Socioeconomic, institutional and legal aspects in groundwater assessment and protection

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The socioeconomic conditions in areas where groundwater is used or recharge occurs are critical to the development of groundwater protection measures. The protection of groundwater may be expensive and disruptive to the inhabitants of the land above the aquifers. Socioeconomic conditions play an important role in determining the likely contaminant loads and types of contaminant that affect the groundwater. It is also critical in determining what types of intervention are possible, how such interventions will be implemented and what resources (including human) will be required and are available.

Institutional and legal issues are also critical in determining the success or failure of groundwater protection policies and strategies. Weak institutions and poor institutional frameworks are commonly identified with poor implementation of water policy (World Bank, 1993; WELL, 1998). The development of groundwater policies and strategies must therefore provide adequate consideration of the appropriate institutional arrangements and consider how the needs of all stakeholders can be incorporated into the policy. The latter demands that there are effective processes of public consultation and participation in policy and strategy development. Legislation is also vital to support...
effective groundwater protection. Not only should the law be supportive of groundwater protection, effective implementation of the law is required to ensure groundwater protection objectives are met (Caponera, 1992; Foster et al., 1992).

The purpose of this chapter is to discuss some of the key socioeconomic, institutional and legal issues that are important to consider in groundwater protection. In Chapter 7, the types of information and methods of data collection will be discussed; Chapter 20 outlines how socioeconomic issues and the institutional and legal frameworks can be addressed in developing groundwater protection.

5.1 SOCIOECONOMIC STATUS: ISSUES OF POVERTY AND WEALTH

Socioeconomic status is a measure of the wealth of individuals, households and communities and reflects their assets as well as the ability of households to obtain goods and services. Socioeconomic status is of importance when considering the level of investment in groundwater management which individuals, communities and societies are willing and able to make.

Socioeconomic conditions influence the capacity for different groups to protect their environment. For instance, in some communities short-term priorities for resource exploitation override the need for resource protection necessary to secure a long-term livelihood, despite the recognition in the communities of the need for such protection.

The poor are usually at greater risk from the adverse effects of poor resource management and it is essential that their needs be properly addressed when developing groundwater strategies. Critical to this approach is to avoid disadvantage for the poor caused by the implementation of groundwater protection policies and strategies. Such disadvantage may occur, for instance, because agricultural use of land is restricted in order to protect groundwater, which may result in reduced incomes and decreased security for poor farmers. Consideration must be given to compensation, financial support, the creation of alternative employment opportunities or provision of new land when no restrictions apply. However, the latter is often difficult to implement and should only be considered where there is strong evidence from consultations that such an approach is acceptable to the communities affected and that the proposed land for relocation is at least the same quality as the land being left.

The implementation of groundwater protection measures will often have important implications for the livelihoods of the households affected and this applies in all countries. For instance, significant changes in land use regulations in developed countries will also have a profound impact on the users of land, water and other resources. Changes may have positive or negative impacts on some or all of the components of livelihoods. The implications of such impacts in terms of compensation, social services and environmental protection should be taken into account when reaching a decision about what and how land use regulations are applied. The population affected must be fully consulted and be willing to accept any restrictions as part of the process of establishing protection norms. Box 5.1 outlines the problems faced in parts of Germany in relation to controlling groundwater contamination when families facing financial hardship are able to access alternative sources of water.
Box 5.1. Socioeconomic factors and illegal use of private wells in some rural areas of Germany

After the political changes in Germany in 1990, the connection of rural areas in eastern Germany to central water supplies was rapidly developed. This was particularly urgent in some mountainous areas of Erzgebirge, Thuringia, as the supply from individual wells was highly unsatisfactory because aquifers in fractured bedrock fell dry at intervals. They were also vulnerable to short-circuiting with surface water and sewage. Connection to central supplies of high quality and reliable quantity in the 1990s was therefore warmly welcomed by the population. Individual wells were abandoned and sometimes illegally misused as undrained sewage pits. As local aquifers were no longer needed for feeding household wells, their protection was no longer perceived as a priority.

However, the introduction of cost recovery for drinking-water significantly increased prices within a few years. At the same time, unemployment rates were very high and available work often poorly paid. As a result, many households struggled financially. This made individual supplies attractive again, and a large number were re-activated illegally. The German Drinking-water Ordinance requires annual monitoring of private wells, which typically involves partial or total cost coverage for the analyses by the well owner, but numerous households connected to a central supply avoided these costs by not registering their re-activated wells for surveillance. Their use only became known because metering showed large numbers of households that were not using any water from the central supply.

Ensuing public health concerns include the high rate of household wells with microbial contamination (up to 60 per cent in one survey) and a high risk of unintentional cross-connection between self-built piping from the household well and the public supply, potentially contaminating the public supply. Furthermore, because of increasing stagnation in the mains due to reduced flow, the costs of the central supply have further increased as flushing is required more often to prevent microbial re-growth. This further reduces the attractiveness of the central supply and encourages greater use of the re-activated wells.

When actions are required by specific communities to protect groundwater resources, consideration must be given to the incentives that may be required and how these can be provided. It should be noted that in many cases such incentives do not refer to direct monetary compensation packages but could, for example, address improved security of tenure for poor farmers in order to promote reduced pollution loads derived from agriculture.

The socioeconomic status of communities is likely to influence the type of interventions that will be feasible for groundwater protection. For instance, in low-income communities in developing countries with shallow groundwater, the use of pit latrines may not be the preferred technical solution for excreta disposal, as they lead to an increased risk of contamination. However, alternative technologies may be too expensive for the majority of the population to sustain. In this case, some degree of contamination
of groundwater may be tolerated in order to reduce a greater health risk caused by the lack of excreta disposal. In urban areas, if contamination is deemed unacceptable, then it is often more cost-effective to provide an alternative (often piped) water supply that uses water from a more distant and protected water source (Franceys et al., 1992). In rural areas it is often more difficult to implement such solutions and the use of an alternative sanitation technology may need to be considered and potentially subsidized.

Similar situations may occur in developed countries where balances need to be made between protection of the groundwater resource and sanitation provision. In rural communities, septic tanks may be used where shallow groundwater is tapped for domestic supply thus representing a risk to the quality of the groundwater source. Off-site methods may not be feasible because of the cost of operation and maintenance. In this case, it is likely to be more cost effective to treat the water or use an alternative source of water rather than attempt to change the sanitation technology.

5.1.1 Livelihood concepts

The concept of livelihoods is now used in many countries when considering the nature of poverty. The basic concept of a livelihoods approach is that the ability of households and communities to sustain and improve their livelihood relies on income, assets, capabilities and their vulnerability. This approach also takes into account gender, environmental sustainability and cultural norms in defining sustainable livelihoods. Chambers and Conway (1991) provided definitions of sustainable livelihoods in relation to both environmental sustainability and social sustainability. DFID (2003) has combined these to define a sustainable livelihood:

‘A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base.’

Stresses and shocks refer to events or changes in assets, income or vulnerability that put pressure on the livelihood. For instance, sudden loss of employment or large increases in price of basic goods result in a shock or stress to the livelihood. Equally, a poor harvest or sudden change in allowed land use may affect the asset base of a community. The onset of a significant health problem may increase vulnerability (infection with human immunodeficiency virus (HIV) being a good example) of an individual such that previous levels of health protection are no longer adequate.

Water and health are both considered as assets within this framework and the degree to which households or communities have access to these assets and their resilience to shocks and stresses are fundamental components of securing a sustainable livelihood. The livelihood approach also encompasses concepts of vulnerability and environmental sustainability when considering poverty.

Vulnerability is composed of risks that are shared by a community (sometimes called exposure), which includes lack of access to a specific water resource, and those risks unique to an individual (often termed susceptibility) such as HIV infection. Vulnerability may be physical, social or political (Nichol, 2000). In the context of groundwater protection, physical vulnerability may refer to the increased risk of contamination from inappropriate land use. Social vulnerability arises from marginalization of parts of a
community within the larger community or society and factors such as gender-specific restrictions to assets or decision-making. In relation to groundwater, this may result in marginalization of women in decision-making regarding groundwater development, management and protection. Political vulnerability typically relates to the capability of communities to be engaged in wider decision-making processes in relation to resource access and management.

The livelihood approach ensures that the sustainability of natural resources and the environment is given an important place in the understanding of poverty. This may be given greater priority in rural areas where livelihood may depend on sustainable use of natural resources (Tamuno et al., 2003). However, natural resources always remain an important component of livelihoods, as sustainability is defined in terms of a livelihood that does not degrade the asset base. This has implications for both rural and urban dwellers. For instance, the protection and sustainable use of groundwater has important implications for urban households that rely on groundwater for domestic supply, as both deterioration and protection of the resource may increase water costs and affect the livelihood of the users.

5.1.2 Source of livelihoods

Understanding the source of livelihood of communities that utilize and potentially pollute groundwater sources is important. Different means of sustaining a livelihood will result in different types of pollution. Where commercial farming is the principal source of livelihood, groundwater may be vulnerable to pollution derived from agrochemicals such as fertilizers and pesticides (Chapter 9). Where irrigation is practised, contamination is likely to increase because many irrigation systems are inefficient, resulting in significant volumes of water infiltrating the aquifer. The water used for irrigation is frequently under-priced and this tends to reinforce the inefficient use of water (World Bank, 1993). However, where irrigation is essential for growing crops, the development of groundwater protection strategies will have to take this into account and compensation packages and alternative irrigation practices (such as drip irrigation) promoted (Chapter 21).

Small subsistence or near subsistence farming may make relatively little use of agrochemicals or irrigation, but their use may be significant in countries where there are government subsidies on agricultural production. In this case, it may be more appropriate to remove the subsidy on agrochemical use than to try to regulate application in particular areas.

Where agrochemical use derives from private purchase, the groundwater strategy will have to consider the capacity of regulatory bodies to develop and deliver incentives to reduce or change applications and the cost of inspection and monitoring. Where there is widespread small-scale private use of agrochemicals, it will be important to consider targeting those areas where groundwater is at greatest risk from pollution, rather than trying to implement broad measures.

The situation with large commercial farming may be simpler to regulate, as there will be a smaller number of people to deal with. Where direct actions are taken to change land use to an economically less productive use, the land-owner would usually expect
compensation and this would have to reflect their overall economic loss. However, in many cases, the restrictions may actually apply more directly to applications of agrochemicals on a seasonal basis, which would not require the same level of economic recompense. It may, however, require systems of monitoring to ensure compliance.

Where the majority of the population derive an income from small-scale agriculture, groundwater protection may be more difficult to regulate as there will be many more farmers whose needs must be addressed. Any compensation packages that are developed in such situations may have a lower per capita outlay than larger farms but it is likely to result in a higher per ha cost. This will increase overall direct costs of the protection strategy. As noted above, alternative incentives may need to be developed in some situations. These may be related to land tenure, but also include aspects such as providing more secure markets for produce or providing improved extension programmes as a way of offsetting economic losses.

5.2 POPULATION AND POPULATION DENSITY

Increasing population and population density can increase the risk to groundwater from pollution and unsustainable abstraction. Balancing the needs for protection of resources against demands from rapidly increasing populations is a key element in groundwater protection. Population growth often provides an impetus for improving protection strategies as the need to secure and conserve high-quality water resources for domestic supply becomes increasingly important. This can provide a strong argument for the need to protect groundwater against pollution.

It should be noted, however, that the protection of particular groundwater resources is also dependent on whether it is considered a key source of domestic water in the long-term. In some cases, other resources (either surface water or more remote groundwater) can satisfy demands for water and the threatened groundwater will not form a key part of the water resources used for supply. This is common in wetter countries where urban groundwater has been abandoned. In other situations, typically much drier counties, alternatives may not exist and groundwater resources will therefore need to be protected.

5.3 COMMUNITY PARTICIPATION AND CONSULTATION

Protection of groundwater resources is a public concern and a public responsibility and therefore requires public participation. Participation can be defined as a process through which all stakeholders influence and share control over development and environmental initiatives and the decisions and resources which affect them. The principle of public participation and consultation is found in developed and developing countries.

The Regional Environmental Centre for Central and Eastern Europe states that: ‘The most fundamental interest that must be addressed in the process of public participation is the basic right of individuals to have a say in matters affecting their lives... The basic right to participate in decisions affecting oneself... applies in circumstances where the rights and interests may be less recognizable [such as
right to have a clean environment]... Taking into account the users’ interests should actively involve the users themselves.’ (REC, 1995).

The American Waterworks Association Policy Statement on Public Involvement states that: ‘Involving the public in decision making... is... important because many drinking water issues, including adequacy of supply, water quality, rates and conservation, are not only technical issues, they are also social, political, personal health, and economic issues. As such, they are best resolved through a process of meaningful dialogue with concerned parties and the public.’ (Kusel, 1998; AWWA, 1995).

The World Bank Policy Research Working Paper states that: ‘Recent evidence from Asia, Latin America and North America suggests that neighbouring communities can have a powerful influence on factories’ environmental performance... where formal regulators are present, communities use the political process to influence the tightness of enforcement. Where formal regulators are absent or ineffective, ‘informal regulation’ is implemented through community groups or NGOs.’ (Afsah and Benoit-Wheeler, 1996).

Community or public participation and consultation are important aspects of resource management as successful implementation is commonly dependent on broad agreement with the objectives and in some cases active public participation in programmes, to ensure these objectives are met. Although the general public in most countries is aware that pollution of surface water is caused by mismanagement of waste and inappropriate land use, awareness is more limited when it comes to groundwater, which is often considered ‘pure’ and clean. This may present particular challenges to ensuring commitment and participation by the public in protecting groundwater resources.

The role of communities may be critical to promoting improved protection, but the nature of the role that they will play may vary. In many situations, communities are consulted but play limited practical roles in the implementation of groundwater protection strategies. In other cases, communities are expected to play an active role in the design, planning and implementation of groundwater protection.

It is important to be clear about the differences in two of the principal approaches to community involvement: consultation and participation. Consultation is a process of discussion with stakeholders about proposed actions or strategy and is geared towards obtaining the opinion from each stakeholder about these and to review the options that are available. However, it may not mean that the agency undertaking the consultation is bound by the outcome of these discussions and usually does not imply a responsibility for action by the community.

Participation is a set of processes where communities and individuals play an active role in the design, planning and implementation of programmes of water resource development or protection. This often implies that the agency and the community have responsibilities for ensuring agreed actions are performed. It is therefore a more long-term and proactive process than consultation. However, for successful participation there must be effective consultation and therefore the two processes are often combined.
5.3.1 Consultation

It is essential that there is proper consultation with stakeholders in the development of policy and implementation of groundwater protection plans. A key activity in the initial stages of policy development is to ensure that the views and needs of different stakeholders are properly reviewed and incorporated into the policy being developed as far as possible. The stakeholders should also have an opportunity to comment on the policy and strategies developed to ensure that these reflect a position of agreement among key stakeholding groups.

Consultation should bring in the views of Government, affected interest groups and the views of the broader society. Therefore various consultation exercises may need to be undertaken to ensure that the views of all concerned and in particular those groups whose livelihood may be directly affected are collected and concerns addressed. Very often, these groups are those most directly affected by water resource management through lack of access to safe drinking-water supplies, contamination of water sources and limited water for irrigation. In order for policy to be effectively implemented, it is important that there is general support for the overall policy and strategy framework within the country. This is an ongoing process and not something that is engaged in only at the start of policy development. It should be seen as a necessary process which supports the development and implementation of resource management policy and strategy.

Perceptions and cultural values attached to water are also important to understand in the context of groundwater quality management and protection. Many of these concepts provide a foundation upon which to build effective protection strategies as they attach important religious or cultural values on the protection of the groundwater. Examples include some aboriginal beliefs about the origins and sacred nature of water in Australia. In other examples traditional beliefs may hamper the development of groundwater protection strategies. For instance in Uganda beliefs about the use of certain springs by ancestral spirits prevented action being taken to improve water sources.

5.3.2 Participation

In wealthier industrialized countries although public participation occurs, the emphasis tends to be on consultation in the development of the underlying principles, policies and plans that define the development of environmental protection. In most cases, groundwater protection strategies are implemented by local or central government with systems of land use restriction, compensation and appeal processes operating. Specific activities required will often result in specific negotiated agreements with individual land-owners.

By contrast, in developing countries, the development of groundwater protection plans and implementation of protection measures is likely to require the direct involvement of large numbers of people and communities. Many of the tasks that will be required can only be undertaken by local people taking responsibility themselves to enforce protection measures, although this means that communities need support to develop effective capacity. The development of community management committees or...
users organizations is an important component in promoting effective resource use (Subramanian et al., 1997).

By understanding these issues, appropriate strategies and plans can be developed that identify key stakeholders, where responsibilities lie and what role is expected to be undertaken by the community. Such decisions will be arrived at partly through stakeholder consultation. However, during the initial stages of the development of the policies and strategies, it is important to collect information about communities in order to be able to provide direction for subsequent discussions.

5.4 LAND TENURE AND PROPERTY RIGHTS

Land tenure and property rights are an important consideration when planning interventions to protect groundwater resources as they will directly influence the scope and depth of consultation and negotiation regarding land use. They may also influence what type of intervention is possible and the nature of any regulations that will need to be developed.

One aspect of land tenure of particular importance is the degree to which ownership of land confers rights of ownership and use of underlying resources. In many countries, ownership of land may confer automatic rights to exploit, although these are increasingly subject to licensing and permitting procedures, but ownership resides with the Government. In these cases, controls over abstraction and land use may be easier to implement and monitor.

In other countries, resource ownership has historically resided with the land owner, although this is being revised in many countries. In the Sultanate of Oman, for example, private ownership of water was abolished by a Royal decree in 1988 and a centrally regulated system of water management introduced with an associated well permit system (Government of Oman, 1995).

Revisions to land laws may require significant transitional periods. For instance, the Spanish Royal Decree of 1986 (No 849) considers underground waters to be in the public domain and licences to abstract are required. Public ownership is however subject to the right of landowners to carry out activities on their land but these must not interfere with groundwater quality. In order to avoid opposition to the transition from private ownership to public resource, the Act gave extensive protection to existing rights owners, and complete transition will not occur until 75 years have elapsed.

Land tenure is often complicated and there are many different forms of rights including customary rights to land, private freehold ownership and publicly owned land, with many different variants (Payne, 1997). In addition to issues of ownership, the nature of tenancy arrangements varies and there are further groups who lack any form of de jure right to abode, but which may have a variety of de facto rights (Hardoy and Satterthwaite, 1989). There are also a significant number of people who have no rights and no security of tenure. The sections below review some key forms of tenure and discuss their implications in relation to groundwater management.
5.4.1 Private land ownership

Private land-ownership is common in many parts of the world and refers to situations where individuals own land, for instance through freehold arrangements. This may be complicated where land is subsequently let to third parties, a common arrangement in European agricultural areas.

This form of land ownership has particular consequences for the development of groundwater protection strategies. The large number of land-owners or tenants may make the process of consultation more cumbersome as the numbers of people involved may increase the time it takes to collect and synthesize local opinions and a greater range of views may need to be accommodated. Such patterns of land ownership will also often result in compensation packages being developed to offset loss of earnings resulting from restrictions placed on land use. However, where such tenure is in place, it may be easier to define a legal framework that can be transparent in its operation and where compulsory purchase or mandatory development controls can be enforced.

5.4.2 Customary land rights

This is common throughout much the developing world and reflects a situation where rights to land are held by a community, although ownership is retained by an individual or the Government. An example of such an arrangement is ‘common’ land within a village where all residents have the right to graze their livestock. In some parts of the world, this may be expanded into communal ownership of land.

Customary rights imply that decisions relating to the use of the land require agreement with all those with rights to use the land, which may result in a more difficult decision-making process when establishing protection strategies. However, customary rights may already implicitly or explicitly restrict activities acceptable on the ‘common’ land, for instance by proscribing activities that would restrict the full enjoyment of rights by others.

Communal rights to land can also offer benefits in terms of discussions with communities regarding actions required to protect water resources. Firstly, the impact of poor groundwater management is likely to be felt directly by the community as in many cases they may be using the sources being polluted from land that is used by the community. Secondly, it introduces the broader concept of public goods that may be easier to accept when restrictions apply across a community rather than to specific individuals. Thirdly, management and protection strategies can be designed to respond to the demands of the community. Where communities have been active participants in strategy development, they will be able to provide a degree of self-policing which may ultimately prove more effective than outside inspection.

5.4.3 Publicly owned land

Publicly owned land is land owned by a Government for all its population. Examples of publicly owned land include national parks where the land is held for the nation, even though some of the land may be let to individual farmers. In some European countries, the catchment areas of major sources of water are purchased specifically for
the purpose of protecting the quality of the water source, particularly where it is used for domestic purposes.

As most groundwater protection policies and plans are implemented by Government bodies, publicly-owned land is the most amenable to restriction of land use, but will still require a process of public consultation during policy development. Particular issues that are likely to need resolution will be changes in allowable use of land where part of the land is let in long-term tenancy to farmers or where there is a public right of access. In the former case, changes may need to be phased or supported by compensation packages, whilst in the latter case, broad consultation should be undertaken to ensure that there is public acceptance of the need for such restrictions. Where public access rights are maintained within areas where there are restrictions, it is essential that appropriate services (such as public toilets) are provided to reduce the potential for release of contaminants into the groundwater.

5.4.4 Informal settlements
Informal settlements – situations where land tenure is unclear and where rights are limited – represent particular problems for groundwater protection. In many cases the residents of such settlements have little or no resources and are vulnerable both to exploitation and to ill-health derived from contamination in the environment. At the same time, such settlements may become a major source of pollution for groundwater resources as they typically lack basic sanitation, solid waste disposal or surface water drainage. Where water supplies are also lacking use is likely to be made of shallow groundwater systems, potentially leading to direct impacts on the health of the community.

Enforcement of land use restrictions in informal areas is unlikely to be successful as they are illegal and unlicensed settlements. However, simply trying to remove such settlements is not only highly discriminatory against the poor, but it is unlikely to be effective and will result in simply shifting the problem and not resolving it. In these situations, it is more appropriate to identify ways of working with community groups to make improvements in environmental health that reduces health risks.

5.5 VALUING AND COSTING GROUNDWATER PROTECTION
An important approach to protection of groundwater is to put an economic and social value on groundwater resources. This value should take into account the direct and indirect cost of protecting the resources as a function of the direct compensation costs (if any) and lost opportunity costs from other, potentially more productive, uses of the land. This should be balanced through placing a value on the aquifer in relation to its importance in supporting economic growth. The latter should consider the current value of groundwater to different industries and the value of each industry to the overall economy. It should also include the incremental marginal costs caused by increased treatment costs (either derived from use of alternative sources or due to pollution of
groundwater) and increased abstraction costs derived from exploitation of deeper resources due to contamination of shallow groundwater.

Most environmental protection activities will result in some increase in the cost of production and distribution of drinking-water and more generally in terms of overall environmental protection. For instance, there may be a requirement to pay compensation to existing land-users or to purchase land in drinking-water catchment areas. Within this debate it is important to obtain the views of the public (perhaps represented by consumer groups) on their willingness to pay for such improvements and to assess whether this will be sufficient to offset costs, discounted over an appropriate period where necessary. Unless there is a willingness by the public (or specific water consumers) to pay the costs of protection, it may be very difficult to sustain intervention strategies. This is discussed further in Chapter 20.

In addition to a direct balancing of economic costs, it is important that social aspects such as the access to safe water supply and the burdens placed upon poor families from having to walk long distances to collect poor quality water should also be assigned a value. One way of doing this is to calculate the likely public health burden derived from poor access to water supply. This may also include a factoring in of the numbers of people whose welfare depends on the continued exploitation of groundwater, whether for domestic use or in agriculture or industry. An example of an approach to valuing groundwater protection is shown in Box 5.2.

**Box 5.2. Putting a value on groundwater: Managua (based on Scharp et al., 1997)**

The city of Managua in Nicaragua is dependent on groundwater for domestic water supplies and therefore groundwater protection is a priority. Work undertaken by the Sustainable Use of Water Resources project developed a methodology to assign a groundwater protection value to groundwater sources as an input to groundwater protection planning. The project used four criteria:

- available quantity
- groundwater quality
- present or planned use
- sensitivity to changes in groundwater level

These criteria were based on the economic valuation of water resources in relation to current use, option for future use and environmental significance.

A protection value was calculated based on scores calculated for each criteria. The scores for quantity, quality and sensitivity to changes in groundwater level were used to define the protection value, whilst the present or planned use criteria was overlain on a final map to indicate current and planned abstraction. The authors note that the protection value was a relative measure based on five classes. The data was compiled into a map on a Geographical Information System (GIS) platform that allowed abstraction to be overlain on the protection value. The authors concluded that the areas where there was currently greatest use corresponded to the areas where the protection value was highest. They also concluded that the approach provided a simple and effective tool to assist planners to develop groundwater protection plans.
5.6 SETTING GOALS AND OBJECTIVES – HOW MUCH WILL BE PROTECTED?

The goals and objectives of groundwater protection programmes must be determined before appropriate choices can be taken. Where they existed, in the past, water resource management and environmental protection agencies often made decisions on goals and objectives exclusively. More recently, however, it has been increasingly recognized that planning agencies, local government authorities, key industry groups and the general community need to be consulted. If the inherent conflicts in land use controls are to be resolved, then the understanding of the resource should be accompanied by an appreciation of its value to the community and of the potential impacts of specific land uses on groundwater quality. The community as a whole should decide what needs to be protected and how much protection it can afford. The introduction of obligatory environmental impact studies in Chile, for example, has included the whole community of affected interests into the decision-making process for the first time (Garcés, 2000). Of course, there are still many countries where little or no protection is afforded.

Protection can either extend across an entire aquifer or be restricted to important recharge areas, or capture zones, for specific water supply wells. The question of how much protection is needed or desired depends on the characteristics of the resource, the degree to which it is used, as well as other community social and economic goals. Alternative macro-protection land use management policies include:

No degradation. The maintenance of the quality of groundwater at no worse than existing levels. Generally, such a policy would only be applied to vital resources, typically a resource that provides the sole source of drinking-water. For practical reasons it can only be applied to groundwater resources in undeveloped areas, or areas of very low intensity development. Further land development will normally be excluded from the designated area.

Limited or controlled degradation. Such a policy acknowledges that existing or proposed land uses will cause a deterioration of groundwater quality, but strives to maintain the quality above certain specified limits. This policy normally involves controlling the density and types of land development, and the prescription of specific management practices for activities that can affect groundwater quality.

Differential protection. Differential protection policies allow for combinations of no-degradation and limited degradation. Land use management practices normally result in a combination of exclusion and restriction. Such differential protection policies allow the development of different protection objectives taking into account factors such as present and potential uses of water resources, the tenure, zoning and uses of land in the locality, and the desires of the communities involved.

Conflicts in land use management for groundwater quality protection. Restrictions on land use for groundwater protection will always have an economic cost, and decisions must be made about how to minimize these costs while maximizing protection. For example, any limitation on the type and amount of industrial or urban development will have a cost. Consequently, the setting of land use controls for groundwater protection can be very controversial. Obviously, landowners have an expectation that their land can be used freely in its economic highest value use. The wider community interest, on the other
hand, can require that groundwater should not be put at risk of pollution. Those responsible, therefore, usually have the difficult task of trying to balance the optimum protection of groundwater resources with the economic interests of the owners of the overlying land surface.

There may be many potential complications involved in land use management, for instance in trying to control problems such as the salinization of groundwater due to irrigation return waters. There may be extreme examples of conflicts, as for instance in the Doon Valley in Uttar Pradesh, India where limestone quarrying is physically destroying the aquifer (Shaman, 1996). Many different types of land use may have to be restricted to protect the quality of groundwater. It is not simply a question of limitations on activities involving toxic materials or the disposal of sewage. Run off from urban areas can be a serious contaminant and it and other sources of diffuse contamination, particularly from agriculture, are those that are best controlled through land use management policies. However, it is with controls over diffuse sources that most conflicts will tend to arise. The problem is particularly acute in rapid growing cities and in those cities in poorer countries where there is reliance on water supplies from shallow aquifers and disposal of excreta in situ.

5.7 INSTITUTIONAL ISSUES

The development of groundwater protection strategies and policies requires effective institutions responsible for the planning, implementation and management of groundwater in the country. In a great number of cases, the failure to protect groundwater resources results not from a lack of appropriate legislation, but because of the poor enforcement of existing regulations. This frequently reflects both weaknesses in the overall institutional framework for groundwater protection and weaknesses within key institutions themselves. Part of the weakness often noted is that the institutions dealing with health, water resource or water supply fail to collaborate to define groundwater protection needs.

Where groundwater policies do not exist or are in need of revision, it is important that a lead institution should be identified for policy direction, and the co-operation of other relevant organizations in decision making should be sought. Generally the lead organization is placed at the central government level. Even in countries where local public participation in water management is high, such as parts of the USA, local water management plans must be consistent with national water quality management objectives and plans.

It is essential that the different roles and responsibilities of different agencies working in the water sector are clearly defined and that one agency is charged with the responsibility to develop, implement and enforce a groundwater protection plan. It is important that the institution identified does not have any conflicts of interest that will compromise its ability to work independently. It is usually preferred that a water resources management body is established that is involved in the approval of development of water sources and the control of the quality of the resource, but is not directly involved in water source development.
Institutional mandates must reflect the aims and objectives of each institution with respect to their roles and responsibilities within the sector (Alaerts, 1997). One of the consequences of this is to consider carefully the scale and scope of activities. For instance, water and wastewater service provision is often most effectively performed when decision-making is devolved to decentralized bodies such as municipalities, water companies or water users associations. National central bodies may still retain some responsibility for policy or strategic development, but may have little influence on operational matters. This implies that when considering roles and responsibilities, the level of action (national policy or local implementation) needs to be considered as well as the area over which the institution has a mandate for action.

The regulation and control of groundwater quality requires a somewhat different approach, although the principles of decentralized operation are still valid. However, although implementation of regulatory activities may be decentralized, there is a need for a strong national institution capable of providing the overall policy and strategic guidance for groundwater protection.

5.8 LEGAL FRAMEWORK

The protection of groundwater requires an adequate legal framework (Caponera, 1992; Soulsby et al., 1999). As governments move towards the strategic management of the country’s water resources, it is often necessary to replace basic common law and property rights with statutory provisions regulating the use, development and protection of water (Caponera, 1992). Legal issues related to water ownership, the means used to control abstraction and polluting activities, and the enforcement of such legislation become important. The framework must be supported by appropriate institutions that are capable of implementing the policies and enforcing the relevant laws and regulations, and these organizations must also have the necessary legal status and powers. The willingness to enforce compliance with pollution control measures and whether regulatory frameworks create incentives for potential polluters to comply are critical in ensuring effective regulation (Lane et al., 1999). Within the general considerations of the scope of environmental legislation, the legitimate demands of economic development must be considered to ensure that a sensible balance is struck between the two (Lane et al., 1999).

Legal frameworks in place or developed for water protection deal often with many other issues apart from groundwater. It is possible to identify the shortcuts that relate solely to groundwater, but it is not usually possible to change the laws so as to concentrate only on groundwater quality. The use of more general laws must therefore be accepted, and the specific legislative provisions that may be applicable to the groundwater situation should be identified and used as appropriate, working within the framework of all the provisions of the relevant legislation.

Legislative reform may be required in order to achieve the objectives of groundwater protection. This may involve the revision of existing legislation to encompass these policy objectives or the development of new legislation geared towards groundwater. The approach adopted depends in large part on the nature of existing legislation, the ease with which this may be updated (bearing in mind that existing legislation may deal with
broader issues and updating may be time consuming) and the importance of groundwater in the national water resources. Furthermore, as noted by Foster et al. (1992), legislative reform will only be effective where political will exists to ensure implementation. These issues are discussed further in Chapter 20.

5.9 REFERENCES


