Global and Local Trends in Water Resources Use

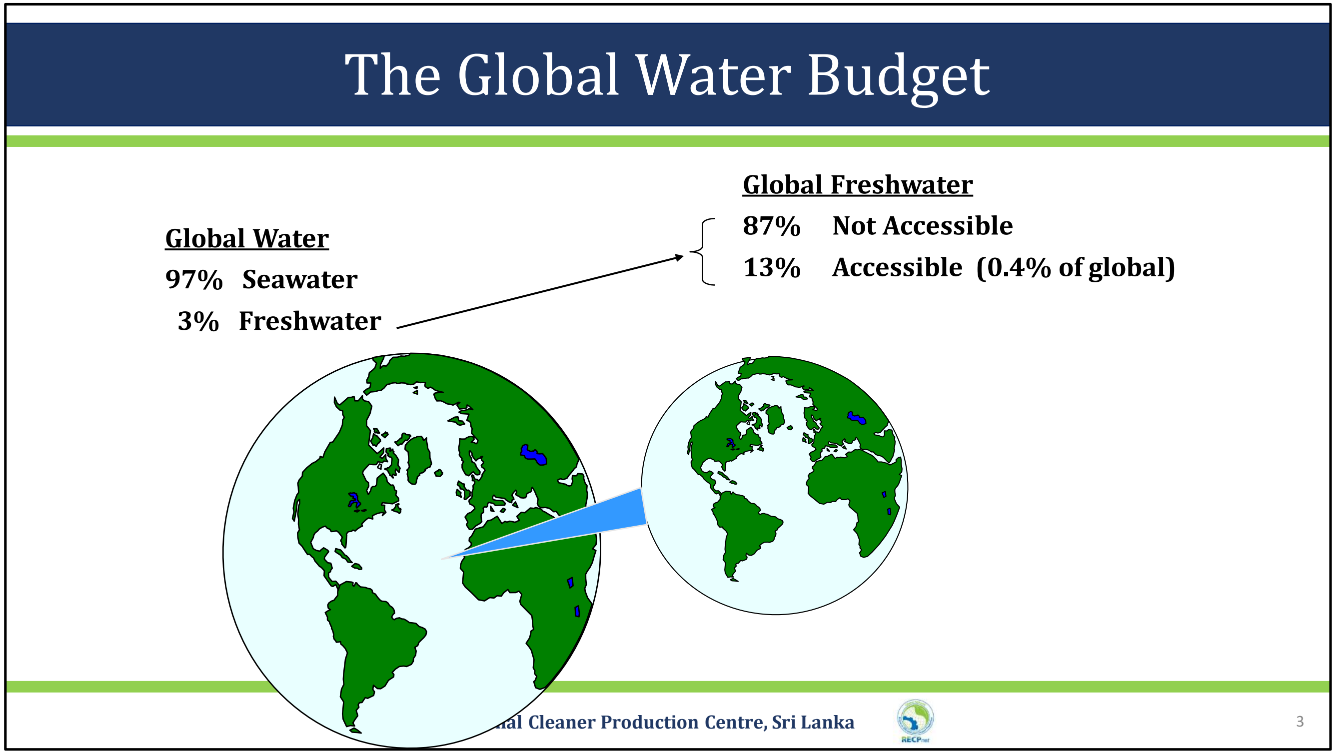
National Cleaner Production Centre, Sri Lanka

1

This module describes the global and local trends in water resources use. The impacts on water resources are also described here.

Outline

- Introduction
- Drivers of Change
- Global water issues
- Strategies for addressing global water issues
- Status of water resources in Sri Lanka
- Strategies to address local water issues
- Concluding remarks



Earth's water exists on land surface in oceans, ice fields, lakes, rivers, streams, and wetlands; it also exists in the subsurface as soil water and ground water and in the atmosphere. Around 97 percent of the Earth's water is in oceans while 3 percent is in inland waters. Of the inland water that resides on and beneath land surface, 87 percent is contained in icecaps and glaciers and for practical purposes is inaccessible. The remaining inland water is stored primarily in the subsurface as ground water.

Drivers of Change

- Population Increase
- Changing life styles
- Urbanization
- Increase demand for food production
- Increasing abstraction and closing rivers
- Technological changes
- Deterioration of water quality
- Geo-political issues
- Climate Change

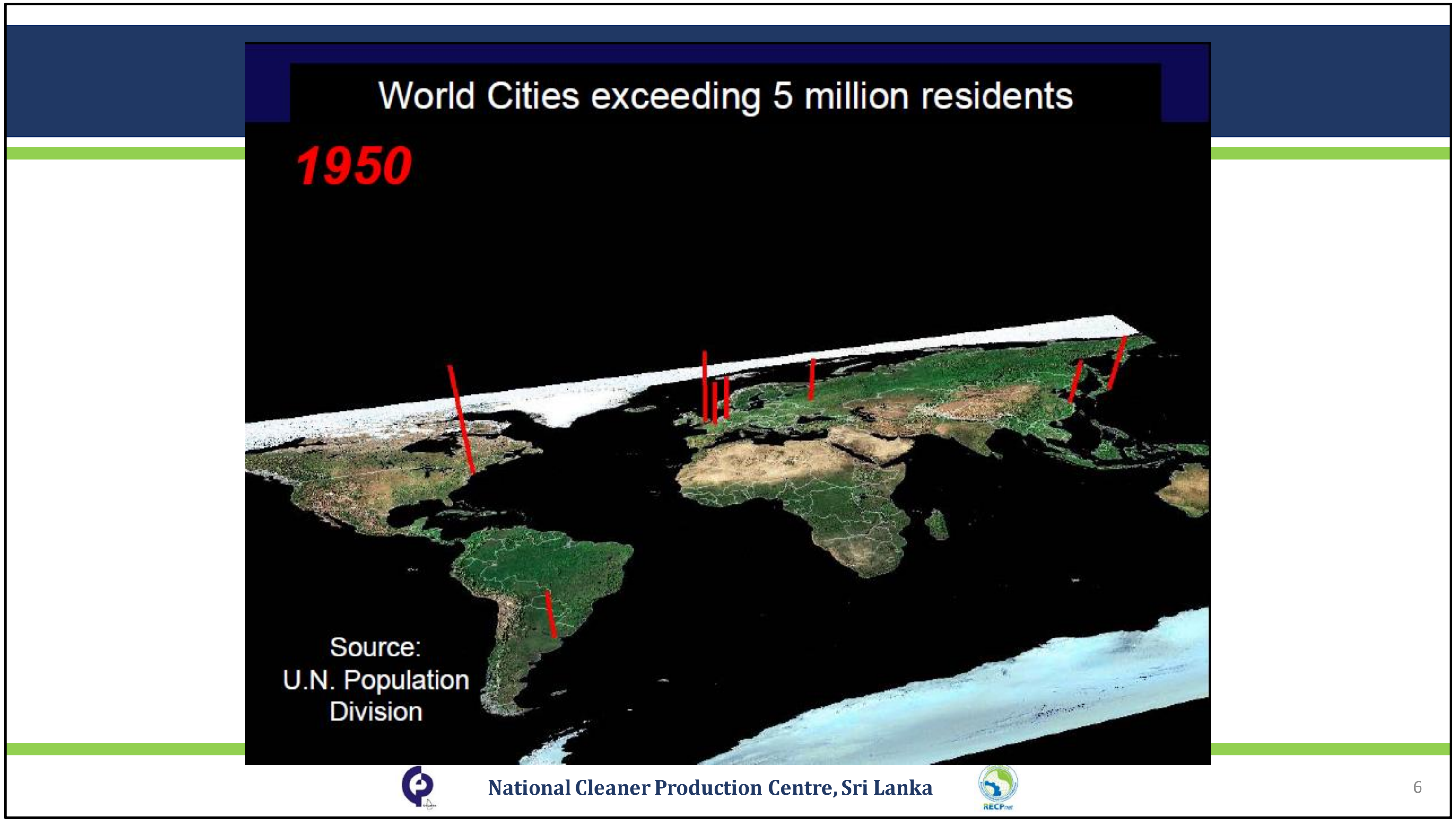
Unsustainable development pathways and governance failures have affected the quality and availability of water resources, compromising their capacity to generate social and economic benefits. Demand for freshwater is growing. Unless the balance between demand and finite supplies is restored, the world will face an increasingly severe global water deficit.

A Challenge to Water Management

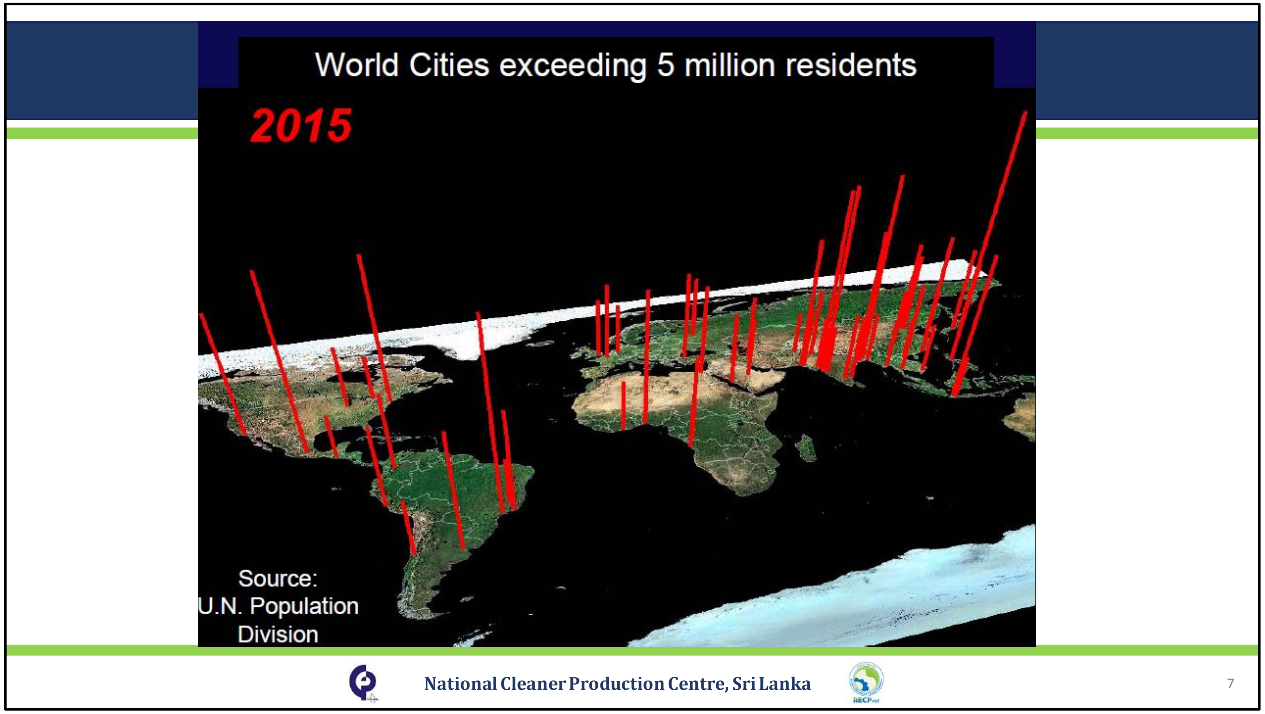
Population growth is a significant driver of increasing water demand, both directly (e.g. for drinking water, sanitation, hygiene and household uses) and indirectly (e.g. through growing demands for water-intensive goods and services, including food and energy).

The global population reached 7.6 billion people as of June 2017. It is expected to reach about 8.6 billion by 2030 and further increase to 9.8 billion by 2050 (UNDESA, 2017a).

Africa and Asia account for nearly all current population growth, although Africa is expected to be the main contributor beyond 2050.



New York city in United States had the highest residents in 1950 and it is 12.5 million. Following New York, London in United Kingdom (8.9 million), Tokyo in Japan (7 million), Paris in France (5.9 million), Shanghai in China (5.4 million), Moscow in Russia (5.1 million), Buenos Aires in Argentina (5.08 million) and Chicago in United States (5 million) are the other cities in the world occupying more than 5 million residents in 1950.

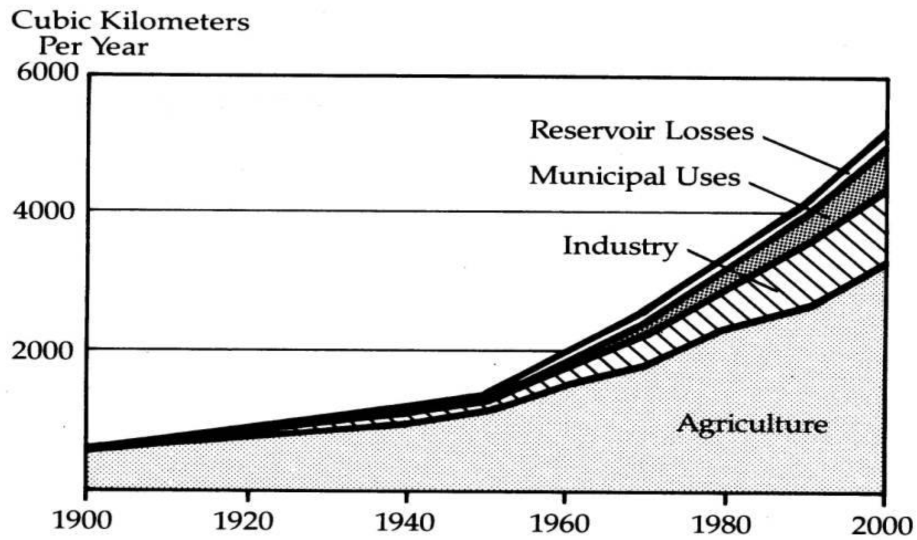


In Northern America, more than half of the population resided in cities with 500,000 inhabitants or more in 2015 and one in five people lived in a city of 5 million inhabitants or more. Latin America and the Caribbean is the region with the largest proportion of the population concentrated in megacities: of the total population of the region in 2016, 12.7 per cent resided in the five cities with 10 million inhabitants or more and the share in megacities is projected to rise to 14.3 per cent in 2030, as Bogotá crosses the 10 million threshold. In both Africa and Asia, more than half of the population lived in rural areas in 2016, but that share is declining. Between 2016 and 2030, the number of cities with 500,000 inhabitants or more is expected to grow by 80 per cent in Africa and by 30 per cent in Asia.

- Cities impact the hydrological cycle in several ways by: extracting significant amounts of water from surface and groundwater sources; extending impervious surfaces thus preventing recharge of groundwater and exacerbating flood risks; and polluting water bodies through the discharge of untreated wastewater. Since much of the water consumed by cities generally comes from outside the city limits, and the pollution they generate also tends to flow downstream, the impact of cities on water resources goes beyond their boundaries. Cities also import significant amounts of food, consumer goods and energy from outside the city, which requires large amounts of water at the point of production, transportation and sale. This virtual demand of cities greatly exceeds direct water use (Hoekstra and Chapagain, 2006).

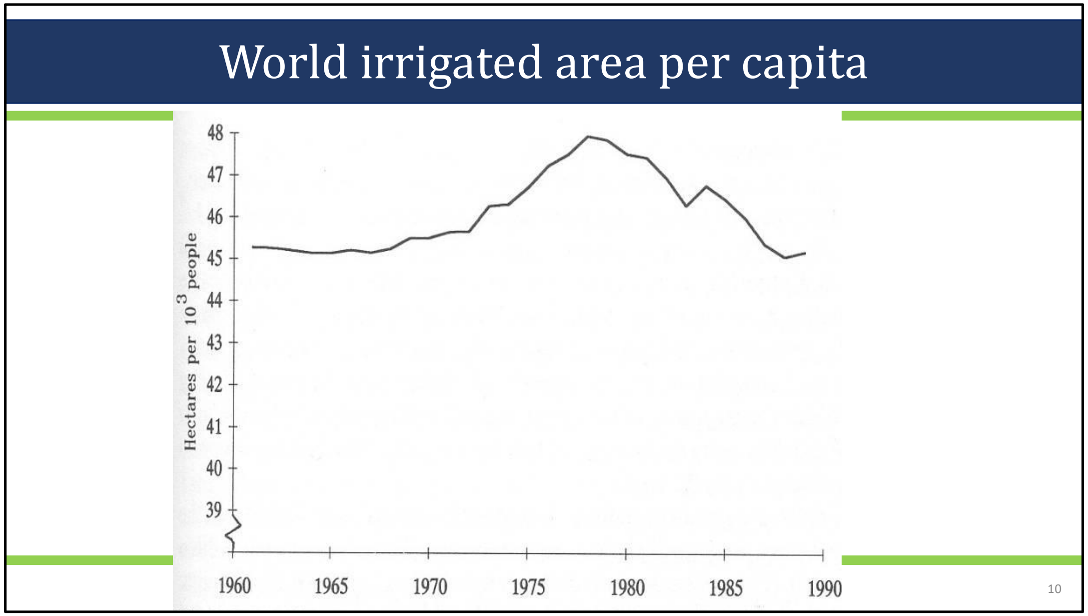
Estimated Annual World Water Use, Total by Sector, 1900-2000

- Agricultural water use: 2/3 of global water use



9

Global water use has more than tripled since the 1950s and now stands at an estimated 4,340 km3 per year. Water planners have responded to these increasing demands by introducing water projects, including dams and diversion projects, and by tapping aquifer water. These options are either running dry or carry economical, political and ecological price tags that no longer make them attractive options. If human needs are to be met, a new approach to water management must develop. Three directions may be undertaken immediately by 1) treating water as a resource and paying the real cost; 2) developing water conservation programs that help meet the increasing water needs without drawing further on natural water sources; 3) addressing the complex interactions between land, vegetation and water, including the effects of human activities that decrease the sustainability of water supplies. Some such effects are salinization due to over-irrigation, erosion, flooding and water system siltation from deforestation and development (land use), and pollution from industrial and municipal water discharges.



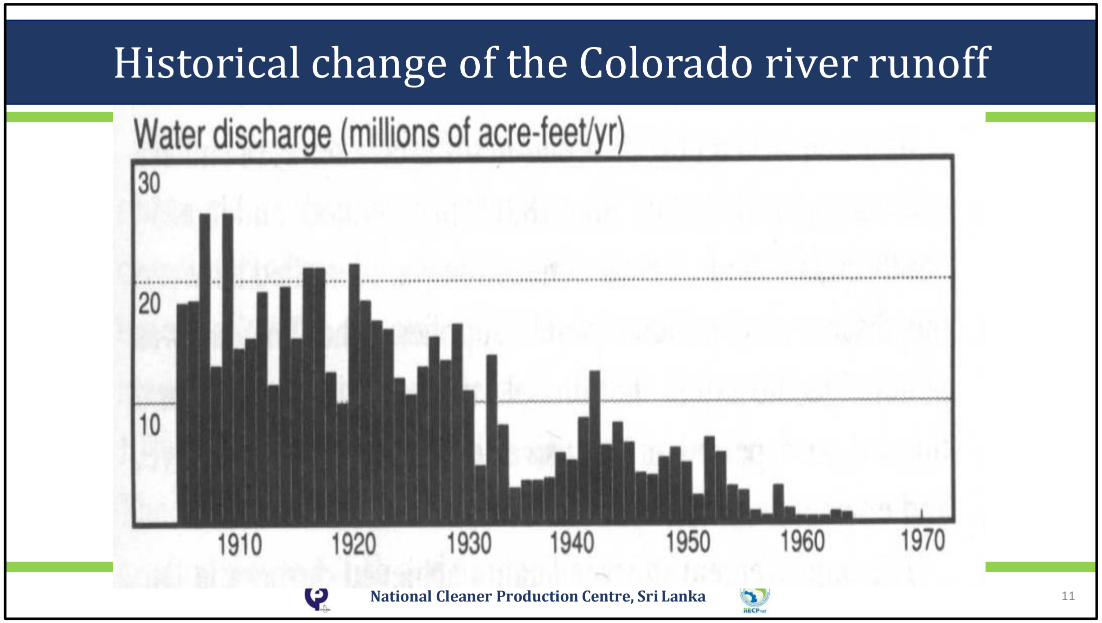
Water supplies for irrigation depend on;

1). Managing precipitation run-off, either diverted from streams or from reservoir storage,

2) Existing groundwater sources or,

3) Reclaimed water from municipalities, either directly or as recharge to groundwater.

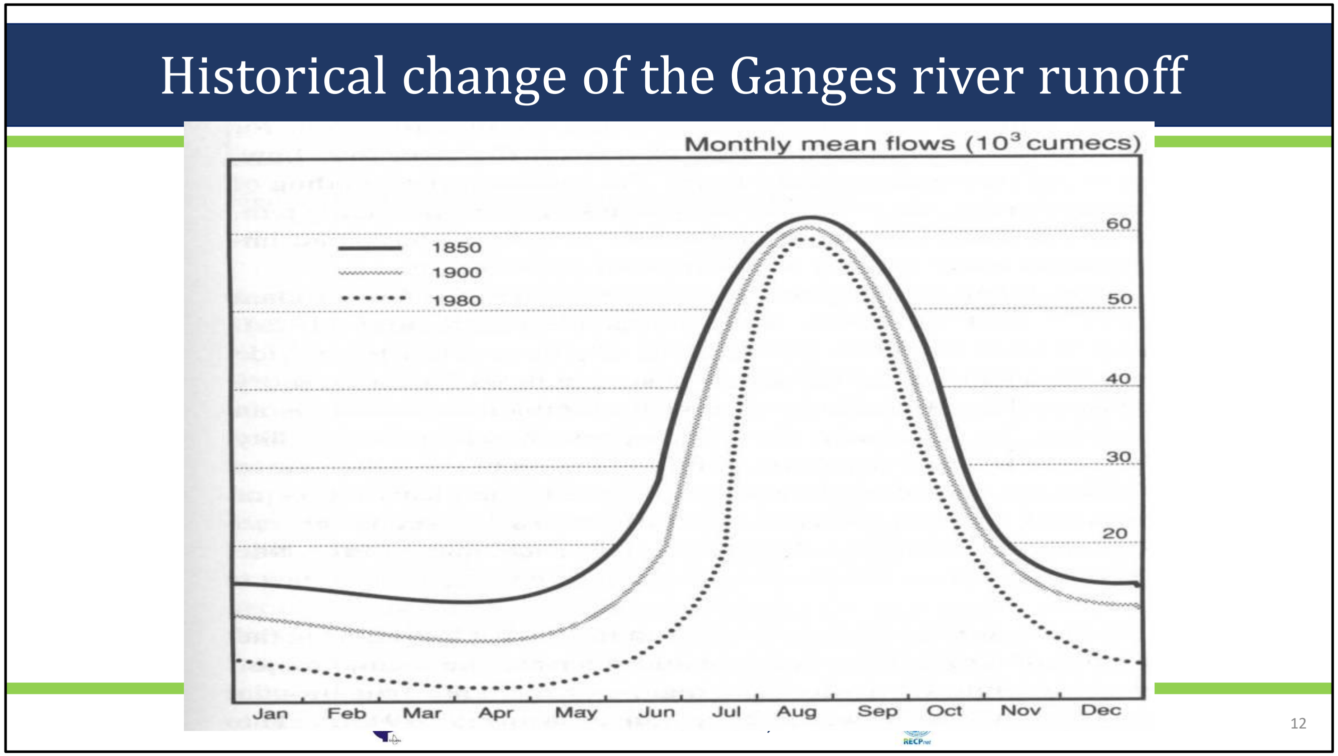
Increases in irrigated area are now failing to keep up with increases in population. After increasing through the 1970s, per-capita irrigated area worldwide is now falling. If this trend continues, feeding the world's growing population will require even greater improvements in yields per hectare or greater food production from nonirrigated lands. Such improvements are likely to be increasingly difficult.



Its source high in the Rocky Mountains, the Colorado River channels water south nearly 1,500 miles, over falls, through deserts and canyons, to the lush wetlands of a vast delta in Mexico and into the Gulf of California.

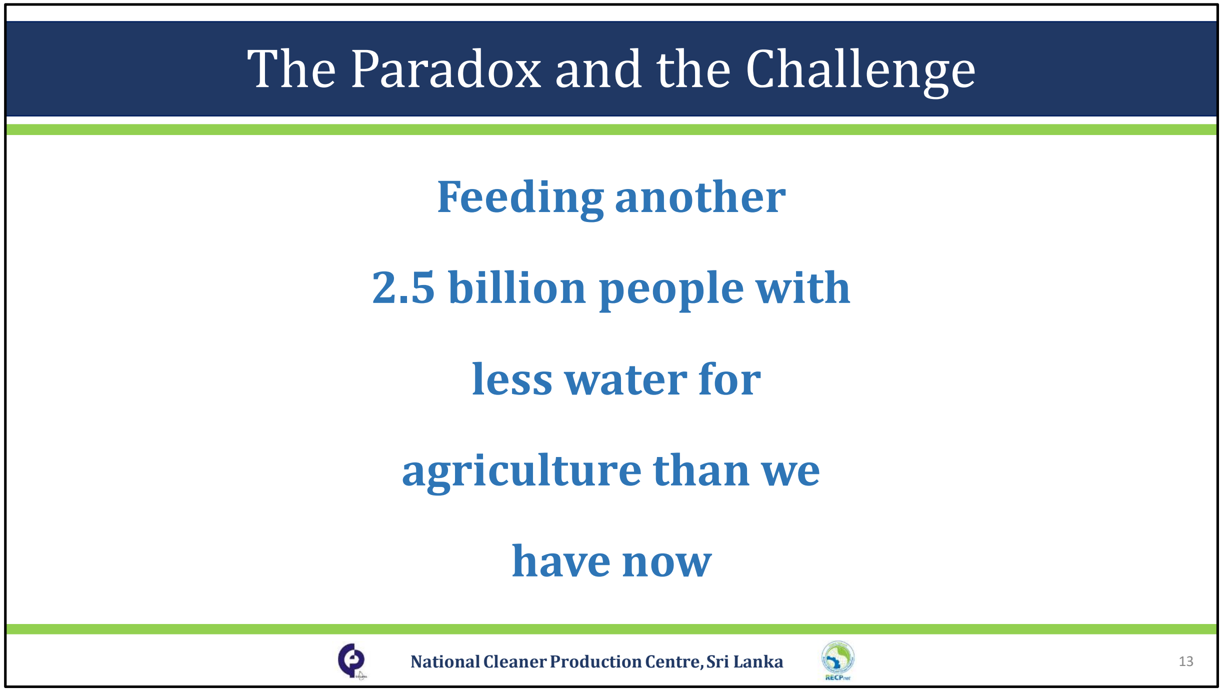
Then, beginning in the 1920s, Western states began divvying up the Colorado's water, building dams and diverting the flow hundreds of miles, to Los Angeles, San Diego, Phoenix and other fast-growing cities. The river now serves 30 million people in seven U.S. states and Mexico, with 70 percent or more of its water siphoned off to irrigate 3.5 million acres of cropland.

The river has been running especially low for the past decade, as drought has gripped the Southwest. It still tumbles through the Grand Canyon, much to the delight of rafters and other visitors. And boaters still roar across Nevada and Arizona's Lake Mead, 110 miles long and formed by the Hoover Dam. But at the lake's edge they can see lines in the rock walls, distinct as bathtub rings, showing the water level far lower than it once was—some 130 feet lower, as it happens, since 2000. Water resource officials say some of the reservoirs fed by the river will never be full again (Video).

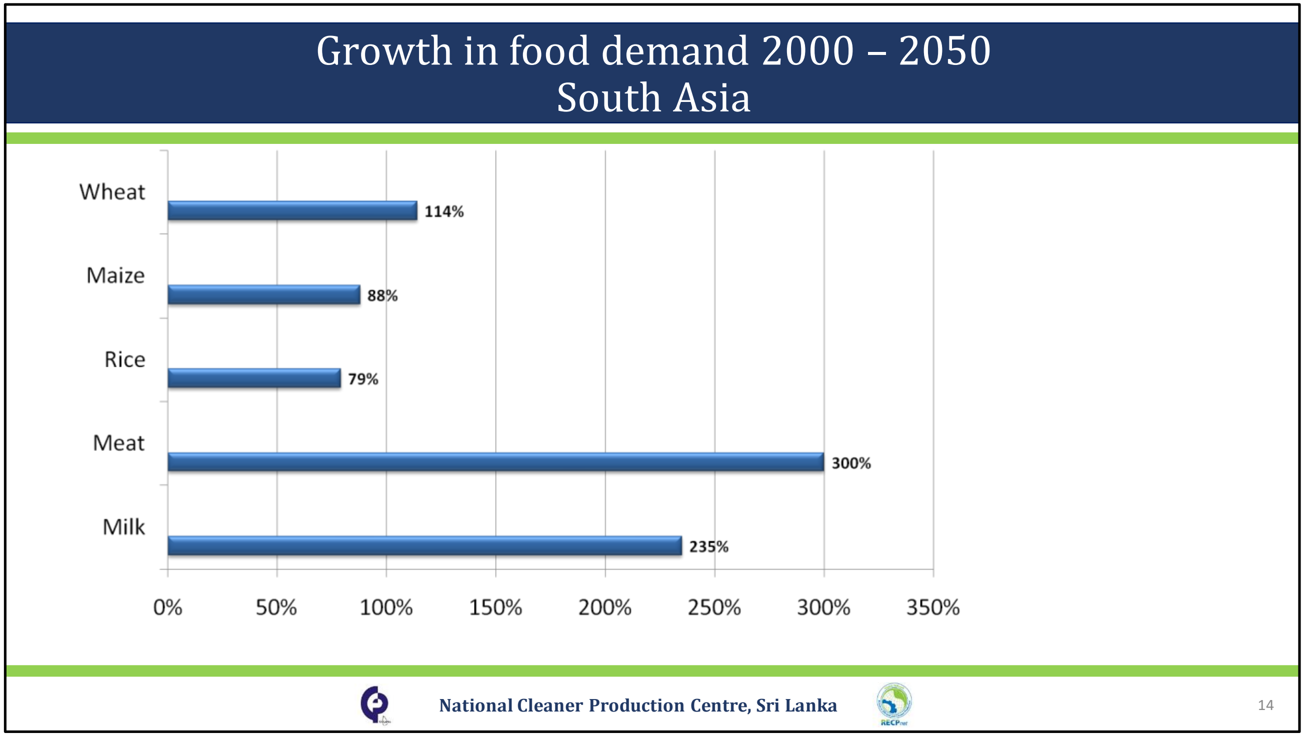


The Ganga river basin (GRB) is one of the most populous river systems in the World. The river is of high importance with an estimated 440 million people directly or indirectly depending on the water that the Ganga and its tributaries provide for agriculture, drinking, hydropower generation, and navigation and for ecosystem services. The perpetual population increase and consequent water resources development has affected the river's flow regime which, in turn, has impacted the water availability, quality of water and thus, riverine ecosystems. The availability of water has become an intriguing issue for irrigation systems, food security and ecosystem health.

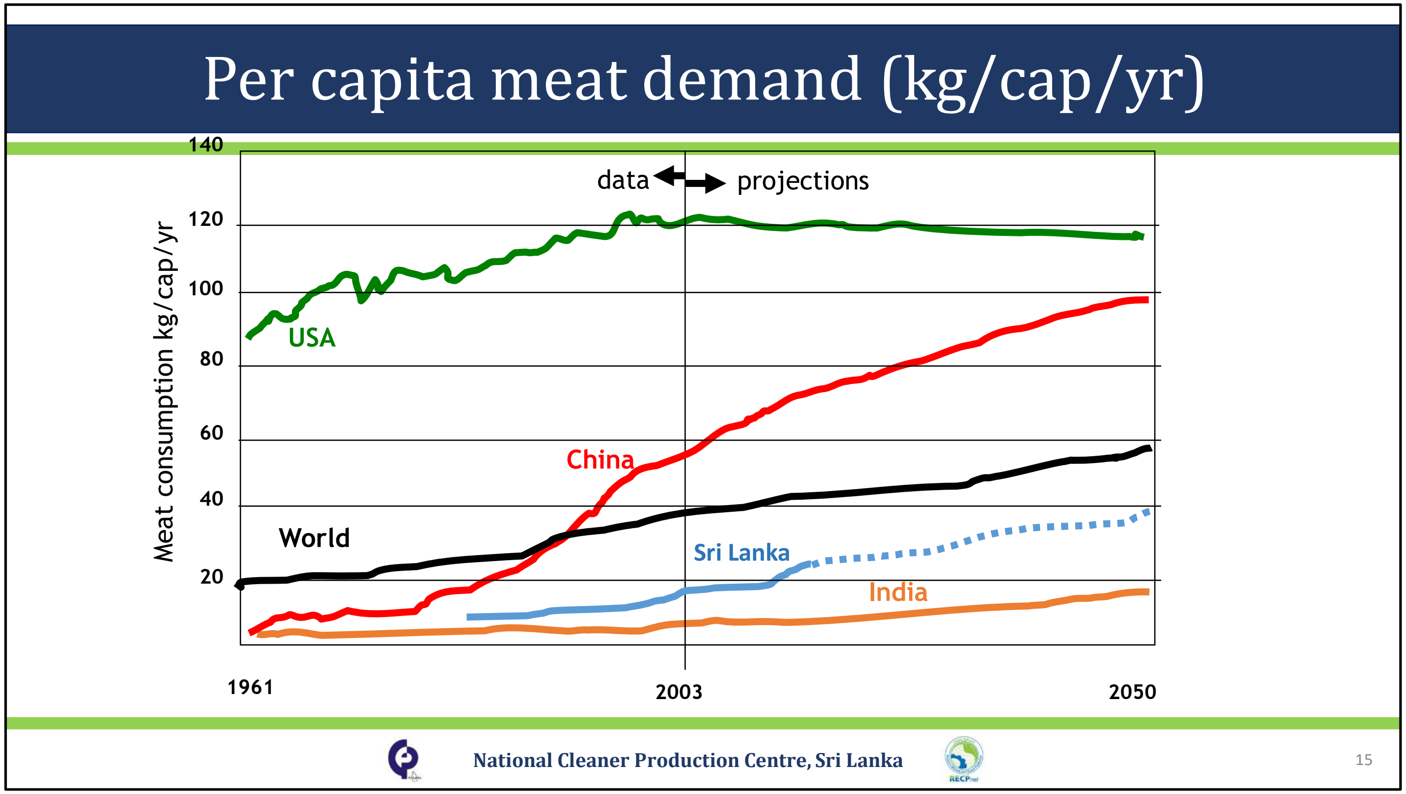
The graph shows the variation of monthly water flow in the Ganges river in the years 1850, 1900 and 1980. the river flow has reduced significantly in year 1980 compared to the year 1850 over 130 years.



By 2050, agriculture will need to produce 60% more food globally, and 100% more in developing countries. As the current growth rates of global agricultural water demand are unsustainable, the sector will need to increase its water use efficiency by reducing water losses and, most importantly, increase crop productivity with respect to water. agricultural water pollution, which may worsen with increased intensive agriculture, can be reduced through a combination of instruments, including more stringent regulation, enforcement and well-targeted subsidies.

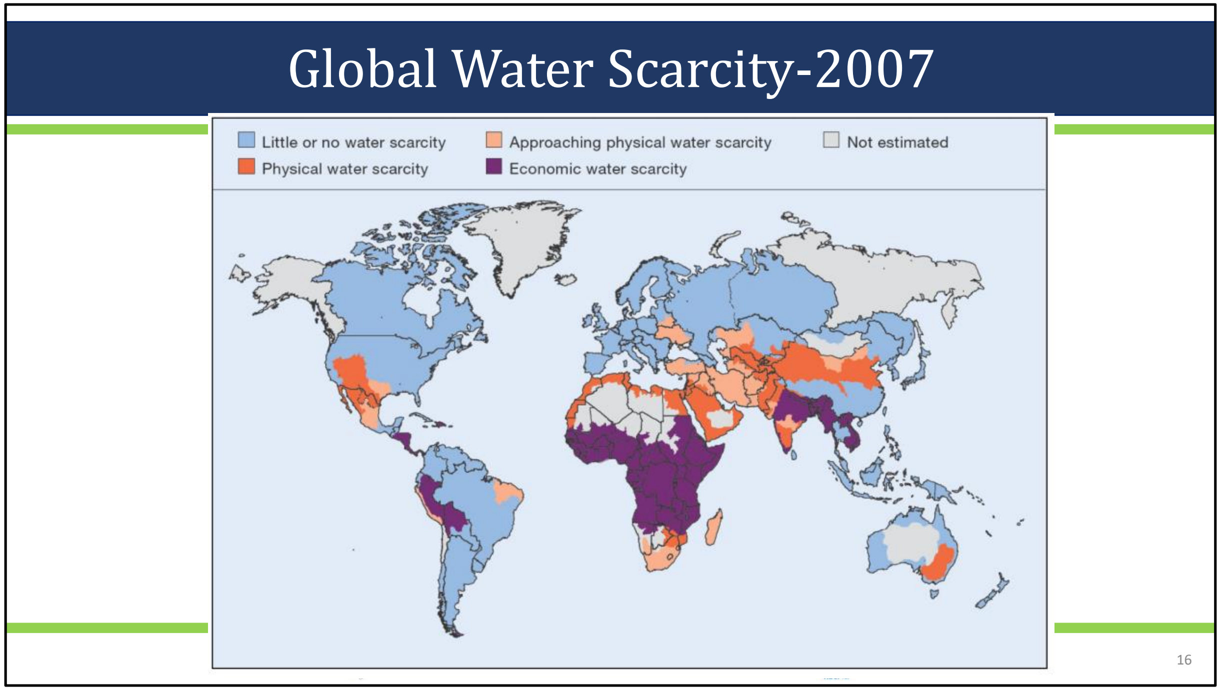


In South Asia, there is a high growing demand for meat and milk. The production of meat and milk requires more water than production of wheat, maize and rice.



Per capita meat demand for world, USA, China, Sri Lanka and India is shown in this figure. With the real data and projections for the period from 1961 to 2050, there is an increasing trend in meat consumption. The per capita meat demand is drastically increasing in China while Sri Lanka and

India have comparably low increment.



Areas of physical and economical water scarcity at the basin level in 2007. Definitions and Indicators: (1) Little or no water scarcity. Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes; (2) Physical water scarcity (water resource development is approaching or has exceeded sustainable limits). More than 75% of river flows are withdrawn for agriculture, industry and domestic purposes (accounting for recycling return flows). This definition, relating water availability to water demand, implies that dry areas are not necessarily water scarce; (3) Approaching physical water scarcity. More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future; (4) Economic water scarcity (human, institutional and financial capital limit access to water, even though water in nature is available locally to meet human demands). Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists. From the International Water Management Institute analysis done for the comprehensive assessment for water management in agriculture using the Watersim model (source: IWMI).

Status of Water Resources in Sri Lanka

17

There are three different climatic zones in the country: wet, intermediate, and dry. Annual rainfall for each climate zone is over 2,000 mm/year for wet zones, between 1,500-2,000 mm for intermediate zones and 1,500 mm/year for dry zones (IGES 2007). These different climatic zones constitute a unique natural feature of the country.

There are 103 natural river basins in Sri Lanka, with a total length of about 4,500km (UNESCO and MoAIMD 2006). The largest river is the Mahaweli River with the size 335km long and 10,448 km2 (MENR and UNEP 2009). In addition, there are a significant number of reservoirs including ancient irrigation reservoirs and recently constructed multi-purpose reservoirs with a total area of 169,941 hectares as following table shows.

- Groundwater resources in the country are estimated at about 7,800 million m3 per year (IGES 2007; MENR and UNEP 2009; Nandalal 2010).
- Groundwater is the major source of water especially in rural areas, and it is estimated that about 72% of the rural population relies on groundwater for domestic use (Nandalal 2010).

State of water quality in Sri Lanka

- Surface Water
  - Rivers water quality is deteriorating due to dumping of domestic and industrial wastes and untreated wastewater in to water ways and leaching of agrochemicals from agricultural lands
  - Expansion of sand-mining activities also affects the river water quality such as increasing turbidity decreasing water flow, and accelerating salt water intrusion.
- Ground Water
  - A common groundwater quality problem in the country is pathogenic pollution mainly caused by poor sanitation systems such as pit latrines.

National Cleaner Production Centre, Sri Lanka 19

It is difficult to comprehend the trend of water quality in public water bodies due to lack of monitoring data. However, the Sri Lanka National Water Development Report (2006) pointed out a variety of quality concerns in Sri Lanka, including contamination by nitrate and bacteria in underground and surface waters mainly due to poor sanitation and untreated wastewater or insufficient wastewater treatment, toxic chemicals from industrial and agricultural activities, and eutrophication in lakes/reservoirs (UNESCO and MoAIMD 2006).

Rivers

Deterioration of water quality has been reported in some rivers. The main cause of water pollution in urban area is dumping of domestic and industrial wastes and untreated wastewater in to water ways. In agricultural areas, agrochemicals are the main pollutants (UNESCO and MoAIMD 2006). Water quality in the Kelani River, which is one of the major water sources for Colombo, is considered to be threatened by untreated or insufficiently treated wastewater (Ratnayake 2010) and solid waste. In general, water quality in lakes and reservoirs is considered good, with the exception of specific areas where industrial activities are taking place. Expansion of sand-mining activities also affects the river water quality such as increasing turbidity decreasing water flow, and accelerating salt water intrusion. Salt water intrusion accelerated by sand-mining activities in the Kelani River affected drinking water supply (MENR and UNEP 2009) and court cases over sand-mining increased from 709 in 2002 to 2,496 in 2005 (MENR and UNEP 2009).

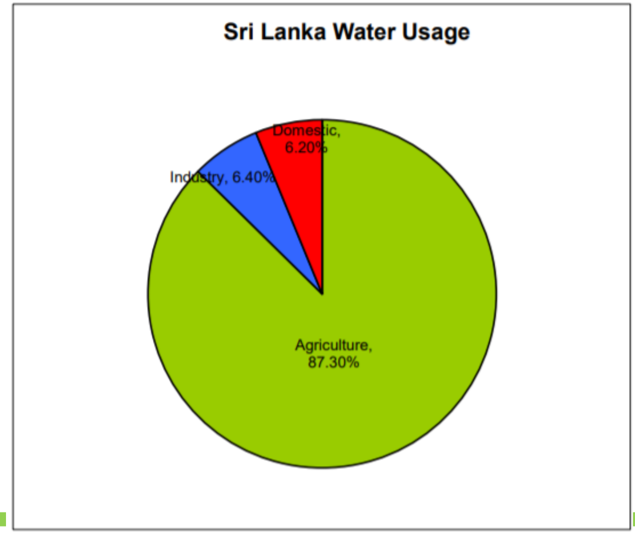
Groundwater

A common groundwater quality problem in the country is pathogenic pollution mainly caused by poor sanitation systems such as pit latrines (MENR and UNEP 2009; Nandalal 2010). Nitrate is also identified in coastal aquifers such as in Jaffna (north coast) and Kalptiya (western coast) because of excessive fertilizer use and untreated wastewater (Nandalal 2010). High salinity is also an issue especially in coastal zones, which is exacerbated by excessive groundwater use. Fluoride and arsenic, which is naturally occuring, was identified in some areas of the country (Nandalal 2010).

- **Coastal water**
  - Studies on coastal water quality in Sri Lanka are few in number, although water pollution in coastal water bodies has grown over the past few decades due to rapid development activities and human settlements both in and outside coastal areas.
  - The Coastal Resource Management Project (CRMP) implemented by the Ministry of Fisheries and Ocean Resources reported that the organic pollution in sea water of the Beruwala and Unawatuna areas attributed to high BOD values throughout the year (MENR and UNEP 2009).

Sri Lanka Water Usage

- Annual Fresh Water Withdrawals by sectors –
  - Agriculture 87.3%
  - Industry 6.4%
  - Municipal (including domestic) 6.2 %



Source: Central Bank, 2010

National Cleaner Production Centre, Sri Lanka

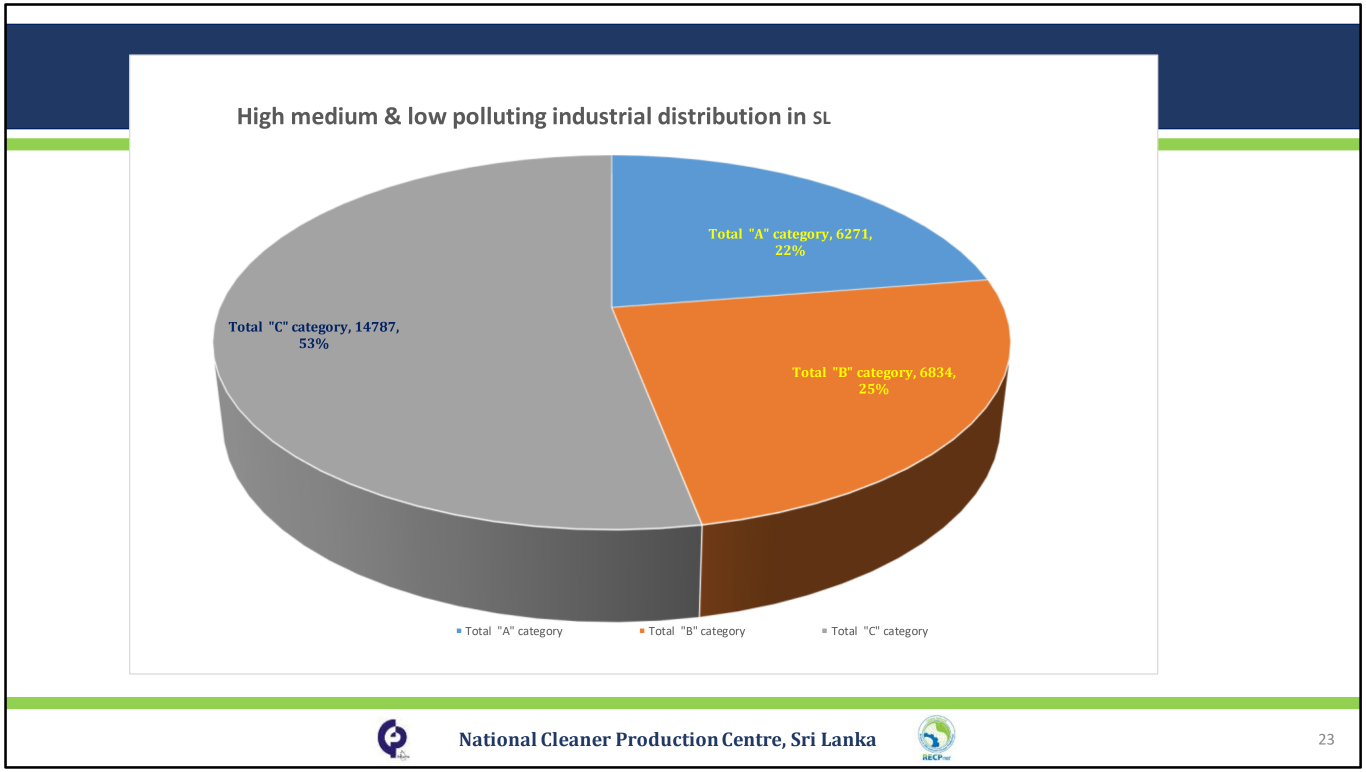
21

Sri Lanka's highest fresh water withdrawal is carried out by the Agriculture sector and it is 87.3% from the total water withdrawal. Industry and

Municipal sectors withdraw 6.4 % and 6.2 % of water respectively.

Major Industrial Sectors Contributing to Water Pollution

- Chemical Industries
- Food and Beverages
- Alcohol and alcoholic beverages
- Metal finishing Industries
- Dairy Industries
- Textile Industries
- Leather Tanning Industries
- Rubber Processing Industries
- Desiccated coconut Industries
- Agrochemical Industries
- Pharmaceutical Industries
- Clay & Glass Industries

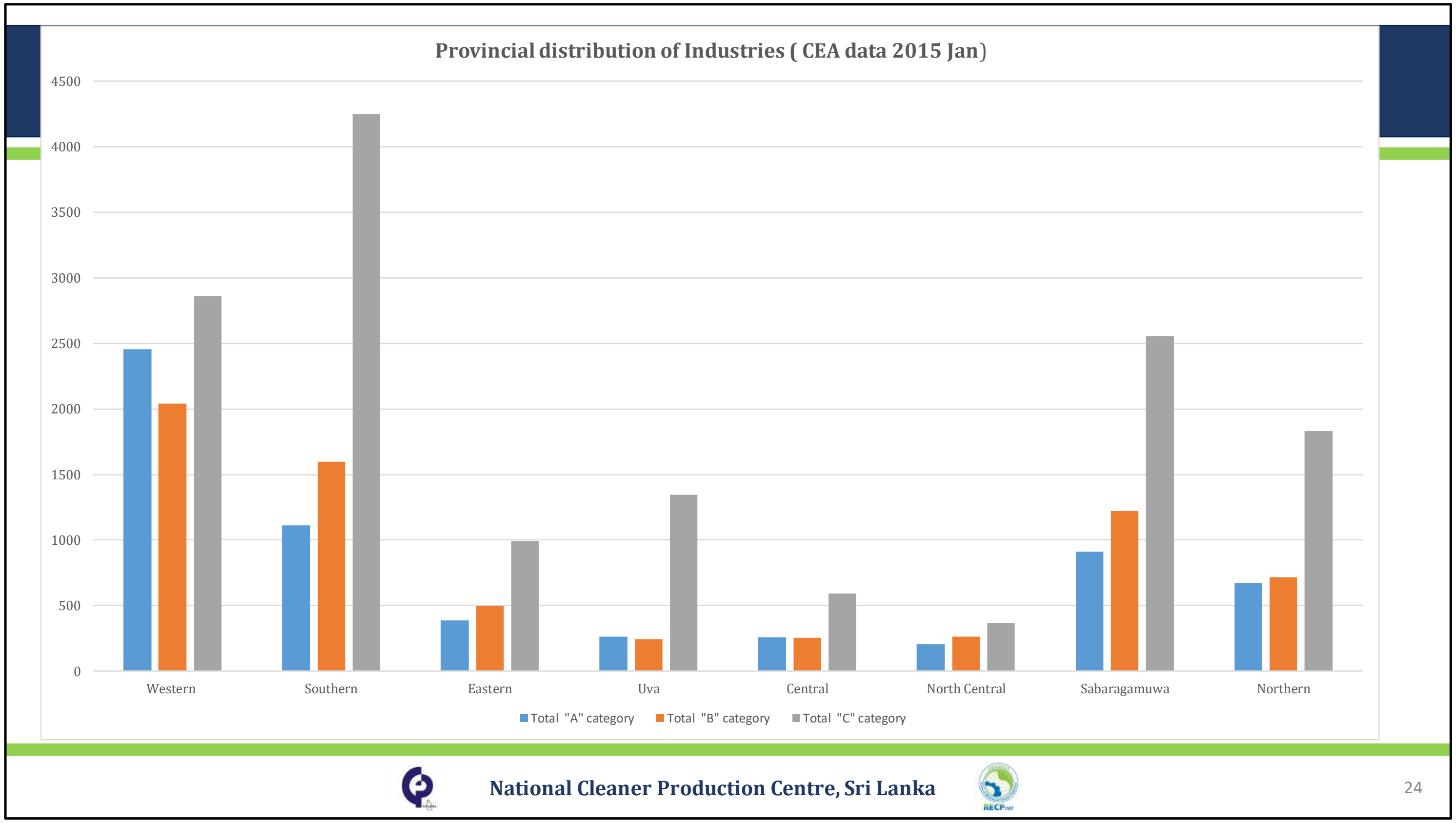


Category A = High polluting industries in SL

Category B = Medium Polluting industries in SL

Category C = Low polluting industries in SL

Low polluting industries have the highest share from the total industries in Sri Lanka. However, high polluting industries have very high impact on water pollution in Sri Lanka.



The above graph shows that Western province accommodate the highest number of high and medium polluting industries compared to other provinces in the country. Further, North Central province has the lowest number of industries.

Export Processing Zones & Industrial Estates in SL

- Export Processing Zones functioning under BOI - 12
- Industrial Estates functioning under Industrial Development Board (IDB) - 15
- Industrial Estates functioning under Urban Development Authority (UDA) - 02
- Some Industrial estates have dry process operations
- Regardless of facilities wet process operations are being carried out in some industrial estates
- No facilities provided for treatment & disposal of waste / wastewater in some industrial estates

Quantity of effluent generated from BOI EPZ

Biyagama EPZ	: 13,000 m^3/day
Seethawaka EPZ	: 9,900 m^3/day
Katunayake EPZ	: 3,000 m^3/day
Mirigama EPZ	: 400 m^3/day
Wathupitiwala EPZ	: 900 m^3/day
Polgahawela EPZ	: 450 m^3/day
Koggala EPZ	: 675 m^3/day
Kandy EPZ	: 1,000 m^3/day
Mawathagama EPZ	: 500 m^3/day
Horana EPZ	: 1,000 m^3/day
Mirijjawila	No WTP
Pallekele	No WTP

Wastewater Discharge Standards-CEA

- Tolerance limits for the discharge of Industrial waste water into Inland Surface waters.
- Tolerance limits for Industrial waste water Discharged on land for irrigation Purposes.
- Tolerance limits for Industrial and Domestic waste water Discharged into Marine Coastal Areas.
- Tolerance limits for waste water from Rubber Factories being Discharged into Inland Surface waters.
- Tolerance limits for waste water from Textile Factories being Discharged into Inland Surface Waters.
- Tolerance limits for waste water from being Discharged from Tanning Industries.
- Tolerance limits for discharged of effluents into public Sewers with Central Treatment Plants.

(See the References material on wastewater discharge standards)

Draft National Water Policy-2019

- Draft National Policy, Strategies and Institutional Framework for Water Resources Development, Censervation and Management – 2019
  - Developed by Ministry of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries and Aquatic Resources Development
  - The overall objective of the policy is to encourage integrated water resources development and management, to ensure that the national water resources are conserved, efficiently managed and equitably allocated among all stakeholders to meet the needs of the society and the environment endeavor to sustainable economic development of the country.

POLICY STATEMENTS

- Policy statements in following broad areas are identified in the current context. It is needed to review
  - Water rights and responsibility
  - Role of state
  - Water resource planning, development conservation and management
  - Water Allocation by needs and priorities
  - Sharing the conservation and management cost of water resources infrastructure
  - Data and Information Management
  - Research and Development
  - Training and Capacity Building
  - Institutional Arrangement

The draft water policy is listed in the reference list.

List of References

- UN Water (2015). Water for a sustainable world.
  - Pages 1-16.
- Video on Colarado River and Climate Change.
- The Ministry of Agriculture, Irrigation and Mahaweli Development. (2006). Sri Lanka National Water Development Report.
  - Pages 1-37.
- National Water Supply and Drainage Board (2014). Handbook for Water consumers.
  - Pages 1-15.
- Draft National Water Policy-2019
- Wastewater Discharge Standards in Sri Lanka.
  - Pages 7-13