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Sanitation-An Economic Perspective

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ABSTRACT

Sanitation is the creation of a clean and hygienic environment and making it sustainable. This paper looks at the facts of sanitation in the economy. The stress is upon economic cost, benefits and other tools of evaluation of sanitation progress. For a huge country like India, with different social and economic contexts, any research on sanitation subject should try to take more than a snapshot of the rural sanitation reality of India. Sanitation behaviour change should not be reduced to selling toilets to people. India faces the challenge of having the most number of people in the world defecating in the open and also has a burgeoning crisis of untreated faecal waste that is contaminating surfaces and ground water creating an imminent health crisis. We must break the myths and monotony branding rural people as ignorant and dirty. Research implications and recommendations and messages in sanitation should begin by honouring and respecting the hard physical labour and their dirty hands and feet.

Keywords: Benefits, Costs, Economics, India, Sanitation, Waste water

INTRODUCTION

All humans produce wastes of various types; for example, urine and faeces, wastes from washing and cooking, and solid wastes produced at home and in workplaces, schools, hospitals and other public buildings. All these wastes need to be controlled and managed for the benefit of people and the environment that they live in. In urban areas where people live close together and space can be limited, managing these wastes is a difficult problem.

Sanitation is described by UNICEF as a comprehensive term referring to “interventions that reduce human exposure to diseases by providing a clean environment”. Certain poor and developing parts of the world are in dire need of such interventions, as human exposure to faecal matter has been responsible for large numbers of illnesses and deaths among children due to intestinal infections and food and water contamination. It is estimated that 1.4 million children die each year due to diseases caused by unsafe drinking water and poor sanitation at present; 2.4 billion people do not use proper sanitation. Worldwide, 946 million people practice open defecation; 564 million of these live in India. The sanitation crisis is so pronounced in India that nearly half of its 1.2 billion people do not have toilets at home. Sanitation is the creation of a clean and hygienic environment and making it sustainable.

The purpose of this article is to examine the nature, scope and importance of economics of sanitation. Unlike the subject sociology of sanitation, economics of sanitation has somehow remained behind.

Sanitation has an economic base too. This article tries to bring the concept of sanitation theory and practice into the realm of economics. The relationship between environment and economic development is not only very close but complex too.

Economic growth is becoming a source of ecological crisis. There is ecological imbalance. It is unhealthy growth. Normative economics should also be considered. The utilitarian model should serve as the guideline for economics of environment. Economic approach to environment includes economic concepts, tools and methods of analysing ecological issues, economic causes and consequences of ecological crisis. We must address economic issues of sanitation both globally and locally.

Facts about sanitation economy

- Today 1 in 3 people or 2.2 billion people around the world lack safe drinking water.
- Over half of the global population or 4.2 billion people lack safe sanitation.
- Almost half of the schools in the world do not have hand washing facilities with soap and water available to students.
- Approximately 50 litres of water per person per day are needed to ensure that most basic needs are met while keeping public health risks at a low level.
- 207 million people spent over 30 minutes per round trip to collect water from an improved source.
- Globally, at least 2 billion people use a drinking water source contaminated with faeces
- Some 297 000 children more than 800 every day under five who die annually from diarrhoeal diseases due to poor sanitation, poor hygiene, or unsafe drinking water
- Children younger than age 5 in countries experiencing protracted conflict are 20 times more likely to die from causes linked to unsafe water and sanitation than from direct violence.
- 1 million deaths each year are associated with unclean births. Infections account for 26% of neonatal deaths and 11 per cent of maternal mortality.
- Hygiene promotion is the most cost effective health intervention.
- 2 out of 5 people or 3 billion people around the world lack basic hand washing facilities at home.
- Loss of productivity to water- and sanitation-related diseases costs many countries up to 5 per cent of GDP.
- Universal access to safe drinking water and adequate sanitation and hygiene would reduce the global disease burden by 10%.
- In urban areas, for every \$1 invested in basic drinking water, an average of more than \$3 is returned in saved medical costs and increased productivity. For every \$1 invested in basic sanitation, the return is \$2.5. In rural areas, the return on investment is even higher: with every \$1 invested in basic drinking water, an average of nearly \$7 is returned in saved medical costs and increased productivity. And in the case of basic sanitation in rural areas, every \$1 returns on average more than \$5 in saved medical costs and increased productivity.

Sanitation is important for all, helping to maintain health and increase life-spans. However, it is especially important for children. Around the world, over 800 children under age five die every day from preventable diarrhoea-related diseases caused by lack of access to water, sanitation and hygiene. In addition, diarrhoea causes children to lose their appetites, which can lead to malnourishment. Limited access to sanitation has become such a worldwide problem that 1 in every 4 children suffer from stunted growth. This leads to “irreversible physical and cognitive damage.

Climate change, increasing water scarcity, population growth, demographic changes and urbanisation already pose challenges for water supply systems. By 2025, half of the world’s population will be living in water-stressed areas. Re-use of wastewater, to recover water, nutrients, or energy, is becoming an important strategy. Increasingly countries are using wastewater for irrigation in developing countries this represents 7% of irrigated land. While this practice if done inappropriately poses health risks, safe management of wastewater can yield multiple benefits, including increased food production.

Options for water sources used for drinking water and irrigation will continue to evolve, with an increasing reliance on groundwater and alternative sources, including wastewater. Climate change will lead to greater fluctuations in harvested rainwater. Management of all water resources will need to be improved to ensure provision and quality although the sanitation SDG targets present us with huge challenges, they also provide us with great opportunities opportunities which we can begin to realise when we start considering sanitation as a service to be delivered, and wastewater and faecal sludge as resources to be reused and not as wastes to be disposed of.

We see such a vision as a key pillar of the sanitation economy. And the exciting thing is that this is already happening! There are many great examples of job creation and economic growth associated with the delivery of safely managed sanitation

services, and many other examples of closing the resource loop in the sector.

We see public and private service providers of all sizes from mega utilities such as Sabesp in Brazil and Manila Water in the Philippines, to small formal or informal entrepreneurs at the local level, such as Container Bases Sanitation providers in Haiti and sludge emptiers in Uganda

LITERATURE REVIEW

Water and the economy

Water crisis is an economic crisis. Time spent collecting water or seeking a safe place to go accounts for billions of dollars in lost economic opportunities. There are 785 million people in the world who lack access to safe water, and of them, women are generally tasked with water collection. They spend hours, multiple times per day, waiting in long lines at community water kiosks or walking to distant sources like rivers and ponds to find it. This is time spent, and income not earned. An estimated \$260 billion is lost globally each year due to lack of basic water and sanitation.

Improving household water and sanitation access impacts household finances and ultimately the economy at a macro level. For instance, access to safe water and a toilet at home can reduce a family's health care expenses. Universal access to basic water and sanitation would result in \$18.5 billion in economic benefits each year from avoided deaths alone. Every \$1 invested in water and sanitation provides a \$4 economic return from lower health costs, more productivity and fewer premature deaths.

Safe water at home empowers women and their families to explore their income-generating potential. Instead of walking to find water, they have time to earn money by doing things like sewing, farming, and teaching. It is with income from these activities they can break the cycle of poverty.

Sanitation in the economy

In 2016 the toilet board coalition ran a feasibility study to explore the potential role of sanitation in the circular economy. The following questions were at the centre of our inquiry:

- Are there products or materials of value being up cycled from toilet resources*?
- Are there scalable business models to deliver sustainable supply of these products to the market?
- Is there commercial interest and demand from large industrial operations to become buyers into the system?

The study engaged twelve small and medium sized businesses (SMEs) engaged in sanitation across low-income markets and twelve experts from multinational corporations, academia, and specialists from across the "waste", or rather resource, management value chain.

In the current experience of supporting toilet innovators and Sani-preneurs, it was found that in addition to creating demand for consumers to buy a toilet, the downstream part of the system is a pervasive challenge transport/collection, and treatment. Not only for the vast numbers of communities without access to a publicly supported sewage has system, but also for the treatment planted them.

The initial inquiry into sanitation in the circular economy with entrepreneurs operating in low income markets, academics, and multinational corporations, has produced six key findings.

- Toilet resources are a major part of the bio cycle that is mostly unexploited
- The circular economy could transform sanitation from a costly service to a self-sustaining and value adding system of resources
- There are 3 circular economy opportunity cycles for sanitation
- There are renewable resources available for corporate supply chains today
- There are innovative applications for industry in the future
- There are significant leapfrog opportunities for low income economies

Economics costs of water and sanitation services

It is economically wise to invest in water and sanitation? Quantifying the costs averted and benefits gained from improvements in water and sanitation is difficult, but best estimates show that the benefits far outweigh the costs of such investments. The United Nations (UN) reports that for every \$1 invested in water and sanitation, there are around \$8 gained through averted costs (for healthcare, illness etc.) and increased productivity. In 2004, the World Health Organisation (WHO) found that investing \$1 in water, sanitation and hygiene education would bring health and other benefits of between \$3 and \$34, depending on the technology used.

Research done for the 2006 UN human development report estimated that the total cost of the current deficit in investment in water and sanitation is \$170 billion, what means 2.6 per cent of all developing countries' GDP.

Achieving the Millennium Development Goals (MDG) on water and sanitation in sub-Saharan Africa would require an additional investment of around \$10 billion a year by delivering the most low-cost, sustainable technology. Universal access to water and sanitation would require \$20-30 billion, depending on the technology.

The economic costs of providing a household with modern water and sanitation services are the sum of seven main components:

- Opportunity costs of diverting raw water from alternative uses to the household.
- Storage and transmission of untreated water to the urban area.
- Treatment of raw water to drinking water standards.
- Distribution of treated water within the urban area to the household.
- Collection of wastewater from the household (sewerage collection).
- Treatment of wastewater (sewage treatment).
- Any remaining costs or damages imposed on others by the discharge of treated wastewater (negative externalities).

Economic benefits of improved water and sanitation services

Investing in sanitation and water improvements leads to various direct and indirect economic benefits:

By reducing direct and indirect health costs: Hygiene and sanitation are among the most cost-effective public health interventions. Almost half of the people living in the developing countries are suffering from one or more of the main diseases associated with inadequate provision of water and sanitation (such as diarrhoea, guinea worm, or trachoma which can lead to blindness). Children in households with no toilet are twice as likely to get diarrhoea as those who have one. Increasing access to water and sanitation is likely to lead to significant health benefits and therefore reducing the financial burden on health systems in the developing world. It is estimated that universal access to even the most basic facilities would reduce the health related costs by around \$1.7 billion, annually including \$610 million in sub-Saharan Africa, which represents around 7 per cent of the region's health budget.

By saving time: People without toilets or taps at home spend a lot of time each day queuing up for public toilets or seeking secluded spots for open defecation, or for collecting water. Improved sanitation would give every such household an additional 1000 hours in a year to work, study, and care for children, engage in collective efforts, and rest. This time has an estimated annual economic value of well over US\$ 100 billion each year. Furthermore, research has shown that households in rural Africa typically spend one fourth of their day fetching water. Some 40 billion working hours are spent carrying water each year in sub-Saharan Africa.

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By increasing the return on investments in education: Various developing countries are raising education spending to meet the MDG targets for school enrolment. That spending will have a greater impact if some of the money goes to providing toilets for students and teachers, with separate facilities for girls. Healthy children learn more than children suffering from worm infections, which sap nutrients and calories and lead to listlessness and trouble concentrating. For example, up to two thirds of all schoolchildren in some African countries are infected with parasitic worms.

By gaining productivity: Improved access to water and sanitation could lead to a large increase in productivity in developing countries, with potential for rising household incomes and economic growth. This includes benefits from reduced diarrhoea which is estimated that 3.2 billion working days would be gained for people aged 15–59 from creating universal access to water and sanitation. Annual time savings from more convenient water supplies would amount to another 20 billion working days most of them gained by women.

By protecting investments in improved water supply: Poor sanitation can limit the impact of drinking water quality improvements. The risks of water contamination during household storage and handling sharply increase in environments that lack toilets. Contamination of local water resources used to supply drinking water can lead to unnecessary investment in more distant and expensive sources.

By safeguarding water resources: Water resources are an important productive asset. Agriculture, fish production, energy production, large-scale industrial processes, small-scale industry, transport, and recreation all suffer economic harm from the increased treatment and other costs due to water pollution by faecal contamination or other pollution sources.

By boosting tourism revenues: In the year 2006, tourism produced over US\$ 6,000 billion-worth of economic activity, accounting for 10 per cent of global GDP and almost 9 per cent of total global employment. Because health, safety, and aesthetic considerations heavily influence people's choice of a holiday destination, good sanitation and water supply is a pre-requisite for a thriving tourism sector.

DISCUSSION

Tools of economic analysis of water and sanitation

If monetary valuation of all major economic costs and benefits seems possible, a cost-benefit analysis may include the following outputs:

Costs and benefits as share of household income: The economic analysis on household level will include all costs and benefits of households. This allows for example to better assess whether the total economic costs are affordable or whether benefits are high enough to be perceived as such. Ratios can also be determined for responsible institutions.

The cost-benefit ratio: The cost-benefit ratio is calculated by dividing the discounted benefits by the discounted costs of the sanitation and water intervention, and can be used to compare a sanitation or water option with 'doing-nothing'.

The internal rate of return: The internal rate of return measures the equivalent return on investment in percentage terms, taking into account monetary cash flows as well as non-monetary costs and benefits over the lifetime of the sanitation and water improvement.

The cost-effectiveness ratio: The cost-effectiveness ratio is a more specific tool that compares costs with a single outcome of sanitation and water improvement, expressed in physical (non-monetary) units such as inhabitants better served, health gain or reduction in pollution. This tool is generally used in public sector planning.

The problem of water and sanitation from an economic perspective

It is commonly said that the problem of water is not one of economics but politics, not one of physical shortage but governance. This is partly correct but not entirely. The generic problem of water and sanitation is one of matching demand with supply, ensuring that there is water of a suitable quality at the right location and the right time, and at a cost that people can afford and are willing to pay.

The difficulty in accomplishing this is partly institutional and certainly includes problems of governance. However, some of the problems of governance themselves have an economic explanation.

The omnipresence of fixed costs in surface water supply creates a classic economic problem of cost allocation which has no satisfactory technical solution [1]. The extraordinary capital intensity and longevity of surface water supply infrastructure, and predominance of economic scale, creates a need of collective action in the provision and financing of water supply that simply does not arise with most other commodities.

Economic benefits of improved water and sanitation services

Investing in sanitation and water improvements leads to various direct and indirect economic benefits:

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Economics of sanitation

A water and sanitation programme report, called economic impact of sanitation in Indonesia, makes that case for that country. The report says that the economic costs of poor hygiene and sanitation in Indonesia reached an estimated US\$6.3 billion or 2.3 per cent of GDP in 2006.

Poor sanitation, including poor hygiene, causes at least 120 million disease episodes and 50,000 premature deaths annually, the report says. The resulting economic impact is more than US\$3.3 billion (IDR 29 trillion) per year. Poor sanitation also contributes significantly to water pollution adding to the cost of safe water for households, and reducing the production of fish in rivers and lakes. The associated economic costs of polluted water attributed to poor sanitation exceed US\$1.5 billion (IDR 13 trillion) per year.

In 2006, Indonesia lost an estimated total of US\$6.3 billion (IDR 56 trillion) due to poor sanitation and hygiene, equivalent to approximately 2.3 per cent of gross domestic product (GDP), the report says.

Health and water resources contribute most to the overall economic losses estimated in the study. These impacts are expected to cause financial losses to people who have to pay for health services, who pay more to access clean water supplies, or who may lose income from work absenteeism due to poor health.

Economic benefits of investing in water and sanitation are considerable: they include an overall estimated gain of 1.5 per cent of global GDP and a US\$ 4.3 return for every dollar invested in water and sanitation services, due to reduced health care costs for individuals and society, and greater productivity and involvement in the workplace through better access to facilities.

Economics of sanitation initiative

The economics of sanitation initiative was launched in 2007 with a WSP study from East Asia, which found that the economic costs of poor sanitation and hygiene amounted to over US\$9.2 billion a year (2005 prices) in Cambodia, Indonesia, Lao PDR, the Philippines, and Vietnam. The ground-breaking study was the first of its kind to attribute dollar amounts to a country's losses from poor sanitation. The report sparked public awareness and Government action in several countries. The ESI initiative was born as a response by WSP to address major gaps in evidence among developing countries on the economic impacts of sanitation. Following the success in East Asia, ESI studies were completed in Africa and South Asia, with a study currently underway in Latin America.

The second phase of ESI in East Asia analyses the costs and the benefits of alternative sanitation interventions in a range of typical contexts. The study results enable decisions on how to more efficiently spend funds allocated to sanitation. The study was conducted in Cambodia, Indonesia, the Philippines, Vietnam, and Yunnan Province in China.

The study found that sanitation interventions have very favourable socio-economic returns to households and society, contributing improved health, clean environment, dignity and quality of life, among many other benefits. In addition, while the study showed sanitation options that protect the environment are more costly to provide, the benefits are highly valued by households, tourists and businesses. When environmental benefits to downstream populations of proper wastewater management are valued, it can considerably increase the economic returns.

ESI work continued at the global level through a WHO publication, Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage, which found that the global economic return on sanitation spending is US\$5.5 for every one dollar invested. The report also estimated the global economic losses associated with inadequate water supply and sanitation at US\$ 260 billion annually.

Sanitation economy

There are three aspects in sanitation economy namely toilet economy, circular sanitation economy and smart sanitation economy.

Companies, across sectors, have the responsibility to provide safely managed sanitation to their employees, throughout supply chains and in communities where they operate. In the toilet economy, toilets not only improve lives, but also become a delivery system for health and hygiene, renewable resources, and information about human health and behaviour. Providing toilets across business operations is no longer an unaffordable cost, but a net contributor to human rights and business value.

Human excreta, or toilet resources, provide new reservoirs of renewable resources for business operations such as water, energy, nutrients and more. In the circular sanitation economy new technologies are creating more cost efficient decentralised alternatives to the capital intensive waste management systems of today. Applying circular economy approaches to sanitation un-locks valuable resources becoming more and more constrained for businesses and society and which are critical to future growth.

In the fourth industrial revolution digital technologies and data are disrupting industries and providing new ways to create business value [2]. In the smart sanitation economy sensing technologies and earth observation *via* satellite technologies provide real-time monitoring of sanitation systems bringing operational efficiencies and new insights about human health and consumer behaviour.

This is new territory. Moving business to a sustainable, sanitation economy, growth model will be disruptive, with big risks and significant opportunities at stake. It will involve experimenting with new circular and more agile business models and digital platforms that can grow exponentially to shape new social and environmental value chains. Knowing how to move first and fast is critical to reduce the risk of assets being stranded by the shift to the Sanitation Economy.

To achieve SDG 6.2 universal access to safely managed sanitation, the Sanitation Economy needs to be implemented at scale. Building a robust market place of products and services, renewable resource flows, data and information *via* sanitation systems will transform sectors, cities, communities and businesses. We have identified 3 key routes to scale to unlock business and societal benefit:

Cities: Cities are growing at unprecedented rates and will be home to an estimated 5 billion people in 2030, 60% of the world's population, with much of the increase in Asia and Africa. All citizens will require access to safely managed sanitation. Applying smart sanitation approaches can help cities to establish Sanitation Intelligence through smart public toilets, smart treatment and smart health.

Sectors: Sectors such as agriculture and manufacturing employ millions of people in economies currently without access to safely managed sanitation. Establishing circular sanitation as a blueprint for sustainable and efficient business operations can provide access to sanitation for millions of people currently without; provide access to resources such as water, energy and nutrients currently scarce for business operations; address health risks for workers and environmental degradation in communities where businesses operate.

Standards: Establishing new standards for decentralised public and community toilets can empower cities with lower cost, faster implementation of sanitation services for growing populations. Standards for the safe use of Toilet Resources for the regeneration of water, energy, nutrients can transform the economics of sanitation from cost to value. Standards for the use of data from sanitation systems can unlock new Sanitation Intelligence to ensure sanitation access, more efficient sanitation system management, and information about human health and behaviour.

Transforming sanitation systems from unaffordable public costs to profitable and sustainable business opportunities will require a new systems approach, new business models and new financial models.

New grid transformation: Sanitation economy systems models are based on the emerging “new grid” idea that blends the best profitability and service features of traditional sewer systems and decentralised “off-grid” solutions into a lower cost, more sustainable hybrid model a network of flows of nutrients, water, energy, data, and finance. Optimisation of “new grid systems” will require scale-up to populations of at least 1 million people.

New business models: The sanitation economy is yielding multiple business models which allow sanitation to generate revenue. Sanitation economy entrepreneurs are achieving various combinations of revenues:

- Toilet economy revenues include transforming toilet access into new consumer spaces of quality, affordable products and services bundled to compound revenue stream opportunities.
- Circular sanitation economy revenues include converting sanitation waste into toilet resources that can be up-cycled into sales of water, energy, organic fertilisers, and potentially high value proteins and other organic chemicals - optimised for local markets and regulation. Several models are already approaching full cost recovery.
- Smart sanitation economy revenues include the potential to optimise efficiencies with digitisation through operations monitoring, and monetise user data, consumer insights, and information about human health and behaviour.

New financial models

The sanitation economy requires an update to the valuation and pricing of new sanitation business models. New evidence of higher value product and service models is emerging and need to be considered in financial models. Blended finance will be required in the short term to enable the needed investment in capital costs to build sanitation economy infrastructure that will unlock commercial finance for revenue generating models at scale. There is a compounding value effect in applying sanitation economy approaches across the 3 economies: The Sanitation economy transforms the economics of sanitation for business and governments from unaffordable costs into sustainable business opportunities.

Toilet economy circular sanitation economy smart sanitation economy

The World Bank has estimated sanitation to be a \$250 billion cost to society each year UN Water estimates a \$1 trillion financing gap per year to reach SDG 6 by 2030.

The World Bank is giving their sanitation work a boost globally: In addition to a growing portfolio of engagements in both rural and urban sanitation, the bank is launching a circular economy initiative building on its recent experiences from Latin America, in which it sees wastewater as a resource to be embraced rather than just a problem to be solved. The report calls for a radical paradigm shift from the linear model of treating wastewater and discharging it in a receiving water body to a circular one focused on reducing water use and consumption and promoting reuse, recycling, restoration and recovery in the form of energy, nutrients, reusable water and bio solids. Such an approach provides economic and financial benefits that can contribute to the sustainability of the sanitation systems and of the utilities operating them. The approach also provides further benefits to related areas such as water supply, agriculture energy production, and greenhouse gas capture.

The World Bank is also fully engaged on a global initiative to rethink approaches to urban sanitation service provision through its ‘Citywide Inclusive Sanitation’ (CWIS) work. The CWIS approach challenges us to ensure that everyone has access to safely managed sanitation by promoting a range of technical solutions that are tailored to the realities of the world’s burgeoning cities and which are flexible and adaptable so that, as cities grow and change, sanitation services adapt with them. In promoting this approach, the Bank encourages governments to focus on service provision rather than on building specific infrastructure, which means considering the financial, institutional, regulatory and social dimensions of the services.

2014-2019 the Government of India has achieved 100 per cent open dedication free status (from just 30 per cent in 2014) by enforcing disruptive approaches to scale up sanitation access by engaging young people, media, influencers and embracing corporate social responsibility. This creates a market for sanitation economy solutions estimated to be a growing \$62 billion market in India alone, which can create many new jobs, improve health, and environmental conditions and create savings for households.

India’s cities are embarking on a massive digital transformation [3]. Pune as India’s first smart sanitation city provides a blueprint for all smart cities to fully capitalise on the emerging technologies described in this report to enhance basic infrastructure and achieve optimised and aspirational smart sanitation at the same time [4,5].

Good sanitation is a win-win for everyone: Workers, businesses and the environment. It is critical for the health and well-being of sanitation workers and their families, so involving sanitation communities from the outset is crucial to ensure their needs are met. Collaborations can drive transformational change. This can have positive benefits for sanipreneurs and also makes commercial sense for businesses.

Economic aspects of sanitation in developing countries

Evidence has demonstrated that the economic cost associated with poor sanitation is substantial. At the global level, failure to meet the MDG water and sanitation target would have ramifications in the area of US\$38 billion, and sanitation accounts for 92 per cent of this amount. In developing countries, the spending required to provide new coverage to meet the MDG sanitation target (not including programme costs) is US\$142 billion. This translates to a per capita spending of US\$28 for sanitation. Annually, this translates to roughly US\$14 million. The evidence compiled in this paper demonstrates that investing in sanitation is socially and economically worthwhile. For every US\$1 invested, achieving the sanitation MDG target and universal sanitation access in the non-OECD countries would result in a global return of US\$9.1 and US\$11.2, respectively.

Given the current state of knowledge, sanitation is undeniably a profitable investment. It is clear that achieving the SDG sanitation target not only saves lives but also provides a foundation for economic growth.

Economic impacts of unimproved sanitation: Poor sanitation causes economic losses associated with the direct costs of treating sanitation-related illnesses and lost income through reduced or lost productivity. In addition, poor sanitation also leads to time and effort losses due to distant or inadequate sanitation facilities, lower product quality resulting from poor water quality, reduced income from tourism (due to a high risk of contamination and disease), and clean-up costs.

Scientific evidence has demonstrated that the economic costs associated with poor sanitation are substantial. At the global level, failure to meet the MDG water and sanitation target would have ramifications in the area of US\$38 billion, and sanitation accounts for 92 per cent of this amount. At the regional level, a recent study conducted in Southeast Asia found that the economic costs of poor sanitation and hygiene amounted to over US\$9.2 billion a year (2005 prices) in Cambodia, Indonesia, the Philippines, and Vietnam, accounting for 2 per cent of the total GDP for all of the countries combined. The key economic impacts in descending order of importance were health, water resources, user preferences (access time cost), and tourism. Poor sanitation affects everyone, but especially the poor and vulnerable (children, women, the disabled, and the elderly).

Several studies have also been conducted to estimate the economic costs associated with poor sanitation. In Ghana and Pakistan, for example, the indirect effect on child mortality of environmental risk factors mediated by malnutrition has added more than 40% to the cost of directly caused child mortality. If one took into account the effect of such malnutrition on impaired school performance and delayed entry into the labour market, the cost would double to 9 per cent of the Gross Domestic Product (GDP).

In Cambodia, poor sanitation has led to economic losses of US \$448 million per year, which translates into per capita loss of approximately US \$32. The economic losses were equivalent to 7.2 per cent of Cambodia's GDP in 2005. This amount was roughly equivalent to the contribution of the fishery sector to the GDP, or twice the forestry sector's contribution. While these economic costs were not all tangible, the immediate money 'in the hand' losses (financial losses) amounted to about US \$160 million per year, which was roughly 2.5 per cent of the GDP, equivalent to nearly US \$12 per capita.

Indonesia lost an estimated US\$6.3 billion due to poor sanitation and hygiene, equivalent to approximately 2.3% of the GDP. Of the impacts evaluated, health and water resources contributed most to the overall economic losses estimated in the study. Poor sanitation, including hygiene, caused at least 120 million disease episodes and 50,000 premature deaths annually. The resulting economic impact was more than US\$3.3 billion per year. The associated economic costs of polluted water attributed to poor sanitation exceeded US\$1.5 billion per year. Poor sanitation also contributed up to US\$1.2 billion per year in population welfare losses (due to additional time required to access unimproved sanitation), US\$166 million per year in tourism losses, and US\$96 million in environmental losses due to loss of productive land.

Economic and financial issues

Willingness to pay for alternative technologies and service levels are key information for setting up financially sustainable water supply, sanitation and solid waste management services. Past research efforts to developing methodologies for determining the willingness to pay for water supply has to be expanded to sanitation and solid waste services. The research on willingness to pay should also study how health and hygiene education influences the willingness to pay.

Additional research efforts are also needed in studying and developing alternative cost-recovery mechanisms. This research should include investigation of alternative models for financing the sector if or when the costs cannot be covered by beneficiaries.

Areas for further research

No exhaustive list of specific research topics and activities with given priorities shall be provided. First of all it should be emphasised, that the principal challenges of the immediate future will not be technological questions - the "hardware" of water supplies, sanitation and waste management but the "software" issues: How are water, sanitation and solid waste services to be organised and financed? How can people be trained, organised, and motivated to install, use, and maintain the facilities? How can institutions develop the sector further and make improvements more sustainable? How to make better use of existing assets? How to provide alternative types of systems to serve low-income neighbourhoods?

Sanitation needs strong action research that is well planned and organised. Community engaged must be emphasised. Action research, as disciplined inquiry, is an invaluable tool that allows educational leaders to reflect upon their practices, programs, and procedures". It is a systematic and orderly way for teachers to observe their practice or to explore a problem and a possible course of action. Action research is also a type of inquiry that is preplanned, organized, and can be shared with others". Action research is understood here as a participatory methodological strategy that articulates investigation and action with the direct involvement of the subjects of the investigated situation. By means of a cyclic process of reflection on research and action, new knowledge is produced and answers and solutions are collectively sought to the problems that are being faced.

Suggested topics for research

- This list is however, not exhaustive. Topics are not rigid.
- Climate change and sanitation
- Drinking water supply, surface water pollution
- Low cost water filtration system
- Groundwater pollution
- Odour issues
- Odour control in sanitation
- Sewer systems and storm water drainage
- Wastewater characterisation and mathematical modelling
- Using water instead of toilet paper? Rethinking over current practice of sanitation (toilet)
- Faecal sludge and waste water impact on marine environments
- Toilet revolution in rural China/other country case can be taken
- Sanitation systems, what should they accomplish and what it means for re-use and disposal
- Pollution of rivers
- The use of antimicrobial plants root for household water and wastewater treatment
- Urban sanitation: Beyond toilets
- Sewer systems & wastewater management
- Potential sanitation solutions during an emergency response
- Guidance for reducing health risks to workers handling human waste or sewage.
- WASH in healthcare
- Scaling up rural sanitation and hygiene
- Market-based sanitation
- Entrepreneurship and sanitation
- Sanitation financing and cost-benefit analyses
- Smart finance and sanitation
- Creating sustainable services through domestic private sector participation
- Supporting poor-inclusive WSS sector reform
- Targeting the urban poor and improving services in small towns
- Mitigating and adapting water and sanitation service delivery to climate change impacts
- Delivering Water Supply and Sanitation (WSS) services in fragile states
- The sanitation ladder and waste hierarchy
- The NGO approach to sanitation

- Best practices in solid waste management
- Traveller's health and sanitation

CONCLUSION

First of all, I hope that this paper will have broken the myth that sanitation is confined to sociology only; it is related to economic also. There is a multidisciplinary approach to the study of sanitation.

Proper hygiene and sanitation is very important for our physical, psychological, social and spiritual health. There are a myriad of ways in which we can keep our surroundings in check and keep them neat and clean. Best practices in theory and practice are needed.

By definition, a sanitation system needs to perform the following: collect and isolate human waste, safely transmit this waste, and then treat this waste before reusing it or letting it out in the environment. A functional toilet performs only a few of these functions: Collection and isolation, temporary storage in the case of on-site systems, and partial treatment. Without concomitant attention to safe waste collection and disposal, "improved toilets" will not necessarily lead to improved health outcomes given the multiple routes through which faecal exposure takes place. Studies have shown that improved health outcomes are dependent on neighbours' access to adequate sanitation, and that sanitation at the community level is necessary to achieve health outcomes.

Culture brings the concept of sanitation practice and philosophy into the realm of sociology in general and action sociology, in particular. When people irrespective of regions and religions develop habits in their lives regarding food and nutrition, health and hygiene, etc., a sense of community culture also develops. Feeling for cleanliness slowly becomes in-built and transforms itself into a behaviour using the mind and the body together. Developing and using systems and institutions for personal and public health and hygiene brings forth behavioural models (e.g. toilet use). In the process however there will be constraints misuse of the systems and mechanisms, refusal to accept and adapt, or resistance to change, say being happy with the old ways of doing things.

For a huge country like India, with different social and economic contexts, any research on sanitation subject should try to take more than a snapshot of the rural sanitation reality of India. Sanitation behaviour change should not be reduced to selling toilets to people. India faces the challenge of having the most number of people in the world defecating in the open and also has a burgeoning crisis of untreated faecal waste that is contaminating surfaces and ground water creating an imminent health crisis. We must break the myths and monotony branding rural people as ignorant and dirty. Research implications and recommendations and messages in sanitation should begin by honouring and respecting the hard physical labour and their dirty hands and feet. Only then should the hand washing and toilets message follow. We need more and more research on sanitation scientific, social science and social service oriented

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