

CHAPTER – II

LITERATURE REVIEW

2.1.0. Introduction

For the present study, the researcher reviewed a wide range of literatures including books, journals, recent reports, case studies, web-based materials, working papers etc. related to sanitation. The academic literature landscape is varied in its focus which includes - the economic significance of sanitation, the intersection between gender and specifically women's involvement in sanitation and water and hygiene related activities. The majority of the literature concerning the issue addresses the importance of integrating women into sanitation initiatives. A number of literatures delved deeper into involvement noting the importance of incorporation of women into sanitation policy, sanitation management and hygiene education. In addition, academic literature also includes information concerning basic sanitation as a human right and the need of incorporating gender component in sanitation initiatives. Keeping in view the different aspects of sanitation, covered by the researcher while reviewing sanitation related literature - the chapter is divided under the following broad heads:

1. Why Sanitation is so important? : Understanding the Economic Significance and Benefits of Sanitation
2. Sanitation and the Need of Gender Mainstreaming
3. The Need of Looking at Sanitation Policies and Approaches from Gender-Lens
4. Need for Inclusion of Women within Water, Sanitation and Hygiene Sector
5. Role of gender in Water Resource Management
6. Studies conducted on 'willingness to pay' (WTP) factor for improved water supply and sanitation
7. Some Other Recent Studies on Sanitation

2.2.0. Why Sanitation is so important? : Understanding the Economic Significance and Benefits of Sanitation

The researcher has reviewed around hundred literatures with an aim to explore the economic significance of sanitation. The outline of this review therefore begins by characterisation of the various types of costs associated with sanitation, the common methodologies employed, followed by examples of costs of various systems and eventually a presentation of financial management schemes. All figures have been cited in the original currency as they appear in the

respective source. Although the researcher tried to collect the most recent available data but one should keep in mind changes in the value of each currency. Special notice should be given to the frequently appearing US\$ that has experienced considerable devaluation in latest years in comparison to many other currencies.

Whenever a sanitation scheme is planned and technologies are chosen, costs always play a crucial role. It is important to distinguish between financial and economic costs. The first refers to costs borne by end users and financing bodies for construction and operation, while the later refers to the overall costs and benefits borne by society.

Although calculating construction costs may be fairly straightforward, there is a considerable difficulty in generating exact figures on running costs for a typical planning horizon of 20-30 years (Sasse, 1998). One should also keep in mind, that variations in local conditions (topography, climate, socio-economic status, legislation etc.) can influence costs significantly (WHO, 2006). Other external impacts on health and environment are even more complex to assess and assign with monetary values. Nevertheless, although some assumptions must be made and perhaps several scenarios considered, it is always imperative to conduct an in-depth study to avoid non-functional systems and to minimise fiscal losses. Hence, detailed economic analysis is usually undertaken for large scale sanitation projects while smaller sanitation endeavours usually consider investment, operational and opportunity costs of capital (Franceys et al., 1992).

The following elements are normally calculated in financial and economic analyses:

- 1- Investment/capital costs: cover all materials, energy and labour expenses for the construction of all facilities and infrastructure necessary. Initial expenditures on equipment and land use are also included here. Relevant preparatory activities such as research and development, training, capacity building and promotion should be accounted for as well.
- 2- Running/recurring costs: refer to all materials, energy and labour expenses needed for the proper operation and maintenance (O&M) of the system. Reinvesting in replacing aged facilities represents a distinct form of running costs. Expenditures on monitoring and evaluation, quality control, issuing of permits and bureaucracy should be incorporated additionally.
- 3- Opportunity costs (of capital): reflect the potential lost profits if alternative investments would have been carried out with the capital used.

- 4- Revenues: applies when income may be generated by reducing greenhouse gases (through Clean Development (CD) or Joint Implementation mechanisms) or by using products such as biogas for energy production, sewage sludge as fertilizer in agriculture, treated water for irrigation etc.

The following elements are considered only in economic analyses:

- 1- Environmental costs/benefits: associated with pollution of soil, water and air, damages to biota and so forth.
- 2- Health costs/benefits: relates to expenditure on medical care.
- 3- Productivity: stems from the environmental and health impacts. Includes lost work and school days due to illnesses, losses to agriculture and industrial sectors from poor soil and water quality, losses to insurance companies and the tourism sector, and so on. Benefits from improved soil fertility or enhanced subsistence economies should be considered if observed.
- 4- Employment: generation of new work positions.

An important dimension that is often overlooked is the socio-cultural aspect. Enhanced sexual equality, convenience, security – all represent benefits to society. Economic (as opposed to financial) analysis considers the real costs for the economy – i.e. shadow pricing wages, subsidies, custom duties and taxes among others (Kalbermatten et al. 1982; Franceys et al., 1992; ADB, 1999).

2.2.1. Guiding principles of cost calculations

In general, calculations are made for the expected lifetime of the facilities, on an annual basis. For a fair comparison of different systems, it is advisable to choose a time reference that fits whole multiples of the various life spans (Franceys et al., 1992). When information is lacking, a rough estimation of O&M costs may be derived as a percentage of the investment costs (Toubkiss, 2000; Hutton & Haller, 2004; UNEP/GPA, 2004; Ilesanmi, 2006). Since maintenance costs of decentralised systems are a function of the number of users, it may be more appropriate to express expenditures per capita and/or per representative household size. This can be done by using the “average incremental cost” and the “total annual cost per household” techniques (Kalbermatten et al. 1982; Franceys et al., 1992; Wedgwood & Sansom, 2003).

2.2.2. Commonly employed methodologies

Net Present Value (NPV) – a means to assess the opportunity cost of money by adjusting future expenditures to their current monetary value. This is typically done by assuming constant, not inflated expenditures corrected by a discount factor. This approach tends to favour systems with lower investment costs even if ongoing costs may be higher (Franceys et al., 1992; Wedgwood & Sansom, 2003; Leal, 2004; Pinkham et al., 2004; von Sperling & Chernicharo, 2005; Mayunbelo, 2006).

Least-cost analysis – identifies the cheapest option amongst various sanitation schemes that yield similar results (Kalbermatten et al. 1982; Franceys et al., 1992). Some methodological variations enable ranking alternatives that deliver output of varying quality and quantity (ADB, 1999). The chosen least-cost alternative can be further investigated by a cost-benefit analysis.

Cost-effectiveness analysis – another technique, widely used for health care interventions, which expresses the ratio of costs and expected outcomes (not quantified in monetary terms). Larsen (2004) for instance, compared costs of various measures to prevent a child's death from water borne diseases in developing countries. Brikké and Rojas (2003) point out that defining effectiveness and effects is not straightforward and may be subjective.

Cost-benefit analysis – perhaps the most widely used approach to evaluate sanitation systems. With this method, a ratio between the expected costs and benefits is calculated, enabling comparison of various sanitation schemes (for examples and discussions see Franceys et al., 1992; Hutton & Haller, 2004; Redhouse et al., 2004; Bajgain & Shakya, 2005; Prihandrijanti, 2006; WHO, 2006). Sasse (1998) on the other hand, argues that the cost-benefit method is not applicable for wastewater systems since sewage treatment does not produce profit. As stated before, it is difficult to assign monetary values to some benefits (Kalbermatten et al. 1982; Brikké & Rojas, 2003). Some methods that tackle these aspects are mentioned below.

Sensitivity analysis – a supplementary tool that scrutinises how changes in quantifiable variables (as opposed to the assumptions made) may influence a project's viability (ADB, 1999; Hutton & Haller, 2004; Bajgain & Shakya, 2005; Mayunbelo, 2006; Prihandrijanti, 2006).

Multi-criteria analysis – used to facilitate decision making on issues with multifaceted impacts that are specified and measured by quantitative and qualitative indicators (Ilesanmi, 2006; WHO, 2006; de Silva, 2007). It is therefore useful in considering indirect impacts on the environment, society and health (UNEP/WHO/UN-HABITAT/WSSCC, 2004). An extensive list of criteria and respective indicators for sanitation planning that considers these aspects have been presented

by Kvarnstrom and Petersens (2004) and further elaborated in TUHH and TTZ (2006). Both sources add that the final selection of criteria should be done on a case to case basis, with regard to the unique conditions that prevail.

Willingness to pay (WTP) or contingent valuation (CV) – a method for estimating consumers' demand (maximal WTP) by surveys, and is therefore practical for financial planning for non-market goods such as water or sanitation services (Wedgwood & Sansom, 2003). Although some controversy exists on the reliability of WTP, it is recognised as a helpful decision making instrument when applied to use goods, as opposed to non-use goods such as biodiversity (Gunatilake et al., 2006).

Measuring health impacts can be facilitated by using combined indicators such as the DALY – Disability Adjusted Life Years (WHO, 2006). Redhouse et al. (2004) suggest a set of indicators with straightforward formulas to calculate impacts of water and sanitation projects such as improved health, avoided lost school days and gender issues although these methods may be oversimplified. In their report to the US Environmental Protection Agency, Pinkham et al. (2004) promote the use of an extensive “integrated wastewater planning” that includes, among other aspects, a review of methods to evaluate non-market goods and services. Hutton (2007) offers a broad and very systematic approach to appraise the economics of sanitation using a variety of costing techniques. He suggests that the relevance of each externality should be considered in each case and qualitatively evaluated if sufficient data is lacking.

2.2.3. Costs and benefits of different sanitation systems

2.2.3.1. Global overview

Proper water and sanitation services are strongly correlated with economical development (Euler et al., 2001; von Hauff & Lens 2001; SEI/UNDP 2006). Poor sanitary conditions result in great economic damages due to, among other things, spread of diseases, loss of school and working days, pollution of natural resources and reduced tourism (Briscoe, 1995; Wright, 1997; von Hauff & Lens 2001; Hansen & Bhatia, 2004; Hutton & Haller, 2004; Hutton et al., 2007a-c). The Millennium Development Goals (MDGs) are some of the most important measures, set with the aim to tackle these problems.

It is evident that providing decent sanitation services and achieving the MDGs in particular is very expensive. Some experts estimate an annual sum of US\$ 11.5 billion for the implementation of the MDGs for sanitation, while others suggest a broad range of US\$ 3.1-80 billion per year with respect to the technologies to be used (Evans et al., 2004; Toubkiss, 2006). Additional

explanations for these disparities include different assumptions on population growth, baseline years and services level (Fonseca & Cardone, 2005). Even when considering the first and rather modest appraisal, current expenditure levels on sanitation (3 billion US\$/year) cover merely a quarter of this sum (WHO/UNICEF, 2000). Two central challenges arise from these findings:

- Cost-efficient sanitation methods must be introduced in order to fill the gap (Kalbermatten et al., 1982; WHO/UNICEF 2000; Hutton & Haller, 2004; UNEP/GPA 2004; Fonseca et al., 2005; Rockstroem et al., 2005)

- Alternative financial schemes that make funds available ought to be explored (Briscoe, 1995; Steiner et al., 2003; Cardone & Fonseca 2003; UNEP/GPA 2004; Panesar et al., 2006; Trémolet et al., 2007b)

Different studies have demonstrated that fiscal gains from enhanced sanitation services surpass investments. Evans et al. (2004) for instance, found out that annual investments of US\$ 20.5 million in Tanzania and US\$ 96.7 million in Vietnam would yield benefits of US\$ 15.4 million and US\$ 66.7 million respectively for the health sector alone. Hutton and co-workers (2007c) calculated that the economical losses associated with lack of sanitation in Cambodia, Indonesia, Vietnam and the Philippines add up to US\$ 9 billion yearly – about 2% of their combined gross domestic product (GDP). Of that sum, they estimated US\$ 6.3 billion could be saved annually if proper sanitation and hygiene practices would be introduced. Additional work by Hutton and collaborators (Hutton & Haller, 2004; Hutton et al., 2007a) showed that benefit of various scenarios of global water and sanitation improvements (meeting at least the MDGs) exceed costs by a ratio range of 5 to 46. These gains are attributed mainly to time savings due to loss of work and school days. Complementary sensitivity analyses conducted by these researchers have shown that even under pessimistic scenarios the benefit-cost ratios do not drop below 1. In a later version of this study (Hutton et al. 2007b) that considered only low-cost interventions for countries that off-track to meet the water and sanitation MDGs, the benefits of improved water supply were expected to be half of improved sanitation solutions, which included septic tanks, simple and ventilated improved pit latrines (VIPs). The higher average benefit-cost ratios of sanitation (9.1 for the MDGs and 11.2 for complete coverage) as opposed to water interventions (4.4 and 5.8 respectively) were ascribed to greater savings related to health and convenience time. The researchers stressed however, that investment in sanitation is more expensive than water.

2.2.3.2. Costs of conventional systems

It is difficult to deliver a concise account on the costs of conventional sewer systems as these are highly variable and site-specific. Therefore, such cost appraisals only offer a general idea on the magnitude and should be treated with caution. Fonseca (2007) estimated the annual per capita sewerage connection costs to lie between US\$ 24-260, however treatment costs and expansion of infrastructure can considerably increase these costs. Fonseca adds that on-site solutions tend to be much more cost-effective, with annual per capita costs of US\$ 11-54 for a simple pit latrine, US\$ 10-172 for a VIP latrine and up to US\$ 799 for septic tank. Data provided by the WHO and UNICEF (2000) indicate that average per capita construction costs of sewer connections or septic tanks in developing countries are higher (US\$ 115-160) compared with pour-flush toilets (US\$ 50-90) and simple or VIP latrines (US\$ 39-60). Annual per capita running costs of these systems were estimated by Hutton & Haller (2004), reaching in average US\$ 5-13.4 for sewers, US\$ 9-12.4 for septic tanks, and US\$ 4-6.4 for latrines. Pinkham et al. (2004) carried out an in-depth cost analysis of on-site systems compared to centralised systems in the USA. They demonstrate through numerous case studies that investment, O&M and opportunity costs of decentralised systems can be more affordable, especially for small communities. Shilton and Walmsley (2005) present typical O&M costs of wastewater treatment methods that reduce organic matter and nutrient loads. Prices per 100 m³ of sewage may be as low as US\$ 2-10 (for mechanical treatment, flocculation and others) or as high as US\$ 60-100 (for activated carbon absorption or ion exchange). Although, several methods are often incorporated to reach the desired effluent quality, Shilton and Walmsley argue that pond systems can be the single most cost-effective solution if land costs are not high. A comprehensive review of different treatment configurations was undertaken by von Sperling and Chernicharo (2005). Their findings confirm that although pond systems require much space, they can provide good performance for relatively low investment (15-40 US\$/person) and recurrent costs (0.8-3.5 US\$/person and year). Further information on conventional systems is given in the next section. Euler et al. (2001) compared the investment and recurring costs of pond systems, activated sludge and UASB reactors for a population equivalent of 50,000 with and without the expected returns from energy gains. Considering only BOD₅ as the discharge standard and assuming (among other things) land prices of US\$ 25/m², the UASB technology (anaerobic treatment) was the most cost-efficient option. These researchers argue that investment and running costs of anaerobic treatment are normally lower than those of activated sludge systems and also of pond systems if land prices are above US\$ 10-12/m².

Randall (2003) depicts the economic damages of eutrophication of the Chesapeake Bay estuarine in the USA caused, among other sources, by sewage effluents. The enormous decline of some aquatic biota populations decreased the productivity of fisheries and resulted in the layoff of thousands of employees. Randall gives other examples for losses to fisheries due to nutrient pollution. A successful effort to improve the sustainability of 11 wastewater treatment plants in the Chesapeake Bay region (in the Virginia Peninsula) was the introduction of an enhanced biological phosphorus removal process. The nutrient rich sludge is composted and sold locally at a price of US\$ 18.3 per m³, and state regulations ensure its proper usage to minimise runoff pollution.

Alternative sewer systems (condominial sewers) with short length, small diameter pipes laid at shallow depths and gentle slope have been tested in Latin America. Savings of about 45% on construction and maintenance can be reached by condominial systems in Bolivia, while at Brazil even cutbacks of 60-80% have been reported (Watson, 1995; Foster, 2000). In an additional economic analysis, Foster shows that (assuming current tariff charges) a condominium sewerage connection in Bolivia can be 30-40% cheaper than a conventional one. Leal (2004) investigated construction and recurring costs of several sanitation concepts for the Al Moufty Al Kobra village in Egypt. She concluded that several source separation alternatives using small bore sewers would be the cheapest options, as opposed to conventional and vacuum sewers.

2.2.3.3. Costs and benefits: conventional vs. reuse-oriented systems

Several researchers have conducted comparisons between ecological sanitation and conventional systems on a monetary basis. Panesar et al. (2006) acknowledge that few economic studies on ecological sanitation are available and that most of them deal with pilot or demonstration projects, which are not reliable indicators for costs analysis. Such projects normally incur additional expenses on promotion, educational activities and production of unique system elements. The researchers nevertheless claim that results indicate that ecological sanitation systems have economic advantage over conventional ones, and stress the importance of using extensive multi-criteria analysis as a common basis for a fair comparison. Unfortunately, most of the researchers that are cited in this section have only considered tangible costs and most benefits (with respect to environment, health etc.) have not been quantified.

UNEP and GPA (2004) developed the concept of the sanitation ladder, which ranks sanitation intervention levels according to their investment and recurring costs per person. Rockstroem et al. (2005) took this chart and added for comparison purposes, the costs of ecological sanitation alternatives from projects worldwide (Table 2, below). Table 2 demonstrates that urban

ecological sanitation systems may cost the half of other centralised systems and even less as an on-site alternative. It should be kept in mind that these researchers considered only the first year of operation in their calculations. Rockstroem et al. (2005) also estimate the per capita yearly costs of providing ecological sanitation in developing countries to range between US\$ 0.5 to 1 for rural areas, and between US\$ 7 to 30 in urban settings. It however is not clear what these costs include and which kind of systems were considered. These sums are equivalent to less than 0.2% of domestic GDP in the developing world, rendering it affordable for households.

TABLE 2
Sanitation cost ladder for conventional and ecological sanitation systems

[Costs include initial capital costs and O&M for the first year of operation]

Conventional Sanitation (sourced from UN Millennium Project, 2005; original source UNEP, 2004)		Ecological Sanitation (various sources see below)		
		Estimated cost per person (USD) incl. operation and maintenance	Estimated actual initial capital cost per person (USD) and household incl. operation and maintenance (hh size is 4.5 unless otherwise given)	Method
Mainly Urban	Tertiary wastewater treatment	800	340 (1190 per hh) (China, hh size 3.5)* (source: Dong Sheng EcoSanRes Programme)	Urine-diverting high standard porcelain dry toilet (indoor and multistory); piped urine system, dry faecal collection and composting, decentralised piped grey water treated using septic tank, and aeration treatment; local collection and transportation costs included
	Sewer connection and secondary wastewater treatment	450	330 (1500 per hh) (Sarawak)* (source: Mamit et al, 2005)	Conventional indoor toilet with sealed conservancy tank, black water collection by truck; local biogas digester; decentralised piped greywater treated using septic tank and vertical biofilm filter technique
	Connection to conventional	300	150 (675 per hh) (estimated)	Indoor dry single-vault urine-diverting pedestal toilet;

	sewer (assumed without treatment)			decentralised piped greywater treatment using constructed wetland; local transportation included
Mainly peri- urban	Sewer connection with local labour (assumed without treatment)	175	88 (400 per hh) (South Africa) 25 (110 per hh) (Mexico, El Salvador, India, South Africa, Zimbabwe) (source: Morgan, 2005)	Dry single- or double-vault urine diverting squatting pan or pedestal toilet with permanent upper housing structure; greywater treatment using on site infiltration pit; transportation assumed as local labour
	Septic tank latrine	160	12 (55 per hh) (source: Lin Jiang, Nanning, Guangxi, China)	Dry single or double-vault urine diverting squatting pan or pedestal toilet (LASF or Skyloo) with permanent upper housing structure; greywater treatment and disposal onsite; local recycling
Mainly rural	Pour-flush latrine	70	8 (35 per hh) (West Africa) (source: Klutse & Ahlgren, 2005)	Soil composting pit with cement slab and simple upper housing structure (Arborloo or Fossa Alterna); grey water treatment and disposal onsite; local recycling
	Ventilated improved pit latrine	65	8 (40 per hh) (Zimbabwe, Mozambique) (source Morgan, 2005)	Soil composting shallow open pit; soil added after each use
	Simple pit latrine	45		
	Improved traditional Practice	10	3 (10 per hh) (estimated)	soil composting shallow open pit; soil added after each use

Source: Rockstroem et al. (2005)

* Initial cost calculations are based on ongoing large scale pilot projects

Shifting from the global perspective to specific case studies, Lechner and Langergraber (2004) investigated the cost effectiveness of three possible sanitation systems for rural villages in Austria. According to this study, a combination of low-flush and dry toilets with decentralised greywater treatment system are expected to have the lowest capital (€4,434) and operational (441 €a) costs per household, compared with conventional sewerage and treatment plant (€8,790; 620 €a) and with conventional sewerage system supplemented by urine separation, storage and reuse (€8,816; 700 €a). These estimations take into account present subsidising

practices without which households' investment and operation expenditures of both conventional systems would rise by about €6,000 and 600 €/a respectively, making the alternative solution even more attractive. Oldenburg (2007) compared the costs of a conventional sewer system with a decentralised sequencing batch reactor to 5 hypothetical ecological sanitation systems in a residential urban area of 4900 inhabitants in Berlin. He considered investment, reinvestment and running costs over a lifetime of 50 years with an annual interest rate of 3%. He found that one ecological sanitation system would be cheaper than the conventional one – separate urine collection (emptied by lorries) and mixed collection and treatment of brown- and greywater in a sequencing batch reactor. Although all new sanitation systems would enjoy 13-17% lower O&M costs, their investment costs may rise by 25-60% due to 1.7-2.4 times longer pipework (particularly critical for 3-stream systems) leading to overall costs that are 3-13% higher. Additional sensitivity analyses conducted did not influence this trend. However, if served by another water utility operating outside of Berlin, which charges higher water and wastewater fees, all 5 ecological sanitation concepts become considerably cheaper. In his doctoral dissertation, Schuetze (2005) analysed alternative water and wastewater systems (rainwater harvesting, greywater reuse, urine separation and vacuum toilets) for existing buildings in Hamburg and Seoul. He found that in Hamburg, user fees (as a function of investment and running costs) would be equal to the existing ones, while in Seoul they would be twice as high as current charges. He concludes that the structure of the fees and their subsidised price (in the case of Seoul) hinder the introduction of these systems. Hiessl and Toussaint (2004) have evaluated three urban (waste) water management models for two German cities. They report that investment and recurring costs of separation and reuse of wastewater streams may be only slightly more expensive than the traditional system. However, after applying a multi-criteria analysis the conventional solution was deemed least desirable.

The Ecological sanitation Club (2003) compared expenses of flush toilets with a mechanical and vertical subsurface constructed wetland treatment with urine diversion dehydration toilets (UDDTs) and a horizontal subsurface constructed wetland system for a girls' school in rural Uganda. Investment, reinvestment, and O&M costs were calculated during a timeframe of 50 years with an annual interest rate of 8%. The results showed that the conventional system would be about 60% more expensive than the ecological sanitation alternative, mainly due to the more compact wetland system and the additional expenditures on pumping required for the conventional system. The researchers however estimated piping would cost the same for both variants which is doubtful and assumed for some reason 15 more UDDTs than flush toilets would be necessary.

According to Holden et al. (2004) urine diversion systems are more affordable compared to other contemporary solutions in South Africa. They have lower capital (ZAR 1,500) and running (0 ZAR/a) costs than VIP latrines (ZAR 2,000; 200 ZAR/a) or waterborne systems (ZAR 10,000; 1,200 ZAR/a). Zimmermann (2006) compared investment, reinvestment, and running costs of potential sanitation system in Syria over a period of 30 years. His results show that UDDTs or constructed wetlands could be €5-20 cheaper per inhabitant and year than oxidation ditches (the currently favourable option). The UDDTs alternative remains undoubtedly cheaper than constructed wetland as long as the number of served inhabitants is below 50,000. More information on costs of wastewater treatment in Syria is reported by Mohamed (2006). The estimated construction (13.9 €/capita) and annual running (~1.0 €/capita) costs of a constructed wetland treatment serving 7,000 people are significantly lower than those assessed for the conventional alternative (200-250 €/capita and 50-100 €/capita, respectively).

Mayunbelo (2006) provides a comprehensive review on costs of VIPs (the common solution) and UDDTs for the entire population of Lusaka, Zambia's capital city. He found that both capital (€43.3 million) and running (2.8 million €/a) costs of UDDTs would be lower than VIP system (€47.7 million and 3.1 million €/a, respectively). The total costs for 10 years of operation in NPV would be €59 million for UDDTs compared with €65 million for VIPs. An additional sensitivity analysis revealed that the number of users per toilet would have a greater effect on investment than on running costs for both alternatives, while changes in the urine storage period would considerably influence investment costs of UDDTs (meaningless for VIPs). It is noteworthy that despite the rather short urine storage period (2 weeks) assumed for application in nearby agricultural lands, if at least some of the urine could be directly used by the households these costs would be reduced as storage is not necessary according to the WHO guidelines.

De Silva (2007) compared costs of UDDTs and VIPs in Accra (Ghana) based on multi-criteria analysis. Investment costs per capita are expected to be €39 for UDDTs and €27 for VIPs while annual operation costs (including transport, treatment and sale of by-products) were deemed similar (€2.2 and €2.1, respectively). A sensitivity test demonstrated considerable influence of the potential selling price of urine and number of users per toilet. Nevertheless the overall benefits of UDDTs with regard to economical, social, environmental, health, institutional and technical aspects were higher. Abaire and Shane (2007) report the substantially lower construction costs of an Arbroloo (soil-composting latrine) in rural Ethiopia (US\$ 5-12) compared with simple latrines (US\$ 33-46) and VIPs (US\$ 70-90), which led to a dramatic increase in the number of latrines constructed within the sanitation programme of the Catholic Relief Services Ethiopia. These researchers emphasise that the ability to plant healthy and

productive trees on the full pits motivates farmers to dig shallow pits in order to relocate the Arbroloo more often to maximise this benefit (see next section for fertilising value).

Ilesanmi (2006) examined six sanitation concepts for an area in a newly planned settlement (Kuje) in Nigeria, designated for 600 inhabitants. The results of his least-cost analysis indicate that the cheapest systems are low- or pour flush toilets with onsite Rottebehaelter treatment; low flush urine separation toilets and greywater separation with onsite storage, Rottebehaelter and constructed wetland treatment; UDDTs and greywater separation with onsite storage and constructed wetland treatment. The estimated overall investment and O&M costs (in NPV over 30 years) of these systems are in the range of € 2,000-2,300 and € 4,000-4,800 respectively, while the corresponding costs of conventional sewerage system with offsite treatment in ponds are expected to be approximately € 32,100 and € 214,000. It is however important to mention, that Ilesanmi did not calculate O&M explicitly but rather estimated them as 10% of the investment expenditures.

Olbrisch (2006) provides additional insights on costs of conventional and ecological sanitation systems in four African cities. In Durban (South Africa) for instance, construction costs are in the range of € 331-398 for a VIP, € 398-597 for urine separation toilets (depending on the size) and about € 928 for septic tanks. According to Olbrisch, emptying of septic tanks and VIPs is done every 5-8 years and costs € 133, while annual costs of urine separation toilets are € 3.30-4.65, rendering them very attractive. Investment costs per sewered connection are € 1,061-1,327 in the city centre (assuming one connection each 25m of sewer) and € 3,981-5,308 in the outskirts (connection every 500m). A fixed annual fee of € 53 per connection is levied on the users.

Etnier and Refsgaard (1998) have studied urine separation systems in rural regions and found them to be the most efficient sanitation method to avoid contamination from organic matter and nutrients and the most cost-effective one. Baten and Mels (2004) have compared the costs of advanced small waste water treatment plants with a source-separation system in rural regions of the Netherlands. While they estimate the investment costs of the ecological sanitation system to be 15% higher, its running costs are expected to be 25% cheaper.

2.2.4. Costs and benefits of different ecological sanitation systems

Some publications on planned or executed ecological sanitation projects describe the costs of introducing the new systems. Details on costs of various ecological sanitation systems from projects worldwide can be found on the project data sheets of the gtz-ecological sanitation

programme (GTZ 2005-2007). Unit prices of various models of urine separation toilets (GTZ 2006l), waterless urinals (GTZ 2005o) and compost toilets (GTZ 2006m) are also available in the technical data sheets. Additional data on average construction costs of urine separation toilets and Skyloo in Africa are provided by Jackson (2005).

The work of the Netherlands Development Organisation (SNV) has contributed much to the widespread use of domestic biogas systems at South-East Asia in recent years, which is now “invading” African markets. The report on phase 1 of the Vietnam programme (BPO, 2006) shows that with an institutional investment of US\$ 2.4 million, 18,000 biogas plants that save households about 5 €/month on energy expenses and 1-1.5 of daily working hours (spent on biomass collection), can be built. Other economic benefits include improved indoor air quality in households, formation of a biogas market, reductions in CO₂-equivalent gas (some 35,000–55,000 tonnes/a), diminished use of wood and fossil fuels and enhanced gender equality. Additional information on the Vietnam programme is available in Heedge (2005) and in Teune and Ma (2007). As part of the Biogas for Better Life initiative 2 million biogas plants, half of which with attached toilets, are planned to be built in Africa by 2020. Winrock International carried out an in-depth cost-benefit analysis of the programme in Uganda, Rwanda, Ethiopia and for sub-Saharan Africa as a whole (Renwick et al. 2007). They estimated attractive financial and economical benefit-cost ratios of about 1.2–1.35 and 4.5–6.8 respectively.

A financial and economic analysis of the veteran biogas programme in Nepal has been published by Bajgain and Shakya (2005). They estimate the annual fuelwood savings (some 6,790 hectares of forest area) of the 111,400 units installed at US\$ 4.8 million and 7.7 million litres of kerosene are saved annually at a value of US\$ 2 million. They also found that household save 3 hours of work daily and US\$ 21 annually on fertilisers through use of biogas slurry, and that 11,000 people have been employed during the project. The SNV and GTZ carried out feasibility studies to implement similar biogas projects in Bangladesh, Ethiopia, Rwanda, Burkina Faso and Tanzania (Nes et al., 2005; Eshete et al., 2006; Dekelver et al., 2005; Huba et al., 2007; Bos et al., 2007). Monetary benefits from reduced CO₂ emissions can be realised through Kyoto Protocol’s Clean Development Mechanism (CDM), which is further discussed in the next section. Snel and Smet (2006) offer additional information on construction and running costs as well as benefits from fuel generation and slurry use of domestic and community biogas plants in Bangladesh.

In India, public toilets with biogas plants have been constructed in different locations to serve poor and deprived populations. Hansen and Bhatia (2004) report that revenues from biogas facilities can recover the additional investment costs in 5-6 years, depending on whether gas will

be used on- or off-site (for more detailed calculations see Bhatia, 2004). Financial assessments of investment and running costs of two other projects of public and school toilets are presented by Wafler and Heeb (2006) and Macwan and Heeb (2006). Both appraisals show high return rates (on investment recovery, see next section) due to the biogas and fertiliser usage. However, it is disputed whether profits derived from the type of crop grown (bananas, in the case of Wafler and Heeb) should be included in the calculation since it involves additional determinants and complicates the calculation. It is simpler to use a surrogate indicator, i.e. the market price of the replaced fertiliser, as suggested by Hutton (2007). China is the nation where domestic biogas has flourished the most. While 15 million Chinese households were using this technology by the end of 2004 (Nes, 2006), newer estimations suggest a figure of 20 million households (Heinz-Peter Mang, personal information). Nes presents the village of Shipai as a case study, where households save € 63.5 annually on energy, fertilisers, work and enlarged livestock. Other benefits mentioned are improved health, employment for technicians and more free time for women.

Investment costs of UDDTs, double pit (or urn) toilets, three-chamber septic tanks and biogas toilets in rural China were reported by Li et al. (2007). Exact figures are not available since financial support was provided as construction materials in some cases while in school projects aggregate costs that include urinals and wash basins were reported. Rough investment costs per household for biogas toilets are in the range of RMB 1,700-3,700, RMB 400-1,300 for UDDTs and around RMB 700 for double urn toilets. Other forms of costs as well as the various benefits were not included in this report. Construction costs of a standard UDDT in rural China were also reported by Kumar (GTZ, 2007g) to be RMB 750. However by using alternative construction materials or building the toilet indoors, expenditure on the superstructure have considerably reduced resulting in a unit price of RMB 300-500. Shayo (2003) reports the construction costs of a UDDT latrine in Dar Es Salaam, Tanzania to reach US\$ 201. Like Kumar, Shayo mentions that these costs were lower when iron sheets, timber or thatch replaced cement in the superstructure, which constitutes up to 35% of the overall costs. According to UNDP/WSP-LAC/CENCA (2006), the capital investment of complete indoor lavatories equipped with a UDDT, a shower, a urinal, a sink and a treatment unit (combined settling tank with grease trap and a reed bed) for greywater and urine in Lima, Peru is US\$ 603 and its typical monthly running costs are US\$ 4.5 per household. Of this sum, the UDDT cost US\$ 265, the urinal US\$ 10, the treatment unit US\$ 100 and the in-house piping US\$ 30.

Prihandrijanti (2006) investigated three sanitation schemes for poor urban areas in Indonesia. The analysis showed higher cost-benefit ratios (NPV adjusted) of two different alternatives of

source separation of wastewater streams with on-site treatment (urine storage, Rottebehaelter with vermin-composting and baffled septic tanks or anaerobic digesters) than that of a centralised (shallow) sewer system with off-site treatment in Imhof tanks. Additional sensitivity tests demonstrated that despite the influence of changes in variables, the ranking of alternatives remains the same. Slob (2005) conducted a detailed study on the logistical aspect of excreta collection and transport from UDDTs in a low-income community of 8000 in Delhi, India. Slob estimated that using a tractor trolley equipped with a pump would be the most cost-effective method to mobilise urine at an investment cost of about €14,000-40,000 and total yearly costs (capital costs, O&M and labour) of €29,000-97,000. The monthly costs per household would then be in a range of €0.3-1 which may match the estimated WTP of around €0.4. Slob expects that dried faeces would be most efficiently transported by an unmotorised tricycle, which investments costs were appraised at €1,500 and total annual costs of €5,300 that are equivalent to a monthly payment of €0.07 per household.

Hutton et al. (2007c) estimated that Cambodia, Indonesia, Vietnam and the Philippines could generate US\$ 271 million annually from biogas and fertiliser production if different ecological sanitation systems would realise their potential market share. Rockstroem et al. (2005) computed the nutrient value of human excreta of the designated MDGs target group between the years 2003-2015, which could amount to an overall value of almost US\$ 3 billion. This corresponds to a mean annual per capita value of US\$ 0.5-5.5, which can contribute significantly to cost recovery in rural areas. In peri-urban and slum areas of Southern Asia this value can be as high as US\$ 10 per person, making ecological sanitation even more attractive. Etnier and Refsgaard (1998) estimated a similar fertiliser value of human excreta of about US\$ 5 per person annually (Pinkham et al., 2004). Abaire and Shane (2007) evaluated the annual fertilising value of urine alone to be US\$ 5 per capita which can replace 23 kg of mineral fertiliser (14 kg of diammonium phosphates and 9 kg of urea) for application on a 900 m² plot. Oldenburg (2007) compared the value of urine with chemical fertiliser taking into consideration the costs of agro-mechanical application in vicinity of Berlin. Although they estimated urine application to be almost 4 times more expansive, urine is still expected to generate a net benefit of 1.9 €m³. They also appraise the value of compost from faeces to be 60 €m³. Renwick et al. (2007) estimated the fertiliser value of biogas slurry to the economies of sub-Saharan Africa, assuming the low usage of mineral fertiliser in the region is negligible in financial terms, to be in the range of US\$ 181-463 per plant and year.

The economic value of untreated urban wastewater reuse in the Guanajuato river basin, Mexico was investigated by Scott et al. (2000). They calculated annual savings of US\$ 135 per hectare

(US\$ 18,900 for all 140 hectares) on commercial fertiliser and an annual value of US\$ 252,000 for the water use. Costs of treating this sewage in a treatment plant are expected to be significantly higher than the current application. Health and environmental impacts were not surveyed in depth, and should be followed up. Initial analysis shows risk of eutrofication in the receiving water body, whereas accumulation of Nitrogen in groundwater and heavy metals in soils was deemed low. Although no clear indication of negative health impacts from pathogens were observed in the Guanajuato basin a detailed study was not undertaken.

A project in a suburb of Tufileh, Jordan, has set up greywater reuse systems for home gardens at 50 low income families (Faruqui & Al-Jayyousi 2002). An economic evaluation of the system found that average benefits equivalent to 10% (US\$ 308) of the annual household income were generated through crop consumption and sale. The value of the recovered greywater as replacement for irrigation water corresponded to 27% of the average water bill. The mean net annual benefit (considering the associated costs) of four households was estimated at US\$ 376 with a benefit-cost ratio of 5.3. It seems however, that the systems were in most cases comprised of basic diversion devices with no or very rudimentary treatment.

Gross et al. (2007) evaluated the economic feasibility of a greywater reuse for garden irrigation treated by a recycled vertical-flow constructed wetland for garden irrigation in southern Israel. With estimated monthly savings of US\$ 20 on irrigation the investment cost (US\$ 600) and annual O&M costs (US\$ 100) are expected to be covered in 4 years time. Friedler and Hadari (2006) have studied the economic feasibility of urban greywater recycling for toilet flushing in Israel when using a membrane bioreactor (MBR) or a rotating biological contractor (RBC) technology. Reasonable investment costs for RBC systems (0.5% of an apartment's price) were found for 5-storey buildings, while O&M costs can be covered by water savings in 7-storey buildings. MBR systems may only be economic under Israeli water prices when serving a cluster of buildings.

2.2.5. Funding

Although commonly viewed as a public service, many governments and municipalities typically only provide the initial capital for centralised urban sanitation systems that serve a fraction of the society, so that the majority of households must finance in-house and on-site installations on their own (Trémolet et al., 2007a). Some countries do not wish to rely on their national budget alone and allow the involvement of private companies in order to raise additional funds. Fonseca and Cardone (2005) present data on water and sanitation funding in developing countries from the year 2000. Local resources still comprised the lion's share (65% from the public sector, 19%

domestic private sector) followed by international aid (12%) and the international private sector (5%). While Trémolet et al. (2007b) provide similar figures, they underline that these are merely rough estimations. According to the WHO and UNICEF (2000), external support accounts for 35% of annual investment on sanitation and over 80% for water supply in developing countries (private investments were not accounted for). Both Trémolet et al. (2007b) and WHO and UNICEF (2000) mention that the degree of reliance on donor funds varies among the nations, the African countries tend to be the most dependant ones.

Planning of initial and future financial resources is required to ensure the construction, expansion and contentious operation. Pinkham et al. (2004) argue that principle issues of financial planning should be addressed before any cost evaluations. In order to guarantee the system's sustainability, recovery of associated costs is to be attained. Should only financial or rather economical costs (and benefits) be considered? Some ecological sanitation publications deal with the so called "financial internal rate of return" (FIRR), while others look at the "economical internal rate of return" (EIRR) as well. Examples for both applications can be found in: Pokharel & Gajurel 2003; Bajgain & Shakya, 2005; Dekelver et al., 2005; Nes et al., 2005; Eshete et al., 2006; Wafler & Heeb, 2006; Macwan & Heeb, 2006; Bos et al., 2007; Huba et al., 2007 and Renwick et al., 2007. Several researchers (Franceys et al., 1992; Bockelmann & Samol, 2005; Cardone & Fonseca, 2003) underline the importance of identifying all costs and funding sources and provide a description of them. Nonetheless, even researchers that look at the macroeconomic scale limit their calculations to few tangible cost factors. One exception is the work done by Renwick et al. (2007) that considered the value of domestic biogas in terms of heath, fertiliser use, reduced greenhouse gases and deforestation, among other things. They estimated a FIRR of 7.5–10% and an EIRR of 80–180% for the Biogas for Better Life programme in sub-Saharan Africa.

How should costs be covered and by whom? While it is generally accepted that end users should pay for running costs, the extent to which investment costs are to be paid by consumers, if at all, is disputed (Cardone & Fonseca, 2003). Sanitation fees or taxes levied on households are the usual ways to raise this money. Unsurprisingly, median sewerage tariffs are lower in developing countries, reaching 0.1-0.2 US\$/m³, while they may be 2 to 6 times higher in North America and Europe (WHO/UNICEF 2000). Hansen and Bhatia (2004) give some examples of tariffs in developing countries that are too low and therefore fail to ensure proper operation. The different types of tariffs, methods to determine tariff levels and means of collection are discussed by Brikké and Rojas (2003), Bockelmann and Samol (2005) and Cardone and Fonseca (2003).

Another common financial tool in sanitation is the utilisation of subsidies. Subsidies may encourage investments in sanitation by the private sector through custom duty exemptions or tax reliefs (Bockelmann & Samol, 2005). Subsidies may also be introduced to assist low-income populations that cannot afford to pay for sanitation services by themselves. There are ample examples of applying subsidies in (eco)sanitation projects (Wright, 1997; Hansen & Bhatia, 2004; Bajgain & Shakya, 2005; Dekelver et al., 2005; Nes et al., 2005; BPO, 2006; Eshete et al., 2006; Snel & Smet, 2006; Huba et al., 2007; Bos et al., 2007). However, improper design of subsidies may create market distortions and result in inefficient allocation of resources (Brikké & Rojas 2003). Against this background, there has been growing criticism on the misuse of subsidies in water and sanitation projects. Data from Briscoe (1995) demonstrate that the rich are those who benefit from subsidised sewerage in Latin America. Interestingly, he also observed that the gap increases in poorer countries, when subsidies are high and when sanitation is concerned. Wright (1997), von Hauff and Lens (2001) as well as Trémolet et al. (2007b) subscribe to this viewpoint too, mentioning that the better-off segments of society are often those benefiting from such subsidies. Participants in the evaluation surveys of the first phase of the Vietnamese biogas programme suggested that more emphasis should be given to impoverished households (BPO, 2006). In the second phase of the programme (perhaps as response to this criticism), three levels of subsidies that match households' economic status will be offered (Heedge, 2005). Another argument against subsidies is that they discourage social responsibility and lead to negligence since they decrease users' sense of ownership (Brikké & Rojas, 2003; Eshete et al., 2006). Mehta and Knapp (2004) mention for instance, the 1.7 million subsidised toilets built in rural Maharashtra, India, of which 43% are unused. This critique does not mean that subsidies need to be denounced, rather that their customary design be altered when necessary.

There is a growing awareness to the benefit of assessing and involving the direct beneficiaries in the financial planning of sanitation systems (Briscoe, 1995; Wright, 1997; Brikké & Rojas 2003; Hansen & Bhatia, 2004; Cardone & Fonseca, 2003; Mehta and Knapp, 2004). When consumers' opinion is not taken into account, it may result in low cooperation, unused toilets and costs that are not recovered (Wright, 1997). A demand-based approach in the planning process, in which stakeholders voice their needs and wants, is therefore promoted (Wright, 1997; Cardone & Fonseca, 2003; Brikké & Rojas 2003; Trémolet et al. 2007b). Kar and Pasteur (2005) recount the success of their Community Led Total Sanitation (CLTS) approach which was pioneered in Bangladesh and spread through South East Asia. CLTS drives communities to become aware of and responsible for their sanitary conditions, design and implement solutions by themselves

without external subsidies of hardware. A financial facility may provide funds and financial management support for sanitation projects designed by local communities as in the case of the Community Led Infrastructure Financing Facility (CLIFF) in India (Trémolet et al. 2007b). Additional examples for such models are provided by Mehta and Knapp (2004), who urge to shift the financial weight towards promotion and resource leveraging activities. Some studies confirm the link between successful cost recovery and public participation expressed by a high WTP for specific sanitation technologies (Wright, 1997; Brikké & Rojas 2003; UNEP/WHO/UN-HABITAT/WSSCC, 2004, Trémolet et al. 2007b).

A financial instrument that has gained considerable popularity in recent years is microcredit. Micro-financing enables poor populations who do not qualify for normal credit prerequisites access to small loans, typically characterised by high interest rates and short reimbursement periods (Bockelmann & Samol, 2005). One acclaimed microcredit scheme innovated by Prof. Muhammad Yunus and his Grameen Bank (awarded 2006 Nobel Prize) in Bangladesh, enjoys a 95% payback rate through collective borrower responsibility, focus on female clientele and denial of collateral (Brikké & Rojas, 2003). Briscoe (1995) points out the increasing involvement of the Grameen Bank in rural water supply, lending some US\$ 16 million for this purpose in 1993. Examples of micro financing in sanitation projects can be found in: Wright, 1997; Foster, 2000; Cardone & Fonseca, 2003; Kouassi-Komlan & Fonseca, 2004; Bajgain & Shakya, 2005; Nes, 2006 and Snel & Smet, 2006.

As mentioned before, an additional potential source of support of sustainable sanitation is available to developing countries through the CDM. Since CDM is relevant to projects that can demonstrate a reduction of greenhouse gases, the immediate candidates would be biogas sanitation projects. Here are some examples for projects that are CDM-approved (In Nepal - CDM Executive Board 2005a & 2005b), about to be approved (Vietnam - Heedge 2005; CDM Executive Board, 2005c) or consider CDM financing in the planning process (other SNV or gtz biogas projects - Eshete et al., 2006; Dekelver et al., 2005; Huba et al., 2007; Bos et al., 2007). Experience from different sanitation biogas programmes show that each biogas digester may save 2-5 tonnes of CO₂ annually (Yapp, 2006) and gains will depend on the carbon market prices and the type of credit gained (Bos et al., 2007; Huba et al., 2007). It is noteworthy that a certain amount of CO₂ reductions must be achieved in order to cover the expenses related to participation in the CDM (preparation, monitoring, certification etc.) which may exclude small scale projects (Yapp, 2006; Bos et al., 2007; Huba et al., 2007). Bos et al. (2007) and Huba et al. (2007) calculated yearly earnings per biogas plant in the first 7 years of operation of €14-84 and €6-60 respectively. Heedge (2005) estimated that the Vietnam project may generate revenues of

€46.3 million however since CDM revenues are only available upon delivery (after reduction has been achieved) and due to the uncertainty concerning the future commitments of the second Kyoto phase, only about €16.7 million can be guaranteed at the moment. Heedge also calculated that through CDM earnings, reimbursement period can be reduced from 4 to 3 years and that after 5 years the FIRR and NPV improve from 2 to 13% and from minus € 20 to € 41, respectively.

Some attention has also been given to the issue of faecal sludge management (FSM). Steiner et al. (2003) investigated several models of financial structures to solve the problems of delayed and/or manual emptying of pits, indiscriminate disposal of sludge and nonexistent markets for biosolids. Their proposal is to alter money flows, so that desludging service-providers would be paid upon disposal to landfills through sanitation taxes and subsidies in addition to being paid directly by households. Snel and Smet (2006) present a detailed account on FSM at the city of Kumasi (in Ghana) and also suggest a shift in financial management and money flows.

2.2.6. Summary and conclusions

Monetary evaluation of sanitation systems involve several difficulties due to long-term planning horizon, impact of local conditions on costs, complexity of assessing externalities, variety in choice of methodologies and definition of system boundaries. Although sanitation services are deemed expensive, many studies demonstrate that investing in sanitation is economically worthwhile and can become more affordable when innovative technologies and financial mechanisms are introduced. The degree to which the aforementioned economic benefits could be realised (or losses mitigated), depends on the sanitation method and design. Nevertheless, although the main impacts on society are external, most evaluations of sanitation systems focus on the financial aspects alone. Therefore, one of the central issues that needs to be addressed is finding systematic scientific methods that assess the true value of sanitation interventions to society that can be widely acceptable.

2.3.0. Sanitation and the Need of Gender Mainstreaming

Gender mainstreaming is a strategy that involves integrating the experiences and knowledge of men and women in the designing, implementation, monitoring and evaluation of policies and programmes in all social, economic and political spheres to ensure that benefits flow equally to both genders (IRC, 1994). This approach has however not been used as a guideline by development practitioners and a UN report show that there is still a lot to be done to ensure women and the most vulnerable members of the society are fully empowered (UN, 2011).

Sanitation programmes have also failed to adequately address social influences such as those related to gender and power which have profound effect on women and empowerment. Women's need for increased participation in sanitation has been informed by a more traditional approach; as household managers, children bearers and environmental conservationists (Metwally et al., 2006). As a result necessities that women in their contexts have been availed but little efforts have been made to change their inferior status in society. For instance availing latrines within household reach to enable them undertake household roles, instead of challenging the norms that perceive women as household managers.

O'Reilly (2010) notes that women possess more knowledge about the environment and are therefore are better positioned to influence their children on sound environment and health management. Additionally, women have expanded social networks where they are able to discuss and share hygiene matters and other issues related to community health such proper child rearing behaviours (O'Reilly, 2010; Zwane & Kremer, 2007). It has also been argued that women spend more time in the homes and are more predisposed to use latrines more than other household members (Metwally et al., 2006). Involving women in sanitation programmes would therefore have the benefit of informing them the kind of sanitation facilities they require, their proximate location and their suitability for use by younger children (Wakeman, Water, Programme, Supply, & Council, 1995). Sanitation programme in using this information as guidelines technically argue that increased construction of latrines leading to reduction of faecal-oral diseases.

Other strategies adopted by sanitation programmes have increased women marginalisation because they reinforce traditional norms instead of empowering them. For instance, in a Nepal water and sanitation project, training women in hygiene awareness helped them improve the health status of their family. The men were trained as latrine artisans and this not only gave them a life time skill, but it also generated financial security as they were able to market their skills beyond their homes; an advantage that women hygiene skills could not offer (Regmi & Fawcett, 1999). A similar study done in Upper Egypt proposed that women and girls should be at the fore front to participate in promoting hygiene and sanitation in their communities because of their environmental sanitation and household health responsibilities (Metwally et al., 2006).

Additionally, sanitation related programmes have laid an emphasis on the importance of behavioural change as a key aspect that contributes to up scaling sanitation. Indeed, it has now and again been emphasized that the problem of sanitation in Africa is linked to behaviour and has little to do with technology (East, 2007). Metwally et al (2006) in their Upper Egypt study

that involved 375 female village health workers found that environmental hygiene awareness was important for behavioural change. In this study an assessment of the knowledge, attitudes and practices done before and after training the health workers on health and the environment found that participants had increased awareness regarding personal hygiene such as the use of latrine. However, about 36% of them still considered open defecation as a good practice because of the benefits associated with human excreta as fertilizers and there was no change regarding the importance of hand washing before and after eating (Metwally et al., 2006). The study considered the importance of cross exchange visits and increased training as an important factor to increase environmental health.

Zwane & Kremer (2007) review argues that behavioural change Information; Education and Communication (IEC) materials should be geared towards meeting the cultural needs of the target population. Sanitation programmes should also perform evaluation on the language of communication to unveil the role of negative and positive messages on modifying behaviour change (Zwane & Kremer, 2007). For instance, in Indonesia, children used songs to mock the villagers they caught defecating in the open and this diminished opportunities to repeat the behaviour. Not only is the mode of communication important to inculcate behaviour, but attention also needs to be paid on how they reinforce traditional roles of women as opposed to offering women a choice in life. In India, for instance, women used songs to encourage people to build latrines and chanted that they preferred husbands who had the ability to build latrines for them (Pardeshi, 2009). This kind of approach can reinforce traditional norms of husband – wife relation in which women are seen to depend on their husbands for daily needs instead of empowering them to be self-sufficient (Cornwall, 2003).

Gender construction and ideologies influence sanitation differently depending on the cultural orientation of the people. These ideologies not only affect men and women differently but are also distinct among women as a social group. In Rajasthan, India, class and status defines women's seclusion whereby upper caste women are expected to confine themselves to their homes while their men undertake public activities such as fetching water and attending community meetings. Women of lower caste can however appear in public spaces and are laden with responsibilities that pertain to domestic needs (O'Reilly, 2010). Therefore, constructing latrine for the caste system reinforces seclusion for the women in upper caste. In her Benin study, Jenkins (2005) found that latrines construction helped retain the status of the Royal Fon family particularly to the women whose appearance on public places was forbidden. However, to other members who were not from the Royal family and particularly people from the rural villages, availability of latrine in the villages helped them retain identity with people from the

urban whose use of latrine is a norm and a sign of status. Given that in Benin, men unlike the women were more likely to be connected to the cities in search of employment, they took up the responsibility of enhancing latrine construction in their villages to maintain rural-urban relationships. Elsewhere, maintaining good hygiene indicates the characteristics associated with good motherhood for the family and children and women are more likely to adhere to proper hygiene norms so as to maintain this status (Rheinlander, Samuelsen, Dalsgaard, & Konradsen, 2010)

Unequal gender and power relations can also influence the choice women make concerning their hygiene behaviours (Movik & Mehta, 2010). In developing countries of Africa for instance, technical work is perceived to be a male domain as it requires more skills and energy with the work women do being perceived as simple and less demanding tasks and deserving lower if no economic significance (Janice, 1989; Sen, 2001).

Feminization of female poverty is further reinforced through cultural and the institutional frameworks whereby women are largely concentrated in informal employment that widens income disparities between them and men while increasing their childbearing, nurturing and household responsibilities. Yet to a woman, economic empowerment may even be more significant because they are more concerned with the welfare of their family and children. Razavi (1998) asserts the need to involve women in programme related work that assures them quality work that has the ability to raise them and their dependents out of their prevailing poverty. A Ugandan project that committed itself to training women in masonry work that was culturally perceived as a men's job had the benefit of increasing women's self-esteem and doubling their income and thus enhancing their capacity to educate their children and maintain household food requirements (Payne, Nakato, & Nabalango, 2008). Indeed a World Bank evaluation of about 122 water and sanitation projects found that women's involvement increased the effectiveness of the projects by six to seven times more (United Nations University, 2010).

It has been pointed out that exerting influence over vital sanitation resource is an effective way of tackling poverty (GWTF, 2004). Yet in most parts of the developing world women have no control over land resources and decision making regarding use, ownership and control is likely to favour men (Flintan, 2008). A Bangladesh study observed that in one case, a husband was more concerned with installing a tube well from his savings and the wife had to sell her asset and hand over the money to her husband to install a latrine (Movik & Mehta, 2010). Increasing women's control over household resources has been associated with greater economic benefits than men largely because they tend to be more transparent (Ayuko & Chopra, 2008). Furthermore, in

Africa, if resources were equitably distributed between men and women, household incomes would increase by 25 % (theguardian.co.uk, 2011).

Over the last decades various ways of enabling enable women to increase their economic capacity have been adopted; among them being establishment of microfinance programmes (MFP). It has been argued that women are better off managing microfinance because they are more credit worthy and accountable than men (Ayuko & Chopra, 2008; Pronyk, Hargreaves, & Morduch, 2007). MFPs have been found to be more favourable to the poor because they do not require collateral evidence (Coppock et al., 2005; Creighton et al., 2006). Also small loans provided through these initiatives cushions against financial crisis and in times of adversity such as during illness when the need to attend hospitals and buy medicines is inevitable. Such monies can also be used to support food purchases and this counters malnutrition. A longitudinal study done in Ghana to assess the nutritional benefits from microfinance in which comparisons were made between participants and non-participants from the same community were compared with control groups from another community found that those communities who had access to microfinance reported lower episodes of stunting and wasting among infants (Pronyk et al., 2007). Integrating MFPs with hygiene promotion and sanitation can have great significance in maximizing the health benefits though this idea has not been fully exploited (Kouassi-Komlan, Fonseca, & Faso, 2004). Studies have however confirmed that when health education and services are linked with the economic activities that most MFPs dwell on, there is an increased gain in the outcomes related to increased management of child diarrhoeal diseases and effective breast feeding behaviours (Pronyk et al., 2007).

The study conducted by Mitik and Decaluwe (2009) in South Africa shows that women, in particular, spend a considerable proportion of their time in the household's common sanitation related activities such as fetching water, harvesting fodder, and collecting firewood especially in rural areas of developing countries. They further suggested and concluded that for ensuring the success and sustainability of any sanitation programme women must be given enough space and opportunity to take active part in it.

Joke Muylwijk (2006) in his study "A gender approach to sanitation, for empowerment of women, men and children", highlights three important concepts such as gender, gender ideology and empowerment related to sanitation sector. According to Muylwijk empowerment has four interdependent elements, which are the social, the economic, the political and the physical aspects. In sanitation all four elements are strongly presented. The study highlights that though women are the worst victims of poor sanitary situations but they are the most important actors in

this field. They have the responsibility, the understanding and knowledge and the most interest in clean facilities and the health of the families. He concludes that in finding solutions for improved hygiene and sanitation need to take gender ideology into account. Participation, of all stakeholders is often suggested as a solution for sanitation programmes, but it is only adequate if the prevalent gender ideology is taken into account. They need to be involved as main actors. And men need to be involved too, because all should be responsible, not just women.

The study of Ilahi (2000) suggests that increased time spent in accessing water will significantly alter women's work patterns and have adverse impacts on income-generating activities. It has also been explored from the same study that women has always been a better manager in comparison to their male counterpart in the context of promoting the state of household level sanitation.

Reddy's (1999) study suggests that in villages of Haryana, on average, a woman spends 138 minutes per day to fetch water. In rural Andhra Pradesh, the average time spent by female household members each day for fetching water ranges from 0.84 to 1.31 hours. This study also observed that even illiterate women performs the role of a hygiene educator in better way than that of the literate male members of the same family; and this is more evident in the context of rural parts of Haryana and Andhra Pradesh.

2.4.0. The Need of Looking at Sanitation Policies and Approaches from Gender-Lens

Global policies over the last three decades provide a framework for understanding women's changing role. In 1981-1990 the UN declared this decade as the 'International Water supply and Sanitation Decade' that aimed at supporting women in their domestic water and sanitation provisioning tasks within their local communities and increasing their participation in project related activities. The Beijing – China Conference (late 1995) articulated the need to address the gender inequalities that was evident for women across all spheres through empowerment strategies mainstreamed in development programme (Maseno & Kilonzo, 2010). Later on the UN World Summit on Sustainable Development held in South Africa articulated the need to strengthen voices of women in decision making regarding water and sanitation because of the crucial role they play in enhancing sustainability (Regmi & Fawcett, 1999; Rosenquist & Emilia, 2005). Largely, Participatory Rural Action (PRA) tools have been used as an entry point to increase women participation and enhance their decision making power (Cornwall, 2003).

Despite some gains in gender equality there continues to be significant gaps especially in Africa (Maseno & Kilonzo, 2010) including the area of sanitation overly because the role of gender and power relations had not been given adequate attention (East, 2007; Movik & Mehta, 2010). Cornwall notes that such tendencies:

Often obscures women's worlds , needs and contributions to development, making equitable participatory development an elusive goal....and to make a difference participatory development must engage with questions of difference: to effectively tackle poverty, it must go beyond 'the poor' as a generic category, and engage with the diversity of women's and men's experiences of poverty and powerlessness (2004:p.5)

Mosse's (1995) account of a farming project in India in which women participation was sought to increase their role in natural resource management and enhancing their community decision making role provides practical example of PRA problems. In this project, meetings were held in the public and because these spaces were considered to be men's areas, women were denied the opportunity to articulate their concerns out of the fear that they were trending on men's spaces. Similarly, the events took place during day time when women were busy with household activities denying them a chance to participate, thereby maximizing opportunities and atmosphere where only men's concerns were likely to surface. Cornwall (2003) notes that although PRA tools are oriented towards addressing gender barriers, for instance the use of daily schedules, the fact that PRA tools are sometimes left to people who are more technically oriented and not social scientists may alter the need to pay attention to details regarding power and gender. Also lack of female personnel in such activities may further silence women's voice (Cornwall, 2003).

In Sub-Saharan Africa, social cultural norms that form the basis of gender and power imbalances may have a knock off effect in up scaling sanitation. Women in this region undertake household chores; cooking , cleaning, fetching water, taking care of young children defecation needs and assisting the sick and the elderly in their sanitation requirements too (Muylwijk, 2006) while men on the other hand only perform non-housework related tasks usually outside the home environment. It follows that during participatory exercises, women's above mentioned tasks may restrict their participation, thus creating a conduit that allows men to benefit more from sanitation related information and awareness and also where their views are likely to dominate (Sa & Larsen, 2008). However because women's work activities are more linked to handling and using sanitation facilities, their limited involvement predisposes them, their children and other

members of the family to sanitation related illness like diarrhoea (Creighton et al., 2006) therefore creating more poverty than solving it.

Gendered beliefs and norms are an important factor that should inform Total Sanitation strategies because they can have an effect on sustainability. Among the Luo community of Kenya existing cultural norms dictate that son-in-laws cannot share latrines with their mothers-in-laws (Avvannavar & Mani, 2008; Rosenquist & Emilia, 2005). Also, among the Maasai communities in Kenya, there is a myth that men do not defecate and this may render efforts to promote sanitation fruitless (Movik & Mehta, 2010). A considerable effort should be given to understanding how societal norms and beliefs enhance or impede promoting sanitation matters.

Even though Total Sanitation appreciates the involvement of women, the institutional norms and beliefs may disregard women views, others may allow them to hold nominal positions that require tedious tasks and/or reinforce their gendered selves (Ayuko & Chopra, 2008; McEwan, 2003). A Northern Kenya study cited a case in which a female committee member complained that she was not allowed to attend a Peace keeping meeting because rules dictated that only one female representative from her region should attend (Ayuko & Chopra, 2008). There is also the problem of conducting undemocratic process of electing women leaders against their will so that they support other externally enforced agendas (NGOs, their husbands) and this may disillusion their capacity to push agendas that address the needs of their fellow women (Regmi & Fawcett, 1999).

A critique of the literature on sanitation studies especially those relating to Total Sanitation, highlights a concern about the approach commonly used that tends to explain the problem through a medical /technological and community health lens thereby concealing the intersections of vulnerabilities that affect women in particular and, thus accounting for the failure to sustain sanitation programmes and policies (Cornwall, Lucas, & Pasteur, 2000; Mehta & Bongartz, 2009; Movik & Mehta, 2010). Alternative sanitation models may open up opportunities for increased women voices by encompassing sanitation within a broader perspective of improved well-being rather than overly emphasizing its disease prevention benefits. Women and girls may desire to preserve their femininity especially during their menstruation and pregnancy period. During these biological processes, female bladder loosens prompting women to continually relieve themselves and this requires that the latrine facility be safe, clean, accessible and offers privacy (Plaskow, 2008). These concerns are unlikely to surface within total sanitation where the language of communication instils shame and disgust to the community members instead of promoting a sense of worth and increased self-esteem. In her Benin study, Jenkins (2005) found

that both men and women derived their the need for sanitation from varying issues associated with non –health benefits such as the need for privacy, increased social status and enhancing ones dignity (UN Millenium Project, 2005). However this study affirmed that women were more concerned with privacy than men an observation that resonates with other studies done in India (Pardeshi, 2009) and Bangladesh (Movik & Mehta, 2010) whereby women participated in latrine construction initiatives because they wanted to keep off from public shame and preserve purdah (a custom in some Muslim and Hindu communities where women are required to maintain seclusion by covering themselves with clothing completely when they appear in public) in public areas.

Community based institutions are aspects that have been explored within participatory development with the belief they will involve all members of the community. Mostly, membership to these requires adherence to certain rules and norms. However women membership (which sometimes requires that one pays to be a member) may not be the only criterion that secludes them. There is the issues of being unable to give their opinions and influence decisions that work for their favour (Cornwall, 2003). In her study in India, Agarwal (2001) found that women in Joint Forest Management (JFM) groups were selected to be members without their consent and men determined who was to be chosen, thus denying women the chance to choose their own female representatives. Women representatives from these groups complained that during the meetings their contribution was ignored and most of the rules regarding forest management were formulated without their awareness, yet their knowledge on fuel and fodder collection was important for the regeneration of forests (Agarwal, 2001). When time to share the forestry benefits came, men controlled the process and the gains they got were diverted to areas that were not of concern to women such as youth groups, liquor or gambling. Angered by the disproportionate sharing of resources, women broke the forest rules and disrespected those who kept forest surveillance (Agarwal, 2001).

A great deal of problems that women encounter in the groups is embedded in the social structures of the society. Women especially from developing nations of Asia and Africa are confined to household roles with public spaces being deemed as men's territories. These seclusion norms may not only be imposed by others (men) but women internalize them as acceptable. Additionally, social norms portray a woman's image as shy, soft spoken and with self -efficacy and this may impede on their ability to speak in public (Agarwal, 2001).

Agarwal (2001) suggests that one of the aspects that influence women decision making power in community based organisations is the lack of attention to women role and therefore meetings

should be adjusted to suit their schedules. More importantly, she suggests, is to devise ways that enhance women's decision-making capacity through women's groups where women have the chance to access membership. Women groups create a 'critical mass' of vocal women thus providing them with an identity. The critical mass of women helps counter hegemonic beliefs by men and attention shifts from those of men to those of family concerns (Agarwal, 2001). During the women meetings women get encouraged to speak and raise their concerns, reinforcing their confidence and self-esteem and this flows over to not only their meetings but also in mixed groups. Cornwall (2003) contends that women representatives may not always speak for the majority of women and efforts should be made to select a female representative who is able to speak in favour of all women.

Sakuntala Narasimhan's (2002) study highlights that the absence of proper sanitation is affecting women's lives. The study depicts the suffering of women's in the absence of toilet is affecting women's lives as well as the worst victims of poor sanitary situations such as case study highlights that both rural and urban areas, women without toilets only go out to relieve themselves in the dark, because their gender ideology tells them that they cannot take the risk to be seen. Furthermore, some of the women affected by the limited access to toilet facilities resort to only solution available is to ensure that their need to use a toilet is reduced as far as possible which means that wait till the dark results in constipation and adapted diet and drinking habits, which give serious health problems. Evidence pointed out to conclusions that the absence of facilities is not merely because of poverty but also because of the cultural inhibitions and constraints regarding women's bodily functions. And that continues to be so, even today, in spite of all the advances that the female half of the population has chalked up in various fields.

Bowen (2007) in her study places a strong argument that improved Water Sanitation Hygiene (WASH) conditions can empower girls to attend school. To date, few rigorous studies have evaluated the impact of school-based WASH interventions on girls' educational outcomes. She further commented that so far (till 2006), no study has exclusively attempted to assess the impact of separate-sex toilets on girls' education in particular.

F.A. Akiwumi (2003) based on his research realises that sustainable water reform in developing countries calls for the participation of indigenous people, particularly women as major partners. However in practice it rarely occurs. Many problems arise because projects do not adopt a cross cultural and interdisciplinary approach in planning.

A study conducted by Bennett (2008) and his colleagues, explains the connection between water and gender for household use as well as in the context of irrigation, focusing on poor urban women, peasants and indigenous women. Attention has migrated from technical dimensions of water provision to the political and social contexts in which water management occurs. In many places where water is scarce, there is a direct relationship between power and water control. For gender equity to occur in the water sector the researchers recommend;

1. Project leaders recognize the heterogeneity of communities and be explicit about the water needs/uses
2. A one size fits all water policy does not work because water management is based on a panoply of intersecting social relations
3. Participation cannot be mandated by decree, instead profound cultural change must permeate all social actors
4. Fostering equitable water resource management requires the elimination of gender biases as a mechanism for increasing the effectiveness and reach of water sector investments and formal structures must be created to move this process forward.

Research conducted by Y.A. Braun (2010) investigates the effects of development policy on gender and food security. It analyses how one policy instituted by a large-scale multi-dam development project, the Lesotho Highlands Water Project (LHWP), affected women's food security in the rural highlands of Lesotho, southern Africa. This was a mitigation policy, aiming to ensure that the LHWP did not negatively impact on the people living in the area where the dams were constructed. However, ethnographic research suggests that the policy itself reinforced and exacerbated gender inequalities that affected women's ability to secure food, and put women at risk of food insecurity within their households. Once again we see that gender issues must be central to the constitution and implementation of development projects.

Through their research, Delgado and Zwarteveen (2007) present detailed ethnographic account of the struggles of two Peruvian women to gain access and control over water and land after having separated from their husbands. From these accounts, it becomes clear that strategies for feminist action cannot and should not solely be aimed at formal laws and policies. Important water powers also reside in day-to-day water management and control practices that are embedded in culture and partly manifested in customary norms and laws, and that occur in social domains that are not normally associated with water management such as the household. The researchers argue that identifying and understanding such non-formal water powers provides an

important additional entry-point for devising feminist water strategies. It helps to see day-to-day 'bottle-necks' that hinder more gender equity in access to and control of water and land, and that stand in the way of a more equitable and democratic water management. At the same time, a focus on everyday water politics can also reveal important sources of agency for women, resources that they can mobilize in support of their attempts to access and control land and water.

Researcher N. Ghosh (2007) through his paper 'Women and the Politics of Water: An Introduction' - makes an attempt to explore theoretical framework for reading the critical essays, narratives and poetry depicting women's struggles over water. Theories were used about capital accumulation, the commoditization of natural resources and women's bodies, bio-political state power, the state of exception, the bare life and the new imperialism. The author is of opinion that these theories illustrate the multiple yet specific ways in which the gendered politics of water plays out in different contexts.

M. Leite (2010) in his article titled 'After the summit: women's access to water and policymaking in Brazil' - argues that following the Earth Summit, Brazil has pursued an ineffective water policy agenda, which has undermined women's right to safe water and adequate sanitation. It sets out some examples of women's involvement in water and sanitation programmes, and argues for the integration of strong gender perspectives in public policymaking and water distribution systems. The article concludes that development projects are currently falling short on tackling women's complex needs and interests in relation to water.

Sultana (2007) in her study looks at the nature of water politics (pani politics) in the context of arsenic contamination of drinking water in rural Bangladesh. Pani politics is found to be a product of intersecting similarities and differences among women and men, where water comes to have material and symbolic power that people can exercise, which can lead to conflicts, marginalization and suffering vis-à-vis water. Gendered location makes a difference in arsenic contaminated areas, where gender differentiated impacts are being observed, in terms of water access, control and ramifications of water poisoning. However, gender has to be understood as intersecting with other axes of differentiation such as social class, age and geographical location, to understand the nuances and multiple ways that arsenic poisoning and water hardship affect lives of men and women in different ways. Attention to such differences highlights the variations in gendered hardships, labor, rights and resources vis-à-vis water, and the way that everyday politics comes to play a role in the ways that people negotiate their lives around water and arsenic in landscapes of social inequality and heterogeneity of arsenic contamination.

Sze (2007) in his essay 'Boundaries of Violence: Water, Gender and Globalization at the US Borders' examines cultural and literary representations of women and water along the US borders. He has made an attempt to analyze Linda Hogan's *Solar Storms* (1995) and Kem Nunn's *Tijuana Straits* (2004) to examine how conflicts over water and pollution are gendered in the context of globalization. Through a close textual reading of these novels in their social, political and historical contexts, he argues that water functions as a metaphor for border environmental and justice issues and their gendered dimensions in North America. Water landscapes and the struggles over water provide the backdrop for these texts because of the unique properties of water and environmental pollution to cross boundaries. In crossing political boundaries, water symbolizes the contested politics and the geographic and cultural spaces between nations and communities that hold unequal power. Water also represents complex forms of violence as a result of large-scale economic development, the cultural changes this development ushers in and their gendered effects.

Zwarteveen (1997) in his article notes the biggest implication to establishing legitimacy for women's needs for individual water rights is the astounding lack of recognition of women as irrigators and water users. He explains the failure of past strategies of demonstrating that women's needs for water are intrinsically different from men's thereby clearly demarcating a separate female water use domain has strengthened the notion that women as a group do not have to be treated as serious actors in the irrigation context—in short allowed women to be treated differently instead of as an equal.

2.5.0. Need for Inclusion of Women within Water, Sanitation and Hygiene Sector

Archer (2005) in his study, conducted in Ghana, focuses on sanitation as an eco-feminist issue, noting the interrelated cycle of women's involvement in water collection and inability to participate in politics, enjoy leisure time, or getting an education. In addition, the study explores that the inequality seen in Ghana is a result of British colonialism, with the role of water collection keeping women in perpetual poverty by preventing economic production. The study duly acknowledges that women need to be involved in all points, including involvement in policy, fair representation within communities etc.

A study conducted by F.S. Arku (2010) and his team with an aim to quantify the amount of time saved if there is access to clean water, in addition noting the positive effects on women when time is not spent collecting water – shows that the saved time would promote women's well-

being. This study suggests that interventions should focus on time components, as lines at dug wells, are often just as burdensome as walking kilo meters for water every day.

Brocklehurst and J. Bartram (2010), through their study explore the importance of clean water to mothers and their daughters, especially during their childbearing years. They observed that pregnant women in many areas are likely to have to carry water from a hand pump outside the home for their baby's delivery. Unsanitary conditions and unimproved water supplies also contribute to diarrhea and malnutrition among children who have been weaned from their mothers.

Devasia (1998) conducted her study involving women from 10 villages with perennial problem of adequate and safe drinking water. These remote villages are situated in the arid region of Vidarbha in the state of Maharashtra, India. The study findings showed that the endeavour to have safe and sufficient drinking water helped the women in fighting not only against poverty but also oppression, exploitation and human rights violation. Discussion and dialogue with men and women of the rural communities were the main methods used for data collection. The participatory research helped the women to realize that they too could be equal to men and advocates of rural sustainable development. The street plays and protests organized by the women and the consistent struggle for water created strong community awareness. The search for safe drinking water and water management by women had an all-pervading effect in all villages. The women also initiated programmes for social forestry and rain water harvesting to protect the environment. For the first time in the recent history of these villages, there was sufficient safe drinking water in seven villages during the summer months of 1997. Keeping in view the findings of her study, stresses that there are many implications of non gender focused policies and interventions and the rural female population is suffering the most. The nature and impact of safe drinking water are rooted in ideology i.e. notions about development, knowledge generation, and ownership of knowledge and the status, freedom, social justice, and power of women. Only when alternatives that are transformational and indigenous will occur from a top down approach to a more democratic approach that utilize decentralized planning and control and institutional arrangements – then only the involvement of rural women in sanitation projects can be ensured.

Geere and Hunter (2010) in their study utilized Linear regression modelling to identify significant correlations between potential risk factors and rating of perceived exertion (RPE) or self reported pain. Independent t-tests were used to compare the mean values of potential risk factors and RPE between sub-groups reporting pain and those not reporting pain. However, these

preliminary findings suggest that efforts should be directed toward eliminating the need for water carrying, or where it must continue, identifying and reducing risk factors for musculoskeletal disorders and physical injury.

Fisher (2008) in his study demonstrates the fundamental linkages between the United Nations' third millennium development goal (MDG) 'to promote gender equality and to empower women' and MDG 7 'to ensure environmental sustainability', with target 10 'to halve the proportion of people without access to safe drinking water and sanitation by 2015'. A synthesis of the evidence gathered for the Water Supply and Sanitation Collaborative Council (WSSCC) shows the connections between women's wellbeing and water supply, sanitation facilities and hygiene practice. The study shows that if women's interests relating to water and sanitation provision are at the centre of planning and implementation of programmes, this has a direct impact on women's life experience, their potential and opportunities. The study also explored the wide ranges of benefits that women use to enjoy, when they themselves are involved in the planning, implementation and operation of water supply, sanitation and hygiene programmes.

Gupta (2009) through his study shows that the existence of source of drinking water in rural areas is one of the most important indicators of development that reflects the economic prosperity of a village. Inclusion of these into monitoring and evaluation criteria for development and poverty is necessary. In addition, he finds that villages with a piped water supply have higher levels of household and per capita income in India, noting social improvement as well including high immunization rates, literacy, and contraceptive prevalence rates.

Saskia Ivens (2008) in her study examines the extent to which women have benefited from increased water access. She argues that while gender equality is crucial for the sustainability of water programmes, its advancement through water programmes has been limited. She calls for more impact studies and suggests the use of empowering participatory approaches.

O'Reilly (2010) with his study-findings stresses that - water supply and sanitation provisions are the key elements in progress towards the Millennium Development Goals (MDGs). Women's participation is considered integral to the sustainability of the projects created to meet these two MDGs. Bringing feminist and geographic critiques to bear on gendered approaches to improving sanitation coverage, the research indicates that latrine building and women's participation may be contradictory goals for sanitation projects, despite the fact that women are the target group for latrine-building interventions. The findings of the analysis suggest that attention must be given to latrine building as both a technical undertaking and a gendered political intervention.

Padawangi (2010) stresses that in regard to community driven development as a driver for change, women's involvement is integral. Women have higher stakes in getting an improved drinking water supply and ensuring system maintenance including elements such as: gender analysis, gender equity provision, women's active involvement in the dialogue and decision making processes and gender based data disaggregation in monitoring and management information systems. At the end of the study, the researcher was having the following suggestions for ensuring success to community-based sanitation initiatives:

1. repetitive visits to one village in the early stages of the rural sanitation project
2. convincing the male members of the society for promoting women's participation in sanitation project
3. women are needed to be convinced through home visits to overcome women's lack of participation in the public decisions.
4. audio visual materials to be used to overcome the low female literacy rate
5. community activists to be involved in rural sanitation program as catalysts of the mass-mobilization process

During their study, Rautanen and Baaniya (2008) observe that the Rural Water Supply and Sanitation Support Programme (RWSSSP) in Western Nepal trained more than 940 persons as village maintenance workers, local latrine builders, rainwater harvesting jar masons and water technicians. Of these, 116 were women. This study investigated the status of these women, years after the training, paying attention to the technical quality of work, personal attitudes, views of the family and community, and socio-economic impacts. The interviewed women were positive about the training and related work, 77% were working, securing full support of their family members.

Ray (2007) in her study finds that although gendered policy has been mainstreamed into the policy frameworks of many international agencies there is almost no documented evidence of donor agencies rescuing to fund a project on the grounds that gender policies of the donor were not being followed. In addition, she calls for the water sector to collect gender disaggregated data as their default practice and to work more collaboratively with the broader community of gender development and scholars.

Regmi and Fawcett (1999) keeping in view their study-findings, stresses on the need of integrating gender into water sanitation and management initiatives for ensuring their success. They further argue that when gender-component incorporation it is done, then the intervention

may contribute to greater gender equality in society and secondly will ensure that women's and men's needs are met fully and efficiently. Many drinking water projects continue to bypass women in the planning, design, and implementation monitoring and evaluation process and pay too little attention to the links between technical change and social relationships. The researchers also suggest that status of women and access to water, sanitation and hygiene should not be seen as mutually exclusive, and rather they enforce each other since a country's development depends on the active participation of both men and women in the development process.

Smith and Garbharran (2004) in their study conducted in south Africa explore the benefits of involving women in the planning, management and completion of a WATSAN project, which are: women as educational leaders elevated their status and validated their importance in the community in which they lived, use of community women in the project also includes the self confidence of many women, and adds to the woman's educational background in addition to allowing them an opportunity to identify and articulate community needs.

Sultana (2009) while concluding her research argues that gender should be understood as intersecting with other axes of differentiation such as social class, age and geographical location. Such intersections produce similarities and differences between people that enable water politics to have multiple ramifications affecting both men and women of different social categories and locations in different ways.

2.6.0. Role of gender in Water Resource Management

Based on their study-findings, Aladuwaka and Momsen (2010) assert that water is one of the most important natural resources, and its effective management is essential given its scarcity. In rural Sri Lanka, the management of available water resources needs special attention because investment for water resource improvement is hard to obtain, and water itself is relatively scarce in the drier areas of the country. The Wanaraniya Water Project pipes water 6.5km from its source to individual houses in the village, saving women daily time and effort. The project is founded on commitments to community participation and the adoption of local knowledge. It was initiated by women, and has been operated and managed by them for the last six years. This study argues that the project can serve as a model for better planning of water management, and focuses on the unique strategies and innovative methods that have been used. In particular, it shows the impact of involvement in the project on women's empowerment. The implementation of the project has helped women to improve their leadership qualities, confidence, self-reliance, and gain more power in the community through their successful establishment of a village water supply.

Athukorala's (1996) research shows that water resource related development is closely connected with socioeconomic development in post-colonial Sri Lanka, as economic development and growth of urban centers and population puts pressure on water resources. Women's involvement in the water supply sector has been established, however there are limited studies conducted in the field of gender participation in the irrigation sector. The sector has not yet recognized the need for social science, whereas donor organizations have put forth funding for many evaluations of this nature. The conflict seems to stem from the difficulty for irrigation professionals to view women as stakeholders, users, producers and irrigators in their own right. The study concludes that gender focused planning will facilitate inclusion of all users in all aspects of management by informing and involving all stakeholders and is a product of agency awareness, staff sensitization and strengthening of will.

The cross-sectional study by Buor (2004) attempts to analyze the health effects of water on women in an expanding metropolis. Results concluded that women who bear the burden of water fetching in the home suffer adverse health effects during water scarcity and identified income as the greatest factor influencing health of women during water scarcity. It calls for strong measure to ensure the judicious use of treated water, increased education of women and community involvement for water management.

The ethnographic study by Delgado and Zwartveen (2007) addresses the need to work from formal laws and policies in conjunction with working from the community level. Identifying the household as the integral ground for advocacy and change, this study suggests the discourses and ideologies that play a fundamental role in shaping women's role in water management need to be negotiated at the household level for any real change to take place.

B. P. Michael's (1998) study on the role of women in water resources management, conducted in Tanzania, asserts that the case of Tanzania regarding the role of women in various aspects of water resources management is typical of many other African countries having a similar cultural background. In most African communities culture dictates that women are subordinates to men and, hence, are socially marginalized to the domestic chores which, though directly related to the use of water, give them no room for decision making on how to utilize this resource. The various decision making levels related to water resources management in Tanzania depict a conspicuous gender imbalance which is a product of a strong cultural background biased against women. This negative male attitude in Tanzania has seriously undermined the development potential of most women who also engage themselves in non-domestic economic ventures at an entrepreneurial

level. Through various approaches, the government is now uprooting the main sources of this socially negative situation in Tanzania

Moraes and Perkins (2007) in their study looks at the role of women in organizations in Brazil, and addresses the need for more women to be involved in the IWRM sector and identifies numerous barriers. It is important to note that experts quoted in this text maintain that women's participation as professionals in the water sector is growing rapidly and in consequence gender distribution is not the main issue to be discussed. In their view the issue is the need for sufficient number of trained and competent professionals is an issue that prevails over gender. The study also poses some suggestions including: working as organized civil society representatives from outside government offers women the possibility of influencing public policy while maintaining autonomy, however identifies there are many race and class-based barriers to active participation of the poor radicalized women in water management structures.

Nurullo-Khojas's (2005) study focuses on Oxfam's program that trained and encourage women to become actively involved in community water-management committees, and the maintenance of water facilities in Tajikistan. The study shows that women and girls often play an important role in collecting water for their households, but in many places, they are excluded from making decisions about the management of water resources within their communities. But in this program of Oxfam, women in Tajikistan are empowered to participate in water management.

The study by Peter (2006), addresses gender at the household level, noting how gender roles and relations between women and men influence access, allocation and use of resources in a rural community. The study notes that there were no significant differences in the roles of men and women as heads of households, suggesting relative gender neutrality and gender neutral development initiatives will benefit equally women and men at the household level. In conjunction to water management, this study suggests gender blind decisions regarding the importance of irrigated crop production for household security may in fact remove the decision making capacity out of the hands of women.

Schreiner (2004) and his co-researchers through their study look at the ways in which the South African government and grassroots organizations envisage and implement democracy achieved since 1994 in the field of water resources management. The researcher notes examples of using catchment management agencies, new policies allowing for water licensing, and water user associations to be created. These examples showcase bottom up movements not only directly empower poor women and men, but proven grassroots approaches can also be replicated at a

much wider scale through government. Thus the top-down and bottom-up nexus provides an exciting opportunity for water to contribute to poverty eradication.

South African Water Research Commission (1999) in its study reveals that while men participate in the decision making around the type and building of the toilet, its maintenance is seen as the responsibility of women since cleaning the house and toilet are not regarded as work for men.

UNDP (1990) in its study on the impact of toilet-design on the usage of toilet among children reveals that women encourage, teach and supervise young children's use of toilet; it has been found that small aspects of design can make a big difference between the use and non-use of toilet facilities among children. Many mothers are fearful of their children using pit latrines because of the size of the hole. In Botswana, a specially designed pit latrine seat for children has led to far higher usage of toilet.

Another study conducted in East Africa by UNDP (1989), found that the location of the latrine can be a major determining factor in women's use of the facility for reasons of security and privacy. It further explored that, women did not use toilets that men built beside the road because they did not like to be seen entering or leaving the toilet.

Study conducted in South Africa regarding the Role of Women in Community Water and Sanitation Supply Projects commissioned by the Mvula Trust (1998) in 1998 found that 64 percent felt that the idea of empowering women through water committees was good since they were the main beneficiaries. The entire sample, except 6 percent of men, said they supported the empowerment of women. Obstacles to women's participation were identified as: lack of confidence; looking after children with no crèche; time constraints; household chores; traditional values and stereotypes; fears of men; husbands who prevent women from participating; lack of education; lack of interest. Many women said that their husbands did not support their participation in public life.

Narayan (1995) while studying 121 Rural Water Supply and Sanitation projects of India found that women's participation is among the crucial variables associated with sanitation project's effectiveness. Without the effective participation of women it is not possible to ensure sustainability of any sanitation programme. At the same time he has found that at household level more 70% of the sanitation related activities are carried out by women, so they must be considered as the key player in ensuring success of any rural sanitation programmes or projects.

Sudman's (1998) paper for the Stockholm Water Symposium's Workshop Eight on the Contributions of Women in the Field of Water Resources focuses on the role of women in water

management positions, public interest groups and environmental groups in California and the western USA. The extent of women involvement in the decision-making process involving water issues has aptly been analyzed by the author. The role of women as consumers of water and guardians of their families has also been discussed. A plan to interest young American women in careers in water has also been explored in this paper. Finally the paper concludes that while American women are moving into water management and political positions, perhaps their greatest influence will come from their unofficial positions as family caregivers and managers. In their daily lives they must make decisions and choices for their families involving natural resources such as water. In certain instances, these decisions have led to specific policy changes.

Tortajada (1998) in his article 'Contribution of Women to the Planning and Management of Water Resources in Latin America' summarises the main findings of a workshop to analyze the contributions of women at the planning, management and decision making levels. One of the most notable findings was the difference in mind-sets of the senior women professionals working in the water sector compared with the women professionals who are active on gender issues. Those involved in the water sector noted the achievement of women, whereas those working on gender issues focused on the discrimination faced by women, both real and imaginary.

Tortajada (2003) in her study conducted in Morocco focuses on the roles that women play and can play in the planning, management and operation of water resource systems in Morocco. Through the author's research notes, it appears to be a matter of education, training and time before more women work in water-related institutions, however, it is important to note that in the case of morocco, nearly 50 percent of the students are female, but after graduation 80 percent of them disappear from the labor market. Given this finding, it appears that the development of women at the professional level may often depend on the family and social support they receive. To further increase women's participation the researcher suggests: to create multidisciplinary groups and in the long term to encourage women to choose professions which are related to water management.

2.7.0. Studies conducted on 'willingness to pay' (WTP) factor for improved water supply and sanitation

Several studies conducted in developing countries over the past ten years have tried to evaluate the willingness to pay (WTP) for improved water supply (Whittington et al. 1991; Briscoe et al. 1990). The empirical results of all these studies show more educated households were willing to pay more for improved water supplies. One of the possible

reasons for this finding is that educated people could be more knowledgeable about the potential health problems associated with the consumption of unimproved water and for that reason; they were more aware of the health issues and therefore more likely to use the improved source.

Sandiford et al. (1990) investigated the factors affecting domestic water use in rural areas in Nicaragua. According to the findings, a decrease in the distance to the water source was associated with an increase in per capita water consumption. Similarly, families where the mother spent more years of schooling used more water than families where the mother had no formal education. The same difference in the father's schooling was associated with greater per capita water consumption. Relevant as they appear, the question that begs for an answer is: what factors explain households' choice of water sources in Mpigi District and Kibibi Sub County in particular? This study was an attempt to answer the above research question.

In a related development, Banda et al (2007) estimated water demand for domestic use in rural South Africa in absence of price information. The dependant variable was a dummy: willing to pay for improved quality or not while the explanatory variables in the regression were availability of water, household income, whether or not the household had a tap (dummy), water used per capita and age. The results of the regression model revealed that availability of water, households' access to a tap and water per capita were significant determinants of willingness to pay for water quantity. Similarly, Asante et al. (2002) analyzed the access to different types of drinking water sources and the choice among sources for households in the Volta Basin in Ghana. Their study found that between 25-75 percent of households in the region use improved water sources. However, due to lack of data, their analysis did not consider costs incurred by households using improved water sources, a possible omitted variable bias in their analysis. Indeed, the demand theory states that, as the price of a good increases, the demand for that good will *ceteris paribus*, decrease (Froukh 2001). Therefore, in this study, it was expected that price would negatively influence households to opt for either free or purchased water sources. In support of this assertion, Raje et al., (2006) demand curve for water was downward slopping. According to their research, household monthly water bill had a negative relationship with WTP for water service improvements.

Stefanie et al (2005) examined access to, use and participation in decisions on improved water supply in the Volta basin of Ghana. The results indicated that probability of using the improved source decreases with price and increases with income. Although insignificant, larger households were less likely to use improved water sources in communities charging prices per bucket. For communities charging a per-bucket price, education had a significant positive effect. In the same vein, households that were headed by women were significantly more likely to use the improved source. According to the results, supply characteristics such as the location and pricing system were identified to have an effect on households' decisions to use the improved source. The study further revealed that opportunity cost also matters in the sense that the further the distance from the water source as compared to the distance from the improved source, the more likely the household uses the improved source. In support of the findings for Stefaine et al (2005), Gazzinelli et al. (1998) also noted that there is an opportunity cost of time used for fetching water. According to these authors, the farther away a source is located from the house and the longer one must queue, the less water from that source will be used. Thus, according to Gazzinelli et al. (1998), the time for fetching water is negatively related to the quantity of water use.

Arouna and Dabbert (2009) carried out a study on the determinants of domestic water use by rural households without access to private improved water sources in Benin. According to the findings, time required for fetching water negatively affected water demand. In addition, water demand from purchased sources was found to be price inelastic among the wealthier households. In support of these findings Sandiford et al. (1990) showed a positive relation between wealth and water use. In this research it was assumed that poverty negatively affects water use because poor people cook less and often have less clothing to wash. Also Arouna and Dabbert (2009) found village population having a negative sign and was significant for free and purchased water at the 10 percent and 5 percent levels, respectively. This shows that people in villages with more inhabitants consume less water. The study also established that the time required for fetching water positively affects purchased water demand implying that the quantity of purchased water used increases with the time required for fetching water. In the same study, Arouna and Dabbert (2009) found out that household size positively affects both free and purchased water demand. Moreover, the variable ratio of children to adults had a negative sign. This seems to show that a child uses less water than an adult. Last but not least, water price was negatively related to water consumption for households that use purchased water and those that use both free and purchased water.

Occupation of household head has also been shown to be one of the significant determinants of the amount of domestic water use (Acharya and Barbier 2002 cited in Arouna, et al 2009). Thus in this study, it was hypothesized that households in paid employment and self-employment will be more likely to opt for non free water sources while those in unpaid family work will be more likely to opt for free water source. This is based on the demand theory which states that, as the price of a good increases, the demand for that good will, *ceteris paribus*, decrease (e.g., Froukh 2001). Indeed, Pattanayak et al (2006 cited by Kanyoka, 2008) results of the linear regression model to assess the determinants of water demand showed that poverty and costs of water as the main significant factors which affect the demand for water among households. Therefore, it is expected that unpaid family work will negatively influence the demand for paid water sources due to lack of adequate sources of income.

In relation to household location and choice of water sources, Stefanie's (2005) research in Ghana found household location as one of the supply characteristics that significantly explained differences in the use of water. According to Stefanie (2005), supply characteristics such as the location affect household decisions to use the improved water sources. In support of Pattanayak et al. (2006 cited by Kanyoka, 2008) conducted a study to determine households' WTP for improved water services offered by the private sector in South West Sri Lanka using a contingent valuation to solicit for data on households' socio economic factors. A multiple linear regression model was used to assess the determinants of water demand. Household location was one of factors which significantly affected water demand, household access to alternative water source and households' perceptions of current water services.

Arouna and Dabbert (2009) contend that in an area where people rely mainly on public water sources (either free or purchased), per capita water use will decrease as the population increases. Furthermore, people can only collect a fixed quantity of water in order to allow everybody to have at least a small quantity of water. In a large population, a household member may have to queue several times before obtaining the desired quantity. Therefore, in this study, the researcher hypothesized a negative relationship between population size and water use. Such a hypothesis has been used in a similar context by Babel et al. (2007).

Whittington et al., (1990) carried out a study in Kenya to determine the value of time spent hauling water. A conditional multinomial logit model (CLM) was estimated to examine

determinants of choice of water source. Money spent on water, time of water collection, household income, a dummy for household perception for taste of water, number of women in the household and years of formal education for the household heads were among the explanatory variables for this model. All the variables were significant with the exception of perception of water taste and education years.

Whittington et al. (1998) carried out a study to assess household demand for improved water and sanitation services in Lugazi, Uganda using Questionnaires that were used to collect information about the current water sources in the area. A probit model was used to assess the determinants of willingness to pay for improved water services. The dependant variable in the probit model was a dummy variable: willingness to pay for public taps while the explanatory variables which were hypothesized to affect household willingness to pay for public taps were: monthly price of using the public tap, wealth group of the respondent, years of education of respondent, number of children in the respondent's household. The probit analysis revealed that the monthly price of public tap offered, wealth and household purchase of water from vendors were the key determinants of willingness to pay for public taps. With regard to education, it is expected that, as the level of education increases among household members, the level of household awareness about the health benefits of water use (quantity and quality) also increases (Keshavarzi et al. 2006; Sandiford et al. 1990). It was thus hypothesized that education level would positively affect the choice of water use. As a proxy for education level, this study used the number of years spent in school by the head of the household.

Mbata (2006) carried out a study to identify the determinants of WTP for private water connection in Kanye, Botswana. The dependant variable in the regression model was WTP by household, whilst household income, household size, education level of the respondent, distance from existing water source were among the explanatory variables. The results of the econometric analysis showed household income, household size, education of respondent, distance from existing water source as some of the significant determinants of household WTP for tap water. However, in Ochieng's (2010) study, distance from water source had no significant influence on household choice to participate in productive water use ($p > 0.10$) and therefore did not influence household's choice to engage in productive water use. Following Keshavarzi et al. (2006) and Froukh (2001), both household size and composition affect water use, and moreover, household size has been found to be the most important factor affecting water consumption.

Pattanayak et al. (2006) conducted a study to determine households' WTP for improved water services offered by the private sector in South West Sri Lanka. Using a multiple linear regression model the study revealed that poverty and costs of water as the main significant factors which affected the demand for water. Other factors which also significantly affected water demand included household location, household access to alternative water source and households' perceptions of current water services. However, although the above variables had a significant impact on WTP, in this study, the researcher was interested in finding out the major factors that explain households' choice of water sources by laying particular emphasis on why some households decided to opt for free and others chose purchased water sources. In this study, the underlying assumption was that a household chooses the water source independently.

2.8.0. Some Other Recent Studies on Sanitation

Keeping in view the inter-linkages between gender, water and poverty, B. Baruah (2007) conducted his study on Self-Employed Women's Association (SEWA) and Gujarat Mahila Housing SEWA Trust (MHT). The Self-Employed Women's Association (SEWA) is a trade union founded in 1972 to organize women in the informal sector in the western Indian state of Gujarat for better working conditions and social security provisions. The Gujarat Mahila Housing SEWA Trust (MHT) and the SEWA Bank are independently registered SEWA sister organizations that facilitate self-employed women's access to housing and financial services, respectively. Baruah's research seeks to document and critically analyze the experiences of MHT and SEWA Bank in partnering with the state, the private sector, funding agencies, urban local bodies and other NGOs in developing and delivering housing, water and sanitation programs for low-income urban families living in slums. Using MHT as a case study, this investigation sheds light upon challenges and opportunities NGOs may face while collaborating with partners with different core philosophies, motivations, working styles, strengths and constraints. The study also makes recommendations that would enable different actors to play an optimal role in partnerships designed to improve the living and working conditions of the poor.

With the experience of his study, Brown (2010) stresses that access to water is a critical component in advancing the human rights of women. Although privatization of water services continues to be pushed by donors such as The World Bank, the available information shows that privatizations are not increasing access to water for poor women. His study examines the significance of right to water and why this right is critical for women and girls. It then focuses on privatization, and the tension between contractual obligations and respect for human rights.

Finally, it explores some strategies and successes from women's involvement in the struggle against water privatization in Tanzania.

Through his study, Haws (2006) notes that the key to sustain development is community organizing. When community organization involves the direct participation of women the changes for success are significantly enhanced. If progress is to be achieved in improving personal health and community well being women have to be involved and in most cases have to lead the way. To ensure that this takes place, international organizations must work with their in country partners to make sure the role of women in their water related projects is clearly defined and accompanied by training and education built into every program.

On the basis of experiences gained from research, Rico (1998) notes that water has become a strategic resource as it is a key element in the drive towards a policy of sustainable development. Men and women need to be incorporated into the approach to ensure that they can satisfy their water related needs and interest and that they can participate in the development of the resource in an equitable and efficient way. Through his study, Rico identifies 5 main obstacles to gender and water inequality which are as follows:

1. limited use made of information resources deriving from censuses, households, etc.
2. a lack of communication and coordination between the competent institutions
3. a lack of strategically defined objectives
4. a lack of investment and resources
5. uncharted areas and gaps in information, especially as regards comparable statistics and indicators

To overcome the barriers the researcher feels it necessary to design and combine indicators and indices that bring to light the links between the dominant gender system and patterns of access to decision making powers over and use consumption and control of water systems and subsequently to design mechanisms to monitor and evaluate the policies implemented.

Schreiner et al. (2004) through their study, have made an attempt to explore ways in which the South African Government and grassroots organizations envisage and implement democracy achieved since 1994 in the field of water resources management, focussing on the democratic, political and economic freedom and equality in resource rights for poor black women, who are central to poverty eradication. The study shows that while the new water policy and law provide an enabling framework for achieving these goals, implementation on the ground encounters both new opportunities and constraints; this has illustrated by several cases of establishing South Africa's new water management institutions: catchment management agencies and water user

associations. The important nexus between state-led democratization of water resources management and bottom-up grassroots movements is also discussed. The study concludes that the Government's affirmative and targeted intervention is indispensable for redressing gender inequalities and eradicating poverty.

The study by Sijbesma (2009) and his co-researchers finds that rural poverty and the status of women would receive a significant boost if policy makers focused on providing employment opportunities for women along with improved water supplies. They suggest that water supply projects should be designed and managed not only for welfare and public health but also for economic stimulus and gender sensitivity in households; microenterprise that targets women, must allow women to influence the planning design and management of traditional and improved water supplies as a group and then within this group more attention is needed on gender relations among women themselves.

The study by Tignino (2007) reflects on the connection between water, women, and International Law. She states that women make up 70% of the world's population living in poverty. Her study explores that women often walk hours to begin the search for drinking water and are exposed to waterborne diseases when washing laundry and utensils in contaminated water.

A study conducted on Rural Water Supply by Symbiosis of Technology, Environment and Management (STEM) for UNICEF (2000)- covering the rural areas of nine major states in India , namely Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh rural areas of nine major states of India.), Bangalore in 2000. It examined a number of aspects related to rural water supply and created a sizeable database through a variety of field surveys and contact meetings at the group, household and individual levels and relate to the status of water infrastructure and issues of water quality and sustainability in nine states in India. The study reveals that rural areas have increasing access to functional water infrastructure. However, it was also clear from the study that the rural population has not developed a sense of ownership of the public (community) water infrastructure, as the willingness to pay is low. It also highlights the pervasiveness of the low quality of drinking water that rural households were using. This was apparent from the study that the extent of bacteriological contamination of drinking water both at the source and the household were nearly of the same magnitude.

Watershed Organisation Trust (WOTR) (2004) – a leading NGO, working in the field sanitation, in its comprehensive study “Making Sanitation A 'Clean' Habit: Lessons from a

School Sanitation Project” outlines the lessons gleaned from the evaluation of a large sanitation project involving 100 schools, largely Zilla Parishad institutions. The project was implemented in 2003 in four districts, Ahmednagar, Beed, Nagpur and Wardha, in the state of Maharashtra and the evaluation was conducted four years later in 2007. The need for sanitation facilities is huge in rural India, while the demand for the same is surprisingly low. Top down efforts like constructing toilets through government and donor funding have fared poorly. Even toilets constructed in schools, although 'appreciated' and 'desired' by the respective authorities fail to maintain the standards a few years later. The project's primary objective was to focus on children, so that they can become effective messengers of hygiene and sanitation at an early age itself, and so that they would take these habits home and trigger change within their community. The project provided toilet facilities in all schools, and drinking water systems based on the need. It also promoted tree plantation and organic composting. All schools were provided with motivation, health and hygiene inputs. Community involvement played a key role. The study report highlights the findings of the evaluation of physical, institutional and mobilization components of the project. The study reveals that the efforts were sustained well in some village schools while there was sheer neglect and collapse of local institutions in others. The active and constructive participation of the villagers in the school activity coupled with the involvement of enthusiastic and interested teachers, keen on improving the performance of the school, were two major factors for success, while the absence of these brought about failure. Further, permitting children to maintain the cleanliness of the toilets also helped them to develop hygienic habits and transfer these to their homes.

Sulabh International Academy of Environmental Sanitation (SIAES) (2008) in a study titled "Disease Burden due to Inadequate Water & Sanitation Facilities in India" highlights the need and impact of provision of safe water and sanitary excreta disposal facilities towards preventing infectious diseases like diarrhoea, cholera, typhoid, hepatitis etc. The study made a comprehensive review of the global, regional, and national as well as state/district level data on water, sanitation and hygiene related diseases burden, including the general progress of public health including the Water Supply and Sanitation services in India and examined the correlation between lack of water safety, sanitation and hygiene and prevalence of related diseases. It also highlights the findings of some case studies carried out in India, which co-relate the burden of infectious diseases with various aspects of water, sanitation and hygiene. It further support the findings, the study team conducted two pilot studies in West Bengal, with a rather small sample size.

The cases in the Nirmal Grams of Murshidabad and Bankura districts indicated that by providing only toilets in the individual houses, the disease burden may not reduce substantially. The issue of sustainability and use of toilets, constructed in the so-called Nirmal Grams need also close examination. The study concludes that there is a need of effective advocacy tool for greater cooperation and coordination between health sector and development sectors like the rural development, urban development and environment, which will result in optimal health benefits from water supply and sanitation programmes in the country.

Indira Khurana and Richard Mahapatra (2009) of WaterAid India in their paper based on secondary research "Right to Water and Sanitation", reviews the current status of drinking water and sanitation in India and concludes that viewing the issue of water and sanitation as a fundamental human right, is necessary to ensure the provision of these basic facilities of the majority of the population in the country. It also highlights that there is a need to understand how the existing laws and regulations can enforce the right to water and sanitation. Right to water has many dimensions such as issues of entitlement, priority of uses within the right, conflict avoidance, the institutional mechanism at the appropriate level to enforce the right, accountability and transparency, accessibility and affordability and the responsibility of source sustainability are some of these.

Study conducted by UNICEF (2004) in the year 2001, while studying the state of sanitation in 12 UNICEF-DFID-Assisted districts in the states of Andhra Pradesh, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and West Bengal - taking into consideration selected sanitation indicators like: use of toilets by households, access and availability of toilets in schools and prevalent hygiene practices at both household and community levels – found that lack of subsidy for households to construct toilets need not be looked at as a limiting factor. On the contrary, it, in fact, confirmed that subsidy tends dilute ownership (and use) of the toilets. In the districts, selected for study it was found that majority of the students had no access to school toilets. It was felt that a special emphasis should be laid on making school toilets available to students; at the same time, special focus should be given on the need for safe water handling practices and the necessity of disposing children's excreta in a proper manner, away from habitations - so that they do not contribute to disease transmission. The study further suggests that for proper cleaning, the necessity of washing hands with soap or fresh ash must be given utmost priority. Special attention needs to be paid to washing: before cooking or serving food; before eating or feeding child; and after defecation and disposal of child's faeces.

UNICEF (2005) and the International Water and Sanitation Centre in their study assessing the impact of school sanitation on girls' education - have noted that education for girls can be supported and fostered by something as basic as a girls-only toilet, arguing that the lack of access to separate and decent toilets at school is impeding girls' access to their education. The study argues that there is a felt need to conduct a systematic review to determine what impact the provision of separate toilets for girls has on their primary and secondary school enrolment, attendance and completion.

The Study on Total Sanitation Campaign (TSC) conducted by Water Aid India (2006) recognises that TSC has been the most significant rural sanitation initiative at the national level in India so far and carries a wealth of learning on policy and programme issues about doing sanitation on scale. TSC has shown remarkable progress in rural sanitation coverage since 2004-2005; Nirmal Gram Puraskar (NGP), launched in 2004, seems to be the major factor in accelerating the pace of coverage. A large number of NGP villages are neither (ODF) nor fully sanitized, which is one of the qualifying criteria for NGP application. This suggests that NGP verification processes are not always sound and are open to manipulation or/and errors. TSC is getting increasingly state led and target driven; one of the stated reasons has been the pressure of achieving sanitation MDG targets ahead of time i.e. by 2012. Approaches and strategies adopted to pursue sanitation vary considerably across states, at times, not really in line with the stated TSC strategy of the programme being 'community led' and 'people centered'. States that have done relatively well have inspired leadership at the state and district levels; committed champions and community leaders; strategies based on social/community mobilisation; and, effective monitoring of TSC activities at the district and village level. In states and districts where PRIs have been actively involved in TSC, the results have been quicker and more sustainable. There is a lack of awareness of disaster risks related to floods, droughts, earthquakes, landslides, cyclones and other events, and their possible impact on sanitation facilities at the household and community levels. There are threats of inappropriate technology options for construction of toilets contaminating sub-surface water sources, thereby increasing the risk of avoidable morbidity and mortality. In fact, technology has emerged as a major factor in safe sanitation, and has yet to get the attention it deserves. Inclusion of women, poor and the marginalised in total sanitation is skewed and undertaken on fairly unequal terms: in places visited in Bihar for example, no consultation with the poor dalit communities even in NGP villages had taken place and women were not even aware of the programme.

Another study commissioned by WaterAid India (2008), led by S.S. Meenakshisundaram carries an independent qualitative assessment of Government of India's Total Sanitation Campaign (TSC) - found that TSC has been the most significant reform initiative in the rural sanitation sector in India so far and has the potential to transform the sanitation scenario in the rural areas of the country resulting in positive public health outcomes. It further explored that Central Rural Sanitation Programme (CRSP) implemented in India during 1986-1998 made it clear that subsidy for toilet construction does not automatically result in desired sanitation coverage and the anticipated public health benefits. The study suggested that the proposed strategy for TSC implementation will be to make the programme 'community led' and 'people centered'. A demand driven approach needs to be adopted with increased emphasis on awareness creation and demand generation for sanitary facilities at the household, community and institutional levels. It is assumed that community mobilisation is the key to creating safe and sustainable sanitation services. Rural school sanitation is a major programme component and an entry point for wider acceptance of sanitation by people in the rural areas.

Devkota (2007) while studying the impact of poor sanitation on health in Nepal has estimated that because of the poor drinking water, in Nepal it has been estimated that every year about 45,000 children below the age of five years die from sanitation related problems, which are attributed to inadequate supplies of water and/ or its poor quality and poor sanitation facilities. He further urged that a minimum of 30 per cent of the total time saved could be used for other economically productive activities if there is an access of water supply in community premises. Inadequate water supplies nearby can also have a significant impact on sanitation.

2.9.0. Conclusion

The review has attempted to show the many faces of sanitation, contrasting it to how programmes have addressed the challenges. Traditionally, technical perspectives to sanitation failed to match the needs of the people particularly women because they were geared towards reinforcing their roles as household wives. With the introduction of behavioural change as a component to facilitate sanitation uptake, other influences such as poverty, gender norms and beliefs and resources availability and control prevented programmes from achieving better results. Current approaches have opened chances where women voices and concerns can be addressed although these empowerment strategies may fall into deep pitfalls if issues related to power and control are not well monitored. It may be concluded from the literature reviewed so

far, that though women are regarded as one of the key components of sanitation promotion and management, but at the same time they still remain under-represented in sanitation world.

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