

Water, Health and Poverty Linkages: Conceptual Framework and Empirical Evidence



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1. Introduction

In recent years, there has been considerable discussion on water and poverty. There is a growing recognition that there are strong linkages between water and poverty, both in terms of alleviation as well as perpetuation of poverty (resulting from mis-management of water resources). In addition to being a basic need for survival of living beings, water is a key resource for development. With a belief that water can drive socio-economic development, many developing countries have promoted water resources over the last five decades. Huge investments have been made in water resources development to achieve several broader objectives such as economic growth, rural and agricultural development, national food security, protection against famines and intensification of land use. All these efforts are believed to have contributed to considerable reduction of absolute and chronic poverty and hunger in most developing countries.

However, a contradictory view is that while there has been considerable positive outcomes, water resources developments have also been environmentally destructive and unsustainable, which have directly or indirectly affected the lives of many people—mostly the poor.

While these are two extreme views, there is a general acceptance of the relationships between water and poverty, and the vital role of water resources in livelihoods of the poor. Water as a socio-economic 'good' plays an important role in the lives of the poor in several ways including its uses for domestic purposes, for production purposes and for nature/environment. Water can also become a socio-economic "bad" when it leads to problems such as water borne diseases (malaria, shistosomiasis), floods, and land degradation including water logging and salinity, water pollution and associated destruction of living beings and natural ecosystems. The poor and marginalized population, which with limited resources remain unable to adopt preventive or defensive measures, are most affected by consequences of water as a socio-economic 'bad'. Improved management of water resources is therefore essential to enhance the benefits and to reduce the dis-benefits of water to the poor.

Water and poverty is going to be a key theme in some of the important international fora including World Summit on Sustainable Development in August-September 2002; Dhaka Meeting on Water and Poverty in Dhaka in September 2002; Water for food Dialogue in Hanoi in October 2002; ADB Water Week in Manila in December 2002; SAWAF Meeting in Islamabad in December 2002; and Third World Water Forum in Kyoto in March 2003.

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The purpose of this paper is to develop a conceptual framework for understanding pathways and linkages between water, health and poverty. The paper also provides empirical evidence on how access or lack of access to water and management/mismanagement of water resources contribute to increasing or reducing health and poverty related problems. Improved understanding of these linkages can help identify strategies for effective actions. The paper draws heavily from recent literature on the subject. While the paper focuses on situation in Sri Lanka, references are also made to situations in other countries.

The paper is organized into four parts. After a brief introduction, the paper provides an overview of various concepts and approaches to poverty in part 2. A brief account of the incidence of global and regional poverty, and detailed discussion on poverty situation in Sri Lanka is presented in part 3. Part 4 of the paper establishes linkages between water, health and poverty, and provides empirical evidence, based on review of relevant literature, on the identified linkages, followed by concluding remarks in the last part.

2. An Overview of Perceptions of Poverty

Different people view poverty in different ways. The worst kind of poverty is when people do not have access to basic food and water to fulfill their basic physical needs, and therefore they are undernourished, weak and are susceptible to diseases. Another kind of poverty is where people may have more or **less** enough food but do not have access to other basic needs such as adequate water for sanitation, health services, clothes and housing. Traditionally, poverty has been viewed in terms of minimum incomes or consumption to meet basic human needs, usually defined in terms of (1) absolute poverty – minimum consumption needs without reference to income or consumption levels of general population, and (2) relative poverty – consumption with reference to average income or consumption of the population. However, it has been argued that the traditional concept of poverty in terms of incomes or consumption is too narrow and is not an adequate measure of poverty and that other aspects of deprivation are also important, with recognition that poverty is more complex and multidimensional, extending from low levels of incomes and consumption to lack of education and poor health, and includes other social dimensions such as powerlessness, insecurity, vulnerability, isolation, social exclusion and gender disparities.

Recent studies on poverty show that the poor people suffer from stunted growth due to malnutrition, early death among children, unsafe drinking water, and low level of schooling. The poor are not adequately protected under the law, not involved in political decision-making, and not adequately supported against droughts and floods. Thus, poverty has not only an economic dimension, it has several non-economic dimensions. Recently the World Bank has collected the voices of more than 60,000 poor men and women from 60 countries to understand poverty from the perspective of the poor themselves. Quoting from the World Bank, “poverty is much more than income alone. For the poor, the good life or wellbeing is multidimensional with both material and psychological dimensions. Wellbeing is peace of mind; it is good health; it is belonging to a community; it is safety; it is freedom of choice and action; it is a dependable livelihood and a steady source of income; it is food.” The poor describe “illbeing as the lack of material things – food especially but also lack of work, money, shelter and clothing – and living and working in often unhealthy, polluted and risky environments”. They also defined poverty and ill-being as bad experiences and bad feelings about the self, anxiety and fear about the future, voicelessness, powerlessness, insecurity and humiliation. Table 1 compiles **various** formal concepts of poverty used in the literature over time. [There is another school of thought who considers poverty as blessing. This is indicated from the following quotations].

“The **two** big advantages I had at birth were to have been born wise and to have been born in poverty” [Sophia Loren]

“I thank fate for having made me born poor. Poverty taught me the true value of the **gifts** useful to life” [Anatole France].

“It is the great privilege of poverty to be happy and yet unenvied, to be healthy with physic, secure without a guard, and to obtain from the bounty of the nature what the great and wealthy are compelled to produce by the help of art” [Samuel Johnson]

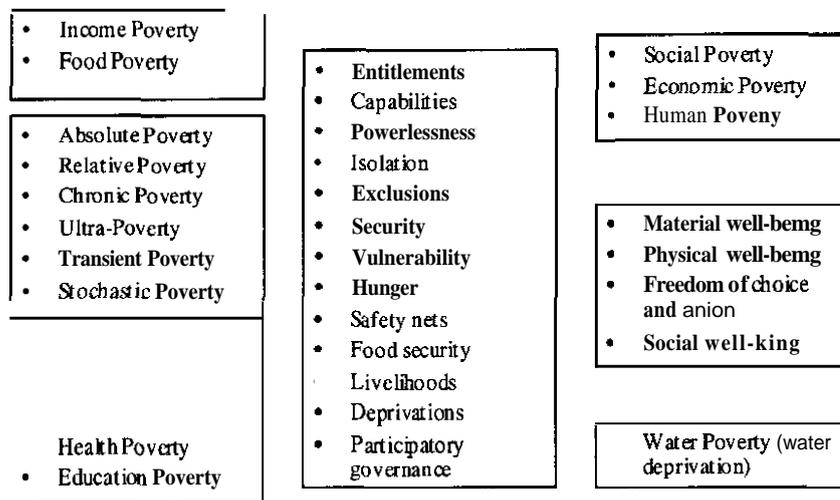
“It is pretty hard to tell what does bring happiness, poverty and wealth have both failed”. [Kin Hubbard]

While looking at poverty from both economic and non-economic dimensions provide a fairly comprehensive approach for understanding poverty, analytical and measurement problems pose difficulties in the application of most of the above concepts. Consequently much of the empirical work in poverty relies on traditional income and consumption measures – estimating poverty lines using a basic needs approach. More recently, emphasis has been on concepts of dynamic poverty that relates to changes in poverty over time – (i) chronic poverty - a state where a household’s income (consumption) is constantly below the poverty line in a given period of time, and (ii) transient poverty - a state where a household’s average income (consumption) is above the poverty line, but the household is confronted with the possibility of temporarily falling below the poverty line – indicating vulnerability of households.

Table 1: Key Terms and Concepts of Poverty



Concepts of poverty



As is clear from the above that poverty is the cause and consequence of several complex factors. Recent research on poverty, particularly rural poverty highlights some of the key characteristics of the poor and incidence of poverty across various countries. These include: (1) poverty tends to be generally higher in rural areas than in urban areas, and urban poverty is largely a function of

rural poverty; (2) the incidence of rural poverty is generally high among resourceless and resource poor households (land and water); (3) the incidence of poverty is generally high in households with a large number of children and single earning members; (4) the incidence of rural poverty is generally higher among households where males/females have no formal education and are unskilled agricultural laborers; (6) poverty is generally higher in non-farm households compared to farm households.

Approaches to Poverty

Poverty is an outcome of several complex factors, processes and actions. There **is** no single indicator that can be used to describe all dimensions of poverty. While poverty is still measured, accounted and understood in material terms (for example, one dollar a day poverty measure is widely used for understanding poverty in international comparisons), several approaches have been adopted to incorporate non-material dimensions of poverty. Soussan (2002) has nicely summarized various approaches to poverty adopted by major international donors/organizations. Some of the major approaches to understanding, measuring and addressing poverty are presented below.

The **UNDP** has developed “**Human Poverty Index**” which **sees** poverty as a lack of basic human capabilities. The index consists of five key indicators: life expectancy, access to safe water and to health services, literacy and the proportion of children underweight aged five and under. Income poverty is also emphasized, with extreme poverty defined as the lack of income to satisfy basic food needs and overall poverty as the lack of income to satisfy a range of basic needs including food, shelter, energy and others.

The World Bank in its 2000 World Development Report emphasizes on **dynamic and multi-dimensional characters of poverty**. The Bank's approach recognizes both material and non-material dimensions of poverty. Key aspects of poverty are given as the inability to satisfy basic needs, lack of control over resources, lack of education and skills, poor health, malnutrition, lack of shelter and access to water supply and sanitation, vulnerability to shocks and a lack of political freedom and voice.

The **Asian Development Bank**'s poverty reduction strategy of 1999 defines poverty as deprivation of essential assets and opportunities, poor access to education and health services, vulnerability to external shocks and exclusion from key decisions that affect their lives. The strategy is based on three core areas: sustainable economic growth, inclusive social development and improved governance at policy and institutional levels. Governance, gender and environmental sustainability are recognized as key elements of the strategy. ADB has recently developed a framework of actions for reducing poverty through water interventions, and the six key areas of action have been identified: (1) pro-poor water governance; (2) improved access to quality water services; (3) improvements to livelihoods and pro-poor economic growth; (4) community capacity building and empowerment; (5) disaster prevention and mitigation; and (6) ecosystems management (for details see Soussan 2002).

The **DFID**'s “**Sustainable Livelihoods Approach**” (**SLA**) recognizes livelihoods as comprising of capabilities, assets (including both material and social resources) and activities required for a means of living. The approach recognizes that poverty is multidimensional and emphasizes that poverty reflects poor access to livelihood assets (natural, social, human, financial and physical capital in the DFID model) and vulnerability to external shocks and trends in society. Core objectives of **SLA** approach are to promote: (1) improved access to high-quality education,

information, technologies and training and better nutrition and health; (2) a more supportive and cohesive social environment; (3) more secure access to, and better management of, natural resources; (4) better access to basic and facilitating infrastructure; (5) more secure access to financial resources; and (6) a policy and institutional environment that supports multiple livelihood strategies and promotes equitable access to competitive markets for all.

The **OECD's Poverty Guidelines (2001)** emphasizes that poverty, gender and environment are mutually reinforcing, complementary and cross-cutting facets of sustainable development. Poverty has **been** recognized as being rooted in the lack of economic, human, political, socio-cultural and protective capabilities.

The recent **Dutch Poverty Reduction Policy** stresses the complex and multi-dimensional character of poverty, including both material and non-material dimensions of poverty. Understanding poverty, and gender and environmental issues are key elements of the policy. The links between local, national and international processes that cause poverty and the roles of different actors in addressing poverty are stressed. Pro-poor growth and good governance are recognized as key to addressing the poverty issues.

The international forums such as **World Summit on Sustainable Development**, linking poverty and environmental management, emphasize the material and non-material aspects of poverty including the lack of income and material means, poor access to services, poor physical security and the lack of empowerment to engage in political processes and decisions that affect one's life. They focus on livelihoods, health and vulnerability as three dimensions of poverty reduction.

Water and Poverty

It should be noted that water is only one of several natural resources in a complex set of stocks of various resources upon which poor people depend. Poverty is an outcome of complex interactions of these resources, institutions, actions and strategies and their ultimate outcomes. It will be naive to perceive that all rural poverty problems could be solved through water. However, as a basic necessity and a vital productive resource, access to water has the potential to significantly contribute to poverty alleviation through its direct and indirect linkages with other resources. Access to water is, therefore, an important and necessary but not sufficient condition for poverty alleviation. Before we go into the details of linkages between water and poverty, let us briefly review poverty situation in Sri Lanka in relation to poverty in other regions of the world.

3. Poverty- Global Picture and Situation in Sri Lanka

Almost half of the world's 6 billion people live on US\$ 2 a day, and one fifth live on less than US\$ 1 a day, with around **44** percent of the world's poor people living in South Asia. (World Bank 2000). While the share of poor population living on US\$ 1 a day has slightly declined over the period 1987 to 1998, absolute number of the poor living below this level has actually increased. Data on poverty projections suggest that if the proportion of poor people below dollar a day remains around the current levels, the number of poor people will increase from 1.2 to **1.8** billion in 2015.

However, there is a considerable regional variation in the incidence of poverty. East Asia, North Africa and Middle East have been able to reduce the number of their absolute poor. In other regions, notably, South Asia and Sub-Saharan Africa, the number of absolute poor have increased over the last one and half decade. These two regions now account for over 70 percent of the

world's population surviving on less than US\$ 1 a day. Within South Asia, there is significant variation in the incidence of poverty across countries. Recently available data on the incidence of poverty indicate is highest in Bangladesh and Nepal, followed by Pakistan (table 2).

Table 2: Incidence of Poverty in South Asia

Country	Population in Poverty (%)			Year of Reference
	Rural	Urban	Total	
Bangladesh	44.9	43.3	44.7	1999
India	27.1	23.6	26.1	1999-2000
Pakistan	22.4	36.3	32.2	1998-1999
Sri Lanka	28.7	13.4	26.7	1995-1996
Nepal	44	23	42.0	1996

Source: Key Indicators of Developing Asian and Pacific Countries, ADB (2002)

Poverty in Sri Lanka

In Sri Lanka, although much work has been done to conceptualize, define and measure poverty, there is no official definition of poverty or a designated poverty line. Conclusions made in various studies undertaken on poverty in Sri Lanka are not strictly comparable, since different definitions of poverty have been used in determining the poverty line. The Department of Census and Statistics and the Central Bank are the two main sources of data for poverty analysis. Data from periodic Censuses, Socio-economic and Labor Force Surveys, Annual Food Balance Sheets, and Household Income and Expenditure Surveys, of the Census and Statistics Department and Annual Reports, and Consumer Finances and Socio-economic Surveys of the Central Bank provide the basis for inter-temporal analysis of poverty. A generally accepted conclusion of the studies based on such data is that about 25 percent of the population live in poverty (measured in terms of household income and consumption), and that abject poverty or destitution does exist in Sri Lanka, but in small pockets.

Some general characteristics of the poor can be derived from different studies on poverty undertaken in Sri Lanka. For example, poor households are larger in size and have a higher dependency ratio. They have limited access to outside resources and little or no productive assets. There is a higher incidence of female-headed households among the poor. Members of poor households have lower levels of educational attainment and a greater proportion of unskilled labor. The level of underemployment, seasonal employment and unemployment is higher among the poor. There appears to be no relationship between poverty and ethnicity, and the type of occupation. The poor can be found among many occupations, including semi-subsistence farmers, low income market oriented farmers, self-employed individuals, urban workers and self employed in tradable and non-tradable sectors (Tudawe, 2000)

The population of Sri Lanka is largely rural with about 85.3 percent¹⁰ living in rural areas (80 percent in rural villages, 5.3 percent in estates in the plantation sector) (World Bank, 2000). Thus poverty is largely a rural phenomenon (those in the estate sector are also considered as rural). As there is no official definition of a poverty line in Sri Lanka, different researchers have used different reference values in estimating poverty. The following Tables 2 to 4 provide a measure of

¹⁰ Source: Extract from report of Census of Sri Lanka, 2001, Department of Census and Statistics.

poverty in three sectors, estimated by different researchers using various reference poverty lines (N. Gunatilleke, 2000)

Table 3: Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1985/86, 1990/91, and 1995/96 – Reference Poverty Line

Sector	Reference Poverty Line : Rs 792 per person per month at 1995/1996 prices								
	1985/1986			1990/1991			1995/1996		
	IOP	DOP	SOP	IOP	DOP	SOP	IOP	DOP	SOP
Urban	18.4	4.4	1.6	15.0	3.4	1.2	14.7	3.0	0.9
Rural	35.6	8.9	3.2	22.0	4.5	1.4	27.1	5.8	1.9
Estate	20.5	3.9	1.3	12.4	2.1	0.6	24.9	4.9	1.6
Sri Lanka	30.9	7.6	2.8	19.9	4.1	1.3	25.2	5.4	1.7

Source: Department of Census and Statistics; and World Bank Sri Lanka Poverty Assessment 1995.

IOP - Incidence of Poverty (Head Count), DOP - Depth of Poverty (Poverty Gap), SOP - Severity of Poverty (Squared Poverty Gap)

Table 3 which shows the poverty level using a lower reference poverty line, indicates that the incidence, depth and severity of poverty are high in rural areas. Poverty in rural villages and estates declined between 1986 and 1991, and increased between 1991 and 1996. Poverty in urban areas has declined continually between 1985 and 1996. For the whole of Sri Lanka, poverty declined up to 1990 and then increased substantially in 1996, but was still below the level of 1986.

Table 4 Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1985/86, 1990/91, and 1995/96 – Higher Poverty Line

Sector	Higher Poverty Line : Rs 950 per person per month at 1995/1996 prices								
	1985/1986			1990/1991			1995/1996		
	IOP	DOP	SOP	IOP	DOP	SOP	IOP	DOP	SOP
Urban	28.1	7.5	2.9	24.5	6.1	2.2	24.9	5.8	2.0
Rural	50.2	14.6	5.9	36.0	8.6	3.0	41.3	10.5	3.8
Estate	20.5	3.9	1.3	12.4	2.1	0.6	24.9	10.1	3.3
Sri Lanka	44.5	12.6	5.0	33.0	7.8	2.7	39.2	9.9	3.5

Source: Department of Census and Statistics; and World Bank Sri Lanka Poverty Assessment 1995.

IOP - Incidence of Poverty (Head Count), DOP - Depth of Poverty (Poverty Gap), SOP - Severity of Poverty (Squared Poverty Gap)

Table 4 which uses a higher poverty line, indicates a similar trend as the lower reference poverty line, in case of all sectors. The magnitude of poverty is obviously higher because of the high poverty line. Urban poverty shows decline between 1986 and 1990 and a marginal rise in 1996. In the estate sector, poverty declines substantially and between 1986 and 1991, but increases above the 1986 level in 1996. The increase in poverty in rural areas between 1991 and 1996 is attributed to the drought that prevailed during this period (World Bank, 2000). The highest incidence of poverty was recorded in 1995/96 among households deriving their income from agriculture. Thus, slow per capita growth in agriculture (only 1 percent during 1990-96), major droughts, contraction in the paddy sector; slow growth in rubber and mining sub-sectors may have contributed to the high poverty levels in these sectors.

Table 5: Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1996/97 - By Reference Poverty Line

Sector	Reference Poverty Line at 1996/97 prices					
	Rs 1032 per person per month			Rs 860 per person per month		
	IOP	DOP	SOP	IOP	DOP	SOP
Urban	17.3	4.1	1.5	10.9	2.2	0.7
Rural	33.3	8.8	2.8	20.3	4.3	1.4
Estate	33.7	6.5	1.8	17.5	2.6	0.7
Sri Lanka	31.2	7.4	2.6	18.9	3.9	1.3
	Contribution to Poverty (Percent)					
	IOP	DOP	SOP	IOP	DOP	SOP
Urban	7.2	7.2	7.3	7.5	7.2	7.5
Rural	86.8	87.9	88.8	87.4	89.0	89.6
Estate	6.0	4.9	3.9	5.2	3.8	2.9
Sri Lanka	100.0	100.0	100.0	100.0	100.0	100.0

Primary Source: Consumer Finances & Socio-economic Survey 1996/97 Central Bank of Sri Lanka.

Secondary Source: Framework for Poverty Reduction in Sri Lanka Draft, Jan. 2000, Department of External Resources, Sri Lanka.
IOP - Incidence of Poverty (Head Count), DOP - Depth of Poverty (Poverty Gap), SOP - Severity of Poverty (Squared Poverty Gap)

Table 5 provides poverty estimates for 1996/97, using data from the Consumer Finances & Socio-economic Survey 1996/97 of the Central Bank. Although not strictly comparable to the earlier data, all sectors show a reduction in poverty when compared to the 1995/96 data at the lower poverty line, with the estate sector showing the greatest improvement. When both 1995/96 and 1996/97 values are compared at the higher poverty line, both urban and rural poverty appeared to have declined, but estate sector poverty had increased substantially. This result is probably due to the large number of non-poor households clustered slightly above the poverty line, sensitive to economic fluctuations such as prices, droughts etc. particularly in the estate sector, which is vulnerable to external factors and natural conditions such as climate and rainfall. For Sri Lanka as a whole, poverty declined both at the lower and higher poverty lines. Thus we can observe a cyclic pattern of decline, increase and decline in poverty for Sri Lanka as a whole. The current declining trend in poverty in Sri Lanka is continuing after 1997.

There is significant variation in the incidence of poverty across regions in Sri Lanka. As shown in table 6, the incidence of poverty is high in Uva, followed by North western region. The incidence of poverty is almost similar in Subragamuva and North Central regions, estimated at little over 31 percent. Western region has the least incidence of poverty, estimated at around 14percent in 1995 (at lower poverty line), followed by southern and Central regions.

The current declining trend in poverty is probably the result of structural changes and opening of the economy, which has sustained a reasonably high rate of economic growth over the last 15 years. However, there is still a large proportion of the population, who remain susceptible and vulnerable to economic changes and income fluctuations because they are clustered at the borderline of the poverty line. Poverty levels are particularly high among landless laborers, and among casual laborers employed in agriculture, mining, construction and the informal sector. Greater vulnerability and insecurity of the poor and those clustered above the poverty line may be due to poor targeting of poverty alleviation programs, large increases in temporary and casual employment, and insufficient attention to risk management in agriculture.

Table 6 Incidence of poverty in Sri Lanka by Region

Province	Poverty Head count					
	Poverty line=Rs. 791.67 /person / month			Poverty line=Rs. 950.00 / person / month		
	1985	1990	1995	1985	1990	1995
Western	19.49	15.23	13.61	30.04	25.92	23.35
Central	30.11	23.49	27.89	45.64	37.88	42.9
Southern	39.24	23.73	26.84	53.37	38.64	41.38
North western	33.78	18.03	33.87	48.5	31	52.38
North Central	33.05	18.16	31.16	50.76	34.12	46.67
Uva	40.45	23.71	37.04	55.56	39.81	55.17
Sabaragamuwa	40.96	23.07	31.59	54.74	35.65	46.77

Source: Basic MIMAP Poverty Profile: Sri Lanka (2000), Institute of Policy Studies, Colombo, Sri Lanka

Sri Lanka has been committed to a well-established social welfare program, providing free health and educational services, since the early 1900s. Public expenditures in health and education grew to 6 percent of the GDP in 1948-52 and remained at this level up to the 1970s (World Bank, 1990). As a result of improved health care and education, mortality rates declined rapidly and population increased at rates close to 3 percent, resulting in a large population increase in the 1950s. Improved education and other social welfare programs began to have an impact on population growth rates, which started to decline by the early 1980s and has been declining ever since. Apart from education and health services, the Government introduced a food subsidy program to reduce the impacts of World War II. This program, which was initiated in the 1940s and continued up to 1977, provided a fixed amount of rice and wheat flour at a subsidized price to all households in Sri Lanka (World Bank 1990).

With the opening up of the economy in 1977, an attempt was made by the government to target food subsidy programs to the actual poor and needy population. In 1978, the food subsidy program was restructured and redirected to the poorest of the population. Consequently, food subsidies were issued only to households with a monthly income of Rs 300 or less for five or more persons. The number of people receiving food subsidies was halved as a result. Toward the end of 1979, food subsidies in the form of a rationed quantity of food was eliminated and replaced by a food stamp program (FSP), for those earning below Rs 300 per month. An evaluation of the FSP showed that only 38 percent of the total food stamp payments reached the intended poorest 20 percent of the population (World Bank, 1990). The remainder of the subsidy went to higher income groups. The FSP is undergoing restructuring to increase the proportion of the subsidy actually reaching the poor from 38 to 80 percent. This would eliminate about half of the number of current beneficiaries of the subsidy scheme.

The food subsidy program provided free or subsidized food to all households, but the first real attempt at poverty alleviation was the Janasaviya Program (JP) initiated by the Government in 1989. The program intended to transfer Rs 2500 per month to each poor household for a period of two years. In addition, JP included components for credit based entrepreneurial development. An evaluation of the Janasaviya Program (World Bank, 1990) identified its many shortcomings. In addition to the program being too costly to be sustainable, the selection criteria were not defined precisely and the benefits not related to incomes, leading to inequities and the inclusion of non-

poor within the program. The benefits were high compared to prevailing income levels, leading to disincentives to work. Poverty, being a long-term problem, cannot be resolved within the two-year limitation of the JP. There was no provision for the inclusion of families falling into poverty after the selection process was completed.

In addition to the JP, another program, the Mid Day Meal Program (MDMP) targeted towards children was started in 1989. A total of US\$ 50 million was spent annually in providing one meal a day to all children in primary and secondary schools under the Mid-Day Meal Program. This program failed because it was too costly to sustain and did not reach the group which was nutritionally most at risk, i.e. the pre-school children. The Janasaviya Program was scrapped, after the formation of the new Government in 1994.

After the scrapping of the JP, a more ambitious poverty alleviation program “Samurdhi” program, was put into operation by the new government in 1995. This program, which is basically an income transfer program, provides direct cash grants to more than 2 million poor families (55 percent of the population). In addition to cash grants, several other subsidiary activities were being implemented through this program to alleviate poverty. These included community and infrastructure development projects, savings programs, banking and credit programs, social insurance programs, training and entrepreneur programs, and self-employment schemes. About 80 percent of the funds allocated to the program were utilized for income transfers, intended to provide as a consumption supplement. In this case, the amount of transfer was related to the income of the household and ranged from Rs. 100 to **Rs. 1000 per month per family**, depending on the household size. The other components of the program were intended to expand the productive asset base of the poor and to create employment and income through community infrastructure development (S. Kelegama, 2001). As per the World Bank (2000) evaluations, both the design and implementation of the Janasaviya and Samurdhi programs have been flawed and their effectiveness in creating opportunities or empowering the poor to overcome economic and social barriers minimized as a result. Political bias of administrators/mobilizers of poverty programs, poor targeting of the programs to the poor, lack of participation of the poor in the development process have been identified as some of the flaws in these programs. The costly poverty programs (up to 1 percent of GDP) have not created sufficient opportunities for the poor. Large expenditures on poorly targeted transfers, lack of sustained rural works programs, long-term administrative costs of hiring poverty workers (over 30,000 workers in the Samudhri Program), and weak exit mechanisms are some of the issues that have to be addressed.

4. Water-Health –Poverty Linkages: Conceptual Framework and Evidence

Around 10,000 people die every day from water and sanitation related diseases and illnesses, majority of them are poor from the developing world..

General: Health and poverty have two-way relationship i.e. poverty is both a cause as well as a consequence of poor health. Poor people remain unable to secure even the basic necessities of life – adequate food, adequate safe water, clothing, shelter and health care. Poverty restricts or deprives access to healthy living conditions, access to preventive measures, and effective treatment, therefore poor are more likely to suffer from adverse health effects, and more often. Water contributes much to good health, and access to adequate safe water is essential for good health. Water influences health directly through its direct consumption for drinking and for sanitation, for its use in food and nutrition in the households, and through its use in producing food, and in the surrounding environment. Potential risk to diseases such as diarrhoea, cholera, typhoid and schistosomiasis, are often linked to unsafe water. The poor are more susceptible to

ill-health than the non-poor, due to their lack of access to adequate safe water, malnutrition and unhealthy living conditions.

One of the major causes of ill-health globally is malnutrition. Nutrition being an important health factor, has both short as well as long term effects on human health. Human body strength (as commonly measured by Body Mass Index) is largely dependent on nutritional factors. Development of stature and strength is sensitive to nutritional inputs and overall health during early childhood and adolescence; improved conditions later in life do not fully reverse the impacts of malnutrition and illness during this period (Martorell, 1998 as referenced in Hamoudi and Sachs, 1999). Improved overall calorie supplies, with appropriate proportions of various nutrition components (e.g. ratio of protein to non-protein calories) improves the chances of child survival, and life expectancy. Almost 800 million people in developing countries do not have access to adequate food to meet their basic needs and over 2 billion lack a balanced diet, which cause ill-health and deaths. WHO now calls poverty as the world's biggest killer.

Poor often lack access to good education, which not only deprives them from reading and writing and high paid jobs, they remain deprived from the information related to health issues. Women's education plays an important role in family's health and well-being. There is large body of emerging literature indicating that, almost universally that at the household level women provide most of the direct care for children, increasing women literacy rates would improve their ability to remain informed about issues to their children's health, and that it would improve childhood survival (e.g. nutritional deficiencies, timely vaccination).

Environment in which people live significantly affect their health and lives. Poor people lack resources to build reasonable dwellings. Living environment is often un-healthy, with potential risk to diseases. For example, risk of infection with malaria is generally higher in low quality and poorly constructed houses which are less effective at preventing the entry of vector mosquitoes (Farmer 1999, Gunawardena et al. 1998).

There is an increasing understanding that poverty and ill-health are the major factors behind environmental degradation, and the healthy environment is essential for good health and effective poverty alleviation. Environmental factors that have significant negative effects on human health are: (1) unsafe and insufficient drinking water and inadequate sanitation; (2) unhealthy food and with no long term security of supply; (3) un-healthy environment for safe food production; (4) food contamination; (5) accumulation of organic chemicals and heavy metal that persist in the environment through the food chain.

In order to understand pathways and linkages between water, health and poverty clearly, we classify water use into three broad categories.

1. Water for domestic consumption
2. Water for production purposes
3. Water use for environmental sustainability

The above three water uses are linked to each other, and water use for one purpose often conflicts with use for other purposes. The conflicts and competition across these uses are growing with increasing populations, rapid urbanization and expanding economic activities. This is why Integrated Water resources Management (IWRM) approach' has been greatly emphasized in the

¹ Integrated Water Resources Management (IWRM) has been recognized as a important tool for efficient and effective use of water resources in a society. Global Water Partnership in its "Framework for Action"

recent years. In this paper, we do not go into the details of sectoral competition for water use which can be found elsewhere, but rather focus on establishing linkages between these uses and human health and poverty. In Sri Lanka, despite massive efforts on improving water supply and sanitation, about 20 percent of the population in rural areas still lack access to water supply and sanitation.

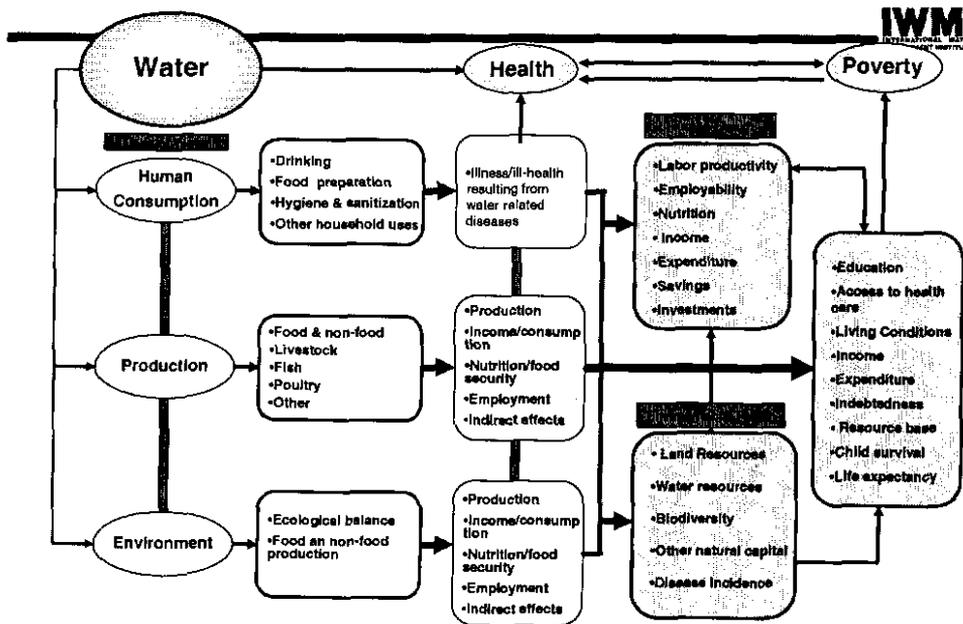
Water for domestic consumption: Water is a basic human need and essential for survival. Access to basic minimum quantity of safe water (roughly around 20 liters per person per day) is every one's right. Unlike all other goods, the utility and value of a glass of water for an extremely thirsty person is infinity. Similarly the value of water for other domestic uses such as food preparation, hygiene and sanitation is also very high. These uses of water are directly related to health. A large number of diseases, including, diarrhoea, dysentery, and cholera are caused by these direct uses of unsafe water, leading to impacts in both short term as well as in the long term.

The immediate costs of illness to individuals and households include the cost of treatment, and the opportunity cost of productive time lost (in the case of children, the opportunity cost of education time lost). In the longer term, the effects are even more adverse as the frequent occurrences of illnesses may result in permanent disabilities, and reducing the life expectancies. Ill-health impacts directly on labor force participation, labor productivity, household incomes and assets, expenditures on necessities and nutrition, savings and investment, education, and other socio-economic and demographic factors.

It is the poor who due to locational, socio-economic and cultural disadvantages are often deprived from adequate safe water and are more susceptible to ill-health and its consequences than the non-poor. Those who survive on daily earnings or seasonal incomes and do not have cash reserves and may remain unable to pay for sudden illnesses. The loss of income and lack of financial capacity to pay push the poor households into debt, pushing them into deeper poverty – further depriving them from education, access to health care, and reasonable living conditions.

(2000) argues that currently unsustainable management practices must be replaced by a holistic approach based on the concept of integrated water resource management (IWRM). IWRM is seen as the means of providing water security, of creating sustainable water policies and practices and of averting the risks to the global water system. There are three fundamental components of IWRM that takes account of economic, social and natural conditions, (1) *Economic efficiency in water use -using water with maximum possible efficiency*; (2) *Equity- equity in access to water* of adequate quantity and quality for the sustenance of human well-being; and (3) *Environmental and ecological sustainability- managing water* in a way that does not undermine the life-support system thereby compromising use by future generations of the same resource (GWP, 2000, technical report 4). The IWRM framework and approach recognize that complementary elements of an effective water resources management system must be developed and strengthened concurrently. These complementary elements include: (a) *the enabling environment* – the general framework of national policies, legislation and regulations and information for water resources management stakeholders; (b) *the institutional roles* and functions of the various administrative levels and stakeholders; and (c) *the management instruments*, including operational instruments for effective regulation, monitoring and enforcement that enable the decision-makers to make informed choices between alternative actions. These choices need to be based on agreed policies, available resources, environmental impacts and the social and economic consequences.

Figure 1: Water, Health and Poverty Linkages



Lack of availability of adequate safe water for domestic uses forces the poor to extract water from alternate sources: (a) often fetching water from long distances with much drain on time and energy. There is significant emerging evidence that poor women and children in developing countries spend significant amount of time everyday in fetching water, influencing their health (such as skeletal deformation, problems in joints), productive potential, education and other economic activities; with significant material and non-material opportunity cost. For example, the studies show that poor access to water decreases school attendance (World Bank 2000/01). The (b) incurring higher financial costs by buying water from informal vendors. This is especially the case in urban areas where poor and low income households cannot get a house connection, either due to unavailability of service or un-affordability to buy water from private vendors at a relatively high price, sometimes 100 percent more than that provided by public authorities (World bank 2000). In the Multi-stakeholder Dialogue on Water Services for the Urban poor organized the Asian Development Bank in May 2002, the lead author of this paper along with a team of experts from various disciplines undertook surveys in the two poorest communities – one served and the other one un-served with piped water supply- in Manila, Philippines. In the served community, average cost of water to a household was around P.Peso 400/month (IUS\$=50 P.Peso), where as in the un-served community the average cost of water to a household was P.Peso 600/month (which constitutes roughly 10-12 percent of total monthly income). Both types of the above costs, socio-economic and financial, do have impacts on household economies, influencing all the variables described in the above paragraph.

An environmental aspect related to domestic water consumption is the production of wastewater – which has both positive and negative aspects. To the extent that wastewater and its nutrient contents can be used for crop production, it can provide benefits to the communities. However, wastewater use can also impose negative impacts including the incidence of wastewater borne diseases as well as degradation of both land and water resources, including groundwater resources.

The main source of pollution in water from the domestic sector comprises pathogenic microorganisms (bacteria, viruses, protozoa and helminthes), with major source of water pollution from industrial sector being heavy metals. The heavy metals can accumulate to the level of concentrations that can cause toxicity to humans. While the affected groups also include the populations consuming vegetables irrigated with wastewater, the most affected groups are the poor, either small holders, tenants or laborers, who are most directly affected by wastewater. For a global review of the impacts of wastewater re-use in agriculture see Hussain *et al.* (2002).

In Sri Lanka, the problem of industrial waste water entering irrigation systems has been reported from a few years in areas such as Kurunegala, Galle, and Ambalangoda, where urban pollution is entering irrigation channels. In Kurunegala, spent dyes from textile factories and spent oil from bus depots enter the town drainage scheme which then enters the irrigation scheme. An area of about 30 ha of land has been abandoned due to this pollution affecting the soil. Studies carried out in Jaffna peninsula showed that about **79** percent of the farm wells in the area contained water with nitrate contents above the value recommended by WHO for drinking water.

There is a plenty of evidence on the negative impacts of unsafe water on human health, and its links to poverty. At the global level, estimates suggest that over 1.1 billion people in the developing countries lack access to adequate quantities of clean water and over **2.4** billion people live without adequate sanitation. About **3** million people die every year from water born diseases, mostly children and women. According to WHO, about 2.2 million people die from diarrhoea, 90 percent of them are children, mostly in developing countries. There is a huge body of literature indicating that improvements in water supplies, hygiene and sanitation improves health. For example, studies indicate that diarrhoea can be reduced by **26** percent when basic water, hygiene and sanitation are supplied.

Water for Production-Irrigation/Agriculture: Water for production, especially in agricultural sector, has been regarded as a powerful factor for providing food security, protection against adverse drought conditions, increased opportunities for more employment and stable income, and for offering opportunities for multiple cropping and crop diversification. Access to reliable irrigation enables farmers to adopt new technologies and intensify cultivation, which lead to increased productivity, overall higher production, and greater returns from farming. This, in turn, opens up new employment opportunities, both on-farm and off-farm, improves income and livelihoods, and the quality of life in rural areas. **All** these factors contribute to alleviation of poverty. However, there are also negative impacts of irrigation (mostly associated with poor management of irrigation) that tend to increase poverty. In this section, we will first focus on anti-poverty impacts of irrigation, and explain some of factors negating these impacts.

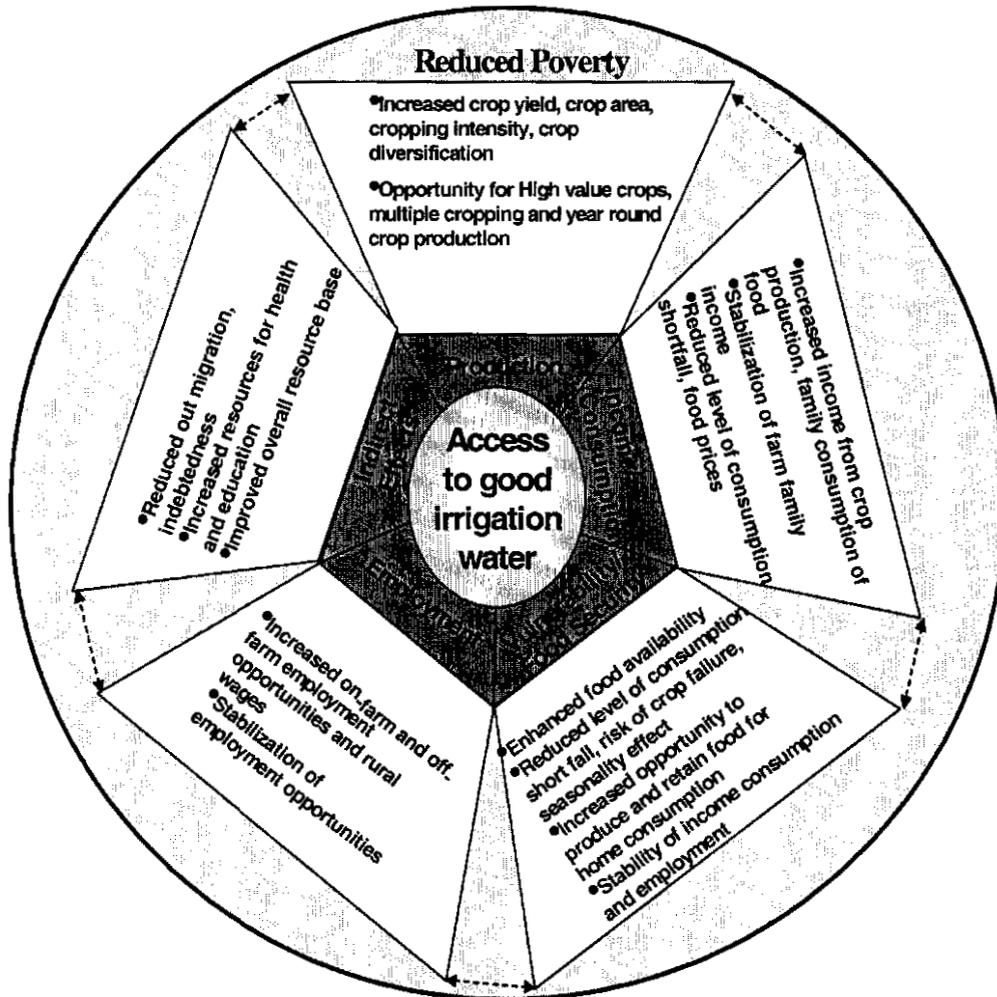
Pro-poor Aspects of Irrigation

There are five key dimensions of how access to good irrigation water contributes to socioeconomic uplift of rural communities and alleviate poverty. These are production, income/consumption, employment, vulnerability/food security, and overall welfare (Figure 2). These poverty-reducing variables are inter-related. In general, access to good irrigation allows poor people to not only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their vulnerability caused by seasonality of agricultural production and external shocks. It should be noted that the poor also use water for other **farm** and non-farm production activities, particularly small-scale rural enterprises such as for livestock rearing, fish production, brick making and so on and so forth. These enterprises are part of poor's livelihood strategies and contribute to reduce poverty. Thus,

access to good irrigation water can contribute to poverty reduction, and to moving people from ill-being to well-being as shown in figure 2.

Figure 2: Irrigation and Poverty linkages

Irrigation and Poverty Linkages



There is an enormous amount of literature showing evidence on the impact of irrigation on above discussed poverty reducing variables. Irrigation related impacts such as expansion in cropped areas, higher cropping intensity, improved productivity, and shift in cropping patterns towards more diversified and high value crops results in improved farm incomes. Table 7 shows recent evidence on the contribution of irrigation to farm incomes for India, Sri Lanka and Vietnam. In all the three cases, farm incomes (expressed in terms of gross margins defined as gross value of product minus cash cost of production) under irrigated conditions are much higher than those under rainfed conditions.

Table 7: Gross farm income for irrigated and Rainfed Agriculture in selected countries in Asia.

	India-Chattisgarh (Indian Rs.)			Sri Lanka (Sri Lankan Rs.)			Vietnam (US\$)		
	Rainfed	Irrigated	% Increase	Rainfed	Irrigated	% Increase	Rainfed	Irrigated	% Increase
Cropping Intensity (in %)	102	152	33	95	157	39	63	194	68
GVP per ha.	1102	15493	29	4	19403	48	348	654	47
Cash Cost	3217	5487	41	4	12895	15	206	366	44
Gross Margins	7806	10006	22	-829	6519	112	130	318	59
Rice Yield (t/ha)	3.0	4.0	25	3.2	4.5	40	2.8	4.8	42

Notes:

GVP = Gross Value Product

Figures are derived from the following sources:

Vietnam: Ut, Hossain and Janaiah 2000

India, Chhattisgarh: Janaiah, Bose and Agarwal 2000

Sri Lanka (Udawalwe basin): Based on IWMI survey in Ruhuna basin 2000 (in progress)

Primary source: Economic and Political Weekly, December 30,2000.

Currency rates:

US\$ 1 = Indian Rs 47 in 2000.

US\$ 1 = Sri Lankan Rs 83 in 2000

Irrigation, through expansion in cropped areas, higher cropping intensity, improved productivity, and shift in cropping patterns towards more diversified and high value and labor intensive crops, increases employment opportunities through increased demand for labor for extended period of time (Patel, 1981, Roy, 1983; Satpathy, 1984; Reddy, 1990; Kallur, 1988; and Saleth 1997). Silliman and Lenton (1985) in their review of 45 micro-level studies (with 25 from India) confirmed the strong positive relationship between irrigation and employment. However, the impact may vary from one project to another depending on a range of factors. Recent data from Udawalwe basin in Sri Lanka indicate that labor use per acre is 125.8 person days for paddy and 154.9 person days for OFC (other high value field crops) cultivation under irrigated conditions compared to only 37.2 person days for paddy and 104.9 person days for OFCs cultivation under rainfed conditions (Hussain and Thrikawala, 2001).

With more employment and increased demand for agricultural laborers, irrigation also helps to increase agricultural wages. A study by Narayanamoorthy and Deshpande (2002) undertakes in-depth analysis of the impacts of irrigation on agricultural wage rates across 17 Indian states using pooled cross-section-time series data covering the period 1974-75 to 1993-94. The results of the study indicate that irrigation has significant positive influence on the real agricultural wages. The key conclusions from this study are (1) there is a positive and significant relationship between the availability of irrigation and the real wage rate of agricultural laborers; (2) wage rates are generally higher in densely irrigated states compared to those with low irrigation facility; and (3) gender wage gap has been narrowing down at a faster rate in states where the level of irrigation is higher. In a recent study in Udawalwe basin in Sri Lanka, Hussain, Marikar and Thrikawala (2002) found that wage rates in irrigated areas are generally higher (Rs. 202/person/day) compared to nearby rainfed areas (Rs. 173/person/day).

All the above factors translate into reducing poverty. There is significant emerging evidence that irrigation has contributed significantly to increasing farm incomes, reducing income inequality

and reducing poverty in irrigated agriculture in Asia (table 8). For example, recent research led by IRRI in India (Bihar and Madhya Pradesh/ Chattisgarh regions), Philippines, Thailand and Vietnam suggests that the incidence, depth and severity of poverty is substantially lower in irrigated and agriculturally developed areas compared to unirrigated and less-developed areas (Thakur et al. 2000; Janaiah, Bose and Agarwal 2000; Hossain, Gascon and Marciano 2000; Isvilanonda, Ahmed and Hossain 2000; Ut, Hossain and Janaiah 2000). Income inequality measured using the Gini concentration ratio² indicates that, on average, income inequality in irrigated agriculture is much less than in rain-fed agriculture. Similar trends have been observed in Bangladesh. Hossain, Sen and Rahman (2000) found that “benefits of expansion of irrigation and technological progress have been fairly equally distributed in irrigated environments compared to nearby rainfed environments in Bangladesh.”

Table 8 Recent evidence on the incidence of income inequality and poverty in irrigated and unirrigated agriculture.

Country	Irrigated agriculture			Unirrigated agriculture		
	Head Count (%)	Poverty Gap (%)	Gini CR	Head Count (%)	Poverty Gap (%)	Gini CR
Vietnam (1996)	17.9	5.7	0.46	60.6	33.4	0.49
Thailand (1998)	20.8	10.8	0.53	55.8	31.8	0.61
Philippines (1997)	30.0	11.0	0.31	39.0	16.0	0.35
India, Bihar (1996)	34.3	10.0	0.29	65.7	33.4	0.40
India, Chhattisgarh (1996)	38.0	5.4	0.30	55.0	13.3	0.34

Note: Gini CR is Gini Concentration Ratio

Source: Figures obtained from various articles and special issues in Economic and Political Weekly, 30 December 2000.

Vietnam: Ut, Hossain and Janaiah 2000
 Thailand: Isvilanonda, Ahmed and Hossain 2000
 Philippines: Hossain, Gascon and Marciano 2000
 India, Bihar: Thakur et al. 2000
 India, Chhattisgarh: Janaiah, Bose and Agarwal 2000

Case study from Udawalwe basin on Irrigation and Poverty

In Sri Lanka, Hussain, Marikar and Thrikawala (2002) undertook a detailed study on the impact of irrigation infrastructure development on dynamics of poverty. The study was undertaken in IWMI's Benchmark Basin - Uda Walawe Left Bank Irrigation System (WLB) in Uda Walawe area (Ruhuna Basin). The study used primary data collected through household surveys conducted three times during the year 2000-2001, from a sample of 858 households, using a detailed multi-topic questionnaire. The results of the study suggest that the incidence, depth and severity of poverty, as measured by both monetary and non-monetary indicators, are the highest in areas where households do not have access to irrigation infrastructure and lowest in areas with access to established irrigation infrastructure and with adequate water supplies. Incidence of chronic poverty is highest in areas without access to irrigation infrastructure (typical rain-fed

² The Gini concentration ratio on income indicates concentration or level of skewedness of per capita income among various income groups; greater the value of Gini concentration ratio, greater the level of income inequality.

areas) compared to areas with access to irrigation infrastructure. As shown in Table 9, the rain-fed Extension area had the highest level of chronic poverty, with a one-fourth of households living below the poverty line throughout the year. Household average incomes and expenditures are higher in areas with access to irrigation infrastructure compared to those areas without it. Household average monthly expenditure in areas with access to irrigation infrastructure is 24 percent higher than in areas with no access to irrigation infrastructure. Overall, highest chronic poverty is found among non-farm households, and in areas with no access to irrigation infrastructure and lowest in areas with access to irrigation infrastructure and adequate water supplies. The study concludes that access to irrigation contributes to food security, balanced diets and reduced vulnerability and poverty at the household and community levels.

Table 9: Poverty Head Count (based on Income) in Udawalwe left Bank Area, 2001.

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiribbanara	Sooriyawewa	Extension/rainfed Area	Ridiyagama	Irrigated I	Rain fed All	Farm	Non farm	71
Incidence of poverty (No. of Observations)			151	229	105	146	693	165	724	134	858
Total Poverty			0.85	0.87	0.84	0.75	0.80	0.85	0.82	0.77	0.81
- Chronic Poverty			0.13	0.11	0.25	0.06	0.10	0.19	0.11	0.16	0.12
- Transient Poverty		0.78	0.72	0.76	0.59	0.69	0.70	0.66	0.71	0.61	0.69
- Non-poor	0.29		0.15	0.13	0.16	0.25	0.20	0.15	0.18	0.23	0.19
Household Annual Expenditure	64360	59024	67243	64907	49398	94283	71473	52898	69856	57341	67901
Household Annual Income	112062	111281	71202	81523	66080	132945	97467	82517	99814	66377	94592
Household Value of household assets (Rs)	18232	13694	17240	19517	8532	32394	21418	10436	20165	14795	19339
Household Value of agricultural assets (Rs)	17415	1752	21731	18837	10484	27749	21002	7309	19811	10575	18369
Housing index	74.4	73.6	78.9	73.3	69.2	84.6	17.2	70.8	77.5	67.8	76.0

Thus, we conclude that access to good irrigation contributes to poverty reduction through improved livelihoods, incomes and employment, nutrition, balanced diets, food security and increased overall expenditures on necessities, savings and investments in wealth generating activities³. This in turn, enables households through their enhanced financial and economic

³ On a more broader scale, IWMI is currently undertaking a study on water and poverty in selected 20 irrigation systems in six countries - Bangladesh, China, India, Indonesia, Pakistan and Vietnam). One of the study hypotheses being tested is that "command areas of specific canal reaches receiving less irrigation water per hectare have lower productivity and a higher incidence of poverty. Preliminary results of the study indicate that the incidence of poverty among households or communities having lack of access to adequate water for agricultural production, under conditions of surface water scarcity and where there are no alternative sources of water (groundwater) and income, is higher compared to those having access to these resources. For example, in a number of systems the incidence of poverty is higher at the tail reaches receiving less irrigation water compared to head and middle reaches of the system. This indicates a direct linkage between water for agricultural production and poverty.

capacity to have improved nutrition, to take more effective measures to prevent and cure health problems, including those related to water.

Do all these positive impacts of irrigation on poverty contribute to reducing the incidence of diseases. The answer is yes. This is through health and poverty linkages as described earlier. For example, the incidence of malaria is usually related to irrigation. However, improved management of irrigation help reduce the incidence of malaria. Moreover, the prosperity brought by irrigation enables households to take effective measures to prevent and treat malaria. Recent research at IWMI in Udawalwe basin (Klinkenberg, 2002, forthcoming) indicates that the incidence of malaria is actively higher in rain-fed and *chena* cultivation areas than in irrigated areas. Irrigated rice cultivation areas are found to have generally lower incidence of malaria. The study attributes the low incidence of malaria in irrigated areas to generally better socio-economic conditions in these areas, which enable people to construct better houses, buy medicine, bed nets and other antimosquito devices. As shown in table 9, household incomes and expenditures, value of household assets, and the index of housing quality are all much higher in irrigated areas as compared to rain-fed areas. This clearly indicates strong linkages between agricultural water, health and poverty.

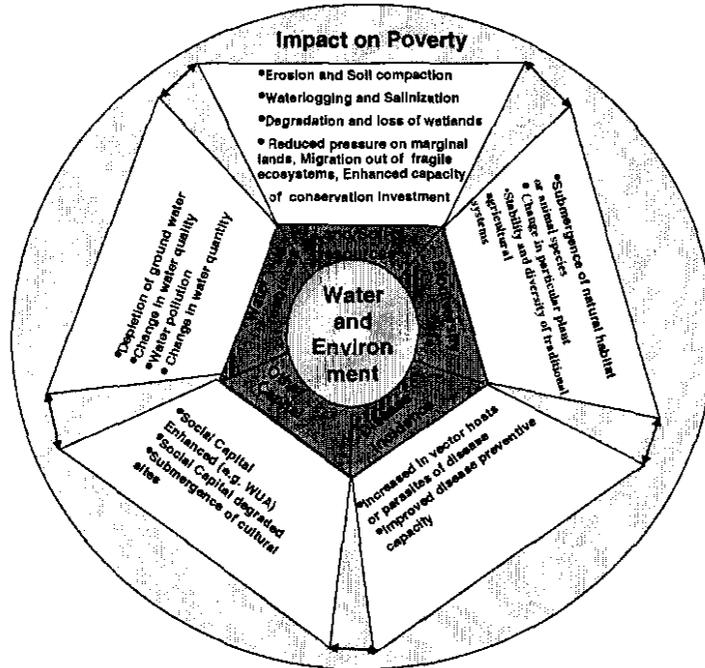
Anti-poor Aspects of Irrigation

Access or lack of access to irrigation depends on a range of factors including infrastructure, institutional or management practices. Poor management of irrigation could not only deprive those having locational, socio-economic and cultural disadvantages, often the poor. It could also lead to deepening of poverty, through a variety of negative impacts. These include environment related negative impacts including those on land/soil and water resources (such as water logging and salinity, land degradation resulting from intensification of agriculture, depletion of groundwater resulting in reduced productivity or abandonment of lands in the long run), and pollution of both surface and groundwater from chemical use), incidence of diseases, change in biodiversity (change in particular plant and animal species, stability and diversity of traditional agricultural systems) and impacts on other natural capital. The poor with limited means to take effective preventive or defensive measures are the most affected from these changes in the environment in which they live.

As mentioned above, poor management of water irrigation leads to degradation of land and water resources. A recent study by UNDP, FAO and UNEP (1993) estimates that 73 percent of agricultural lands in South Asia are degraded by one or the other form of land degradation. In this study, land degradation is estimated to cost US\$ 9.8 billion per year in the region. On-farm effects include declining yields, higher input use to maintain yields (i.e. increase in cost of production and low profitability of crop production), conversion of land from high value uses to low value uses, low cropping intensity due to the need to lengthen fallow periods, temporary or permanent abandonment of lands – resulting in lower overall agricultural production. External off-farm (or negative externalities) effects include water pollution by chemicals, health problems, and damages to infrastructure. All these factors tend to negate the benefits of irrigation. Various estimates suggest that in Pakistan, around 6.3 million hectares are affected. Similar estimates for India range from 5.5 to 13 million hectares. In Uttar Pradesh in India, a study estimated a 50 percent decline in crop yields over eight years due to salinization and water logging in irrigation systems (Joshi and Jha 1991). In China, there is evidence that grain yield reduced by 19.1 percent due to erosion, by 0.2 percent due to salinity and by 11.1 percent due to multiple cropping intensity (Rozelle and Huang 1995).

Figure 3 Irrigation, Environment and Poverty Linkages.

Irrigation, Environment and Poverty Linkages



Modern intensive irrigated agricultural production requires inputs of both pesticides and inorganic fertilizer. An indication of the ecological impacts of pesticide use in Sri Lanka is the finding that chemicals have contributed to the decline of inland fish species living in tanks and rice fields. Increased fertilizer runoff from irrigated areas stimulates the growth of algae and plants on the water ways. The increased decomposing algae and plant material use up oxygen in the water and causes fish and aquatic organisms to die.

The other irrigation related environmental effect is weed infestations. Aquatic weeds such as *Salvinia molesta* and water *hyacinth* cause major problems, especially in areas with high inflow of fertilizer nutrients. In Sri Lanka, an estimated 30,000-50,000 ha of rice land are affected by *Salvinia* (Steele et al. 1997:17). The economic costs associated with this weed are high due to costs of prevention and production losses. Estimated crop losses in *Salvinia* affected areas are 2 to 3 percent of yield and that altogether 9000 to 25000 ha are affected in Sri Lanka. This amounts to estimated losses of Rs. 9-22 million.

Drainage flows from the Kirindi Oya irrigation and Settlement Project and Badagiriya irrigation scheme severely affected the Malala and Embilikala lagoons. Salinity of lagoons have dropped affecting the population of water birds. Prawn fishing, which previously provided livelihoods to several hundred poor families has also been affected (Matsuno, van der Hoek, and Ranawake, 1998).

Continuous increase in ground water levels, owing to excessive leaching of irrigation water and poor drainage, in many cases leads to water logging accompanied in some arid areas with salinization of soils. Salinity makes it difficult for plants to absorb water through their roots and plants may also absorb toxic ions from salt concentrated water. It may also interfere with the activities of the soils microbial populations leading to retardation of the soil nutrient

transformation process. For instance, researchers found that after Kirindi Oya irrigation system came into operation, salinity levels in the older downstream irrigation systems increased. Retardation in the growth of rice plants was observed in the affected locations, especially in the poorly drained areas. In these instances, it is usually the poor who are affected the most.

A study carried out on pesticide poisoning in major irrigated areas of Sri Lanka has revealed that the problem is especially serious in intensively cultivated areas. The study further revealed that the incidence of serious acute pesticide poisoning in the sample area ranged from 2.6 to 2.9 per 1000 during 1990 to 1994. In 1994, pesticide poisoning accounted for 29 percent and 50 percent of all deaths recorded in the two rural hospitals surveyed (Merry, 1997). In 1994 pesticide poisoning accounted for 29 percent and 50 percent of all deaths recorded in the two rural hospitals surveyed.

There are more than 30 diseases linked to irrigation, vector-borne diseases are probably the most pronounced, especially Schistosomiasis (also called Bilharzia), Malaria and Japanese encephalitis (Steele et al. 1997:10). The incidence of malaria is usually related to irrigation. However, there are only very few studies analyzing the relationship between irrigation and health and its socio-economic implications for households. Two of the related recent studies are by Konradsen *et al.* (1997a and 1997b) for Anuradhapura district in the dry zone of Sri Lanka. The studies were conducted in poor villages, where majority of households were low income subsistence farmers and workers. The net yearly income of the households was estimated at Rs. 12900 (US\$ 258). In the first study the respondents were asked to identify and rank the three biggest problems and the five most important diseases in the village. Malaria was ranked as the third most serious problem, following inadequate water for cultivation and poverty. Also, malaria was considered to be their major health problem, followed by diarrhea and eye diseases. Among 216 households included in the study, there were 178 self-reported episodes of malaria. The number of episodes ranged from 0 to 5 per individual and from 0 to 11 per household.

Item	Expenditure per episode (Rs.)
Transport	31.8
Blood examination	1.8
Treatment	19.5
Meals at health facility	29.6
Special diet at home	47.6
Other (such as hiring labor)	18.7
Sub-total	149.0 (=US\$3)
Loss of working day and school days	+ The number of average days lost per episode of malaria was 7.8 days of the

Based on Konradsen *et al.* (1997)

The study estimates the total direct expenditure on a single malaria episode at **Rs. 149** or roughly US\$3. Among few households, direct expenditure on single episode of malaria amounted to over 10 percent of their annual income. The study estimates that on average 7.8 days were lost per episode of malaria. In addition, average of 2.9 days were lost by the person accompanying the malaria patient for treatment. Since the incidence of malaria increases from November to February (Maha season), the opportunity cost of lost days during peak cultivation period is very high. Using the estimated wage rates of Rs. 75 per day for female and **Rs. 100** per day for male, the cost of lost labor days comes out to be considerably high in relation to household incomes. Apart from these direct and indirect financial costs, households see malaria as a stress factor that hampers the village progress. In this study, some of the respondents expressed as ‘people in our village have been brought down to this level of poverty due to malaria; it drains the energy from people’, and ‘malaria makes you weak for a very longtime although the doctor says you are cured’. Other costs incurred by the government (various interventions/measures, health facilities), which are costs to the society, may be even higher than the direct and indirect financial and economic costs to the households. The above health related direct and indirect cost do impact on household economy and the level of poverty.

Water for Environmental Sustainability: Water is essential for environmental health/ecological balance, just as safe water is essential for human survival and good health. In addition to its role in maintaining ecological balance, water use for environment has the five key dimensions similar to those for water use in the production process particularly in agriculture - production, income/consumption, employment, vulnerability/food (in)security, and overall welfare. Therefore, water use for environment has direct linkages with poverty, as is clear from the following statement:

“the poorest often suffer most from the consequences of environmental degradation because of their immediate dependence on the natural resource base for their basic necessities (food, energy, water and housing). Much of the income of the rural poor is derived from natural resources and environment-dependent agricultural activities. Surveys from 13 developing countries show that the rural poor depend for 40-85 percent of their income from agriculture” (Pinstrup-Andersen and Pandya-lorch, 1994)

In the analysis of the links between water and environment, the issue of poverty needs to be at center stage. As Navalawala (2001:73) puts it succinctly alleviating poverty is both a moral imperative and prerequisite for environmental sustainability. The contribution of irrigated agriculture to meeting the food requirements of the world is clearly substantial. But, this contribution can be maintained and improved only if irrigated agriculture is environmentally sustainable, and does not lead to poor health of people.

5. Concluding Remarks

Water, health and poverty are closely linked to each other. Health and poverty have two-way relationship: good health brings prosperity, and prosperity brings improvements in health; or conversely poor health may create and perpetuate poverty and poverty may lead to poor health. Water is at the center and contributes to both health and poverty. Water influences health through direct consumption for drinking and for sanitation, and for its use in food and nutrition in the households. Water also contributes to livelihoods of the poor as a key input in the production process in agricultural and non-agricultural uses and in the environment in which poor people live and depend on. Good human health and environmental health contributes to poverty reduction, and vice versa, with water being key to both. Poverty causes natural resources degradation,

influencing environmental health, which in turn creates more poverty. Improved management of water resources through IWRM and pro-poor approaches will help alleviate poverty, and **will** help improve health of both humans and environment.

“If the free society cannot help the many who are poor, it cannot save the few who are rich”
[John F. Kennedy]

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