SANITATION
DEFINITION

- **Sanitation**: Refers to the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon people health and the environment. Good sanitation includes appropriate health and hygiene awareness and behaviour, and acceptable, affordable and sustainable sanitation services (WHO, 2001)

- Sanitation is the **hygienic means** of promoting health through prevention of human contact with the **hazards of wastes**.
DEFINITION

• Hygienic means of prevention can be by
  – using engineering solutions
    • sewerage
    • wastewater treatment
  – simple technologies
    • latrines
    • septic tanks
  – personal hygiene practices
    • handwashing with soap

• Hazards is an agent of disease & can be either
  – physical
  – biological/microbiological or
  – chemical
DEFINITION

• Wastes are those that can cause health problems
  – human and animal faeces
  – solid wastes
  – domestic wastewater
    • sewage
    • sullage
    • greywater)
  – industrial wastes &
  – agricultural wastes.
INTRODUCTION

- It can be applied to a specific aspect, concept, location, or strategy, such as:
  - Basic sanitation
  - On-site sanitation
  - Food sanitation
  - Environmental sanitation
  - Ecological sanitation
INTRODUCTION

• Basic sanitation
  – refers to the management of human faeces at the household level
  – this terminology is the indicator used to describe the target of the Millennium Development Goal on sanitation

• On-site sanitation
  – the collection and treatment of waste is done where it is deposited
    • pit latrines
    • septic tanks &
    • imhoff tanks

• Food sanitation
  – refers to the hygienic measures for ensuring food safety
INTRODUCTION

• Environmental sanitation
  – the control of environmental factors that form links in disease transmission
  – subsets of this category are
    • solid waste management
    • water and wastewater treatment
    • industrial waste treatment &
    • noise and pollution control

• Ecological sanitation
  – a concept and an approach of recycling to nature the nutrients from human and animal wastes. (*Jogjajakarta experience*)
Wastewater Sanitation

• Wastewater collection
  – The standard sanitation technology in urban areas is the
    • collection of wastewater in sewers
    • its treatment in wastewater treatment plants for
      – reuse or
      – disposal in rivers, lakes or the sea.
  – Sanitary sewers are
    • sewers combined with storm drains or
    • separated
  – Combined sewers are usually found in
    • central
    • older parts or
    • urban areas
Wastewater Sanitation

• Wastewater collection
  – Heavy rainfall and inadequate maintenance can lead to combined sewer overflows or sanitary sewer overflows. Thus, diluted raw sewage being discharged into the environment.
Wastewater Sanitation

- Wastewater collection
  - Industries often discharge wastewater into municipal sewers, which can complicate wastewater treatment unless industries pre-treat their discharges
  - The high investment cost of conventional wastewater collection systems are difficult to afford for many developing countries
  - Some countries have therefore promoted alternative wastewater collection systems such as condominial sewerage (uses smaller diameter pipes at lower depth with different network layouts from conventional sewerage)
Wastewater Sanitation

• Reuse of wastewater
  – The reuse of untreated wastewater in irrigated agriculture is common in developing countries.
  – The reuse of treated wastewater in landscaping (esp. on golf courses), irrigated agriculture and for industrial use is becoming increasingly widespread.
  – In many peri-urban and rural areas households are not connected to sewers.
  – They discharge their wastewater into septic tanks or other types of on-site sanitation.
Wastewater Sanitation

• Ecological sanitation
  – Ecological sanitation is sometimes presented as a radical alternative to conventional sanitation systems.
  – Ecological sanitation is based on composting or vermicomposting toilets where an extra separation of urine and faeces at the source for sanitization and recycling has been done.
Wastewater Sanitation

• Ecological sanitation
  – It thus eliminates the creation of blackwater and eliminates fecal pathogens from any still present wastewater (urine).
  – If ecological sanitation is practiced municipal wastewater consists only of greywater, which can be recycled for gardening.
  – However, in most cases greywater continues to be discharged to sewers.
Wastewater Sanitation

• Sanitation and public health
  – The importance of waste isolation lies in an effort to prevent water and sanitation related diseases, which affects both developed countries as well as developing countries to differing degrees.
  – It is estimated that up to 5 million people die each year from preventable water-borne disease, as a result of inadequate sanitation and hygiene practices.
  – The affects of sanitation have also had a large impact on society.
  – Published in Griffins Public Sanitation proven studies show that higher sanitation produces more attractiveness.
Wastewater Sanitation

- Sanitation and public health
  - Poor / Inadequate sanitation may lead to problems in:
    - Drinking water quality
    - Bathing waters
    - Water resources
    - Water Supply & Sanitation monitoring
    - Developing Water Supply & Sanitation & hygiene
    - Water-related disease
    - Wastewater use
    - Healthcare waste
    - Emerging issues
    - Economic aspects
Wastewater Sanitation

• Sanitation and public health
  – How can water-related diseases be prevented during emergencies?

• The 3 top priorities concerning drinking water & sanitation during an emergency situation are:
  – ensuring the provision of enough safe water for drinking and for personal hygiene to the people affected by the crisis;
  – ensuring that all people affected by the crisis have access to hygienic sanitation facilities;
  – promoting good hygiene behaviours.
Wastewater Sanitation

• Global access to improved sanitation
  – The Joint Monitoring Program for water and sanitation of WHO and UNICEF has defined improved sanitation as
    • connection to a public sewer
    • connection to a septic system
    • pour-flush latrine
    • simple pit latrine
    • ventilated improved pit latrine
  – According to that definition, of the world's population has access to improved sanitation
    • 8% in 1990
    • 62% in 2008
  – Only slightly more than half of them or 31% of the world population lived in houses connected to a sewer.
Wastewater Sanitation

• Global access to improved sanitation
  – Overall, 2.5 billion people lack access to improved sanitation and thus must resort to open defecation or other unsanitary forms of defecation, such as
    • public latrines or
    • open pit latrines
  – This includes 1.2 billion people who have access to no facilities at all.
  – This outcome presents substantial public health risks as the waste could contaminate drinking water and cause life threatening forms of diarrhoea to infants (*PAK experience on AGE among children*).
Wastewater Sanitation

• Global access to improved sanitation
  – Improved sanitation, including
    • hand washing &
    • water purification
  could save the lives of 1.5 million children who suffer from diarrheal diseases each year.
  – In developed countries, where less than 20% of the world population lives
    • 99% has access to improved sanitation &
    • 81% were connected to sewers
Basic Level of Sanitation

- The minimum acceptable basic level of sanitation is:
  - appropriate
    - health and hygiene awareness &
    - behaviour
  - a system for disposing
    - human excreta
    - household waste water & refuse
  which is
    - acceptable & affordable to the users
    - safe
    - hygienic & easily accessible &
    - does not have an unacceptable impact on the environment
  - a toilet facility for each household.
Unhygienic Practices

• The unhygienic practices are clearly the results of:
  – Lack/inadequate
    • awareness on health and hygiene
    • sanitation facilities
    • inadequate water supplies
    • toilet
    • hand washing facilities
  – poor facilities for the safe disposal of
    • waste water &
    • other domestic waste
Common Health Problems

• Most common health problems associated with poor sanitation are:
  • diarrhoea & dysentery;
  • bilharzia
  • malaria
  • cholera
  • worms
  • eye infections and skin diseases &
  • increased risk of
    • bacteria infections &
    • disease for people with reduced immune systems (HIV/AIDS)
Effects of Poor Sanitation

• Poor sanitation leads to these health problem because many of the infective organisms are spread
  • from hand to mouth or
  • from hand to food to mouth.
• Between through drinking contaminated water directly & during food preparation, oral-faecal infections are mostly transmitted in latter.
• A number of important public health problems have direct influence by
  • improving hygiene practices &
  • providing sanitation facilities
• Important public health messages
  • understanding how infections are transmitted &
  • how to break the cycle of infection
Disease Transmission

- Disease transmission paths

- Faeces provide food for many organisms that cause diseases in humans

- And action that prevents these organisms from getting to the faeces or from getting onto or into human bodies will help to break the cycle of infection
The Environmental Impacts of Poor Sanitation

- Most human activity impacts on the environment.
- Sanitation systems involve
  - disposal &
  - treatment of wastes.
- A range of pollution risks to the environment are due to
  - inadequate sanitation or
  - inadequate maintenance or
  - inappropriately designed systems
- May leads to esp. contamination of water resources
  - surface &
  - ground
- However, there’s a limit where the system can assimilate pollution without deteriorating water quality.
Impact of Sanitation Systems on Water Quality

- Factors that affect the impact of sanitation systems on water quality are:
  - size and density of the settlement being served
  - sensitivity (or Class) of the receiving water resource
  - type of sanitation system
  - capacity of the service provider to manage the system &
  - depth to ground water and the soil type
Failed or inadequate sanitation

- Pollution resulting from failed or inadequate sanitation systems is associated with:
  - direct contact with faecal contaminated or leachate water can cause
    - water borne disease
    - other health risks such as blue baby syndrome (methemoglobinemia) in bottle fed infants (high nitrates)
  - the growth of aquatic plants (mostly algae), which in turn results in
    - increased treatment costs
    - reduced recreational value of the water body
    - possible growth of toxic algae and loss of bio-diversity
  - depletion of the oxygen in the water column which can also result in
    - a loss of bio-diversity &
    - a complete shift in the natural biota of the stream
The Economic Cost of Poor Sanitation

The United Nations Children Fund (UNICEF) and World Health Organisation (WHO) has linked investing in sanitation to:

- reduced morbidity and mortality and increased life expectancy
- savings in health care costs
- reduced time caring and sick leave (back to work)
- higher worker productivity
- better learning capacities of school children
- increased school attendance, especially by girls
- strengthened tourism and national pride
- direct economic value of high quality water such as irrigation water for crops &
- reduced water treatment costs
Social and Psychological Problems

• Social and psychological problems associated with poor sanitation
  • toilets placed at a distance from the home
  • inadequate communal facilities
  • inadequate disposal of waste &
  • other poor sanitation practices result in loss of
    • privacy &
    • dignity
  • exposure and increased risks to personal safety
  • especially women & elderly who are the most inconvenienced
  • although the school attendance of girls in schools in remote area is high compared to other urban area, it is nationally recognised that poor sanitation facilities at schools can be one of the main reasons for girls to drop out.
Addressing Sanitation Problem

• The sanitation problem will be addressed by means of the following strategic interventions:
  • facilitating the participation of communities
  • promoting health and hygiene
    • awareness & practices
  • development and use of local resources
  • upgrading of existing facilities
  • adopting an integrated environmental management approach
  • developing a common approach to implementation &
  • undertaking specific programmes to clear the backlog
Role Players In Sanitation Improvement Programme

• The improvement of sanitation is everybody’s business & should not be seen as a government-sponsored top down programme.

• The role players who could contribute towards a sanitation improvement programme include:
  • householders and communities (first and foremost)
  • community based contractors
  • local government
  • state government
  • national government
  • the private sector, including
    • funding institutions
    • consultants
    • contractors &
    • materials & equipment suppliers
  • non-governmental organisation (NGO)
Monitoring the Sanitation Programme

• The following broad categories of monitoring the sanitation programme are required:
  • the involvement of communities
  • the promotion of health and hygiene awareness and education
  • the impact of sanitation improvement programmes on the health of communities
  • compliance with the integrated environmental management approach and the environmental impacts of sanitation systems
  • development of common norms and standards, guidelines and other tools
  • programmes to clear the backlog
  • integrated development plans as well as the Water Services Development Plan and Integrated Investment Plan components
  • the allocation, application and management of funds &
  • the construction of sanitation facilities
Solid waste disposal

- Disposal of solid waste is in
  - landfills (most commonly conducted)
  - Incineration
  - recycling
  - composting &
  - conversion to biofuels
Solid waste disposal

• In the case of landfills
  – advanced countries typically have rigid protocols for daily cover with topsoil
  – underdeveloped countries customarily rely upon less stringent protocols.

• The importance of daily cover lies in the reduction of vector contact and spreading of pathogens. (*LiLaTi*)

• Daily cover also
  – minimises odor emissions &
  – reduces windblown litter
Solid waste disposal

- Likewise, developed countries typically have requirements for perimeter sealing of the landfill with clay-type soils to minimize migration of leachate that could contaminate groundwater (hence, jeopardize some drinking water supplies).

![Types of Solid Waste](image)
Solid waste disposal

• For incineration options
  – release of air pollutants, including certain toxic components is an attendant adverse outcome.

• For recycling and biofuel conversion
  – sustainable options that generally have superior life cycle costs, particularly when total ecological consequences are considered.

• For composting
  – value will ultimately be limited by the market demand for compost product.
Sanitation in Developed Countries

- In USA, sanitation is a legislative requirement of OSH, which is governed by 29 CFR Part 1910.141.
Sanitation in Developed Countries
(Water Supply and Sanitation in the United States)

1. Technical and environmental overview
   - Infrastructure

2. Water sources
   - Cities supplied primarily by surface water without water treatment
   - Cities supplied primarily by surface water with water treatment
   - Cities supplied primarily by groundwater
   - Cities supplied by a mix of groundwater and surface water
   - Water use

3. Institutional overview
   - Service providers
   - Regulators
   - Other stakeholders

4. Issues
   - Water scarcity and climate change
   - Pollution
   - Investment gap
   - Access
   - Pricing and affordability
   - Retiring workforce
   - Fluoridation

5. Responses to address issues
   - Supply-side management
   - Demand-side management
   - Water reuse
   - Pollution control
   - Federal assistance
Sanitation in the developing world

• The United Nations Millennium Development Goals (MDGs) include a target
  – to reduce by half the proportion of people without access to basic sanitation by 2015

• In recognition of the slow progress being made towards the MDGs sanitation target, in December 2006, the United Nations General Assembly declared
  – 'The International Year of Sanitation' in year 2008.
Sanitation in the developing world

- The year aims to develop awareness and action to meet the target. Particular concerns are:
  - Removing the stigma around sanitation, so that the importance of sanitation can be more easily and publicly discussed.
  - Highlighting the poverty reduction, health and other benefits that flow from better hygiene, household sanitation arrangements and wastewater treatment.
- Research from the Overseas Development Institute suggests that sanitation and hygiene promotion needs to be better 'mainstreamed' in development, if the MDG on sanitation is to be met.
Sanitation in the developing world

• Currently, promotion of sanitation and hygiene is mainly carried out through water / waste water institutions.

• Many institutions that should carry out activities to develop better sanitation and hygiene in developing countries
  – educational institutions can teach on hygiene &
  – health institutions can dedicate resources to preventative works (to avoid, for example, outbreaks of cholera).
Sanitation in the developing world

• Research programme on Community-led Total Sanitation (CLTS) is a radically different approach to rural sanitation in developing countries and has shown promising successes where traditional rural sanitation programmes have failed.

• CLTS is an unsubsidized approach to rural sanitation that facilitates communities to recognize the problem of open defecation and take collective action to clean up and become ‘open defecation free’.

* The Institute of Development Studies (IDS)
Sanitation in the developing world

• It uses community-led methods such as
  – participatory mapping &
  – analysing pathways b/w faeces & mouth

as a means of galvanizing communities into action.

• An IDS 'In Focus' Policy Brief suggests that in many countries the Millennium development goal for sanitation is off track and asks how CLTS can be adopted and spread on a large scale in the many countries and regions where open defecation still prevails.
Sanitation in the food industry

• Sanitation within the food industry means
  – adequate treatment of food-contact surfaces by a process that is effective in destroying vegetative cells of microorganisms of public health significance
  – substantially reducing numbers of other undesirable microorganisms
  – without adversely affecting the product or its safety for the consumer

* (U.S.F.D.A., 21CFR110, USA)
Sanitation in the food industry

- Sanitation Standard Operating Procedures are indispensable for food industries in US, which are regulated by 9 CFR part 416 in conjunction with 21 CFR part 178.1010.
- Similarly in Japan, food hygiene has to be reached through the compliance of Food Sanitation Law.
- Malaysia adopts Food Act & HACCP (hazard analysis critical control points).
Sanitation in the food industry

- Additionally, in the food and Biopharmaceutical industries, the term sanitary equipment means equipment that is fully cleanable using Clean-in-place (CIP), and Sterilization in place (SIP) procedures: that is fully drainable from cleaning solutions and other liquids.
Sanitation in the food industry

• The design should have a minimum amount of deadleg or areas where the turbulence during cleaning is not enough to remove product deposits.

• In general, to improve cleanability, this equipment is made from Stainless Steel 316L, (an alloy containing small amounts of molybdenum).

• The surface is usually electropolished to an effective surface roughness of less than 0.5 micrometre, to reduce the possibility of bacterial adhesion to the surface.
THANK YOU

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