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Economic Viability and Sustainability of Environmental Services: Community Participation for Water Supply and Sanitation in Pakistan

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Abstract

This paper is aimed to analyze the relationship among community participation, economic viability, and project sustainability. Our case study is based on a community based water supply and sanitation in Pakistan. We start this paper by offering a review of strategies for sustainable water supply, which leads to discuss community water supply. Here, we take a comprehensive picture of the contemporary research on this issue. We try to link the major research work for blueprint approach versus learning process, decentralization and local organizations, and community participation. All those three ingredients are essential for attaining a sustainable management structure for water supply schemes. We further, analyze three perspectives on institutional aspects, community organizations, and role of communities in water supply schemes. This gives us the insights into the pros and corns to involve communities as primary stakeholders.

Thereafter, we present our model for project sustainability. Community participation, along with institutional support from other relevant agencies and feasibility of technical aspects related with water supply, can help community organizations to achieve sustainable management of the water supply schemes. This will also help to improve the economic viability of the schemes, which can be assessed through benefit cost ratio. The benefits can be estimated in terms of willingness to pay (WTP) by adopting a contingent valuation (CV) survey. The economic viability and sustainable management both affect the project sustainability. The project, under case study, had been designed and implemented on the principles of community participation. Therefore, we assess the economic viability, where we can also see the difference in WTP for public water supply (from previous research) and this community water supply. We assume health benefits, in terms of savings due to reduced water related sickness episodes, as the main economic benefits, which can affect the WTP. However, health benefits are closely linked with the household characteristics. This leads us to build a relationship between household characteristics and the WTP.

Our results suggest that children and women, being the primary stakeholders, are having the significant and positive impact. Literacy and income are also significant variables, as both of those variables are directly related with health and hygiene practice, which is essential to multiply health benefits from water supply. We estimate a benefit transfer function from the CV based WTP of 5 sample communities. We adopt this transfer function to estimate the social benefit in 51 communities under this project. The households have to bear only maintenance costs, under unified project policy. Comparing those costs with the benefits, we get positive results for economic viability. This suggests that the project will be sustainable, provided sustainable management under community participation remains intact.

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1 Introduction

The Brundtland report made a major breakthrough to conceptualize "sustainable development" as the most appropriate development process to achieve long-term development objectives on sustainable basis (World Commission on Environment and Development 1987). This report is the main resource to understand the impact of economic growth on the environment and the sustainability of the natural resources to continuously support the life on the Earth.

Water is one of the most essential life-supporting natural resource. On assumption of water being a free and abundant gift of Nature, this resource had been exploited through its uneconomical use and also by discharging many polluters into it. Moreover, the increasing population that has already crossed 6 billion is putting enormous pressure on this resource. Therefore, the current studies and statistics suggest that water is no more a resource in abundance that can sustain the traditional exploitation over long-time. Current studies show that only three percent water available on earth is suitable for drinking and agriculture and most of that is also locked away in the polar ice caps leaving only 0.3 percent of the total fresh water reserves on earth in rivers and lakes. Surface water combines with ground water to fulfill the fresh water requirements for drinking as 10 percent, industry as 21 percent, and agriculture as 69 percent (Gleick 1993, Shiklomanov 1993).

This is a clear warning that water should be carefully used on the socio-economic principles and to make sure that water should remain clean and available for meeting intra-generation and inter-generation needs. The sustainability of water has been linked with people's willingness to pay for it (Black 1998). This situation has motivated the international and national policy makers to outline the strategies to meet the challenge. Nigam and Rasheed (1998) observe that this challenge is twofold: ensuring sustainable financing and environmentally sound use of water resources.

Though a major portion of water is being consumed by agriculture sector, but the demand for household consumption is on the rise to meet the growing population coupled with raised living standards. Moreover, a big number of people living in developing countries are yet to get an access to safe water supply and environmental sanitation. WHO statistics predicts that by the year 2000, still 750 million people will not have adequate access to safe water supply and 3.3 billion people will be living without having reliable environmental sanitation facilities (WHO et al. 1996). For those unfortunate people, water supply and sanitation can work as a lifesaver, because 10,000 people die from water related diseases every day in a relentless global calamity (UNDP-World Bank 1999).

To avert this tragic situation, various strategies have been tested to increase the coverage of safe and sustainable water supply. We believe that sustainability of project depends on the project management and as well as on the economic appraisal. Community participation affects both of those factors; though, most of the research has only been focused on the linkage between project management and community participation. We intend to further see the impact of community participation on the economic appraisal.

In this paper, we provide the holistic picture of our research. The overall purpose of our research is to show a linkage between community participation and economic viability of development projects in the low-income areas of the developing countries. We initially discuss the previous research on the community participation for effective project management. Then, we thoroughly investigate a community based water supply project in Sindh province of Pakistan. Here, we have analyzed the major economic impacts, in terms of reduced water related sickness.

We have also carried out an economic valuation by conducting a contingent valuation (CV) survey to estimate willingness to pay (WTP) for households (Memon 2001). This survey was conducted in accordance with the mainstream guideline; moreover, the outcome meets the necessary requirement of scope sensitivity under economic theory (Memon and Matsuoka 2001[a]). Then we have generated a benefit transfer function to calculate total social benefit to establish benefit-cost (B/C) ratio (Memon and Matsuoka 2001[b]). Hence, we can assess the project sustainability from sustainable management and as well as from economic viability point of view.

Overall formation of this paper is as follows: In the second section, we highlight the strategies for sustainable water supply. In the third section, we discuss the various issues related with community water supply. We discuss about the case study, and data collection, including CV survey, in the fourth section. In the fifth section, we present the hypothesis. We discuss our analysis to build a relationship among WTP, household characteristics, and health benefits in the sixth section. We discuss and present the benefit transfer

based social benefit in the seventh section. In the conclusion, we discuss about the sustainability of this project and then highlight the academic and policy implications of our research.

2 Strategies for sustainable water supply

A combine effort to improve the coverage of safe and sustainable water supply, mainly for the poor people living in the developing countries, was initiated in the World Water Conference in Mar del Plata, Argentina in 1977. A declaration was adopted to initiate a new era in international co-operation for improved water supplies and sanitation in the developing world and the decade of 1980s was declared as the 'International Drinking Water Supply and Sanitation Decade' (IDWSSD) to radically overhaul the perception and investment strategies (Black 1998). Major emphasis during this decade was given to the development of appropriate technology as most of the investments had already failed due to inappropriate and imported technology from the donor countries.

During early 1980s, a lot of research for appropriate technology was conducted and equipment for surface and ground water was tested in the field and finally invented suitable equipment for different regions depending on the environmental and economic factors. However, this appropriate technology did not meet the desired expectations for achieving the sustainable water supply and sanitation, mainly in the in small communities of 1000 to 5000 people. As most of the poor people live in the communities outside the cities where water supply and sanitation schemes cannot be operated above the marginal costs to generate profits and to motivate private sector due to poverty, land-use planning and socio-cultural characteristics of these communities (Majumdar 1993).

The desired objectives were not achieved mainly due to the inadequate efforts to address community participation, local organizations, institutional development, environmental awareness, and finance and economics for the water supply and sanitation schemes (Bell 1990, Chambers 1993, Majumdar 1990, Narayan 1995, Pasha and McGarry 1989, Pickford 1990, Uphoff 1997). During IDWSSD the projects were also initiated to improve the role of communities and women for the planning, implementation, and operation and maintenance of water supply and to streamline the institutional set-up for optimizing the input-output relationship.

However, those projects were either taken only as pilot projects, or the projects were not pursued actively due to opposition from the centralized management structure of the governments in the developing countries. UNICEF and WEDC arranged a workshop for water and sanitation staff in 1990 to share the experiences for addressing those core issues and to initiate efforts for active role of communities including women, institutional development, and strategies for sustainable finance and economics of the projects (Cotton et al. 1990). Moreover, the experiences of IDWSSD made it clear that development is not merely as economic growth, but also a 'broad-based', 'people-oriented' process (Bell 1990)

During Earth Summit in Rio in 1992, the major emphasis was given to redefine the role of stakeholders to meet the targets of Sustainable Development (World Bank 1992). After the 1992 conferences in Dublin and Rio, a set of Dublin-Rio principles was adopted to effectively address water sector. UNDP-World Bank's water and sanitation program strategy for 1999-2003 is based on those principles, which stress the following points:

- Water is a finite resource essential to life and should be managed holistically in all its uses.
- Development efforts must be participatory; water should be managed at the lowest appropriate level.
- Women must play a central role in water projects.
- Water has an economic as well as social value.

(UNDP-World Bank 1999)

Based on the above principles to improve the sustainability of water supply and sanitation in the smaller communities, it was realized that community itself is the major stakeholder and has to decide about their needs, level of service, implementation and O&M of the schemes. Hence, a word 'community' was added to water supply and sanitation schemes. The World Bank Conference on community water supply and sanitation in 1998 emphasized that demand responsive approach (DRA), institutional rules and a relationship between DRA and sustainability are the main issues for achieving effective investment decisions (UNDP-World Bank 1998).

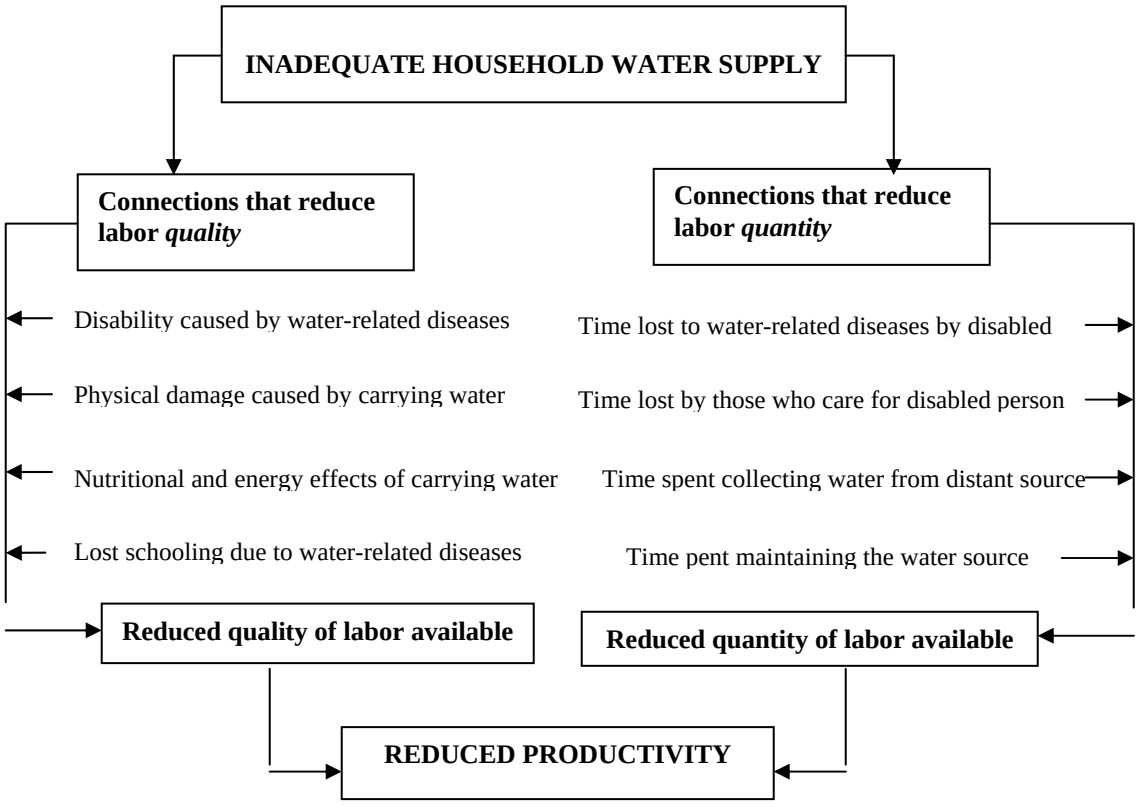
3 Community water supply

3-1 Contemporary research

A detailed research was done by academicians and professionals, to analyze the community water supply and sanitation projects, to addresses the impact of various strategies on the sustainability of the projects and their effects on the communities. That research can be divided into two major areas: socio-economics and socio-institutional development. Various methodologies ranging from social cost benefit analysis (SCBA) and distribution effects to the willingness to pay (WTP) with special emphasis on contingent valuation methods (CVM) were tested and modified to optimize their use for this specific type of projects. Curry and Weiss (1993), Dixon et al. (1988), Gilpin (1995), and Gittinger (1982) have approached cost-benefit analysis and social cost-benefit analysis for the projects addressing the needs of poor people in the developing countries. Jenkins (1998) work has got simplified approach to add the distributive effects in the project analysis. Meier (1983) and Majumdar (1990) have shown the simplified ways to calculate marginal cost and appropriate tariff with income distributive effects for water supply.

Furthermore, they have analyzed that urban water supply schemes can be operated above marginal costs to generate profits; however, the water supply and sanitation services in smaller communities normally operate below marginal costs requiring some sort of subsidies to meet the costs. Willingness to pay methodology with main emphasis on contingent valuation methods has been adopted by many researchers in this area. Whitehead and Houtven (1997) have done a case study in a developed country while Rosen and Vincet (1999) carried out a detailed study in the developing countries of Sub-Saharan Africa. They have found a connection between household water supplies and labor availability as shown in the Figure 1.

Figure 1
Connections between household water supplies and labor availability



Source: Rosen and Vincent (1999)

These studies observe that there is quite high willingness to pay for the water supply even in the poor communities. However, if some of the communities cannot afford to pay for that, then government intervention is required as it is difficult to distinguish water as a public or private good. Because water borne diseases are health hazard in many parts of the world and positive externalities mean that nation as a whole will be benefited from the labor productivity gains and reduced cost for health care (Nigam and Rasheed 1998).

Socio-institutional research, which has been targeted by academicians and professionals, relates with various disciplines to highlight the issues concerning socio-political setup, community participation and development, decentralization and institutional strengthening, health and hygiene awareness, and role of donor agencies. The researchers' main emphasis is on the modified role for all the stakeholders with communities as the major stakeholder having all the voice and exit options. The impact of various beneficiary and client characteristics on the sustainability and overall performance of the project have been analyzed to suggest the improvements in the existing policy for this sector (Narayan 1995). The various approaches for this group or research can be classified as under:

3-1-1 Blue Print Vs. Learning Process:

Blue print or master plan is a traditional bureaucratic style of planning where decisions are taken at central level and every detail of project implementation and finance has been planned in advance. This approach assumes that everything is known, and hence can be planned, estimated and procured in advance (Narayan 1995). Many of the traditional policy makers presume that blue print approach can push the production possibility curve outwards (Coverdale and Healey 1987). Unlike blue print or master plan, learning process or participation approach is flexible with changing definitions of roles, obligations, procedures and methods, collegial authority, and free lateral communications (Chambers 1993).

Therefore, most of the details of project implementation and finance are flexible to be changed as per the ground realities to be encountered during implementation phase. Demand-based water supply can only be a success through learning-process approach, as the goals and objectives are clear with relatively high level of uncertainty and ambiguity, and costs and budgets are indicative rather than detailed and inflexible (Narayan 1995). However, centralized planning is based on top-down process for an assessment of needs by the central bureaucracy, therefore, the real development rarely reach to the poor with sustainable solutions to their problems (Narayan, 1997[a]). Therefore, to make fix commitments in an evolving economy may constrain capabilities for corrective adaptations in the future (Ostrom et al. 1993).

However, most of the agencies in developing countries are working with a centralized structure and these are very reluctant to adopt learning process approach due to either doubts about loosing their grip on the project or due to doubts about the rate of success for this approach. Learning-process approach also requires policy makers to learn more and put more efforts, as adaptation of this approach places a premium on innovative implementation and it requires even more skills and creativity than the traditional planning (Esman and Uphoff 1984).

Tacconi and Tisdell (1992) observe that this approach is seen inappropriate for the bureaucratic agencies, geared to a timely budgeting and delivery system, so, one solution could be to reform the agencies which is difficult or to design this approach in a way that can fit into blue print approach. There is also a danger that in many countries the projects only adopt the word of 'community' just to give a feeling of adopting the learning process approach while the fact is that most of these projects are still being managed through blue print approach. In South Africa, Community Water Supply and Sanitation Program (CWSSP) is not found on demand-driven principles as the projects are selected based on nationally coordinated planning process (Palmer 1998). Table 1 shows a comparison between blue print and learning process approaches.

Table 1
Comparison of the Blueprint and Learning-process Approaches

Action	Blueprint Approach	Learning-process Approach
Role of government	Provide services	Policy framework and to facilitate participation
Role of client	Peripheral and pay service charges	Central and their needs are the focal point
Initiative	Agency	Client
Initial stage	Data collection	Awareness and action
Data	Extensive socio-economic and physical data before hand	Baseline surveys and then adopting PRA or similar approaches
Planning and Designing	Static and by the Experts	Evolving and involving people
Project documents	Master plans, detailed with every thing pre-planned	Clear objectives, goals, strategies, monitoring and evaluation criteria, and outline plans at local level (no detailed planning)
Project management	Implement project cycle, meeting financial and physical targets on time	Conflict resolution and problem solving environment for sustained improvement and performance
Supporting agencies	Existing or built as per traditional hierarchy	Built at bottom with vertical and horizontal spread
Project resources	Funds from government and contractors for implementation	Mainly local people's assets
Project implementation and training	As per master plan…rapid and widely targeted	Following the pace of clients
Service delivery	Standardized	Diverse
Communications	Pyramid: reports down to top and orders top to down	Horizontal with mutual sharing and learning
Indicators of success	Quality and quantity with per unit costs	Effective use of services, sustainability, empowerment
Evaluation	External as a terminal entity	Internal (people and project staff) and on-going
Leaders	Positional and changing	Personal and sustained
Errors	Hide	Learning
Effects	Create more dependency on outsiders	Empower local people to meet their own challenges

Source: Adapted from Korten (1980)

However, one can conclude that each approach has strengths as well as weakness, therefore, it is helpful to take advantage of what each can do best (Esman and Uphoff 1984). Ostrom et al. (1993) also observe that cost of failure in both of the cases may be different but the result will be more or less same: inadequate infrastructure that impedes development.

3-1-2 Decentralization and Local Organizations:

'Decentralization' has been the main area for the development research. Most of them (Esman and Uphoff 1984, Klugman 1994, Narayan 1998, Shah 1998, Uphoff, 1997) have shown that decentralization can be very effective tool for development projects in the smaller communities, as government agencies, local organizations and communities have to work hand-in-hand for efficiency, effectiveness, and accountability.

The agenda for community-based development cannot be practically implemented without fundamentally changing institutional structures, rules and incentives (Narayan 1998). However, Ostrom et al. (1993) has analyzed through 'institutional analysis' or 'new institutional economics' that decentralized institutions also have the deficiencies like centralized institutions for managing the development projects in the smaller communities.

Hence, the polycentric institutional setup can optimize the achievements in infrastructure development in smaller communities. Estache and Sinha (1994) calculated that the elasticity of per capita infrastructure expenditure with respect to the degree of decentralization in developing countries is about 0.3 percent and this is quite significant as the public investment in infrastructure averages 4 percent of national output. The broad-based concept of decentralization is that the local governments are empowered with decision-making, authority, resources, and the organizational skills and capacity to carry out the tasks expected of them within this framework (Narayan 1997[a]).

Klugman (1994) refers to the three modes of decentralization: concentration, delegation, and devolution. While Uphoff (1986) suggests that to understand the decentralization, one must ask where the persons making decisions were located and to whom they were accountable. Uphoff (1997) has further elaborated that devolution is the case where the decision-makers are both located non-centrally and accountable to local populations, and if only the decision making is being decentralized without being making them accountable to local people then it is only de-concentration. Therefore, bringing decision-makers closer to the people, accompanied by established mechanisms of local accountability, can improve the overall effects of decentralization (Klugman 1994).

Similar is the situation in the two populous countries like India and Indonesia for water supply and sanitation as the 74 and 60 percent people live in smaller or rural respectively. The decision-making is mainly done by central government (mainly for financing), and even if the project selection is done by state bureaucracy but those decision-makers are not directly accountable to the people (Brown 1998, Lyer 1998). This is one of the factor that majority of poorer population in those countries is still without sustainable water supply and sanitation. Though decentralization is having much potential for promoting more rapid, equitable and sustainable development (Uphoff 1997) but countries initiate decentralization reforms for a variety of reasons and many of those are overlapping (Fiszbein 1997).

Esman and Uphoff (1984) recommend four broad-based strategies for managing the development targets more effectively: public investment, a policy environment, technologies, and effective institutions (network of government agencies, private enterprises, and local institutions). They further elaborate that without effective institutions, infrastructure cannot be built or maintained, public services will not be provided or utilized, appropriate technology will not be used appropriately, and development in smaller communities will be slogan rather than a reality.

However, in many cases decentralization may have only some potential to decrease transaction costs associated with the highly centralized provision of public infrastructure as many of the institutional changes (decentralization) have not yielded the expected results (Ostrom et al. 1993). These obstacles to the decentralization can be effectively mild down by local capacity building and effective institutional development within the socio-political structure of these communities, which is dominant by the elite group. Moreover, phenomenon of elite domination is not unique to local governments and nor to developing countries (Klugman 1994). Under this scenario, decentralized institutions become captive to the whims of the local elite (Shah 1998).

There are various studies conducted by the researchers to optimize the institutional development and local capacity to avoid the negative effects of either centralized bureaucracy or the decentralized institutions under local elite. Ostrom et al. (1993) recommended that 'polycentric institutional arrangements', in contrast to the centralized and decentralized arrangements, offer citizen the opportunity to organize not one but many governing authorities as the varied functions of these governments mean that individuals maintain citizenship in several governments simultaneously. However, the more important issue may be to assess the local and institutional capacity and suggest the ways to build and strengthening that capacity to make it an appropriate input for most suitable institutional structure at the local level.

Uphoff (1997) suggests that the success of this institutional structure depends on effective initiative by the appropriate actors; incentives for appropriate actors to take efforts; mechanism for accountability by those who are affected by the decisions and forums for deliberation; and finally not linking the local capabilities with the literacy statistics. Fiszbein (1998) observes that local capacity is hardly an end in itself: it is rather means to

achieve a combination of objectives, therefore, prior to analyze capacity one may ask "capacity to do what?" Esman and Uphoff (1984) suggest that the capacity to carry out the following local organizational task more effectively:

(1) Intra-organizational tasks: planning and goal setting, and conflict management;
(2) Resource tasks: resource mobilization, and resource management;
(3) Service tasks: provision of services, and integration of services; and
(4) Extra-organizational tasks: control of bureaucracy, and claim making on government.

Uphoff (1997) concludes that successful decentralization will move in a dialectical relationship wit creative committed and effective central government action, supporting greater capacities in the public, private and voluntary sectors at lower levels.

3-1-3 Community participation

This is the most important ingredient for sustainable development which has been defined by Narayan (1995) as a voluntary process by which people, including disadvantaged (in income, gender, ethnicity, or education), influence or control the decisions which affect them and the essence of participation is exercising voice and choice. Analysts have developed various theories and methods to address community participation from various angles.

Chambers, Scoones and Thompson with others have contributed towards 'participatory rural appraisal' (PRA) approach. PRA had been developed from rapid rural appraisal (Chambers 1994[a]). PRA helps communities to strengthen their local knowledge and capacity for analyzing their own needs and selecting the projects to meet those needs. PRA is very useful for participatory appraisal and planning; participatory implementation, monitoring and evaluation of programs; topic investigations; and training and orientation for outsiders and local communities (Chambers 1994[a]).

Chambers (1994[b]) further observes that PRA helps reversals of frames (outsiders to insiders), modes (individual to group, verbal to visual, and measuring to comparing), relations (reserve to rapport and frustration to fun), and power (extracting to empowering). However there are few dangers to be taken care while adopting PRA. The worst dangers could be instant fashion, rushing, formalism, and routine and ruts (Chambers 1994 [c]). PRA has been successfully launched by various national and international agencies and it has been modified to invent new techniques including participatory learning and analysis (PLA) and participatory poverty analysis (PPA).

After a successful implementation of PRA, the academicians and professionals around the world analyzed other modes and means of participation. The real need for 'community participation' as a major source for 'sustainability' was realized as the analysis of project failures make it clear that the people who know most about their own problems normally have the least say to change their fortune and the people who have say in political and government structure mainly lack in-depth understanding of the problems of the people which they are trying to solve (Uphoff 1997).

Therefore, the main focus was turned towards the 'people' who are the real beneficiaries or users or clients of the public services. Hence, if the focal point is people and their needs, then there are good chances to achieve sustainable outcomes (chambers 1987, Tacconi and Tisdell 1992). However, there are many different disciplines of community participation, which have been addressed by the researchers. Main disciplines, which have significant impact over the 'beneficiary characteristics' and 'agency characteristics' (Narayan 1995, 1997 [a], 1997 [b], 1998, Esman and Uphoff, 1984, Uphoff, 1997).

Beneficiary or client characteristics have the major influence on the sustainability. These characteristics include commitment of client for the service required (demand-responsiveness), capacity and traditional collective to organize themselves for that particular service (social capital), Skills and knowledge of clients, and quality of leadership and dependence on charismatic leaders (Narayan 1995). Commitment of the client is the most crucial factor to achieve sustainability, as it is most obvious that people will be committed to the particular service (by paying in cash, kind, time, efforts) if they value that service (Black 1998). Moreover, local people will only make any commitment, if they can understand that benefits are higher than what they are paying.

However, this commitment should be initiated and managed through a local organization (for example community organization) to check the problem of 'free ride' by the some individuals as discussed by Ostrom et al. (1993). Furthermore, Narayan (1995) argues that demand changes over time; therefore, projects gauged demand during implementation by getting communities to demonstrate their interest and commitment before project construction began.

In the case of sub-urban china, where people mainly rely on their own efforts to finance, effective access to safe drinking water has been increased enormously from 50 percent in 1985 to about 90 percent by the end of 1997 (National Patriotic Health Campaign Committee 1998). Unlikely, in Ghana, where local communities and agencies are yet not decided about the project rules to introduce effective demand-responsive approach, only 35 percent people have access to drinking water and 15 percent of households have got sanitation facilities (Asamoah 1998).

Hence, it is observed that demand as measured by level of commitment before construction mainly by investing up front costs, is a significant contributor towards both project effectiveness and overall beneficiary participation in decision-making (Narayan, 1997 [b]). Similarly, Pickford (1990) recommends that water supply and sanitation project should be selected on the basis of communities' demonstrated willingness and ability to participate. However, the knowledge or awareness of the communities can affect the real demand or commitment.

Experiences with Sindh (Pakistan) water supply and sanitation project suggest that there was considerable variation in the demand, before and after health and hygiene awareness programs for the communities and also after these local people came to realize that how much they loose due to water related diseases (this research by Memon and Matsuoka). Pasha and McGarry (1989) observe that one of the problem with the Punjab (Pakistan) sanitation program was that sufficient sanitation promoters (awareness facilitators) were not recruited and trained. Therefore, the demand-responsive approach can be effectively implemented through learning-process approach for planning, as the sub projects should be designed in a response to the expressed priorities of the poor (Narayan 1997 [a]).

Social capital is broadly defined as the norms and mores of society which enable the members to trust each other, to organize themselves and work together to resolve conflicts, mobilize resources, and network with outsiders to solve their problems (Narayan 1998). However, it is difficult to examine the effects of what is meant by social capital, but it is practical to measure its effects (Narayan and Pritchett 1997). Therefore, it is essential to increase the effects of social capital by strengthening the local institutions so that people, having various roles in those organizations, can create mutual expectations to further lead to more desired and more predictable actions on the part of all persons associated with a role, both role incumbents and those affected by that role (Uphoff 1997).

This shows that main thrust of the development should be towards the strengthening of social capital by building local organizations. Though, it is easier to strengthening already existing local organizations, rather than starting the new one, but sometimes it is worth starting from the scratch (Narayan 1998). Moreover, experience suggests that if the institutions of participation are in place with the objectives to analysis the particular need and to solve that need through participatory project management, then participation can work well (Cunha and Pena 1996).

However, the capacity of organizing and working together cannot generate the optimum outcomes, if all the disadvantaged groups do not effectively participate. Water supply and sanitation services have direct effects on the women and if they don't get an effective voice and choice then sustainability of the project can be affected. Klugman (1994) observes that in most of the developing countries, women have been excluded from traditional and modern forums of decision-making. Therefore beneficiary capacity can be strengthening only if all the ingredients including gender issues are optimally addressed.

Local knowledge and skills are also one of the important factors for specific service delivery. Indigenous knowledge is very helpful to design the service delivery and the level of local knowledge is not correlate with level of local literacy rates as in many cases the unheard advises from the local people for design, location and/or materials proposed resulted in the project failures or cost-over-runs (Uphoff 1997). He further suggests that the poor and poorly educated people are able to understand well if not fully the dynamics of social, economic, ecological and political systems that effects their lives.

Similarly, local people's skills to mange and operate the services should be carefully analyzed and effective training should be incorporated for further strengthening their skills to effectively handle the required tasks including operation and maintenance of water supply and sanitation facilities. Leadership is also a vital

ingredient for effective management as these qualities among clients can accelerate the pace of development process.

Narayan (1995) suggest that the community should be led by strong leaders, who get things started and community on a whole should have broad-based leadership qualities to make the things keep going well; however, leadership is highly correlated with the extent of local control. As far as role of traditional leaders is concerned, they have advantage of having better access on information and their needs are greater, therefore, there are good chances that they will capture most of the benefits (Narayan, 1995). Byrnes (1992) observed that in Pakistan's northern province, community elite plays a positive role in initiating drinking water supply schemes, however, in southern provinces (mainly Sindh) they capture irrigation water often blatantly and disproportionately.

Agency or project design characteristics include consensus on objectives, implementation flexibility, autonomy of projects, extent of participation as a goal, extent of local knowledge being used, and extent of project as being physical-target driven (Narayan, 1995). The project designs or agencies having competing objectives, or those objectives may not compliment each other can make the targets more difficult to achieve. Narayan (1998) suggests that complex projects with multiple and competing objectives should be avoided.

Narayan (1995) observes that in the water supply project for smaller communities, broadening objectives beyond construction to include sustainability, targeting poor, empowerment, equity, and cost sharing means realign inputs, rules, structures, and procedures. Participation can be an objective as well as a means of development, hence, the assessment and analysis of participation is made more complex (Esman and Uphoff 1984). Therefore, 'participation' should be clearly mentioned in project documents with desired targets as some of the community-based project designs may take 'participation' as far granted and not mention it as an objective or an input.

Implementation flexibility has been discussed under the planning approaches includes blue print or master plan and learning-process or participatory planning approach. Narayan (1995) analyzed 121 water supply projects and observe that an adaptive learning approach is the most suitable, which means that there is no implementation blueprint approach to follow, though temptation to standardize all the procedures early, even before implementation starts, is especially great in large projects.

In water supply and sanitation sector large project covering a wider geographical area with varying socio-economic conditions is quite different from a big project located in one area (for example construction of a big dam). The project staff, from various disciplines may be working over the wide geographic areas and dealing with various organizations, needs, common vision, and autonomy (physically and financially) to pursue whatever can generate the optimum results (Narayan 1995). However, effective community-driven monitoring and evaluation can establish the desired accountability mechanism.

In many successful projects, capacity building, and empowerment were selected as specific objectives, though those were achieved in a wide variety of cultural, political, and environmental and technological context. Therefore, it is obvious that effective agency or project designs should pursue participation as a goal and suggest strategies for meeting that goal. Most of agencies are trying to make participation as a goal; however, the centralized, authoritarian, and formalistic nature of many bureaucracies in the developing world calls for passive populace (Esman and Uphoff 1984).

Moreover, even if there is no strong opposition to 'participation' from agency staff, but even then without any motivation they may not pursue it as a goal. This motivation can be diffused through new incentives or changing the structure of existing incentives for them. Ostrom et al. (1993) analyzed that people working in capital cities have incentives for career development as they work near to their bosses, and they can get most of the necessities for good living including good education for their children so a better opportunity to make their children's life more secure in long term.

Incentives more than just financial and luxurious living have been discussed by Simon et al. (1958) as: (1) opportunities for distinction, prestige, and personal power; (2) desirable physical conditions in the workplace, including clean, quiet surroundings or a private office; (3) pride in workmanship, service for family or others, patriotism, or religious feeling; (4) personal comfort and satisfaction in social relationships; (5) conformity to habitual practices and attitudes; and (6) a feeling of participation in large and important events. Therefore, a comprehensive set of suitable incentives for the particular project area should be incorporated in the project design to get an appropriate support for 'participation' as a goal. Moreover, the goal of participation should be monitored and evaluated to incorporate lessons learnt through experiences, as participation is an iterative process (Narayan 1995).

The value of indigenous knowledge is already discussed in beneficiary characteristics. However, the agencies should purse physical-target driven approach to evaluate its participation and capacity building targets against the sustainability of the physical infrastructure like water supply. Therefore, overall project performance could be monitored and evaluated to incorporate changes for better project designs. Finally, community participation can be concluded with the remarks of Narayan (1997) that achieving sustainability at the local level requires community participation, demand-orientation, and local organizational capacity, and there is widespread agreement on these propositions.

3-2 Major issues for sustainable community water supply

3-2-1 Institutional aspects from Ostrom's perspective

Ostrom et al. (1993) has developed a term "Institutional Rational Choice" (IRC) which combines two important assumptions: (1) actors are "intentionally rational" for their own welfare and that of their families; and (2) same individual will behave differently in different decision situations and that institutional rules play a critical role in defining those situations. Based on these assumptions, the authors suggest that the better solution is to link institutional incentives with sustainable development. Altering individual's decision situations by developing self-governing institutions could do this. Therefore, polycentric institutional arrangements are the solution for maintaining sustainable development, as there are problems with centralized and as well as with decentralized arrangements.

Authors arrived on the above assumptions and recommendations after a detailed analysis of "sustainable infrastructure" within specific "institutional" arrangements. They rely mainly on the World Bank's definition for "sustainability", where it is measured as an investment's outcome that economic rate of return must at least equal to the opportunity cost of capital. This will make even those projects as unsustainable, which are continue to operate in long run but fail to generate benefits over and above the costs. Moreover, the same project can be sustainable or vice versa in different institutional arrangements.

Those institutional arrangements affect the decisions regarding methods of mobilizing resources from beneficiaries to arrange the recurrent costs for the maintenance of the facility. Moreover, the principal objective of this analysis was to clarify the causes of unsustainable infrastructure investment and to specify the institutional design prerequisites for maintaining facilities whose operation is or promise to be economically efficient. Though the distributive effect of equity is the prime concern in the development projects in developing countries, but the primary focus should be on an efficient allocation of scarce resources.

Therefore, the trade-off between equity and efficiency should be on the principles of maximizing returns from the targeted investment. Furthermore, the institutional arrangements should help to increase efficiency and accountability and to promote the achievement or redistributional objective. Finally, as the public infrastructure is intended to increase public and private economic activity (directly or indirectly), therefore, the infrastructure must be adapted to facilitate the ever-changing economic activity due to changes in natural and social environment.

Hence, the institutional arrangements, responsible for sustainability, have to be analyzed on the rapidly expanding concept of 'new institutional economics' or 'institutional analysis'. This analysis targets the human behavior that is responsible for the failures in achieving sustainable infrastructure. Much of the analysis, prior to this study, targeted only either private or public institutional arrangements and recommends the state intervention if market fails and vice versa. Moreover, that literature only offers choice between centralization and decentralization and that is gross oversimplification as the sustainable development is too complicated to be addressed through simple concepts of centralized and decentralized arrangements.

Prior to analyze institutional arrangements, it is appropriate to distinguish between the attributes that first complicate the provision decisions and then complicate the production decisions. Provision refers to: (a) kinds of goods and services to be provided by a designated group of people, (b) the quantity and quality of the goods and services to be provided, (c) the degree to which private activities related to these goods and services are to be regulated, (d) how to arrange for the production of these gods and services, (e) how to finance the provision of these goods and services, and (f) how to monitor the performance of those who produce these goods and services.

Production is mainly technical process of transforming inputs into outputs. However, it should be decided that who will be responsible to produce infrastructure facility as government agencies can produce

some type of infrastructure by themselves and the other type of infrastructure might be contracted out to other private or public agencies. Different institutions can undertake various phases of project cycle, including construction and operation and maintenance. Finally, financing the construction, and operation and maintenance is complicated and depends on the nature of goods and services. Though government agencies might rely on grants, aid, and subsidies, however, non-governmental agencies have to mainly rely on the users' willingness to pay.

Main attributes of environmental infrastructure in smaller communities include: (i) non-excludability and the free-rider problem, (ii) problem of joint use, (iii) problems of measurement, and (iv) rent seeking. Production can be affected by the attributes including: (i) economies of scale, (ii) asset specificity, (iii) rate of deterioration, and (iv) public-private industry structure.

Ostrom et al. (1993) recommend that polycentric or non-central institutional structure can provide reduction in strategic and information costs while retaining the advantages of large-scale production agencies when economies of scale are present. This set-up distribute authority with numerous jurisdictions as all the public authorities will have official standing, and no individual or group serves as the final, all purpose authority that stands above the law. Therefore, it offers citizens to organize not one but many governing authorities like national government, regional government, and local government. Each government structure having sector ministries and each ministry having design, construction and O&M departments and consumers can also form user-groups and can directly access to financial institutions and construction firms for infrastructure development.

Therefore, authority exercised by various governments varies enormously and depends on the purpose of the authority. This will also help to counter the problem of sub-optimal or excessive spending due to countrywide uniform set of services. Moreover, the authors suggest that indigenous institutions are an important source of social capital for forming effective non-central (or polycentric), public-private, institutional arrangements within which sustainable infrastructure can be developed. Those indigenous institutions represent communities' knowledge about how to get things accomplished that require a collective action. Furthermore, under this set-up, competition among producers is encouraged and public sector actors play a crucial role in funding, contracting, and monitoring, even when production is organized privately.

3-2-2 Community Organizations: Esman and Uphoff's perspective

Esman and Uphoff (1984) observe that community organizations are the most important factor in the development projects as those organizations are accountable to their members and also involved in development activities. Moreover, these organizations can be differentiated from local government on the basis that the later operates more as local administration or public office. The three objectives of local organizations viz.: efficiency, equity and empowerment can also be optimized through the former (community organizations). The authors have offered a correlation analysis to build a relationship among performance of local organization task variables and relationship with the overall performance. These tasks were also correlated with the development outcomes. The authors suggest, on the basis of the analysis that all the correlations are in a positive direction for task analysis. Resource management is the task, which is highly correlated with other task performances on the average; conflict management comes next. Both simple correlation and multiple regression tell that internal operations are somewhat more strongly associated with local organization performance than external tasks.

Moreover, environmental and structural variables have been tested with the performance variables to find out relationship and trends through correlation and regression analysis. The social relationships are different from universally standard scientific rules as the effects of social variables are not constant and these effects can work in either direction. The actors with regard to local organization and the development projects are many and varied but there is some consensus among them and some concentration of resources so that activities do not work at cross-purposes, desired outcomes – whether the probable or the deviant ones – may be promoted. Then the next question is what structure is more appropriate?

For economic gains, few structural features are significantly associated with either agricultural or non-agricultural gains. Social benefits are not much associated with any particular structure; however, literacy and enrollment gains are correlated with multi-functionality and health improvements with economic heterogeneity. Equity effects are strongly linked with any type of structure, though better access to services results more often in all-female organizations than in all-male ones. Reduced discrimination is associated with horizontal linkage

and with less government linkage, as well as with all-female local organizations. Participation in decision-making has also got significant relationship with multi-functional, larger, vertically and horizontally linked, and government unlinked (more autonomous) organizations.

Overall picture shows that multi-functionality is generally positively associated, just as formalization is negatively associated. Government linkage is generally negatively associated with specific gains, though not clearly with efficiency gains or with redistributing assets for the poor and it is reasonable that better official ties could be helpful in these specific areas of performance. The most interesting finding is that economic homogeneity does show up as a contributing factor to improving income and service for poor. Finally, all-female composition is more favorable for equity and reduced discrimination, but not for empowerment or for economic and social benefits.

3-2-3 Role of communities in water supply schemes: Narayan's perspective

Narayan (1995) observed that beneficiary participation contributed significantly to project effectiveness (Figure 2), even after statistically controlling for the effects of seventeen other factors. Moreover, participation at all the stages of project cycle (design, implementation, construction and maintenance) was significantly greater than it was during any single stage; however, it was the single most important determinant of overall quality of implementation.

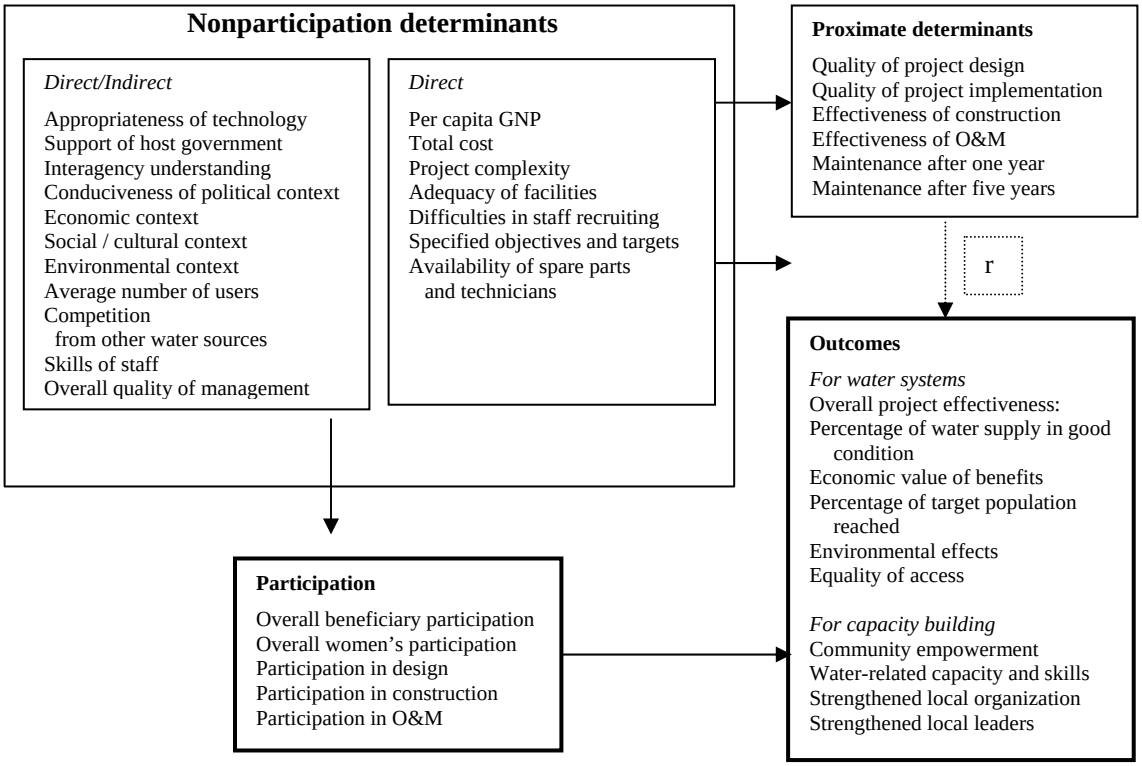
The shortfalls, analyzed by the author, suggest that high level of participation did not necessarily mean that women's participation was high and women's participation needs to be specifically targeted and resources should be diverted and ensured that these resources were invested appropriately. The other outcomes from the above model suggest that forms of effective participation varied tremendously. Agencies' control on "what, when, how, and where" is having negative effects on participation. NGOs have very positive correlation with success. Physical and technical issues had more priority than the social issues, mainly to manage physical works

Moreover, participatory process is non-linear and iterative. Participation is mainly linked with user investment in capital costs; local ownership ad control; and agency responsiveness to feedback. For water supply schemes, at beneficiary level, two factors are most important: demand-commitment before construction and degree of organization of the beneficiaries. At agency level, relative autonomy and degree of client orientation are the most important factors. Moreover, client-oriented strategies require making beneficiary participation a goal to be monitored and evaluated, and to reward the staff for achieving it.

Furthermore, using local knowledge for designing and implementing projects; and investing in building the capacity of local people including providing information to help people to make informed choices and allowing time for communities to organize themselves. The main hindrances, addressed by the author are: unwillingness to give up control over implementation details; a lack of incentives for staff to support client orientation through new institutional arrangements; and unwillingness to invest resources for building the community capacity or social organization to manage physical infrastructure

Finally, the sector policies, project design, and implementation strategies must be changed fundamentally in water supply and sanitation programs in the smaller communities. Moreover, a shift from centralized ownership of systems to local ownership and control. Above all, instead of being supply-oriented, the projects must become demand-responsive and participatory.

Figure 2
Impact of participation and nonparticipation determinants on the project outcomes



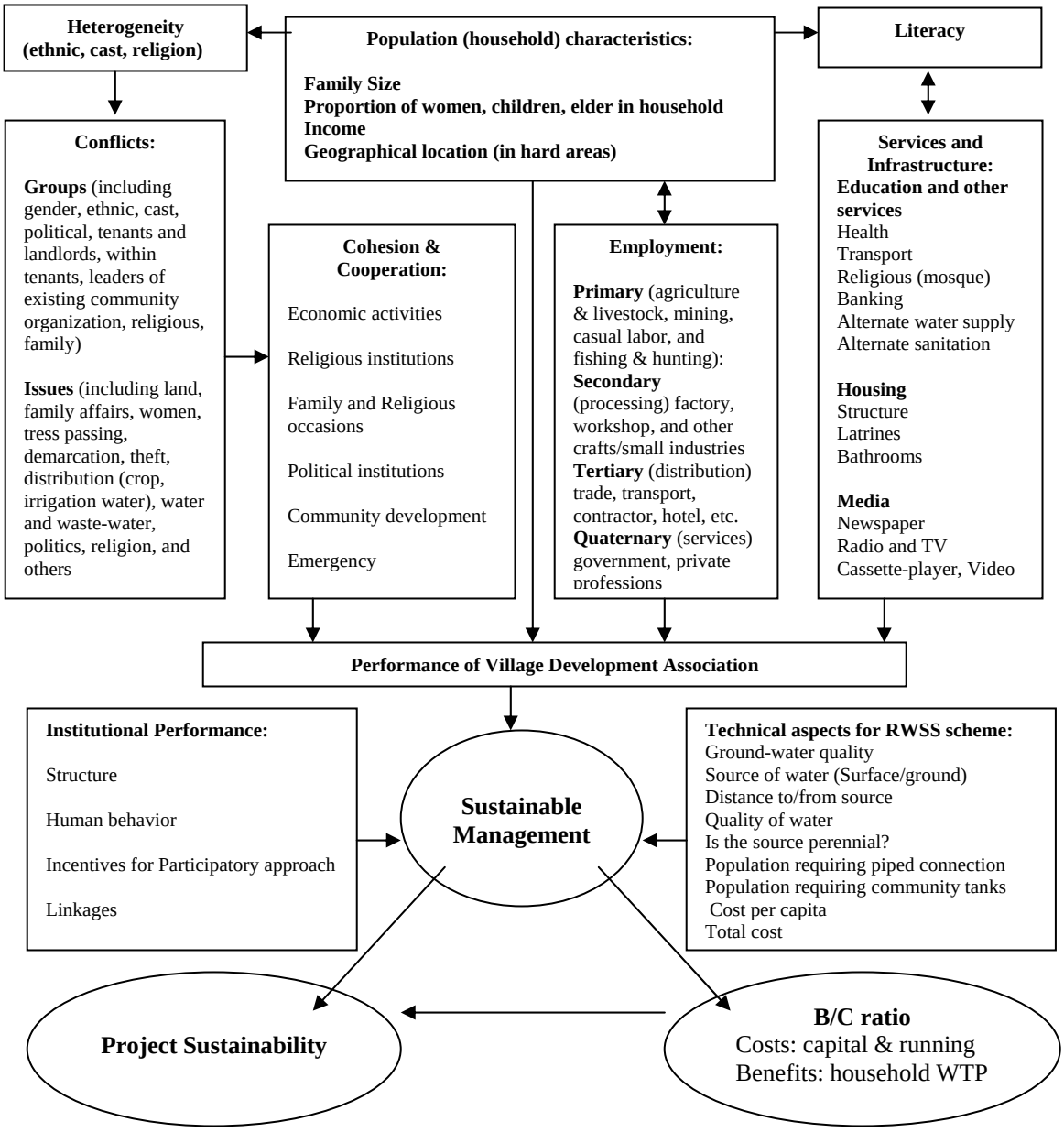
Source: Narayan (1995)

3-2-4 Project sustainability model

The overall project sustainability depends on the project management and as well as on the economic appraisal. From community participation point of view, the community organization should be responsible for that. This organization may have any name like development association, community organization, community based organization (CBO), and so on. The performance of those associations depends on the various socioeconomic characteristics and its democratic setup. The sustainable management of any infrastructure project including water supply depends on the three aspects, viz.: performance of VDA, institutional performance by the relevant public sector, and the technical aspects.

The economic appraisal could be done on any of the required principles of cost-benefit analysis (CBA). However, benefit-cost (B/C) ratio might be the most appropriate in this situation, when there are no competing projects to supply water. Thus, if B/C is more than one or equal to one, the project could be socially viable. The overall model for project sustainability is shown in Figure 3.

Figure 3
Sustainable management model for community water supply



3-2-5 Economic benefits of water supply

Various studies have been done across the Globe to evaluate the benefits of safe drinking water. However, most of the studies differ in focus point and as well as in evaluation methodology. Prior to discussing about the case study and our methodology, it would be helpful to have a broader picture of different approaches, as shown in Table 2.

Table 2
Literature review on benefits of RWS

	Authors	Objective	Study Area	Method	Outcome
1	Harrington, W., Krupnick, A.J., and Spofford, W.O. Jr. (1989)	Economic losses due to outbreak of waterborne disease (Giardiasis)	Pennsylvania (USA)	RP	**Morbidity loses**: US$858-1255 per case **Defensive measure:** US$1.13-3.59 per person per day *Total:* US$16.7-45.5 million
2	Mu, X., Whittington, D., Briscoe, J. (1990)	Village water demand behavior	Ukunda (Kenya)	RP	**10% reduction in collection time for kiosks would change the probabilities:** vendors 0.33 to 0.26 Well 0.09 to 0.09 Kiosks 0.58 to 0.65
3	Whittington, D., Okorafor, A., Okore, A., and McPhail, A. (1990)	Cost recovery / water fee	Nsukka district (Nigeria)	RP & SP	**Edem village:** 57% responses (WTP) < N20/m 67% people were paying N25/m to vendors in dry season **Ekwegbe village:** 2% people can pay up to N40/m 40% people were paying N50/m to vendors in dry season
4	Brisco, J., de Castro, P.F., Griffin, C., North, J., and Olsen, O. (1990)	Water demand by using CVM	Brazil (3 rural areas)	SP	**Connection probabilities:** 15% high if income doubles to US$320 68% down if the fee doubles to US$7 3% high if distance to source is 100 meter
5	Whittington, D. (1992)	Effects of block water fee (tariff)	Kumasi (Ghana)	RP	0.25-0.29 cedis/gallon for relatively well off people. 0.32-0.36 cedis/gallon for relatively poor
6	Altaf, M.A., Whittington, D., Jamal, H., Smith, V.K. (1993)	Water supply policy	Punjab (Pakistan)	SP	**Brackish water zone:** Mean WTP 40 rupee/month 80% WTP 25 rupee/month 80% WTP 35 rupee/month for improved & reliable service
7	Lovei, L. and Whittington, D. (1993)	Behavior of multiple agents in water supply	Jakarta (Indonesia)	RP	Net revenue maximization at 3 taps per 1000 households
8	Griffin, C.C., Briscoe, J., Singh, B., Ramasubban, R. and Bhatia, R. (1995)	Contingent valuation and actual behavior for predicting water supply connections	Kerala (India)	SP & RP	**Behavior modeling (Probit):** 56.5% would not connect (who shown willingness). 12.5% would connect (who did not show willingness)
9	Choe, K., Whittington, D. and Lauria, D.T. (1996)	Economic benefits of surface water quality	Davo (Philippines)	SP & RP	**CVM (use value):** 37,30 peso/month (OLS, Tobit) before health advice, 40, 51 peso/month (OLS, Tobit) after health advice **CVM (non use values):** 26,1 pesos/month & 20, 33 pesos/month **TCM (use value only):**

					36, 51 peso/month (OLS, Tobit)
10	Asthana, A.N. (1997)	Household choice for water supply systems	Bhopal (India)	RP	Mean values are less than the existing fee. Min. values are negative and max. values are mostly above the existing fee.
11	Altaf, M.A., Jamal, H., Liu, J.L., Smith, V.K., and Whittington, D. (1997)	Private benefits from public water system	Punjab (Pakistan)	RP & SP	**Sweet water zone:** 100% WTP at 20 times reduction in the fee against only 10% WTP at 8 times reduction. Brackish water zone
12	Crutchfield, S.R., Cooper, J.C. and Hellerstein, D. (1997)	Benefits of safer drinking water	USA (four regions)	SP	US$45 – US$60 for nitrate- reduction. US$0.09 –US$9.95 difference in WTP for safer and nitrate-free water
13	Larson, B.A. and Gnedenko, E. (1998)	Avoiding Health risks from drinking water	Moscow	SP	**Logit model:** Medium Income coefficient is –0.09, 0.71, 1.44, -0.05 and high income coefficient is –0.17, 0.92, 1.66, -0.94 for settle, filter, mineral, and boil water respectively. **Avoidance measures:** 33% settled, 88% boiled, 23% filter, and 13% bottled.
14	Burtraw, D. and Krupnik, A. (1999)	Value of health from great lakes cleanup	USA	RP	**Damages from Mercury:** COI X 2 = WTP US$289,000 per case **Cancer:** COI X 1.5 = WTP US$204,000 **Mortality effects:** US$70,000-US$130,000
15	Rosen, S. and Vincent, J.R. (1999)	Productivity and rural water supply	Sub-Saharan Africa	RP	**Savings in time (person-years per year):** Collection time: 1,271,3351 Care for sick child: 53,462 Adult sickness time: 84,738
16	Hagihara, K., Asahi, C. and Hagihara, Y. (2000)	Environmental risks and use of municipal water	Ohtsu city (Japan)	SP	**Consumption patterns before and after information on health risks:** Tap: 38.7%, 11.6% Boiled: 59.0%, 50.4% Mineral: 31.3%, 65.6% Purifiers: 29.2%, 63.2%

4 Case Study

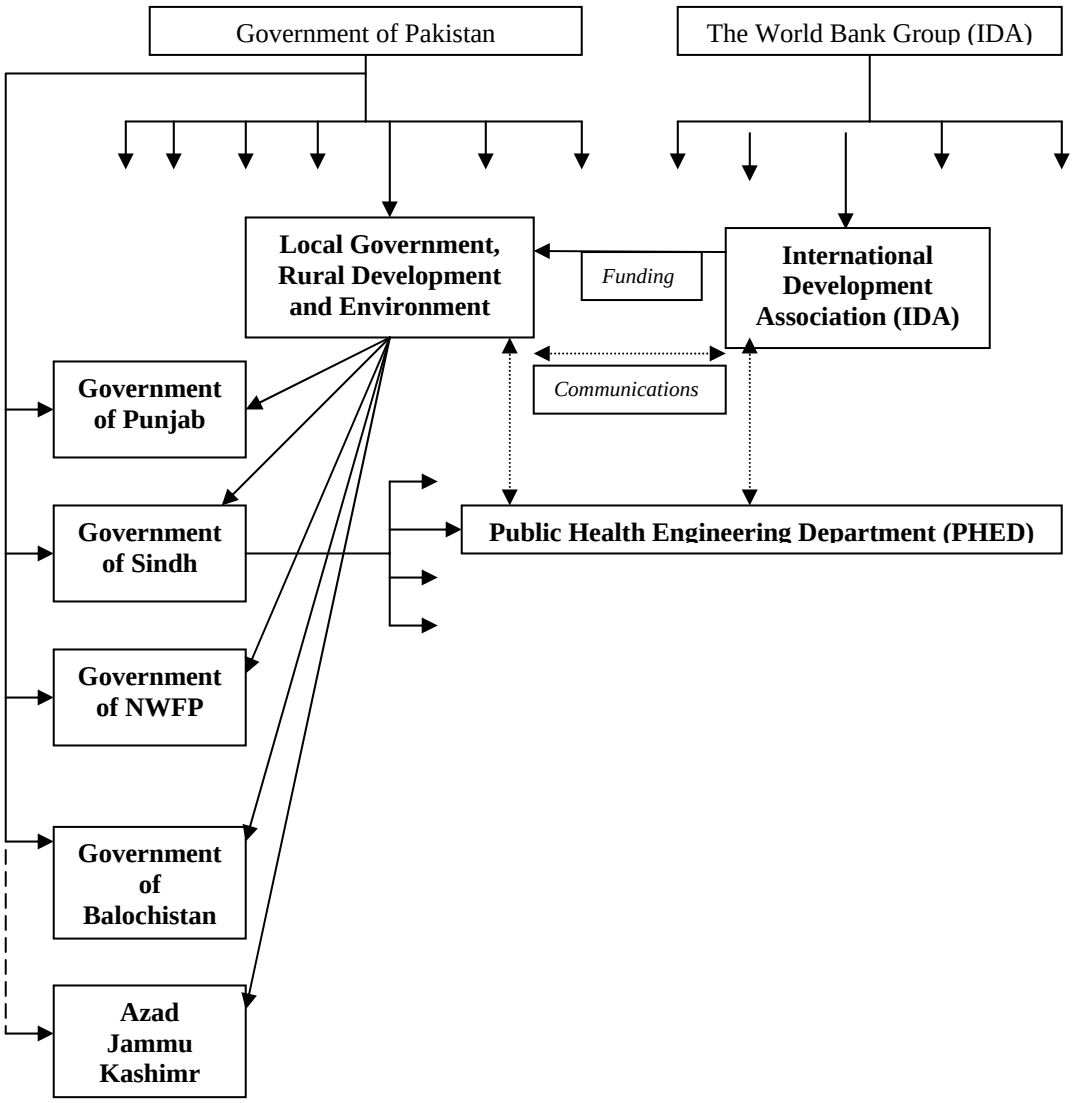
Multilateral and bilateral development agencies have been pursuing the goal to promote the primary stakeholders (communities) to take an effective role in project cycle. Therefore, when the water supply and sanitation project was agreed between Islamic Republic of Pakistan and International Development Association (IDA) in 1991, a development credit agreement was signed to achieve the following objectives:

(1) To improve the health and productivity of the population, particularly women and children, thereby reducing poverty and deprivation from the project areas; and, to this end;
(2) To increase the coverage and service levels of water supply and sanitation facilities in those areas;
(3) To strengthen the implementation and coordination capacity of the institutions involved in the water supply and sanitation sector; and

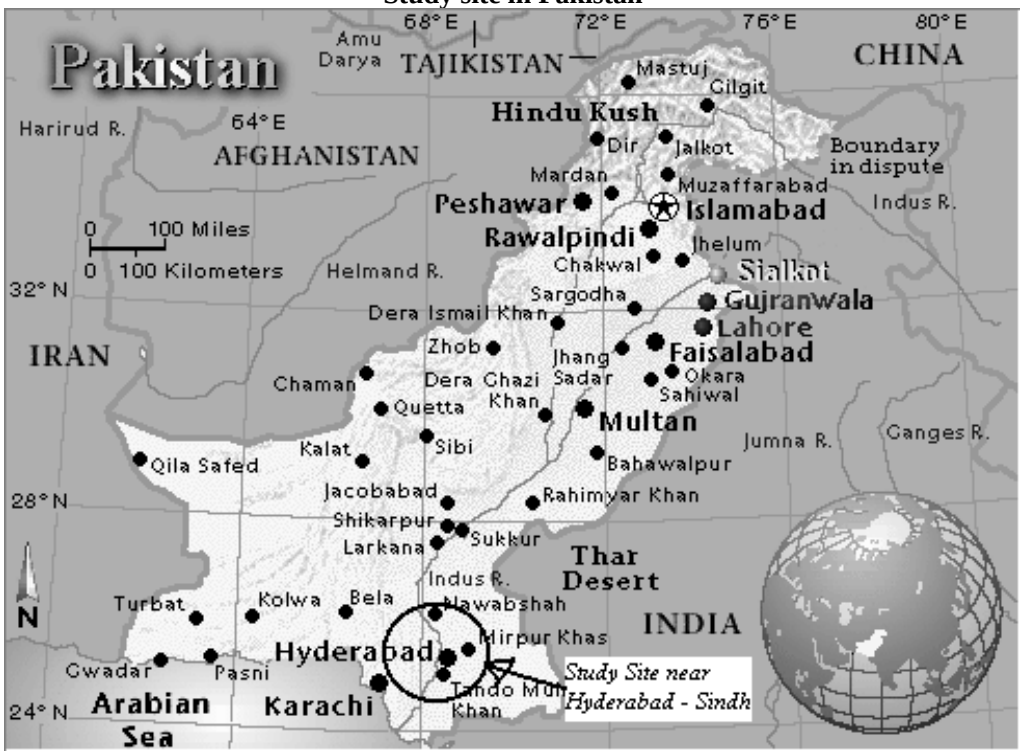
(4) To assist in the implementation of sustainable and financially viable policy under which responsibility for the operation and maintenance of the water supply and sanitation facilities would pass on from government agencies to the communities who will be the main beneficiaries from such facilities.

Project funding and communication chart (Figure 4) shows that ministry of local government, rural development and environment was involved at the central government level to create a channel for the flow of funds to all the provincial governments and Azad Jammu Kashmir (AJK). The smaller communities in Pakistan and AJK are the beneficiaries. Our case study is based on Sindh province having Sindh water supply and sanitation project. Map 1, 2, and 3 show Pakistan, Sindh province and 5 selected sample communities for data collection.

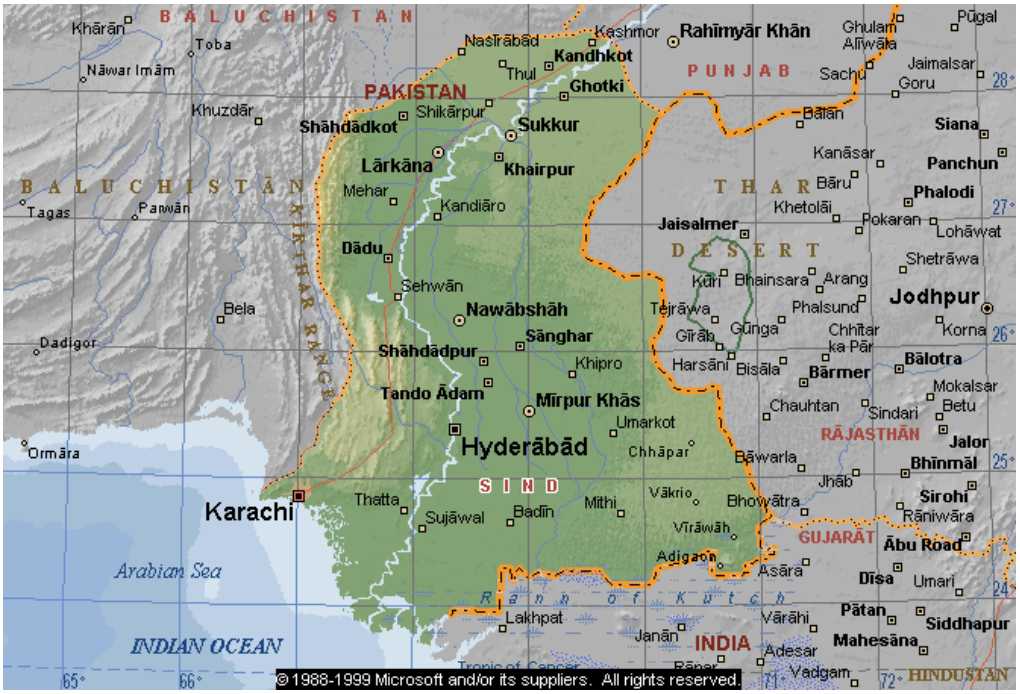
Figure 4
Project Funding and Communications Chart for
Water Supply and Sanitation Project (IDA assisted) in Pakistan



Map 1
Study site in Pakistan



Map 2
Sindh province in Pakistan



Map 3
Selected communities for carrying out survey

4-1 Sindh water supply and sanitation project

Sindh province (Map 2) is the southern and second biggest province in Pakistan. The underground water is sweet in some of the zones near Indus river, while most of other underground aquifers are either brackish or having very deep water table. Population of Sindh is about 30 million out of Pakistan's total population of 135 million, and more than half of its population is still living in smaller communities. The project component for Sindh province (SRWSSP) had to cover 300 new mechanized water supply schemes, 100 new mechanized drainage schemes, and 480 rehabilitation of mechanized water supply and drainage schemes.

As mentioned, under this project, communities had to be involved from planning to implementation and then they have to operate and maintain schemes by themselves. However, these communities had required to go through a standard community development and participation process, which includes formation of community organization and women organization with democratic norms and having representation from all classes of the community. They had to meet quite often and keep record of all the meetings and actions. They had to go through health and hygiene training to maximize the environmental effects. Then they had to collect regular fees from each household for maintenance and operation of the schemes.

4-2 Selection of sample communities

Five communities were selected from two districts of Sindh province (Map 3). Hyderabad district is the headquarters for SRWSSP; thus, the schemes were started in this district earlier than rest of province. Dadu district is quite a huge district in terms of area, but one part of it (Kotri sub-division) is near to Hyderabad. The schemes in those areas have already been completed for over couple of years. Therefore, health benefits have been comparatively sustained over those few years. The selection of these communities from all the communities within the same district is based on the discussions with project implementation teams. Their general point of view for those communities was that there are some household characteristics, which may differ from one community to another community.

Three communities have been selected from Hyderabad. Vidh was supposed to be most problematic area as no canal or well water was available within easy access. The households had to fetch water from one pond, which was very polluted and sometimes animals also used to swim in that pond. The water supply scheme is based on canal water, which is located quite far from the community and where from water is being supplied by double pumping. Khair Mohammad Jawar has got relatively better ground water and their scheme is also a ground water scheme, where tube well is under operation. Umer sand is near to a watercourse and people used to take water from there.

However, quality of water was not satisfactory and some people used to buy water from vendors. In Dadu district one community Bhutto is near to Indus river, where from people used to get water. In the other community, Abdullah Khaskhelli, people used to get water from old wells. Population ranges from 840 in Abdullah Khaskhelli to 1452 in Khair Mohammad Jarwar with an average population of 1172. All of these communities enjoy electricity connections and also have at least one primary school.

The water supply has been designed on the WHO standards to provide at least 20 gallons per capita per day. The design population was taken for 12 years with an increase of 3% per year. A monthly water fee is fixed by VDA and they can ask for increased fee in case if there are higher expenditures. In most of the communities, the monthly fee is ranging between 30 to 50 rupees per household (One rupee equals to two yen or US$0.018). Though there are some exceptions of far below charges especially in sweet water zone as is in the case of Khair Mohammad Jarwar community, where the fee is 15 rupees per household. The government provided the capital costs from IDA funding. The range for investment costs were fixed from 4000 rupees per capita for the communities with less than 1000 people to 2000 rupees per capita for communities with over 3000 people.

4-3 Data collection

The data, used for this study, is based on secondary and as well as on primary sources. The project reports were reviewed at the head office and divisional offices of public health engineering department (PHED). The reports for individual schemes mention about socioeconomic, health, community participation, and technical aspects were also analyzed. After careful analysis of all those materials, five communities were selected and field visits were planned with the help of a team of four persons, who were actively engaged with this project since early 1990s.

Three visits were made to each community. On the first visit an overall observation was made to learn about various activities and socioeconomic behavior of the communities. Various uses of the water and its probable impact on the health were also observed with an expert opinion from a team member who is a doctor and engaged as senior health and hygiene educator with this project. The second and third visits were scheduled to interview the households and acquire the direct data about their perception on health impact as the change in water related sickness (diarrhea, typhoid, malaria, and skin diseases) episodes during the last whole year in comparison to the year before water supply scheme was operational. The households were also inquired about their household characteristics and finally they were asked if the water fees has to be raised by the community organization, whether they will be willing to contribute accordingly. This WTP questionnaire was based on iterative bidding game under contingent valuation method.

The data were collected during June 2000, when due to mango season the labor activity was intensive in that area. The households were selected at random, but on the first day during the general observation visit, it was kept in view to select the houses with the housing conditions to rationally distribute households according to their outlook for housing conditions. All the households were told about the spirit and intentions for conducting this field research. They were briefed about what data is required to make this study worth taking and they were told that they can refuse to answer any or all of the questions, if they feel like that.

4-3-1 Socioeconomic characteristics and health benefits

The socioeconomic characteristics and health benefits were collected through direct interview from the 30 households in each community. There was no significant deviation among the sample and population statistics, when we compared sample with population statistics. The data covers three aspects viz. household characteristics, health benefits, and willingness to pay. Detailed interviews were conducted with household leaders, who are men. Health impact was also discussed with the women by including one lady

sociologist and a health and hygiene educator. However, full length interviews, including their illicit response for the WTP was avoided. This was mainly due to two reasons. First, it is not a culture to make a direct interview of women by a male interviewer. Second, women still leaves the financial decisions on their men, though they express their concerns with them, and that can be reflected into the results.

Household characteristics were relatively straightforward except for income. This may have seasonal impacts, mainly on labor requirements. The details were gathered for one year's overall income patterns to calculate average monthly income. For lost income with no substitution family labor, if there were considerable losses during sickness. Only in the jobs like carpenters, electricians, plumbers, and daily wages factory workers substitution is either not available or the substitution labor income does not go to the same household; thus, the lost income becomes a factor.

Most of the air pollution related health impacts have been calculated based on the epidemiological data (Ostro and Chestnut 1998). However, there could be two dangers if this is adopted for the smaller communities in the developing countries. First one is the reliability and availability of the data. Most of the people try various mitigation methods and do not visit the hospitals, which are located in bigger or more urbanized communities. The basic health units do not record the nature of disease in most cases and number of the patients can only suggest that during any particular season the particular disease is on the increase or decrease.

Moreover, even if the number of patients for particular water related diseases (let us say diarrhea) could be ascertained, then still it is difficult to relate it with water supply intervention only. Esrey et al. (1990) reviewed the studies measuring the impact of water supply for reducing water-related sickness episodes, and observed various levels of achievements for different projects and locations.

The second danger is that the analysis of this data could be misleading depending on various assumptions and analytical tools and variables. Cairncross (1996) observes, "Epidemiological data suggesting the change in various water related health impacts could be misleading, depending on the scope, nature, seasonality, and other socioeconomic characteristics." Keeping those factors in view, we adopted the direct interviews on the same pattern as adopted by Alberini et al. (1996). Households' point of view is vital to be linked with their WTP as they perceive health risks differently from the scientists or medical experts. Ravenswaay and Wohl (1995) suggest that their interpretation of the risks, they feel, often diverges significantly for that of scientists and two approaches may yield different policy designs; nonetheless, it is important to consider how consumers weigh the costs and benefits.

After discussions with local doctors and households, we selected three major disease types viz. diarrhea, malaria, and skin disease. A detailed discussion with each household leader helped to draw an ex-ante and ex-post scenario for one year, to cover all the seasonal effects. Then monthly average was taken to standardized the variable. All those disease were given equal weight, as the medical expenditures for each episode were normally uniform.

Before collecting primary data, a detailed examination of secondary data was done in collaboration with the project teams and community leaders. Project reports, health and hygiene and socioeconomic studies, technical studies, and records of community organizations were reviewed to finalize the selection of the communities. However, a wide range of primary data was gathered for the variables, discussed in the model. The data were analyzed and the results for the full and reduced models are presented here.

4-3-2 CV survey

We incorporated CV questionnaire in the participatory survey to get the reliable information from the households. Three main biases under contingent valuation method (CVM) were tried to avoid. First one is information bias through initial statement and subsequent discussions. The second bias is sampling by taking representative random households. The third bias is strategic bias by making them to understand the nature of academic survey, which will not affect them strategically, as they already enjoy water supply. We have followed the mainstream guidelines, for conducting a credible survey, as shown in Table 3.

Table 3
Adoptability of various guidelines to implement contingent valuation (CV) survey

NOAA guidelines (quoted in Griffin et al. 1995)	*Procedures adopted for implementing CVM in the case study of Hyderabad,l Sindh (Pakistan)*
1. Interview in person rather than on the telephone	In-person and detailed interviews
2. Future rather than historical event	Change in water fee in the future
3. Referendum format (as opposed to open-ended)	Bidding game
4. Start with describing accurate scenario	Introductory statement and also detailed semi-structured interview before starting CV survey
5. Reminder for an effect of WTP on consumption	Yes, reminding of impact on their spending pattern
6. Reminder for substitutes	Discussing alternatives for avoiding/curing diseases
7. Follow-up questions /debriefing questions	Informal discussion at the end of interview
CV: A User's Guide (Carson 1999)	
1. An introductory section to set general context	Yes (same as NOAA)
2. A detailed description of good to be offered	Yes, water quality and quantity will be improved
3. The institutional setting for providing good	Yes, through community organization
4. The manner in which good will be paid for	House connections
5. A survey method (open-ended is less in priority)	Bidding game (same as NOAA)
6. Debriefing questions to know the reliability	Yes (same as NOAA)
7. Relevant characteristics (demographic, attitudes)	Yes, household characteristics and water use pattern
8. Focus groups: outputs – language – pilot studies	Water supply – Sindhi & Urdu – one pilot study
9. Population sample for public good	Proportionate sample to cover whole community
10. Data: bigger sample for continuous variable	30% to 40% of whole community was covered
11. Mode of Survey: In-person survey (NOAA)	In-person (same as NOAA)
12. Non-respondents: Treatment	Not applicable
13. Professional Interviewers	Professionals team (sociologist, economist, doctor, and engineer)
14. Payment vehicles: one time vs. utility bills	Continuous payment through water fee
15. WTA questions: hard to make these understood	WTP questionnaire only
16. WTP (function): plausible variable coefficients	Most of results are plausible
17. Outliers: protest zeros or few high values (open-ended) and spike in distribution at zero (discrete)	No protest zeros or high values and income/affordability problem
18. Distribution of per capita economic values:	
Guidelines for WTP studies (WASH 1988)	
1. Household characteristics	Yes (same as Carson 1999)
2. Avoiding biases	Precautions for strategic, Information, and Sampling biases
3. Bidding game: Turning from upward to downward slope then take mid point ($1.0 Y and $1.5 N, then WTP is $1.25)	
4. Team building to cover major aspects	Yes, (Same as Carson 1999)
CV surveys in developing countries (Whittington 1998)	
1. Explaining what a contingent study is all about	Prior to formal CV questionnaire, during participatory survey, they understood the nature, process, and type of answer required
2. Interpreting responses to contingent valuation questions	Debriefing session (same as NOAA guidelines and Carson 1999)
3. Setting referendum prices (90-95% rejection for highest price)	Though our study is based on iterative bidding, but the highest bid was only proposed by hardly 10% respondents. The range between minimum and maximum bid is also quite wide
4. Constructing joint public-private CV scenarios	Community organizations are prime stakeholders and they also

	operate and maintain the water supply system. This aspect is also covered in the participatory survey
5. Ethical problems in conducting contingent valuation surveys	
(a) When is the use of a referendum elicitation procedure unethical	There was no split type survey in the same community and the confidence building was done during participatory survey.
(b) How honest should one be about the institutional regime contemplated for delivering the "hypothetical" goods or services	As mentioned, VDA is the main actor for delivering the good. After sustainable delivery of the good, and democratic setup of VDA, the respondents were having confidence that the WTP values are only required to know, whether delivery of the good can sustain over time within the same setup

Arrow et al. (1993) is the comprehensive attempt, by the renowned professionals' panel with two Noble Laureates under National Oceanographic Atmospheric Agency (NOAA), to provide guidelines to judge credibility of a CV survey. Carson (1999) further clarifies the good practice and asks for a caution to be taken while implementing NOAA guidelines.

For the developing countries, Whittington (1998) highlights some of the very important issues including difference between willingness to pay and willingness to accept, appropriate CV design, cultural taboos like saying "no" as impolite gesture, limits for referendum prices to match the local economic conditions, constructing a Joint-Private CV scenarios, and ethical issues for a CV survey .

Household WTP was assessed through adopting bidding game under contingent valuation method (CVM). This method has been well recognized by the economists in this area (WASH 1988, Griffin et al. 1995, and Choe et al. 1996). This was in continuation of the previous two parts of the overall survey targeted to collect socio-economic characteristics, and the water-related health impacts. Hence, household leaders had a full picture of water-related health benefits and their relationship with the household characteristics.

5 Hypothesis for economic valuation

5-1 Background

Improvements in any of the environmental media can bring health benefits in terms of reduced sick episodes. These health benefits affect individuals at different level, depending on the population and risk characteristics (Hammitt 2000[a]). Health risks are different for air pollution, water supply, and soil pollution. These could be assessed through a dose-response function (Pearce and Cowards 1996). Population characteristics are mainly considered as age, income, health status, and education.

However, other population characteristics can be added depending on the scope of the analysis. The impact of these characteristics over the willingness to pay (WTP) for an environmental good varies from one location to another. Hence, the values from study site to the policy site, under the benefit transfer, are being adjusted accordingly (Ostro and Chestnut 1998). This variation depends on the socioeconomic and demographic conditions at the each location. Hence, WTP values for environmental improvements to reduce health impacts are different in the developed countries than those in the developing countries (Chestnut et al. 1998).

This phenomenon may also be applicable to distinguish the WTP in smaller and larger communities of the developing countries, where the gaps in socioeconomic conditions are wide. The population characteristics in the smaller communities, of developing countries like Pakistan are quite different from those of the characteristics in the developed countries. An analysis of those characteristics can lead to understand their behavior on the WTP values in these areas.

The socioeconomic characteristics are dynamic in nature, as these are still long way from the saturation levels in the local communities. The results of the previous studies may become invalid or week after a few years. This is mainly due to changes in project designs, which are aimed to improve socioeconomic indicators including the role of women and children. Furthermore, literacy, which have been doubled in the countries like Pakistan over the last ten years have made an influence over the behavior of other characteristics also.

Population characteristics are generally taken as individual characteristics in the developed countries (Ostro 1983, Crutchfield et al. 1997, and Hammitt 2000[a]). However, in these communities household characteristics are analyzed to assess their impact over the health benefits and the WTP (Alberini et al. 1996, and Altaf et al. 1997). Household unit is a strong institution than an individual in the smaller communities. Moreover, the environmental media like drinking water supply has a joint effect and the people pay for these services on the household basis rather than on the individual basis. This is also evident from the socioeconomic behavior of the households in water supply schemes (Narayan 1995).

WTP is an important tool to support policy and project planning. WTP is also being widely researched by the environmental economists. Therefore, we assess the influence of the household characteristics over the WTP, in terms of health benefits of water supply and sanitaiton. The results will help to assess the benefits of water supply in various regions and policy can be modified to accelerate the pace of water coverage. To achieve these objectives, we discuss about the overall WTP model for the water supply and sanitation in the next section.

5-2 The WTP model for water supply

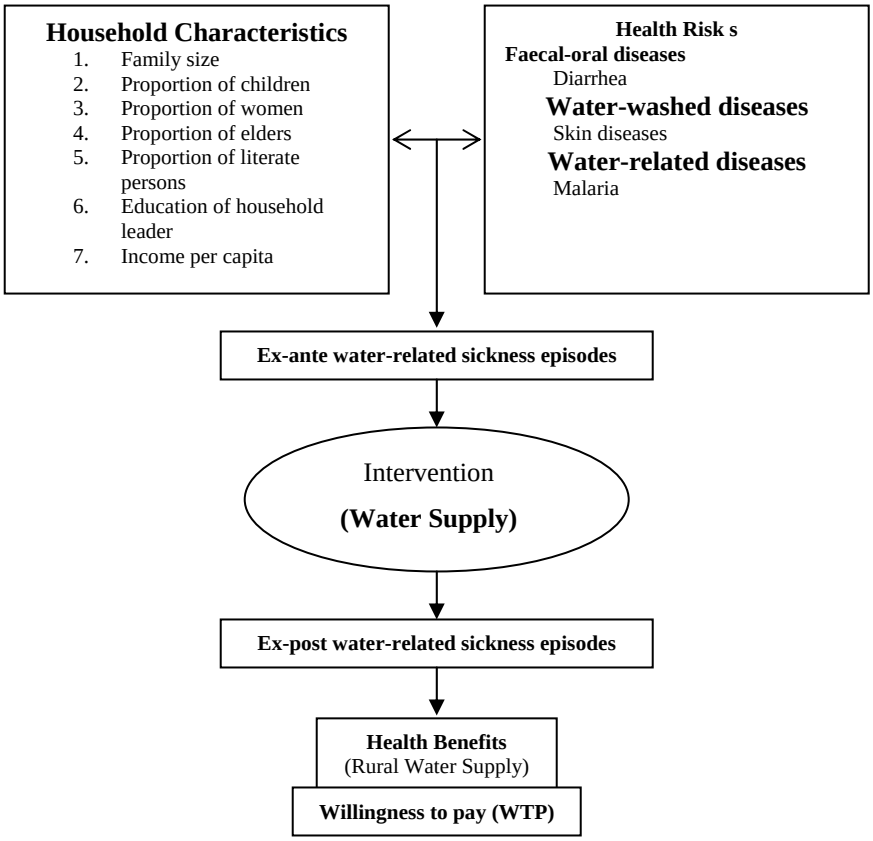
The WTP model for this study follows the mainstream research model, where the WTP is based on the environmental health benefits. The variation in the individual WTP values, estimated through either stated preference (SP) or revealed preference (RP), depend on the interaction between population characteristics and the health risks (Hammitt 2000 [a]). This model is shown in Figure 5.

Here, interaction between water-related health risks and household characteristics generate the water-related health impact for each household. This health impact is measured in terms of sick episodes for the water-related diseases. Health benefits of the water supply are estimated as the difference in sick episodes between ex-ante and ex-post scenario. These health benefits for each household are related with the WTP values. Assuming local water-related health risks as uniform for all the households, the WTP is related with the health benefits.

Health impacts have a close relationship with the household characteristics, as children are the worst victims of water related health sickness. Women have to take care of those children; therefore, women also benefit with the reduced sickness. Households with higher income can spend on the costly mitigation activities, like visiting doctor instead of getting local treatment; hence, their WTP could be higher to avoid the sickness. Similarly, the literacy plays a positive role to avoid the sickness.

This hypothesis is based on the general perception of the daily life in smaller communities, where cash is very limited and people have fewer possibilities to generate cash. This is also evident from the lost labor, which may not be a significant factor, as family or marginal labor provides the substitution, if some is sick or not going on the work due any reason. Therefore, the major immediate economic gain will be in terms of savings on health costs. Though savings in time for fetching water, had been a significant issue for researchers, but this does not provide the substantial cash for households, which can be diverted to pay for water supply.

Figure 5
Relationship among household characteristics, health benefits, and the WTP for RWS



5-3 Water-related health risks

Air pollution related health risks follow a dose-response function (Pearce 1996). However, water is comparatively a different environmental media and requires different analytical framework. First of all water-born diseases have multiple transmission routes (Cairncross 1996) and water supply intervention can get different results in different situations for the same health risks (Esrey et al. 1990). The second important difference relates with the impact of quantity and quality of water over the human health. Water-related health risks are either related with quantity or quality of water. Most of the diseases, including diarrhea, in the developing countries can be reduced with the improved access or coverage to the drinking water (Cairncross 1996).

Water-related health risks can be categorized under Bradely-Feachem classification system (Quoted by Rosen and Vincent 1999) and shown in Table 4. The incidence and prevalence of these diseases vary from region to region. The national and regional data sources can lead to identify to specific water-related health risks in a particular region. However, diarrhea and malaria are the most common water-related diseases around the Globe (Table 5). Skin diseases in various forms are also a major risk, which can be avoided with improved water quality and quantity. Hence, these three health risks have been selected for the case study area in Pakistan. These health risks can be assumed as uniform within the study area, as all the smaller communities are exposed to almost similar type of challenges.

Table 4
Water-related health impacts

Faecal-oral (waterborne or water-washed) (waterborne: caused by drinking water water-washed/scarce: caused by transmission from other persons and skin or eye contact with water)	*Low infective dose:* cholera, typhoid *High infective dose:* diarrhoeal diseases, amoebic and bacillary dysentery, ascariasis, gastroenteritis, infectious hepatitis, paratyphoid, enteroviruses (some), hookworm
Water-washed diseases (caused by poor personal hygiene and skin or eye contact with contaminated water)	*Skin and eye infections:* scabies, trachoma and flea, lice and tick-born diseases, skin sepsis and ulcers, conjunctivitis, leprosy, yaws *Other:* insect and arachnid-borne typhus
Water-based diseases (caused by parasites found in intermediate organisms living in water)	*Penetrating skin:* Schistosomiasis and other helminthes *Ingested:* dracunculliasis
Water-related diseases (caused by insect vectors which breed in water or bite near water)	*Breeding in water:* dengue, filariasis, malaria, onchocerciasis and yellow fever *Biting near water:* trypanosomiasis (sleeping sickness)

Source: adopted from Rosen and Vincent (1999)

Table 5
Estimates of morbidity and mortality of water-related diseases

Disease	Morbidity (Episodes/year, Or as stated)	Mortality (Deaths/year)	Relationship of Disease to Water Supply and Sanitation
Diarrhoeal Diseases	1,000,000,000	3,300,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Infection with intestinal helminthes	[1]1,500,000,000	100,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene
Schistosomiasis	[1]200,000,000	200,000	Strongly related to unsanitary excreta disposal and absence of nearby sources of safe water
Dracunculiasis	100,000	-	Strongly related to unsafe drinking water
Trachoma	[3]150,000,000	-	Strongly related to lack of face washing, often due to absence of nearby sources of safe water
Malaria	400,000,000	1,500,000	Related to poor water management, water storage, operation of water points and drainage
Dengue Fever	1,750,000	20,000	Related to poor solid wastes management, water storage, operation of water points and drainage
Poliomyelitis	114,000	-	Related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Trypanosomiasis	275,000	130,000	Related to the absence of nearby sources of safe water
Bancroftian filariasis	[1]72,800,000	-	Related to poor water management, water storage, operation of water points and drainage
Onchocerciasis	[1,4]17,700,000	[5]40,000	Related to poor water management in large-scale projects

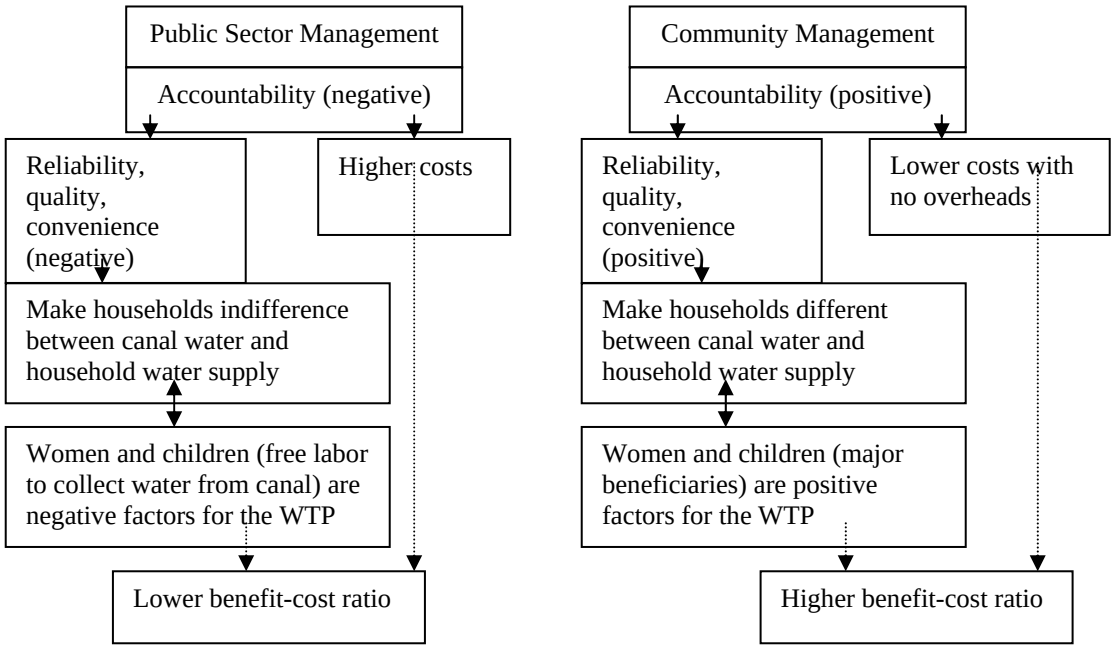
Notes: [1] People currently infected[2] Excluding Sudan [3] Case of the active disease. Approximately 5,900,000 cases of blindness or severe complications of Trachoma occur annually [4] Includes an estimated 270,000 blind [5] Mortality caused by blindness
Source: WHO data (http://www.who.int/inf-fs/en/fact112.html)

5-4 Identifying major household characteristics

These water-related health risks interact with the various household characteristics to generate the health impact. First of all, family structure is an important characteristic to be linked with the incidence of sick episodes. The total number of household members or family size can be directly proportional to the number of sick episodes, under the uniform health risks. Furthermore, children are the worst victims of the major water-related health diseases including diarrhea (WHO 1996). Thus, households with bigger proportion of children are more prone to get higher incidence of the sickness in the absence of proper water supply. This makes a major impact on the women, who are mainly responsible for home making activities including taking care of sick children (Rosen and Vincent 1999). The reduced number of the sick episodes will relieve children from the sickness and the women from taking care of sick children.

The second aspect of household characteristics is linked with the education and literacy. The hygienic behavior is very vital to optimize the health benefits of water supply and this behavior is linked with education or knowledge about health and hygiene (Alberini 1996). Furthermore, unlike air pollution's unilateral behavior, water has a bilateral behavior (Larson and Ekaterina 1998). Hence, water related problems could be treated at both, production and as well as at consumption points. This consumption point treatment heavily relies on the averting behavior. Here, income is the important aspect for the averting behavior (Lauria et al. 1999). The water contamination can be avoided with better water storage facilities, and appropriate dishes for drinking water and cooking the food with that water. With varying family sizes in these areas, it would be appropriate to take per capita income.

Figure 1.3
Cause and effect of two policy options for costs and benefits



Source: Conceptual model.

5-5 Relationship between the health benefits and the WTP

Willingness to pay should be linked with all the major health benefits of the water supply. Water-related health benefits help to reduce health impact for various diseases (Rosen and Vincent 1999). Some of the cost effective analysis studies in health economics focus water supply as an intervention for a particular disease against the other interventions including immunization, ORT, promotion of personal behavior regarding breastfeeding and hygiene. These comparative studies assess the economic efficiency of various

interventions to reduce the health risks (Marines et al. 1993). However, this comparison may not produce logical results. On the first place water supply affects a combination of health risks and not the one risk at a time. On the other place, water supply supports other interventions to achieve sustainable results. Therefore, environmental economists argue that water related interventions have been established as a primary tool and starting point to control the disease (Hamer et al. 1998).

Health benefits, the reduced number of the sick episodes, will increase the savings in health expenditures for each household. These savings will improve household utility function, and this improvement under Hicksian compensate variation can be related with household WTP for water supply. Based on Freeman (1993) general model, if utility 'U' is a utility function, 'X' is other goods, and 'H' is health, which is again a function of water related sickness 'y' due to water 'q', then:

$$U = U[X, H(y,q)] \quad \textbf{(1)}$$

Let X is constant at 1 then the change in marginal utility (δU) with a marginal change in other goods (δX) will be taken as λ. The change in marginal utility (δU) with a marginal change in health (δH), as result of marginal change in water related sickness (δy), will be taken as Lagrangean coefficient λ, multiplied by price incurred on water related sickness '*py*':

$$\frac{\partial U}{\partial X} = \lambda \quad and \quad \frac{\partial U}{\partial H}.\frac{\partial H}{\partial y} = \lambda py \quad \textbf{(2)}$$

If 'I' is household income and 'X' is taken as 1, then indirect utility function could be written as:

$$V = V[I, H(y,p,q), 1] \quad \textbf{(3)}$$

From indirect utility function, willingness to pay (w_q) for water will be equal to the decrease in income due to water (q) fee, as this reduction in income is due to the water related diseases which are due to the existing level of water (q). Therefore, WTP (w_q) will be equal to the marginal change in direct utility with a marginal change in health status as a result of water, and divided by 'λ' as shown:

$$w_q = -\frac{dI}{dq} = \frac{\partial V / \partial q}{\lambda} = \frac{\frac{\partial U}{\partial H}\frac{\partial H}{\partial q}}{\lambda} \quad \textbf{(4)}$$

By substituting equation 2 in equation 4, we can get WTP for water supply as savings on health costs with a decrease in water-related sickness, which is due to a relationship between water and health:

$$WTP = py.\frac{\partial H / \partial q}{\partial H / \partial y} \quad \textbf{(5)}$$

5-6 Relationship between household characteristics and the WTP

The base model by Hammitt (2000[a]) related population characteristics, including age, income, health risks, and education, with the WTP. However, for non-rival goods like water supply, there is non-separable decision process (Smith and Houtven 1998). Hence, household characteristics can be adopted as population characteristics, as Smith and Desvousges (1987) has argued, based on Becker (1974). The research in the developing countries is mainly focused on the family size, proportion of various groups like children and woman in a household size, education of household leader, income, and location of the household (Choe et al. 1996, Alberini et al. 1996, Altaf et al. 1993 and 1997, and Lauria et al. 1999).

This study selects seven household characteristics viz. family size, proportion of children, proportion of women, proportion of elders, proportion of literate persons, education of household leader, income per capita, and location of household in brackish water zone or in sweet water zone. These characteristics are closely related with the water-related health effects and having an impact over the WTP. Hence, these characteristics are sufficient to assess the variations in the WTP values from one household to another. Their importance is discussed in the following paragraphs.

Health effects are directly related with the number of household members. Bigger the family size more will be the sickness episodes under the constant risk. However, the proportion of children is an important factor to change magnitude of health risks for the overall family size. Children are prone to the water-related sickness mainly diarrhea. Hence, if the proportion of children is bigger, then the health impact will also be high. In the previous studies proportion of children was assessed as a negative variable, as they have to collect water from the distant sources (Altaf et al. 1997). Therefore, both of these household characteristics are important to influence the WTP.

The gender issue is the most important issue in the developing strategy including water supply (Narayan 1995). Few years back, proportion of women were supposed to be negatively related with the WTP on the pretext of the free labor they were providing to collect water from a distant source (Altaf et al. 1993). However, the projects, based on community participation approach, help to increase their voice and choice, as they are the primary stakeholders who have to also take care of sick children. This normative level (people-centered development) thus supports reversals of the new professionalism, where women come before men, and children before adults (Chambers 1993). Thus women's power is premised on a collective notion of empowerment, which helps them to politicize their demands (Razavi and Miller 1995).

In Pakistan, the projects targeting women's voice and choice are also showing success (Kane 1997). The World Bank (1989) observes that Pakistani women are far more active in the economic activities in the smaller communities than what is generally believed, and despite the statistical invisibility of women, the results are readily visible to those who choose to look. Sindh water supply and sanitation project had an intensive community participation process and also requiring active women organizations. Therefore, the communities under this project may show a positive relationship between proportion of women and the WTP for water supply.

Education also has a major role to play in the developing countries, where literacy rate is still low in comparison to the cent percent literacy in the developed countries. This is evident from the previous results also, showing a positive correlation between educated household leaders and the WTP (Altaf et al. 1997, and Lauria et al. 1999). As discussed above, hygienic behavior is essential to capture most of the health benefits. This behavior is strongly linked with the education and knowledge (Alberini 1996). Hence, personal hygiene can be linked with the individual's education or ability to learn about the hygiene. Furthermore, literate people can make an influence over the decisions. Therefore, an assumption can be made regarding a positive correlation between proportion of literate people in a household and the WTP.

Income is generally assumed as having a positive correlation with the WTP (Hammitt 2000). However its elasticity is very small even in the developed countries (Crutchfield et al. 1997). In these areas of the developing countries, family size is considerably bigger, but there are noticeable variations within the same community. Hence, it would be appropriate to capture the impact of per capita income over the WTP. However, income might be having a significant multicollinarity with the other household characteristics including literacy and family size. Therefore, it would be logical to test a full household model including income per capita, and a reduced model by omitting this variable.

Though geographical conditions are not considered as household characteristics, but most of the studies try to analyze their impact also. Hence, living in smaller communities outside cities versus urban areas, or living in less dense versus highly dense areas of the same urban boundaries was taken into consideration (Crutchfield 1997, and Lauria 1999). In this water supply project, the difference between brackish or low water table zones and sweet water zones is significantly important (Altaf et al. 1997). Scarcity of water is also having significant impact of the health (Cairncross 1996). Hence, in the full model, we include this variable and in the reduced model we omit this variable.

Moreover, only the significant variables in the full model will be analyzed in the reduced model. Full and reduced model for the WTP can be written as:

$$WTP = \alpha + \beta_1 \text{ Family size} + \beta_2 \text{ proportion of women} + \beta_3 \text{ proportion of children} + \beta_4 \text{ proportion of elders} + \beta_5 \text{ proportion of literate people} + \beta_6 \text{ education in years of the household leader} + \beta_7 \text{ per capita income} + \beta_8 \text{ household located in a brackish zone} \quad \textbf{(6)}$$

$$WTP = \alpha + \beta_1 \text{ Family size} + \beta_2 \text{ proportion of women} + \beta_3 \text{ proportion of children} + \beta_4 \text{ proportion of elders} + \beta_5 \text{ proportion of literate people} + \beta_6 \text{ education in years of the household leader} \quad \textbf{(7)}$$

6 Data analysis and results

Basic facts of the selected communities have been compiled and shown in Table 6.

Table 6
Basic facts of the sample communities in the study area

Community	Population				Housing			Basic School	Basic Health Unit	Bus	Average Income
	Children	Male	Female	Elders	Bad	Fair	Good				
Vidh	714	337	288	52	139	44	65	Y	N	Y	3600
K.M.Jarwar	829	309	291	23	150	8	86	Y	N	Y	3800
UmerSand	317	279	303	156	56	55	42	Y	N	N	4500
Bhutto	589	273	244	19	88	4	142	Y	N	N	4000
A.Khaskheli	378	252	168	42	72	18	60	Y	N	Y	4300

For health benefits, we have taken three major water related diseases. Due to the various sources for the same disease, those diseases could not be eliminated by only supplying safe water. The ex-ante and ex-post sickness episodes with total health benefits are shown in Table 7.

Table 7
Household Health benefits in the selected Communities

Community	Health Effects (ex-ante) Average (No. of sick episodes)			Health Effects (ex-post) Average (No. of sick episodes)			Health Benefits Average
	Diarrhea	Malaria	Skin	Diarrhea	Malaria	Skin	Number (Percentage)
Vidh	7.73	4.2	4.5	3.3	2.7	2.7	7.8 45.3
K.M.Jarwar	9.0	5.0	4.9	4.7	4.0	4.1	6.0 30.2
UmerSand	9.8	5.0	5.5	4.8	4.5	4.4	6.6 32.2
Bhutto	10.4	5.4	6.2	4.4	4.6	5.1	7.7 34.9
A.Khaskheli	9.5	6.3	4.8	4.8	4.5	1.4	7.7 36.4

6-1 Household characteristics and WTP

Statistics for household characteristics are shown in Table 8. Mean versus median values suggest that there is no problem with normality curve. Hence, OLS model would be a better choice for

regression analysis. Moreover, in this table, we have shown the positive or negative impact of household characteristics, as observed in the previous studies.

Table 8
Description of selected variables used in the analysis

Variable Name	Mean	Median	Description	Sign in previous studies
Dependent variables				
WTP	41.07	40	Household willingness to pay for drinking water per month in rupees (50 Rupees = 1US dollar)	
Ln (WTP)	3.66	3.69	Natural log of WTP	
Independent variables				
Ln (Family size)			Natural log of total household members	+ (Altaf et al. 1997)
Children	44.52	44.44	Percentage of children, below 16 years of age in a household	- (Altaf et al. 1997)
Women	21.78	22.22	Percentage of women, from 16 to 60 years of age in a household	- (Altaf et al. 1993)
Elders	6.14	0.00	Percentage of elders, above 60 years of age, in a household	- (Choe et al. 1996)
Literacy	45.56	45.45	Percentage of literate persons in a household	
Education	1.66	1.00	Years of education for household leader	+ (Lauria et al. 1999) - (Choe et. al. 1996)
Ln (Income per capita)	6.11	6.13	Natural log of per capita income in a household	+ (Lauria et al. 1999))
Brackish	0.61	1.00	If the household is located in brackish water zone	+ (Altaf et al. 1993)

Notes: positive and negative signs show the impact of household characteristics with the WTP, based on the previous studies.

Multicollinearity among various household characteristics has been identified, and as expected, income is having strong correlation with family characteristics and the literacy. Brackish water zone is also having strong relationship with the total family size. Both of these variables have been omitted from the reduced model. The results of multivariate regression analysis are shown in Table 9. WTP values were taken as linear and as well as in natural log. Therefore, two full models and two reduced models were analyzed.

Table 9
Relationship between WTP and household characteristics

Dependent Variable	WTP OLS (Full Model)	WTP OLS (Reduced Model)	Ln (WTP) OLS (Full Model)	Ln (WTP) OLS (Reduced Model)
Constant	-17.724 (-1.144)	26.742 (6.081)	1.754 (4.803)	3.258 (28.073)
Ln (Family size)	2.211*** (5.724)	-4.785E-02 (-0.112)	7.173E-02*** (7.873)	6.177E-03 (0.548)
Children	0.102** (2.208)	0.108** (2.032)	3.016E-03*** (2.763)	2.871E-03** (2.044)
Women	0.138* (1.770)	0.201** (2.242)	4.518E-03** (2.461)	5.847E-03** (2.471)
Elders	-3.816E-02 (-0.413)	_	2.318E-05 (0.011)	_

Literacy	0.104** (2.255)	0.142** (2.481)	2.174E-03** (2.004)	3.526E-03** (2.335)
Education	-3.840 (-1.147)	_	-1.431E-02* (-1.810)	_
Ln (Income per capita)	4.512* (1.855)	_	0.163*** (2.999)	_
Brackish	20.368*** (10.453)	_	0.592*** (12.888)	_
Number of samples	150	150	150	150
R^2	0.513	0.110	0.619	0.129
Adjusted R^2	0.485	0.073	0.598	0.092

Notes: T-values are given in brackets *** Correlation is significant at 1% ** Correlation is significant at 5% * Correlation is significant at 10%

Family size is significantly positive in both of the full models only. In the brackish zone, where water has to be collected from distant sources, size of family is an important factor. The consumption of water per household increases with the number of household members. This increased consumption puts more pressure in the brackish water zone, which is evident from the full models. The main hypothetical issues for this study were related with women and children, as they are the primary beneficiaries of the health benefits. The results support this hypothesis, as these two variables are significantly positive in all the four models. The impact of women is slightly higher than the children. Similarly, proportion of women is a significantly positive variable for the communities under this project.

From the educational aspect of the household members including the leader, the main hypothesis was based on the proportion of the literate persons per household rather than the education of the household leader. This variable is also positively significant in all the models, suggesting that overall literacy is having a strong impact on the WTP values. Increased proportion of literate people can help to maximize the household health benefits through better hygienic practices. While focusing a household as a unit, it is plausible to analyze the overall impact of literacy.

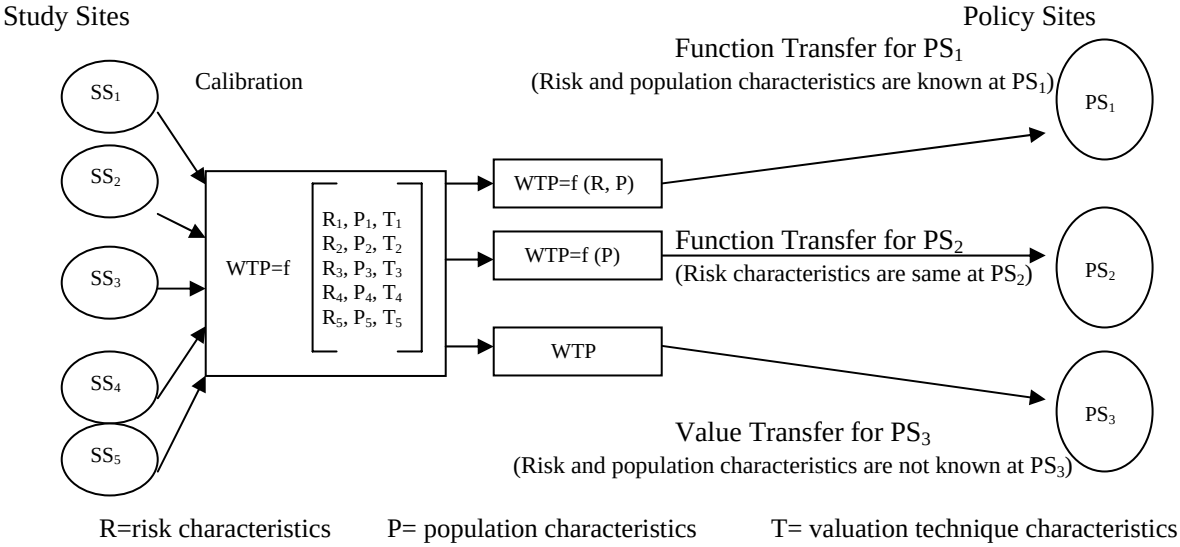
Income per capita is significantly positive in this study in accordance to the general trend. However, here we can appreciate that by putting income in per capita terms, its impact becomes bigger. Therefore, it is helpful to analyze its relationship with the WTP with its availability for each person in the same household. Finally, households living in the brackish zone are willing to pay more than the household located in sweet water zone area. This result also supports the research, indicating a strong relationship between water quantity and the health impacts. Proportion of elders in a household, and education of the household leaders are not significant variables, thus omitted from the reduced model.

7 Valuation of social benefit

7-1 Benefit transfer function

CV is an expensive technique in terms of money and time. Hence, environmental economists are adopting the estimated WTP, at one place (study site), to estimate the WTP at another place (policy site). This adoptability process is generally termed as benefit transfer. However, these values are not the forecasts, and they usually do not attempt to predict other exogenous influences on people's behavior (Smith 1992). Benefit transfer can be categorized into value transfer or point transfer, expert judgment or Delphi technique, and function transfer. The last category has been subjected to a comprehensive research and various techniques including the meta-analysis are being incorporated to get a better transfer function. Conceptual framework for function transfer and value transfer is shown in Figure 6.

Figure 6
Conceptual framework of benefit transfer



7-2 Contemporary research in benefit transfer

The benefit transfer had been mainly adopted to estimate benefits of natural resources (Desvousges et al. 1992, Parsons and Kealy 1994, Brouwer and Spaninks 1999, and Brouwer 2000). However, environmental health risks have been dominating most of the recent research including health risks from solid waste (Smith and Desvousges 1987), air pollution (Smith and Huang 1995, Chestnut et al. 1997, Chestnut and Ostro 1998), water pollution (Kask and Shogren 1994, and Smith et al. 2000), and scarcity of water (Rosen and Vincent 1999). The researchers have been trying a variety of approaches and techniques. The value transfer or point transfer was the initial phase, which has been now further developed and requires validity tests prior to transfer values (see Brouwer 2000). Benefit transfer function had been preferred over the value transfer, as Loomis (1992) argue that rather than transfer for a single value researcher needs to transfer entire demand function.

Benefit transfer protocol is the basic requirement to develop a benefit transfer function. Kask and Shogren (1994) propose that the protocol should include commodity specifications, site and sample characteristics, and market and exchange mechanism. Here commodity, and site and sample characteristics can be taken as risk and population characteristics, which influence the WTP for health risks (Hammitt 2000[a]). Risk characteristics may include baseline risk, change in probability or severity of risk, latency period, and sources of risk. Population characteristics may include age, education, income, family size, and demographic location. The third aspect of benefit transfer protocol takes into account characteristics of valuation technique including the policy measures for providing the environmental good. There is a wide range of valuation techniques available for non-market valuation (Smith 1993).

Brouwer and Spaninks (1999) show that errors in transferring value can be as large as 56% and in case of benefit function transfer the error can go as up as 475%. Benefit transfer function, cannot be directly applied due to limitations of assuming and estimating a linear relationship between the benefit measure and these characteristics; thus, existing studies are used to calibrate a preference structure and a WTP benefit transfer function as well. The most advanced technique, for calibration, is assumed as meta-analysis (van den Berg et al. 1997).

7-3 WTP model for benefit transfer

To remove those shortcomings, we propose a WTP model for benefit transfer. Three main factors affect the WTP estimates viz. benefit characteristics, population characteristics, and valuation technique characteristics:

$$WTP = f(\text{Risk characteristics, Population characteristics, Technique characteristics}) \quad (1)$$

Water supply helps to reduce water related health risks (Memon 2001, Rosen and Vincent 1999). However, that reduction varies from one region to another region (Esrey et al. 1990). This variation in risk reduction is closely linked with the household characteristics (Memon 2001, Alberini et al. 1996) and those household characteristics can be considered as population characteristics (Smith and Desvousges 1987). Family structure is the most important aspect in various regions, as women and children are considered as the primary stakeholders for water supply schemes (Rosen and Vincent 1999). Furthermore, elders are also prone to diarrhea, which is considered as biggest water related health risk.

Literacy is the most important characteristic to achieve better risk reduction results due to its correlation with the awareness for better health and hygiene practices (Alberini 1996). Income is usually a significant factor but having a very tiny effect on the WTP (Hammitt and Graham 1999). In benefit transfer, it may be difficult to get the secondary data for detailed household income at the policy site. Hence, the assumption for income being a constant factor within the local communities of a same region could be made (Altaf et al. 1993). Location of household is very important factor to influence the WTP. The severity of access to the water increases the WTP (Piper 1998). The households located in brackish areas can have higher WTP than the sweet water areas.

Last but not the least, valuation technique can make a real difference between valid and invalid estimates, and subsequently on the benefit transfer function. The criteria and check points has been suggested for various techniques. CV, among all the techniques, has prompted the most serious investigation of individual preferences ever undertaken in economics (Smith 2000). However, one should be careful in planning and implementation of CV, as many respondents may not understand the hypothetical market or nature of goods including the health risks due to problems with risk communication (Hammitt and Graham 1999) or due to unfamiliarity with the risks and their units (Krupnick et al. 1999). Furthermore, individuals may provide inaccurate information due to strategic behavior as a result of constructed nature of the survey (Burtraw and Krupnick 1999).

7-4 Benefit transfer function for the case study

Our CV survey had been done in accordance with the mainstream guidelines (Memon and Matsuoka 2001[a]), including the necessary condition for judging the validity of WTP by scope sensitivity (Hammitt[b]). Thus, we can adopt those results to get reliable benefit transfer function and to estimate the WTP for other communities in the same region. Based on our original assumption, water related risk characteristics are constant in the same region.

Thereafter, we have already identified the important population characteristics, which can influence the WTP. The household characteristics include proportion of children, women, elders, literate family members, and per capita income. While the demographic characteristics include sweet water zone, brackish water zone, and sever-brackish water zone. The communities located in the last zone are worst hit by water scarcity as the surface water is also at the distance of more than 3 kilometers; thus, requiring double pumping system to deliver the water for the community.

The required data to estimate a benefit transfer function, from the CV survey for the 5 communities, is shown in Table 10. Mean WTP for Vidh at Rupees 58.5 is highest, as this community is located in the sever-brackish zone. While, mean WTP for KM Jarwar is lowest at Rupees 24.5 due to its location in the sweet water zone. Similarly reduction in risk is 47.2% in Vidh against the 31.6% risk reduction in KM Jarwar. To make an assumption for constant per capita income, we take average income of all the five communities and then divide it with the average family size of those 5 communities. We get overall average 4040 rupees household or 460 rupees per capita income.

Table 10
Actual sample data from five communities

Community	HH size (Mean)	Children % (Mean)	Women % (Mean)	Elders % (Mean)	Literate % (Mean)	Reduced sick episodes Av. monthly (Mean)	Reduced sick episode % (Mean)	WTP Rs/month (Mean)
Vidh	9.4	49.3	25.9	4.8	48.9	7.8	47.2	58.5
KM Jarwar	8.4	44.4	18.5	5.6	43.1	6.0	31.6	24.5
Umersand	9.2	45.6	23.7	6.6	40.6	6.6	32.3	41.3
Bhutto	8.1	46.7	17.8	4.8	42.5	7.7	34.9	39.8
A Khaskhelli	8.7	39.3	23.3	9.6	52.7	7.9	35.8	41.2

Valuation instrument is also constant throughout the study. Hence, we generate the benefit transfer function, based on above population characteristics and by adopting simple ordinary least square semi-log regression model. The benefit transfer model has been estimated (Memon and Matsuoka[b]) and the coefficients are shown in Table 11.

All the coefficients are positive and the coefficients for income per capita, brackish water zone, and sever-brackish water zone are having bigger magnitude. Due to significance of almost all the variables, we adopt the whole model to estimate the benefits from the secondary data, which had been collected by the project teams under this project.

Table 11
Benefit transfer coefficients

Dependent Variable	Ln (WTP) OLS Model	
Constant	1.018^{***}	(2.684)
Children %	$3.749E^{-03***}$	(3.383)
Women %	$7.534E^{-03***}$	(4.143)
Elders %	$5.036E^{-03**}$	(2.322)
Literate %	$1.233E^{-03***}$	(3.614)
Ln (Income per capita)	0.325	(5.673)
Brackish ground water (Yes=1, No=0)	0.255	(6.054)
Severity for availability of water (Yes=1, No=0)	0.412	(7.768)

Notes: T values are shown in parenthesis
*** Significant at 0.01
** Significant at 0.05

7-5 Comparison of actual and generated WTP

First of all we estimate the WTP for our original communities from their secondary data, covering all the households in the community. A comparative analysis of the WTP, based on benefit transfer versus the WTP based on original CV survey, is shown in Table 12.

Table 12
Comparison between actual and transferred WTP

Community	Actual WTP Rupees/month	Transferred WTP Rupees/month	Difference Rupees/month	Error %
Vidh	58.5	61.06	2.56	4.4
KM Jarwar	24.5	30.72	6.22	25.4
Umersand	41.3	40.63	-0.67	-1.6
Bhutto	39.8	39.60	-0.20	-0.51
A Khaskhelli	41.2	40.46	-0.74	-1.8

The error between those two WTP estimates for Vidh, Umersand, Bhutto, A Khaskhelli, and KM Jarwar is 4.4%, -1.6%, -0.5%, -1.8%, and +25.4% respectively. The difference in absolute terms is not that high, as in three communities it is even less than one rupee, while in the worst case of KM Jarwar, it is little more than six rupees. Hence, except for the KM Jarwar, all the four communities are within a small range of error. KM Jarwar is the only community from sweet water zone in our original CV survey. In the sweet water zone, people are not yet highly motivated to manage collective water supply system rather they prefer to get sanitation schemes. Hence, the WTP for water supply, from this community, could be biased and subsequently can generate invalid results for sweet water zone areas.

Moreover, the other reason for a bigger error could be the limitation of data, as we have only one community from sweet water zone in our original survey. Hence, for better results we need to have more samples from similar type of communities. Though Vidh is also one community from sever-brackish zone, but it's brackish characteristic is same with the other three communities. Moreover, people in real need may show a real WTP, which can be consistent in all the communities with those sever conditions.

7-6 Social benefit and project appraisal

By adopting benefit transfer function, we estimate the WTP for 51 communities under this project (Table 13). The households in sweet water zone would show the WTP ranging from rupees 29.8 to rupees 33.5. The brackish water zone households' WTP ranges from rupees 35.9 to rupees 41.4, while the households in sever-brackish zone would show the WTP in a range from rupees 58.9 to rupees 62.1. The estimated social benefit in each community depends on the number of houses. From Table 13 we can observe that this benefit ranges from rupees 2143 to rupees 7722, rupees 3065 to rupees 18913, and rupees 6697 to rupees 29039 for sweet, brackish, and sever-brackish water zones respectively.

Benefit transfer function helps to estimate social benefit of a policy or project at much lower cost and in minimum time. The estimated benefit shows that 15 communities in sweet water zone can generate about 80,000 rupees with an average of over 5,000 rupees for each community. Similarly, brackish water zone can generate about 200,000 rupees for 27 communities with an average of over 7,000 rupees, and sever-brackish water zone can generate about 100,000 rupees for 9 communities with an average of over 11,000 rupees. In total, all the communities can generate about 380,000 rupees with an average of about 7,415 rupees per month or about 88,500 rupees per annum.

Table 13
BT based WTP for water supply and sanitation in Sindh (Pakistan)

S.No.	Village	District	Water condition	HH size	Child%	Women%	Elders%	Literate%	Household WTP Rs./month	Houses	Village WTP Rs./month
1	Panhwar Bhutto	Shikarpur	S	11.1	31.3	29.2	6.9	9.4	**29.8**	129	**3843**
2	Ibrahim Chutto	Hyderabad	S	7.1	50.5	24.8	1.0	13.3	**30.2**	71	**2143**
3	Sami	Khairpur	S	10.0	43.8	28.0	0.3	16.7	**30.2**	203	**6130**
4	Raharki	Ghotki	S	8.7	48.6	23.1	0.6	37.4	**30.5**	126	**3837**
5	Rawal Phour	Hyderabad	S	10.7	56.9	19.4	2.0	29.8	**30.5**	162	**4935**
6	Sattabo	Khairpur	S	11.0	48.7	22.7	1.9	35.0	**30.5**	138	**4205**
7	Haji Jaffer Hakro	Hyderabad	S	10.8	45.6	23.8	4.5	31.1	**30.6**	124	**3797**
8	Ghazi Khan Wassano	N.Feroz	S	7.2	54.7	21.8	3.2	23.5	**30.7**	201	**6173**
9	KM Jarwar	Hyderabad	S	7.8	51.3	20.7	3.7	40.4	**30.8**	179	**5512**
10	Jinhan Soomro	Hyderabad	S	8.9	45.1	23.5	1.2	53.1	**30.8**	260	**8013**
11	Suleman Soomro	Hyderabad	S	8.4	50.3	23.4	0.5	46.0	**31.0**	248	**7690**
12	Dino Mako	Ghotki	S	6.7	52.5	22.7	0.9	47.6	**31.2**	221	**6900**
13	Bahishti Lashkar Khan	Ghotki	S	8.3	59.1	18.6	5.3	35.5	**31.3**	247	**7722**
14	Bhounr	N.Feroz	S	8.6	48.0	23.0	5.1	51.4	**31.6**	110	**3473**
15	Maroon Kakepota	Shikarpur	S	8.3	37.7	39.6	2.8	38.8	**33.5**	167	**5599**
16	Gul Mohd Khurrero	Thatta	B	9.5	21.3	17.4	14.7	23.5	**35.9**	109	**3909**
17	Mir Kabi Khan	Hyderabad	B	8.9	62.4	14.1	0.8	31.0	**38.4**	186	**7140**
18	Belo	Thatta	B	11.7	54.7	16.5	4.1	27.7	**38.5**	120	**4614**
19	Haji Chaglo Jokhio	Thatta	B	14.1	38.2	24.2	6.2	28.9	**38.8**	81	**3142**
20	Jahmpir	Thatta	B	9.1	43.7	25.3	4.7	13.1	**38.8**	499	**19384**
21	Ghotana	Hyderabad	B	10.4	55.2	18.3	2.2	32.3	**38.9**	111	**4317**
22	Serwatch Sujawali	Thatta	B	12.5	36.8	26.9	6.4	19.8	**38.9**	97	**3777**
23	Bubak	Dadu	B	8.8	37.6	27.9	6.5	11.3	**39.0**	312	**12164**
24	Mir Muhammad Solangi	Khairpur	B	6.4	51.0	21.7	3.8	24.2	**39.2**	129	**5057**
25	Azmat Khan Kolachi	Ghotki	B	19.1	42.1	20.5	10.6	32.6	**39.3**	272	**10685**
26	Bago Wadadan	Sanghar	B	13.7	42.4	25.6	2.4	35.0	**39.3**	152	**5978**
27	Hussainabad	Khairpur	B	9.2	53.1	21.2	2.9	33.1	**39.6**	305	**12090**
28	Bahar Mirjat	Hyderabad	B	6.7	55.5	19.6	2.0	39.5	**39.6**	397	**15738**
29	Bhutto	Dadu	B	7.0	52.4	21.7	1.7	38.4	**39.7**	160	**6348**
30	Rip	Badin	B	8.7	50.6	22.4	3.1	35.4	**39.8**	169	**6723**
31	Tarr Khawaja	Thatta	B	10.8	40.4	22.1	9.7	43.4	**39.8**	141	**5618**
32	Umed Ali Dal	Hyderabad	B	8.5	36.0	23.1	14.6	31.2	**39.9**	132	**5268**
33	Saeed Matto	Hyderabad	B	11.2	60.8	18.1	2.3	38.1	**40.0**	134	**5356**
34	Tarai	Badin	B	11.4	56.3	20.9	2.4	39.4	**40.2**	167	**6717**
35	Piaro Goth Station	Dadu	B	8.4	49.4	24.5	1.4	42.8	**40.2**	470	**18913**
36	Unerpur	Dadu	B	6.9	44.2	24.1	3.5	52.8	**40.3**	231	**9302**
37	Garho	Sukkur	B	7.2	53.2	22.8	3.5	34.7	**40.3**	108	**4353**
38	Shah Bux Lashari	Mirpur Khas	B	8.9	40.2	28.7	1.5	46.2	**40.3**	73	**2945**
39	Jhangoo Wasan	Khairpur	B	8.9	51.4	22.8	1.0	55.1	**40.6**	151	**6124**
40	A Khaskhelli	Dadu	B	8.7	40.7	24.3	8.1	49.9	**40.6**	97	**3936**
41	Umersand	Hyderabad	B	8.4	30.0	28.7	14.8	31.3	**40.7**	125	**5093**
42	Mori	Hyderabad	B	11.1	49.0	25.9	0.0	64.9	**41.4**	74	**3065**
43	Ghari Jaggir	Dadu	B-S	8.4	49.1	22.0	4.0	23.2	**58.9**	147	**8658**
44	Chak-Char	Umerkot	B-S	7.0	45.7	27.1	0.6	21.2	**59.3**	113	**6697**
45	Molvi Mohd. Soomro	Badin	B-S	9.2	55.1	18.8	3.1	39.7	**59.7**	138	**8242**
46	Mohsin Pali	Umerkot	B-S	7.6	52.5	22.3	1.7	36.8	**60.1**	146	**8779**
47	Kachi Village	Sanghar	B-S	7.8	55.2	20.2	0.0	51.1	**60.3**	152	**9164**
48	Ladhan	Dadu	B-S	10.2	53.0	23.4	0.6	39.7	**60.6**	149	**9026**
49	Vidh	Hyderabad	B-S	8.6	57.1	20.0	1.6	52.1	**61.2**	169	**10346**
50	Dad Khan Jarwar	Hyderabad	B-S	9.2	51.8	24.7	3.5	33.3	**61.3**	168	**10298**
51	Deh 22 Jamrao	Sanghar	B-S	6.5	39.8	28.7	1.4	63.8	**62.1**	468	**29039**

The schemes in sweet water zone are mainly based on ground water, thus incurring lower costs, while the schemes in sever-brackish water zone are based on double pumping incurring higher costs. The running costs are normally taken as one percent of the capital costs per annum, which are 5 million on an average (Project Reports 1995-1997). This suggests that average capital costs would be around 250,000 rupees per annum for 20 years saturation life of the scheme. Furthermore, the running costs would be 50,000 rupees per annum. Comparing the per annum social costs and benefits would yield the benefit-cost (B/C) ratio of around 0.3, which less than 1. However, as per project policy for households to meet the running costs only, the social benefit is much higher and would yield B/C ratio of around 1.77. Hence, those social benefits can make these schemes viable from the running costs point of view.

8 Conclusion

Community participation could not only be the requirement for project sustainability. Economic viability is an essential requirement for long-term sustainability; however, community participation helps to improve economic viability. The community based water supply schemes provides evidence of women and children having significant impact over the WTP, unlike the previous research on public water supply schemes, where those two groups of community were the negative factors due to their free labor for fetching water. Community participation also involves health and hygiene training for multiplying the health benefits of water supply, which again make a positive impact on the WTP.

The outcome of cost-benefit analysis suggests that due to low affordability and poverty, we cannot still run those schemes on long run marginal costs. Thus, international agencies or local governments still need to provide subsidies either as full or partial share in capital costs and for major breakdowns. However, this is comparably a better choice, because previous public sector management failed to even generate running costs and they have to rely on continuous subsidies without any accountability from the consumers. Our survey shows that n this community based management setup, the recovery would be more than the running costs and efficiency of the management will be improved due to direct accountability by the consumers.

On the benefit valuation methodological fronts we can gain a lot of insights form this research. Firstly, CV is a viable tool to estimate the WTP even in these poorer communities of the developing countries. We can enhance the credibility of CV surveys by adopting participatory approach. Pre-CV questionnaire phase, to collect the data for socio-economic variables and health risks, can be used as confidence building by adopting semi-structured interviews under PRA.

Secondly, we can adopt mainstream guidelines for our CV survey in the developing countries also. However, we have to be assured about the acceptance of different elicitation modes and payment vehicles. Hence, pilot surveys could be a better starting point to finalize the design of CV for the intensive survey. The principles economic theory could also be valid in those low-income areas, as we have assessed from scope sensitivity.

Thirdly, to save the time and money without loosing the validity of the WTP estimates, we can adopt one-study based benefit transfer function in the same region. The estimated WTP values could vary a bit from the primary elicited WTP values. Depending on the policy guidelines, benefit transfer function could be a better alternative choice. However, the selection of appropriate CV study should be done carefully, especially in accordance with the mainstream guidelines and according to the validity of WTP estimates under scope sensitivity analysis. Moreover, domestic transfer function would be a better choice due to similarities in socioeconomic conditions.

Based on the outcomes of this research we can chalk out the future research agenda from academic and as well as from policy point of view. The CV surveys can make a comparison among the different CV instruments and then try to invent some techniques to reduce the comparative significance of those instruments. Once, we can get comparable results with those instruments, the possibilities of international or cross regional meta-analysis based transfer function would be increased. Modern statistical tools can also help to arrive at reliable transfer function for cross boundaries. For policy purposes, we can assess the validity of each mainstream guideline in the specific situation and region to arrive at a better CV practice in a regional context. We can also help to build a regional database for those CV surveys to make data accessible for policy and research purposes.

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References:

Alberini, A., Eskeland, G.S., Krupnick, A., and McGranahan, G. (1996), *Determinants of Diarrheal Disease in Jakarta*, Policy and Research Working Paper 1568, the World Bank, Washington D.C.

Altaf, M.A., Jamal, H., Liu, J.L., Smith, V.K. and Whittington, D. (1997), *Measuring the Private Benefits from Connections to Public Water Systems in Developing Countries: A Case Study of the Punjab, Pakistan*, Duke Economics Working Paper # 97-24, Duke University, USA

Altaf, M.A., Whittington, D., Jamal, H., and Smith, V.K. (1993), Rethinking Rural Water Supply Policy in the Punjab, Pakistan, *Water Resources Research*, 29(7): 1943-1954

Asamoah, K. (1998), Ghana: The Community Water and Sanitation Project, Community Water Supply and Sanitation Conference (May 5-8, 1998), NNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R., and Schuman, H. (1993), Report of the NOAA Panel on Contingent Valuation, *Federal Register*, 58: 4601-4614

Becker, G.S. (1974), A Theory of Social Interactions, *Journal of Political Economy*, 82(6): 1063-1093

Bell, M. (1990), Reconstructing Communities as Agents of Progress, In: Cotton, A. et al. (eds.), *WATSAN 2000*, Proceedings of UNICEF orientation/Training Workshop for Water and Sanitation Staff, WEDC, Loughborough

Black, M. (1998), *Learning What Works: A 20 Year Retrospective View on International Water and Sanitation Cooperation*, UNDP-World Bank Water and Sanitation Program, Washington, D.C.

Brouwer, R. (2000), Environmental Value Transfer: State of the Art and Future Prospects, *Ecological Economics*, 32: 137-152

Brouwer, R. and Spaninks, F.A. (1999), The Validity of Environmental Benefits Transfer: Further Empirical Testing, *Environmental and Resource Economics*, 14: 95-117

Brown, G. M. (1998), Responding to Demand: Two Approaches from Indonesia, Community Water Supply and Sanitation Conference (May 5-8, 1998), NNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Burtraw, D., and Krupnick, A. (1999), Measuring the Value of Health Improvements from Great Lakes Cleanup, Discussion Paper 99-34, Resources for the Future, Washington, D.C. http://www.rff.org

Byrnes, K. J. (1992), *Water User's Associations in World Bank-Assisted Irrigation Projects in Pakistan*, Technical Paper 173, The World Bank, Washington, D.C.

Cairncross, S. (1996), Water Quality, Quantity, and Health, In: Drangert et al. (eds.), *Conference on Safe Water Environments*, Water and Environmental Studies Report No. 24, Linkoping University, Sweden

Carson, R.T. (1999), *Contingent Valuation: A User's Guide*, Discussion paper 99-26R, University of California, San Diego ftp://weber.ucsd.edu/pub/econlib/dpapers/ucsd9926r.pdf

Carson, R.T., Flores, N.E., and Meade, N.F. (2000), *Contingent Valuation: Controversies and Evidence*, Discussion paper 96-36R, University of California, San Diego ftp://weber.ucsd.edu/pub/econlib/dpapers/ucsd9636r.pdf

Chambers, R. (1983), *Rural development: putting the last first*, Longman, Harlow (England)

Chambers, R. (1987), *Sustainable Livelihoods, Environment and Development: Putting Rural People First*, Discussion Paper No. 240, Institute of Development Studies, Sussex

Chambers, R. (1993), *Challenging the Professions: Frontiers for Rural Development*, Intermediate Technology, London

Chambers, R. (1994[a]), The Origins and Practice of Participatory Rural Appraisal, *World Development*, 22 (7)

Chambers, R. (1994[b]), Participatory Rural Appraisal (PRA): Analysis of Experience, *World Development*, 22 (9)
Chambers, R. (1994[c]), Participatory Rural Appraisal (PRA): Challenges, Potentials and Paradigms, *World Development*, 22 (10)
Chestnut, L.G., Ostro, B.D., and Vichit-Vadakan, N. (1997), Transferability of Air Pollution Control Health Benefits Estimates from the United States to Developing Countries: Evidence from the Bangkok Study, *American Journal of Agricultural Economics*, 79(5): 1630-1635
Chestnut, L.G, Ostro, B.D., Vichit-Vadakan, N., and Smith, K.R. (1998), *Final Report: Health Effects of Particulate Matter Air Pollution in Bangkok*, prepared for Royal Thai Government, Bangkok
Choe, K., Whittington, D. and Lauria, D.T. (1996), The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Phillippines, *Land Economics*, 72(4): 519-537
Cotton, Andrew and et al. (1990), *WATSAN 2000*, Proceedings of UNICEF orientation/Training Workshop for Water and Sanitation Staff, WEDC, Loughborough
Coverdale, A.G. and Healey, J.M. (1987), Project Appraisal and Project Aid: A Decade of Experience in Rural Development, *Journal of Agriculture Economics*, XXXVIII(1)
Crutchfield, S. R., Cooper, J. C., and Hellerstein, D. (1997), *Benefits of Safer Drinking Water: The Value of Nitrate Reduction*, US Department of Agriculture, Washington, D.C
http://www.econ.ag.gov/epubs/pdf/aer752/AER752.PDF
Cunha, P. V. and Pena, M. (1997), *The Limits and Merits of Participation*, Workshop on Partnerships and Participation, Mexico
Curry, S. and Weiss, J. (1993), *Project Analysis in Developing Countries*, St. Martin's Press, London
Desvousges, W.H., Naughton, M.C., and Parsons, G.R. (1992), Benefit Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies, *Water Resources Research*, 28(3): 675-683
Dixon, J. A., Scura, L. F., and Carpenter, R. A. (1988), *Economic analysis of environmental impacts of development projects*, Asian Development Bank, Manila
Esman, M. J. and Uphoff, N. T. (1984), *Local Organizations: Intermediaries in Rural Development*, Cornell University Press, Cornell
Esrey, S.A., Potash, J.B., Roberts, L. and Shiff, C. (1990), *Health Benefits from Improvements in Water Supply and Sanitation: Survey and Analysis of the Literature on Selected Diseases*, WASH Technical Report No. 66, U.S. Agency for International Development, Washington, D.C.
Estache, A and Sinha, S (1994), *Does Decentralization Increase Public Infrastructure Expenditure?* Background paper for the 1994 World Development Report, The World Bank, Internet.
Fiszbein, A. (1997), *Decentralization and Local Capacity: Some Thoughts on Controversial Relationship* , Technical Concentration on Decentralization, Rome
Freeman, A.M. (1993), *The measurement of Environmental and Resource Values: Theory and Methods*, Resources for the Future, Washington, D.C.
Garrod, G., and Willis, K.G. (1999), *Economic Valuation of the Environment: Methods and Case Studies*, Edward Elgar, Cheltenham
Gilpin, A. (1995), *Environmental Impact Assessment : Cutting edge for the twenty-first century*, Cambridge University Press, New York
Gittinger, J. Price (1982), *Economic analysis of agricultural projects*, The John Hopkins, Baltimore
Gleick, P.H. (1993), *An Introduction to Global Fresh Water Issues*, In: Gleick, P.H. (ed.), *Water in Crisis: A Guide to the World's Fresh Water Resources*, Oxford University Press, Oxford
Griffin, C.C., Briscoe, J., Singh, B., Ramasubban, R., and Bhatia, R. (1995), Contingent Valuation and Actual Behavior: Predicting Connections to New Water Systems in the State of Kerala, India, *The World Bank Economic Review*, 9(3): 373-395
Hamer, D. H., Simon, J., Thea, D., and Keuch, G.T. (1998), Childhood Diarrhea in Sub-Saharan Africa, Child Health Research Project Special Report, The ARCH Project, Harvard Institute for International Development, Massachusetts
Hammitt, J.K., and Graham, J.D. (1999), Willingness to Pay for Health Protection: Inadequate Sensitivity to Probability? *Journal of Risk and Uncertainty*, 8: 33-62
Hammitt, J.K. (2000[a]), Valuing Mortality Risk: Theory and Practice, *Environmental Science Technology*, 34(8): 1396-1400

Hammitt, J.K. (2000[b]), Evaluating Contingent Valuation of Environmental Health Risks: The Proportionality Test, *AERE Newsletter*, 20(1): 14-19

Harrington, W., Krupnick, A.J., and Spofford, W.O. Jr. (1989), The Economic Loses of a Waterborne Disease Outbreak, *Land Economics*, 25: 116-137

Homedes, N. (1995), *The Disability-Adjusted Life Year (DALY) Definition, Measurement and Potential Use*, presented at the European Bioethics Conference at "Institute Bojra de Bioetica", Spain

Jenkins, G.P. (1998), *Evaluation of Stakeholder Impacts in Cost-Benefit Analysis*, Development Discussion Paper No. 631, Harvard Institute for International Development, Harvard University, Internet

Kane, M. (1997), *Gender and Participation in Agricultural Development Planning: Lessons from Pakistan*, Women in Development Services, Food and Agriculture Organization, Rome

Kask, S.B., and Shogren, J.F. (1994), Benefit Transfer Protocol for Long-term Health Risk Valuation: A case of surface water contamination, *Water Resources Research*, 30(10): 2813-2823

Klugman, J. (1994), *Decentralization; A Survey of Literature from a Human Development Perspective*, UNDP Occasional Paper 13, Internet.

Korten, David (1980), Community Organization and Rural Development: A learning Process Approach, *Public Administration Review*, 40

Krupnick, A., Alberini, A., Cropper, M., Simon, N., Itaoka, K., and Akai, M. (1999), *Mortality Risk Valuation for Environmental Policy*, Discussion Paper 99-47, Resources for the Future, Washington, D.C http://www.rff.org

Larson, B.A. and Gnedenko, E. (1998), *Avoiding Health Risks from Drinking Water: Theory and Moscow Study Results*, Development Discussion Paper No. 619, Harvard Institute for International Development, Harvard University
http://www.hiid.harvard.edu/pub/pdfs/619.pdf

Lauria, D.T., Whittington, D., Choe, K., Turingan, C., and Abiad, V. (1999), Household Demand for Improved Sanitation Services: A Case Study of Calmba, the Philippines, Bateman, I.J., and Willis, K.G. (eds.), *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries*, Oxford University Press, New York

Loomis, J.B. (1992), The Evolution of a More Rigorous Approach to Benefit Transfer: Benefit Function Transfer, *Water Resources Research*, 28(3): 701-705

Lyer, P (1998), Uttar Pardesh State, India; The Swajal Project; Experiences with Implementing a Demand-Responsive Approach, *Community Water Supply and Sanitation Conference* (May 5-8, 1998), UNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Majumdar, J. (1990), Finance and Economics, In: Cotton, A. et al. (eds.), *WATSAN 2000*, Proceedings of UNICEF orientation/Training Workshop for Water and Sanitation Staff, WEDC, Loughborough

Martines, J., Phillips, M., and Feachem (1993), Diarrheal Diseases, Jamison, D.T. et al. (eds.), *Disease Control Priorities in Developing Countries*, Oxford University Press, New York

Meier, G. (1983), *Pricing Policy for Development Management*, Johns Hopkins Press for EDI of World Bank, Baltimore

Memon, M.A. (2001), Household Characteristics, Health Benefits, and Willingness to Pay for Rural Water Supply in Pakistan, to be published in: *Journal of International Development Studies*, 10(1)

Memon, M.A., and Matsuoka, S. (2001[a]), Validity of Contingent Valuation (CV) Estimates from Developing Countries: Scope Sensitivity Analysis, submitted to *Environmental Economics and Policy Studies*

Memon, M.A and Matsuoka, S. (2001[b]), Benefit Transfer Function to Estimate WTP for Rural Water Supply in Pakistan, submitted for *Journal of International Development Studies*

Memon, M.A and Matsuoka, S. (2001[c]), Can Meta-analysis Improve the Validity of Benefit Transfer? A Case Study from a Developing Country, submitted for *Journal of Environmental Economics and Management*

Mitchell, R.C., and Carson, R.T. (1989), *Using Surveys to Value Public Goods: The Contingent Valuation Method*, John Hopkins University Press, Baltimore

Murray, C.J.L., and Lopez, A.D. (1994), *Global* Mortality, *Disability, and the Contribution of Risk Factors: Global Burden of Disease Study*, Harvard School of Public Health,
http://www.healthnet.org/programs/procor/gbd3.htm

Narayan, D. (1995), *The Contribution of People's Participation: Evidence from 121 Rural Water Supply Projects*, Environmentally Sustainable Development Occasional Paper Series No. 1, The World Bank, Washington, D.C.

Narayan, D. (1997[a]), *Design of Social Funds: Participation, Demand Orientation, and Local Organization Capacity*, Discussion Paper No. 375, The World Bank, Washington, D.C.

Narayan, D. (1997[b]), *Designing Community Based Development*, Technical Concentration on Decentralization, Rome

Narayan, D. (1998), *Participatory Rural Development* In: Lutz, Ernst (Editor), *Agriculture and Environment*, A World Bank Symposium, The World Bank, Washington, D.C.

Narayan, D., and Pritchett, L. (1997), *Cents and Sociability: Household Income and Social Capital in Rural Tanzania*, Policy Research Working Paper 1796, The World Bank, Washington, D.C.

National Patriotic Health Campaign Committee, People's Republic of China (1998), *The World Bank Credit Implementation Description Report of China Rural Water Supply and Sanitation Projects*, Community Water Supply and Sanitation Conference (May 5-8, 1998), NNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Nigam, A. and Rasheed, S. (1998), *Financing of Fresh Water for All: A Rights Based Approach*, Staff Working Papers, Evaluation Policy and Planning Series, UNICEF, New York

Ostro, B. D. (1983), Air Pollution and Morbidity Revisited: A Specification Test, *Journal of Environmental Economics and Management*, 14 (1): 87-88

Ostro, B. and Chestnut, L. (1998), Assessing the Health Benefits of Reducing Particulate Matter Air Pollution in the United States, *Environmental Research*, Section A, 76: 94-106

Ostrom, Elinor and et. al. (1993), *Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective*, Westview Press, Oxford

Palmer, Ian (1998), Mvula Trust: An Independent Approach to Rural Water Supply and Sanitation in South Africa, *Community Water Supply and Sanitation Conference* (May 5-8, 1998), NNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Parsons, G.R., and Kealy, M.J. (1994), Benefit Transfer in a Random Utility Model of Recreation, *Water Resources Research*, 30(8): 2477-2484

Pasha, H.A. and McGarry, M.G. (1989), *Rural Water Supply and Sanitation in Pakistan: Lessons from Experience*, World Bank Technical Paper Number 105, UNDP-World Bank Water and Sanitation Program, The World Bank, Washington, D.C.

Pears, D. and Crowards, T. (1996), Particulate Matter and Human Health in the United Kingdom, *Energy Policy*, 27 (7): 609-20

Pickford, John (1990), Community Participation; Some Management Alternatives, In: Cotton, A. et al. (eds.), *WATSAN 2000*, Proceedings of UNICEF orientation/Training Workshop for Water and Sanitation Staff, WEDC, Loughborough

Piper, S. (1998), Using Contingent Valuation and Benefit Transfer to Evaluate Water Supply Improvement Benefits, *Journal of the American Water Resources Association*, 34(2): 311-320

Ravenswaay, E.O. and Wohl, J. (1995), Using Contingent Valuation Methods to Value the Health Risks from Pesticides Residues When Risks are Ambiguous, Casewell, J.E. (Ed.), *Valuing Food Safety and Nutrition*, Westview Press, Boulder, Colorado

Razavi, S. and Miller, C. (1995), *From WID to GAD: Conceptual Shifts in the Women and Development Discourse*, Occasional paper 1, UNRISD
http://www.unrisd.org/engindex/publ/list/opb/opb1/toc.htm

Rosen, S. and Vincent, J. (1999), *Household Water Resources and Rural Productivity in Sub-Saharan Africa: A Review of the Evidence*, Development Discussion Paper No. 673, Harvard Institute for International Development, Harvard University, Internet

Scoones, I., and Thompson, J. (1994), *Beyond farmer first; rural people's knowledge, agriculture research and extension practice*, Intermediate Technology, London

Shah, A. (1998), *Balance, Accountability, and Responsiveness; Lessons about Decentralization*, World Bank, Washington (Internet)

Shiklomanov, I. (1993), *World Fresh Water Resources*, In: Gleick, P.H. (ed.), *Water in Crisis: A Guide to the World's Fresh Water Resources*, Oxford University Press, Oxford

Simon, H. A. et al. (1958), *Public Administration*, Alfred A. Knopf., New York

Smith, K.V., and Desvousges, W.H. (1987), An Empirical Analysis of the Economic Value of Risk Changes, *Journal of Political Economy*, 95(1): 89-114

Smith, V.K. (1992), On Separating Defensible Benefit Transfers From "Smoke and Mirrors," *Water Resources Research*, 28(3): 685-694
Smith, V.K. (1993), Non-market Valuation of Environmental Resources: An Interpretive Appraisal, *Land Economics*, 69(1): 1-26
Smith, V.K. (2000), Fifty Years of Contingent Valuation, presented in: *Kobe Conference on Theory and Application of Environmental Valuation*, 22-23 January 2000, Kobe University
Smith, V.K, and Desvousges, W.H. (1987), An Empirical Analysis of the Economic Value of Risk Changes, *Journal of Political Economy*, 95(1): 89-114
Smith, V.K, Huang, J. (1995), Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models, *Journal of Political Economy*, 103(1): 209-227
Smith, V.K., and Osborne, L.L. (1996), Do Contingent Valuation Estimates Pass a "Scope" Test? A Meta-analysis, *Journal of Environmental Economics and Management*, 31: 287-301
Smith, V.K., Houtven, G.V., Pattanayak, S., and Bingham, T.H. (2000), *Improving the Practice of Benefit Transfer: A Preference Calibration Approach*, Interim Final Report Prepared for U.S. Environmental Protection Agency http://www.epa.gov/waterscience/economics/benefits.pdf
Tacconi, L. and Tisdell, C. (1992), Rural Development Projects in LDCs: appraisal, participation and sustainability, *Public Administration and Development*, 12: 267-278
UNDP-World Bank Water and Sanitation Program (1998), *Community Water Supply and Sanitation Services*, Conference Proceedings (May 5-8, 1998), Washington, D.C.
UNDP-World Bank Water and Sanitation Program (1999), *Water and Sanitation Services for Poor: Innovating Through Field Experiences*, Program Strategy 1999-2003, Washington, D.C.
Uphoff, Norman T. (1986), *Local Institutional Development: An Analytical Sourcebook with Cases*, Kumarian Press, West Hartford, CT
Uphoff, Norman T. (1997), *Institutional Capacity and Decentralization for Rural Development*, Technical Concentration on Decentralization, Rome
USEPA (2000), *Handbook for Non-Cancer Health Effects Valuation*, EPA Science and Policy Council, Washington, D.C.
van-den Bergh, J.C.J.M., Button, K.J., Nijkamp, P., and Pepping, G.C. (1997), *Meta-analysis in Environmental Economics*, Kluwer Academic Publishers, AH Dordrecht, The Netherlands
Whittington, D. (1998), Administrating Contingent Valuation Surveys in Developing Countries, *World Development*, 26(1): 21-30
WASH (1988), *Guidelines for Conducting Willingness-to-Pay Studies for Improved Water Services in Developing Countries*, WASH Field Report No. 306, U.S.A.I.D., Arlington
Whitehead, J. and Houtven, G. (1997), *Methods for Valuing the Benefits of the Safe Drinking Water Act: Review and Assessment*, Internet
WHO, UNICEF, and Water Supply and Sanitation Collaborative Council (1996), *Water Supply and Sanitation Sector Monitoring Report: Sector Status as of 31 December 1994*, WHO, New York
World Bank (1989), *Women in Pakistan: an Economic and Social Strategy*, Washington, D.C.
World Bank (1992), *World Development Report 1992: Development and the Environment*, University Press Book, Washington, D.C.
World Bank (1996), *Staff Appraisal Report on Islamic Republic of Pakistan – Social Action Program Project*, Country Department III, Population and Human Resource Division, The World Bank, Washington, D.C.
World Health Organization (1996), *Water and Sanitation*, Fact Sheet No. 112
http://www.who.org/inf/fs/fact112/html
World Commission on Environment and Development (1987), *Towards Sustainable Development: Our Common Future*, The Brundtland Report, Oxford University Press, Oxford