aspect like public participation which could have been a deciding factor in the successful implementation of GAP was not given adequate attention (PAC 2004).

Despite the criticisms, the GAP has been successful in generating environmental awareness at the government level. As a result, the Government of India has approved the second phase of GAP on June 10, 2010 (NGRBA 2010; The Times of India 2010) as they believe the project would bear fruitful implications on pollution load reduction in the Ganga River. It is anticipated that treated effluent from sewage treatment plant may be used for irrigation purpose, while there are opportunities for employment particularly during the implementation stage. In order to minimise the limitations identified during the
first phase of GAP, an Environmental and Social Management Framework (ESMF) has been incorporated within its second phase. Among various other issues, the ESMF essentially comprises the involvement of NGOs and the community for monitoring and evaluation of the sub-projects of GAP in order to improve the quality of the Ganga River (NGRBA 2010).

7.3 Lessons learned from the international experience

It is evident from the above illustrated international experiences that a number of institutional, administrative, technical and economic conditions are necessary in order to implement a pollution control system to improve river water quality. A common argument is that for the successful implementation of any pollution control measure, the following issues should be considered:

- Appropriate legislative measures
- Community involvement
- Political commitment
- Cost-effectiveness
- Information disclosure
- Presence of market (in case of pollution trading) with fairly large number of participants
- Strong organisational capacity (for effective administration, monitoring and enforcement) including a governing body
- Appropriate engineering and technical measures
- A long-term action plan.

Further, the reviewed case studies indicate that a combination of instruments for controlling water pollution is required. This is in concert with findings by other authors who have also recommended joint usage of several pollution control instruments (Bernstein 1997; O’Connor 1998). In this process the advantages of each instrument can be exploited, particularly in a developing country context. Murty (1999) and Perman et al. (1999) have also supported the view that the policy instruments are not necessarily mutually exclusive categories and a sustainable water pollution control strategy may
combine two or more of these instruments. An effective strategy also requires collaboration between different stakeholders like policy makers, entrepreneurs, community members, researchers and other interest groups.

It was suggested in Chapter 18 of Agenda 21 (a program of the United Nations related to sustainable development) that success in pollution control and management depends ‘on the right combination of economic and regulatory mechanisms, backed by adequate monitoring and surveillance and supported by an enhanced capacity’ (UNCED 1993, paragraph 63) of relevant organisations. This implies the importance of an integrated approach for pollution control which relies on the use of an adequate mix of policy instruments and encourages the application of innovative and cost-effective processes. Further, UNEP (2002) has emphasised that the perception of developing an integrated approach should be based on common sense, innovativeness and flexibility, which would lead to creative partnerships among multiple stakeholders.

The introduction of an integrated approach for river pollution control should recognise water quality objectives, the setting of water quality standards and the use of best available policy instruments (such as the pollution taxes or the tradable permits) as the essential elements for prevention, control and reduction of water pollution (ICWE 1992; UNDSD 1992; UNECE 1994). These elements should be applied through an action plan to formulate an integrated management system as suggested by Enderlein (1995). An action plan for water pollution control may include the formulation of policies; developing regulations for wastewater discharge and pollution control; monitoring and enforcement; training and dissemination of information (Larsen and Ipsen 1997). The overall purpose of having an action plan is to achieve the goal of effective and sustainable water quality management in different phases to meet short and long term targets.

The instruments which were identified and discussed in Chapter 2 provide sufficient means to address any known water quality problems. It is the task of the water quality manager to decide which instruments would most adequately solve the problem at hand, and to ensure that the selected instruments are made available and operational within the appropriate institutional framework. However, in order to facilitate taking such decisions, it is important that suitable decision support mechanisms (such as the one demonstrated in Chapter 6) be readily available for the water quality manager.
It is evident from the preceding discussions that the international experiences have facilitated a better understanding of the implications of various policy approaches for pollution control, but the solutions for the Buriganga River will have to be developed considering the local needs and institutional capacity. It is not possible to completely replicate any example from the international practices and apply it to a new context for pollution management. However, the lessons learned from the international experiences pave the way to formulate suitable policy measures for pollution management in another river.

7.4 Appropriate measures and policies for pollution control in the Buriganga River

It was identified in this research (Chapter 4) that the Buriganga River suffers from severe pollution problem both in dry and wet seasons, and is unfit to support the aquatic ecosystems. The findings on the assessment of the present pollution control system (Chapter 5) have indicated that several interventions based on CAC based measures are already in place to combat the pollution problem of this river. However, from the management perspective, an effective system could not be established yet, possibly because the efforts were not co-ordinately put into practice. In addition, the multiplicity of responsibilities with the overlapping of institutional boundaries and the absence of any incentive based mechanism for the polluters render the present system ineffective. In order to suggest an effective improvement of the present system, the approach was to determine and propose those measures which could be easily incorporated within the existing system by the relevant stakeholders such as regulators, pollution emitters and communities.

The findings of Chapter 6 in this research open up the possibility to introduce cost-effective incentive based instruments for water pollution control in the Buriganga River. Considering the need for establishing an efficient market (IC 1997; Siebert 2005) in order to apply a tradable ambient permit system, which is perceived to be relatively difficult in the Bangladesh context, the pollution tax system would be the most effective economic instrument to apply for mitigation of pollution in the Buriganga River. Moreover, it is advantageous to use an effluent tax system compared to the tradable permit system, as the previous experiences indicate that a tax creates relatively less transaction costs for individuals and corporations (IC 1997). The pollution tax system would also enable the
pollution emitters of the Buriganga River to know in advance about the costs of investing in pollution abatement and the tax that would be incumbent if the polluters exceed a certain level of pollution.

However, the implementation of pollution tax system may incur political and enforcement difficulties mainly through opposition from pollution emitters whose costs would normally be increased. In such case, the introduction of revenue recycling measure (as mentioned in section 6.3.4) could be a mitigating factor. On a long term basis, such pollution tax mechanism with revenue recycling does not aim to generate revenue for the government rather it aims to improve the abatement system of the pollution emitters.

Previous studies on pollution tax system (Baumol and Oates 1988; Bernstein 1993; Murty 1999) have stressed that the application of this measure may become effective on a long term basis and only during normal (not emergency) circumstances. Hence, along with the pollution taxes, it may be advantageous to have provisions for using direct controls (technology or emission standards) on a stand-by basis, which would be put into effect when unforeseeable emergency situations occur. This further justifies the proposition of having a mixed system of regulations for the Buriganga River within an integrated system for the purpose of taking advantage from both EI and CAC based regulatory mechanisms.

In order to make the proposed integrated management system (as illustrated in Figure 7.1) successful and sustainable, a set of approaches could be initiated by the Government of Bangladesh. These approaches require a paradigm shift from the predominant reliance on the CAC based system, to a mixed system of regulatory measures with involvement of all relevant stakeholders. At the policy level, some important mind-set changes are needed in order to give a renewed sense of using combination of pollution control instruments. However, O’Connor (1998) identifies that whatever pollution control instruments are chosen, problems of implementation particularly in developing countries ‘arise from a variety of factors i.e., administration, politics, inconsistencies and flaws in design’ (Rammont and Amin 2010, p. 28). Hence, the application of such approaches that aim to solve water quality problems more effectively through a combination of pollution control instruments necessitate the implementation of a set of policy initiatives, which are discussed in the following sections.
7.4.1 Legislative changes

It is important to consider whether the proposed system is consistent with the existing legislation in Bangladesh which regulates the pollution in the river. In the present context, application of the integrated system may require a legal basis of taxing for pollution. The legal reform should also incorporate the scope to vary the emission tax rates from time to time and/or to impose strict regulations on short notice in case of emergency situations. In this context, legal agreements between polluters and regulatory authorities could be formed in order to ensure the collection of pollution taxes. Moreover, provisions should be made within the legislations for public participation and community consultation and also for necessary disclosure of information (both by the regulatory authority and the pollution emitters) on pollution and the state of river water quality.

7.4.2 Strong organisational capacity

The involvement of multiple government authorities should be aborted in favour of a single authority that would be fully responsible for pollution control in the Buriganga. For this purpose, a Buriganga River Management Authority (BRMA) could be formed for water quality control designated to work under the supervision of the Ministry of Environment and Forests (MOEF). This should be a special governmental entity solely empowered to regulate the quality of water in the entire river. For this purpose, the existing activities of other relevant government agencies (as listed in Table 5.1) should be merged into this authority. This process could eliminate the observed problems of blame culture, double standards and the absence of coordination within the existing government organisations that are responsible for controlling river water pollution. The regulatory authority should be equipped with appropriate methods and personnel to coordinate the activities of regular monitoring of effluent discharges and to enforce the collection of pollution taxes. The pollution taxes could be collected and the revenues could be recycled (as mentioned in section 6.3.4) through the National Board of Revenue (NBR), which is the central authority responsible for tax administration in Bangladesh. The use of such existing fiscal channel for collecting revenues would lower the administrative costs of the new system (World Bank Group 1999).
Figure 7.1. Conceptual framework and elements of the integrated management approach for pollution control in the Buriganga River
7.4.3 Community participation and commitment

Civil society groups, NGOs and CBOs have made significant contributions in raising public opinion and awareness against the pollution problem in the Buriganga River but they can play a more catalytic role. To this end, specific tasks and responsibilities of NGOs and CBOs need to be identified in order to ensure their effective involvement in pollution control. Within the proposed integrated approach, these organisations can be directly involved in regular and systematic monitoring of the water quality at receptor points, raising the level of education and awareness of the general public regarding the impact of pollution in the river and maintaining social pressure on the polluters and the authority to keep the river clean. Hence, these organisations should be considered as veritable arm of the efforts towards controlling the pollution of the river within an integrated system. Education and awareness regarding the impact of pollution in the river are an essential element of the integrated management system. This will further increase the capacity of the public to access the accurate information as well as interpret and react to that information.

The task of monitoring river water quality by NGOs and CBOs would be a new practice in Bangladesh; given the capacity and the willingness of the local people for their contribution, it may be anticipated that they would be able to perform this responsibility in an effective manner. According to the proposed system, shifting the responsibility for water quality monitoring from the regulatory authorities to the community groups may also lower the administrative costs (World Bank Group 1999). However, for this purpose, a procedure and guideline for water quality monitoring by the NGOs and CBOs is required to simplify their tasks. The guideline may include the methods for testing the water quality parameters, frequency of water quality monitoring at the receptor points, choice of parameters to be analysed on the spot, and the procedures for preservation and transportation of water samples to the laboratory to analyse other parameters. A training module is also required to prepare the NGOs and CBOs to enable them to conduct standard analytical procedures, data validation and reporting. Moreover, necessary training programs should be directed by experts in the field to equip the community for this purpose.
7.4.4 Application of economic incentive based measures

It was found that during the normal situation (non-emergency), uniform emission tax system (or the Pigouvian tax based policy instrument, e.g. LBL system of NSW) should be an appropriate long term pollution abatement policy in order to achieve the economic efficiency of pollution control of the Buriganga River (Chapter 6). Given the economic and environmental benefits of the possible application of this instrument, it is important to recognise the performance of incentive based instruments with recycling of revenues for pollution control within the national environmental policies in Bangladesh. Moreover, the EI based instruments should be considered not as substitutes to the existing environmental standards but as their complements. As mentioned earlier, within the legislative structure, provisions could be made to adopt the concentration based water quality standards (CAC based measure) by the regulatory authority only to deal with the emergency situations (such as extremely low flow condition of the river or in the event of major environmental accident).

7.4.5 Disclosure of information

Disclosure of information is a prerequisite for effective implementation and administration of and compliance with any pollution abatement instrument. Currently in Bangladesh there is no effective system of sharing information related to river water pollution. The government should have a positive attitude towards transparency of information and should play an active role in the generation and dissemination of information. The regulatory authority should maintain a database on relevant pollution related information on the Buriganga River and should provide that information freely or at nominal costs to the concerned personnel (like researchers, students and concerned CBO, NGO and municipal representatives) when required. The data on pollution could be generated through community involvement (as discussed in section 7.4.3) and by ensuring a regular monitoring of water quality parameters both at receptor and discharge points. Moreover, the polluters could also be held liable for not providing information on their current pollution emission rates (both in terms of load and concentration) on a regular (monthly or annual) basis. In this regard, there should be legal provisions for imposing significant penalties by the pollution control authority (such as the proposed BRMA) for providing false statements by the pollution emitters.
7.5 Conceptual framework of the proposed integrated management approach

The conceptual framework of the proposed integrated approach presented in Figure 7.1 intends to help the policy makers in Bangladesh to start thinking in a different way, shifting the focus from technical measures to alternative management interventions in order to improve river pollution control system for the Buriganga River. The conceptual framework of the proposed approach incorporates application of cost-effective pollution abatement measures and direct involvement of the society in order to ensure a healthy existence of the river. It is anticipated that the implementation of the proposed integrated system will contribute towards developing an economically, socially and environmentally sustainable river pollution control system in Bangladesh.

Within the integrated approach, a joint effort among the regulators, the pollution emitters and the community members (including the CBOs and NGOs) is required to achieve success in pollution control. The concerned participants can share ideas and plans on pollution control issues and help each other with monitoring and enforcement, disclosure of information and on improving public awareness on water pollution. A coordination committee with representatives from the relevant stakeholders could be established within the proposed BRMA in order to perform these activities on a regular basis and in a systematic manner. Moreover, as the success of pollution control instruments relies heavily on political support, commitment on the part of the community and the pollution emitters, therefore, an agreement among all the stakeholders needs to be ensured for the introduction of an integrated management system.

The three major groups of stakeholders—community members, regulators and pollution emitters are involved in a partnership within the proposed integrated management approach. The involvement of different stakeholders is inevitable with the introduction of a mixed system of regulations. In this approach, community members (particularly those exposed to pollution) have a vital role in monitoring the river water quality on a regular basis. This is essential in order to generate updated information on the state of the river which could deteriorate due to the impact of pollution. The regulators’ role is to exercise the most effective pollution control measures (such as the pollution tax in the form of the LBL system as mentioned in section 6.3.4) in order to guarantee the best outcomes for the river water quality. The pollution emitters’ (individuals or corporations) role is to take
necessary steps to abate pollution (both on a short and a long term basis) from the discharge points by responding to the pollution measures as set by the regulators.

A fundamental shift for the proposed new approach would be to use pollutant load as the basic unit of measure, rather than pollutant concentration, particularly at the discharge points. The reason is that with a pollution concentration based regulatory measure (i.e. effluent standards in terms of mg/L), a polluter could be penalised for exceeding the concentration limit on just one occasion, while the overall emissions (in terms of amount) could be significantly less. On the other hand, another polluter may escape being penalised for keeping the pollution concentration limit within the standards in spite of discharging comparatively higher levels of pollution (NSW-EPA 2001b). In such case, the important task of the regulatory agency would be to calculate and record the actual load (pollutant specific) and also to calculate the load based fee on a regular interval. In this case the experience of the NSW Government’s LBL scheme may be adapted for the Buriganga River (as mentioned in section 6.3.4).

This research has found that in the present condition both municipal and industrial wastewaters are being mixed before they are discharged into the Buriganga River. If this is continued, it would be complicated to impose the tax on individuals or corporations (such as municipalities, DWASA, industry associations) who are held liable for the discharge of excess pollution. Therefore, before introducing the pollution tax system for the Buriganga River, separate disposal and drainage of municipal and industrial wastewater has to be ensured as a prerequisite. Initially this could be an expensive endeavour as technical infrastructure needs to be developed for the purpose but it would be a worthy investment in the long run.

Furthermore, previous experiences showed that polluters often resist application of EI based instruments because they believe that they have greater negotiating scope over the design and implementation of CAC based regulations than they do over EI based regulations (Bernstein 1997). Also, there has not been any earlier experience on the use of EI based instruments for pollution control in Bangladesh. Due to these realities, polluters of the Buriganga River may be resistant to the introduction of proposed pollution taxes. Before the introduction of any such EI based instrument, a clear understanding on the implications of these instruments needs to be provided by the pollution control authority.
to the relevant stakeholders of the proposed integrated system. Support for the implementation of incentive based instruments can be solicited through the process of consultation, for example by conducting workshops where numerical evidence on the effectiveness of these instruments could be demonstrated.

### 7.6 Conclusion

The findings of this research indicate that there is scope for combining various measures for pollution control in the Buriganga River. This chapter provided an outline of an integrated management approach by identifying specific instruments, stakeholders and their specific responsibilities. The proposed approach replaces the conventional view of pollution regulation, which was earlier focused exclusively on interactions between the government and the pollution emitters. In the new system, the responsibility to apply various pollution management elements is shared among different stakeholders including regulators, community members and pollution emitters. Stemming from this integrated approach, the intended pollution control system will not only be confined to monitoring at the discharge points, and enforcing rules and standards by the regulators, but it will also adopt non-traditional measures such as community monitoring and pollution taxes. It is expected that these measures will harness the power of the society and the incentives of individuals. In this process, the EI based instrument can be used as complement, rather than substitute for the existing regulatory instruments. These alternative measures will provide more flexibility, efficiency and cost-effectiveness for pollution control in the Buriganga River. However, as evident from the international experience on river pollution management, some policy initiatives need to be undertaken by the government in order to apply the proposed integrated approach in practice. These include bringing necessary changes in legislation; strengthening organisational capacity; providing economic incentives for pollution emitters; involving local community to monitor the river water quality; and incorporating disclosure of information.