

Some Issues on Water Conservation and Water Quality in Sri Lanka

1. Water - The Most Important 'Limited' Natural Resource

The 'hydrosphere' is the collective term given to all different forms of water in the earth's surface, whether oceans, shallow seas, lakes, rivers, groundwaters or glaciers. Less than 0.5% of the total hydrosphere is present on the continents as lakes and rivers. About 70% of the earth's surface is covered by the oceans, thus, constitutes 98.8% of the hydrosphere as marine waters. The major part of fresh water (0.7% of the hydrosphere) is trapped as fresh water glaciers, and only 0.5% of hydrosphere is available to fulfil our needs such as drinking, cooking, agriculture, industry, etc.⁽¹⁾ This is an estimate, it may be less today.

The oceans are linked with other fresh waterbodies in the hydrosphere through the hydrological cycle, in which water evaporates from the oceans into the atmosphere and falls as rains or snow on the continent and returns via rivers and lakes to the oceans again. The average composition of fresh and marine waters in the hydrosphere remains unaffected. A major percentage of fresh water is stored in aquifers as groundwater resources.⁽¹⁾ Groundwater is the traditional potable water resource for about 70% Sri Lankans. Surface water stored in reservoirs ('wewas') is the main source of water used for agriculture in Sri Lanka⁽²⁾.

2. Historical Aspects of Water Conservation in Sri Lanka

The conservation of water in Sri Lanka commenced with the construction of the first reservoir by King Pandukabhaya (380 - 310 B.C.). He constructed the first 'wewa' (tank or reservoir) based on the knowledge of

Science and Technology during that period. Since then, there have been nearly 35,000 reservoirs constructed in Sri Lanka. The conservation and the subsequent usage of the conserved water in this manner are unique to Sri Lanka⁽³⁾, and are not found in Europe or American Continent. There are similar types of reservoirs in some Asian countries, but the scientific aspect is confined only to Sri Lanka. With availability of water for healthy living and for irrigated agriculture, the economic development was achieved during the Anuradhapura period. Subsequently, it was also evident in the Polonnaruwa period (King Parakramabahu the Great, 1153 - 1186 A.D.). 'Let not a drop of water be sent to the sea without utilising it for the benefit of man kind' said King Parakramabahu the Great, and constructed reservoirs. 'Wewa' and 'Dagaba' were the main theme of the ancient sociological village unit concept in Sri Lanka which led to sustainable development. Two main objectives in the conservation of water were:

- (i) to provide water of suitable quality for irrigation during the dry season such that an uninterrupted agricultural activity with the production of food is maintained,
- (ii) to improve the health of the people by making the water of suitable quality available for domestic purposes.⁽⁴⁾

It seems that an economic prosperity of ancient Sri Lankans was dependent on the conservation and subsequent continuous availability of water of suitable quality for human needs. Even though it is not the agricultural economy today, the conservation of water still plays a significant role in economy of the country. Therefore, the two terms "water" and "economic

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development" cannot be separated from one another. In his book on "Environmental Aspects of Sri Lanka's Ancient Irrigation System", Prof. C.G. Weeramanthri has stated that traditional wisdom has much to teach us. He further says that the concept of sustainable development was a part of our ancient culture associated with the irrigated agriculture. The modern international environmental law has only recently appreciated the necessity of this concept of sustainable development, and often discusses the concept as a modern invention.⁽⁵⁾

It is undoubtedly obvious that Science and Technology was directly responsible for the economic development of Sri Lanka during that era. Those who are not familiar with science wrongly argue that ancient Sri Lanka had only the technology without science. It is true that ancient Sri Lankans did not have the so-called modern science which is not more than 500 years old. The ancient technology was based on unwritten science, and is not the modern science. The survival of the ancient technology was possible for several years due to its association with this unwritten form of science which would have been in some cases a kind of family secrets. **The survival of technology is dependent on science.** The economic development through agriculture in ancient Sri Lanka was due to the application of 'Sciences' to the technological, needs during that period. The concept of 'sustainability', implies meeting human needs while preserving the environment and natural resources needed by future

generations.⁽⁶⁾ Therefore, the technology based on the 'unwritten science' preserved the natural resources for us to use even after 2400 years, i.e., sustainability. The unwritten science which led to the sustainable economic development in the ancient period does not exist today. Therefore, a need arises to apply modern science to ancient as well as modern technologies to meet the current human needs which are quite different from the human needs of our ancestors. The development of the so-called modern science during 19th and 20th centuries led to the changes of the human needs. The highest priority during this period was to meet the human needs at any cost. This was not the sustainable development. It was only during last two decades, more emphasis was paid on the economic development by providing human needs without affecting the environment - sustainable development. The sustainable development achieved during the ancient time was completely ignored or disregarded. Often, the concept of sustainable development is taken as a modern invention. In fact, it is a concept regarded as a part of our ancient culture. It would be fruitful for us to have some understanding on the application of unwritten science to ancient technology in order to achieve economic development by the application of modern science which is familiar to us now for the existing technology.

3. Historical Aspects of Water Quality in Sri Lanka

"Respect water" is the concept introduced to me by my teachers in the village school in the early 1950's. This can be considered as the wisdom from the past relating to sustainable development - "Unwritten Science". The term "respect" included not spitting or urinating on water, i.e., not to pollute water. This was practised in Sri Lanka in the past 2,500 years in the domestic and agricultural use of water. The

ancient design of toilets was based on the concept "respect water", thus prevented the pollution of water in the past 2,500 years. Do we respect water today in our domestic usage? We have blindly followed the rest of the world in designing toilets without considering the wisdom from the past. The technology from elsewhere was copied without applying the science required to prevent the pollution of water. Urban population and also the village population today, disregard the ancient concept "Respect Water". This concept helped the ancient Sri Lankans to re-use water without any adverse effects, thus achieving the sustainable development.

The ancient science was also responsible for maintaining the irrigation water of suitable quality. After the reign of King Pandukabhaya, several successive kings constructed several thousand reservoirs ('wewa') mainly to conserve the rainwater. Very little evidence could be gathered on the construction of reservoirs by building dams across flowing streams or rivers. In such instances a forest cover was maintained in an around the streams carrying water to the reservoirs and also the canals which supplied water to paddy fields.⁽³⁾ The belief such as divine being living in trees assisted to preserve the forest cover. In addition, powerful dictatorship and good governance prevented people even to clear a forest. One method of achieving sustainability in the ancient irrigation projects is by maintaining the forest cover. The modern science reveals that clearing of forest increases the sodium ion concentration of irrigation waters, thus making the water unsuitable, ultimately leading to loss of soil permeability. The ancient water management was based on this type of ancient scientific views (unwritten science) associated with the fact that large reservoirs had not been constructed to collect drainage waters from one irrigation system and to reuse the water to irrigate several thousand

hectares. The reuse of irrigation water was confined to a cascade system which involved the collection of drainage waters in small reservoirs with a subsequent use for irrigation of a small area less than 10 ha. The ancient science would have given the indication that the irrigation water quality is deteriorated after usage leading to the loss soil permeability. A small area affected in this manner can easily be abandoned without an adverse effect on the economy.

4. The Awareness of Water Quality

Nearly 2,400 years old irrigated agriculture, which was responsible for sustainable development of Sri Lanka in the ancient time, has not been given adequate consideration in the education system in Sri Lanka. Is the irrigation water quality a part of our school curriculum? No! Because there are no irrigation tanks (reservoirs) in the United Kingdom (UK) or in the United State of America (USA). Sri Lanka blindly follows the UK and the USA, and has taken no steps to incorporate irrigation water quality criteria in teaching even though we have about 35,000 irrigation water tanks. The Chemistry curriculum of the G.C.E. (A/L) is designed to maintain the international standard such that students of the affluent families who fail to gain admission to local universities may find places in foreign universities without sitting for another examination. At present, the course contents in all science subjects are geared for the minority (3%) who enter the universities. In many developed countries, the personnel who have written and published books for the secondary level are not allowed to participate in the designing or the revision of the course content. This is because the vested interest inadvertently predominates over the National interest. Since there is no such a rule in Sri Lanka, the students who offer science subjects at G.C.E.(A/L) do not find any usefulness of the subjects,

if they fail to gain admission to the universities. Sri Lanka suffers because the vested interest predominates over the national interest. A frequent revision of the curricula is essential to suit rapid changes in some aspects of scientific knowledge. It is suggested that a permanent body should undertake revision of the curricula of science subjects at G.C.E. (A/L) after conducting research on the aspects of catering to 97% of the students. This is cost effective since it helps in the development of the knowledge economy of the country. There is a very high resistance from many sectors in the revision of the curriculum suitable for local conditions such that about 97% students who could not gain admission to local universities are benefited. (7)

A report issued in advance to the Earth Summit, August 2002 in Johannesburg reveals that more than 76 million people, mainly children will die from water-related diseases by 2020 unless urgent action is taken to clean planet's water supplies. The World Health Organisation (WHO), in a report issued in 2000, estimated that, there are already 4,000 million cases of diarrhoea each year, killing as many as 5 million people. It has been reported that, the per capita availability of water in the Asian region has declined by 40-60 per cent from 1955 to 1990 (35-year period). If this trend continues, there would be a severe water problem in Asia in the year 2025. Water, like any other matter, cannot be created or destroyed, but water can be made unsuitable due to pollution. There is now a need to care water resources in Sri Lanka such that we will not face the anticipated water crisis in 2025. i.e. Preparedness! It has also been reported in the Sunday Observer of 26th June 2005 that, water shortages and water pollution cause four million deaths per year around the world. This means, **one person dies every eight seconds**. The science education plays a vital role in the preparedness for such a disaster. Our schoolchildren are well aware of

global warming, depletion of ozone layer, etc. There are no direct deaths due to these atmospheric effects, but these can affect developed (rich) countries. Therefore, developed countries ensure that these aspects are incorporated into teaching curricula by convincing the 'Educationalists' in Sri Lanka. Though a Sri Lankan student is well aware of the depletion of ozone layer, global warming, etc., he is not aware of the quality of water he deals with, in his day-to-day life. The water pollution does not affect the developed countries since they have very expensive modern methods to purify water. Since water pollution is a localised problem affecting us directly, our 'Educationalists' are not convinced by the 'Consultants' from developed countries to incorporate water into the teaching curricula. Can we have an indigenous curriculum suitable for Sri Lanka, taking all our aspects into consideration? The only way to increase the awareness of water quality is to incorporate it to school curricula disregarding the advice from so-called 'Consultants' from developed countries. (7)

In many important aspects of public life, the term "quantity" is always given a predominant position whereas the term "quality", applicable to the same aspect, is either ignored or not being given adequate consideration in Sri Lanka. This is true for water, which is the most important natural resource vital for life. However, some consideration is given for the quality of "potable" (drinking) water since there is an obvious undesirable effect of the potable water of poor quality, but little or no consideration is given for irrigation water quality in Sri Lanka, even though we have about 35,000 irrigation water tanks (reservoirs). An example for the priority for quantity is given below. In the past 1000 years, about 100 hectares of paddy fields have been cultivated using water from small tank ('wewa'). An irrigation scheme was introduced

to this area about 50 years ago. In this program, a canal was diverted into the tank to increase the 'quantity' which generally makes the cultivators happy. The poor quality of water in this canal led to loss of soil permeability, and the 100 hectares of paddy field were abandoned. The villagers in the area who lost their paddy fields due to an attempt to increase the 'quantity' at the expense of the 'quality' by engineers provide evidence for such disaster. (4) This necessitates the incorporation of water quality in all aspect of the use of water to prevent the anticipated water crisis in 2025.

5.The "Preparedness" to Prevent a Water Crisis

Daily News , Tuesday May 17, 2005

"Tensions over water will increase as scarcity increases, but outright conflict can be avoided" by Steve Lonergan

It is important take following steps to prevent the anticipated water crisis in 2025:

- (i) A gift from God - *Respect Water* - Not practicable today
- (ii) A suitable Legal framework - *Water Policy*
- (iii) The restructuring of economies away from water - intensive sectors - *A change of the crop pattern*
- (iv) The awareness of Water Quality- *Regular Monitoring*
- (v) Regulations on Re-use - *Industrial recycling*

All ancient civilisations in the world were associated with water bodies such as rivers. The anticipated water crisis in 2025 can be mitigated by regular water quality monitoring programmes which ultimately leads to the development of water quality criteria based on the human needs. These criteria will provide guidance for water

management problems. The modern methods of this nature could be guided by the history which provides evidence for the existed excellent sustainable water management system without any, so called modern scientific inputs. It was really the input of unwritten science ('Respect water') to water management technology. Good governance in the ancient period prevented people even from clearing a forest. One method of achieving sustainability is by maintaining the forest cover. The modern science reveals that clearing of forest increases pollution of water thus making the water unsuitable. The ancient water management was based on this type of ancient scientific views (unwritten science). The re-introduction of good governance is essential to prevent the water crisis in 2025. The strict implementation a water policy plays an important role. It should be mentioned that all stakeholders, including me, should be accountable for use of water. The accountability should be a part of water policy. The accountability should be associated with the water entitlement. Historical aspects on this could be considered, and a suitable modification could be made acceptable to all. The water quality

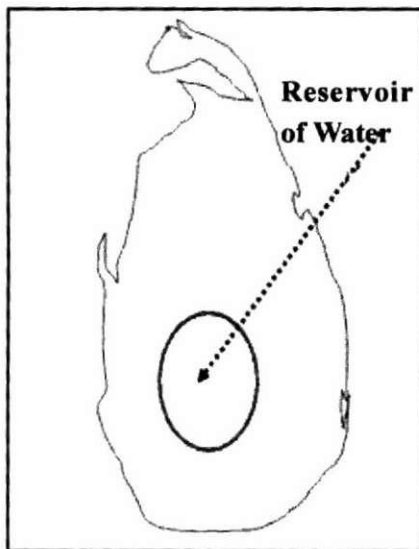


Figure 1 : Central hill country was kept as a reservoir of water in the ancient time

cannot be generalised as 'quantity'. The water quality should be associated with the purpose that water is used, e.g., potable water quality, irrigation water quality, industrial water quality, etc. Re-use of water, especially by industries, should be emphasised.

No historical records reveal that there were human settlements in the central hill country over 800 hundred years ago⁽³⁾ (Figure 1). The hill country was the reservoir of water feeding most of the man-made wewas even during a severe drought.

pollution of water resources confined to it. The sustainable water management will thus be a reality. In this way, Sri Lanka can be divided into five regions (provinces). (Figure 2)

The Mahaweli Region : This includes the catchments of the Mahaweli river and Maduru Oya. The southern limit is the Morawewa catchments.

The Ruhuna Rata Region : This would be the region east of Mahaweli including the catchments area of Walawe Ganga and Matara district.

The Maya Rata Region : This is the region south to Maha Oya including the present Galle district with an eastern limit of Mahaweli region.

The Raja Rata Region : This comprises the area limited by Maha Oya in the south, Mahaweli region boundary in the east and the northern limit is the catchments area of Malwathu Oya.

Yalpanam Region : This comprises of Jaffna Peninsula and Manner area including the catchments area of Aruchi Aru.

There is also some historical evidence that the administrative division of the country was based on the water resources.⁽³⁾ Each administrative division (province) can optimise the use of its water resources without being polluted. This would be the first step that should be taken to safeguard the country against the severe water crisis in the future. Preparedness leads to the prevention or mitigation of disasters. Prevention is always better than cure.

6. Irrigation Water Quality

The largest user of water in Sri Lanka is irrigated agriculture. The irrigation water flows through a system of tunnels, streams, reservoirs ('Wewa'), canals, etc. before it reaches the field where crop is grown. During this flow, some soluble salts

The existing nine provinces (regions) have been demarcated by British rulers without any basis. If the watershed of rivers would be the major criteria for the division of the country into provinces, each province can take adequate steps for proper water management thus prevent the

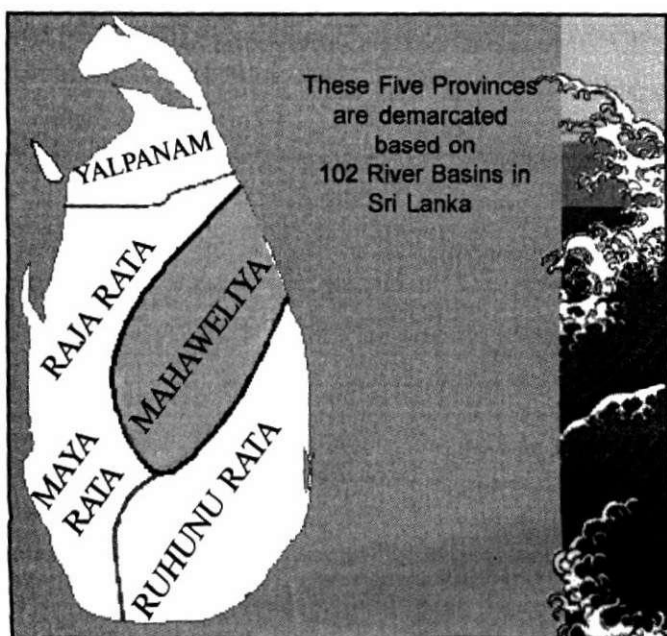


Figure 2 : Proposed demarcation of the provinces based on water-sheds of 103 river basins

are always dissolved in, and the water becomes saline, containing high dissolved salts. Man's activities such as industries, deforestation, etc. in and around water flow enhance dissolution of salts. In the fields, the water will undergo evapotranspiration, resulting in the accumulation of dissolved salts, which will affect the soil properties, especially the soil permeability and subsequently crop growth. It has been reported that in countries such as Afghanistan, Pakistan, Egypt, etc. millions of hectares of irrigated lands have been abandoned due to the loss of soil permeability which affected the crop growth⁽¹⁰⁾. The previous example is the abandoning of about 100 hectares of paddy fields in Sri Lanka due to the loss of soil permeability⁽⁴⁾. This may be possible in all the other irrigation schemes, if the priority is given only for the quantity rather than the quality. Therefore, it is essential to take adequate precautionary measures, especially in the areas irrigated by Mahaweli waters, in order to prevent any such salt danger caused by the increased utilisation of irrigation water resources⁽¹¹⁾. **Prevention is better and less expensive than cure.**

The Mahaweli irrigation project involves utilisation of water of the Mahaweli Ganga to irrigate an extensive area of dry zone. When complete, the Mahaweli Development project is expected to supply water for the irrigation need of 900,000 acres for two crops a year. The master plan also envisages the generation of 2,037 million kilowatt hours of hydroelectric energy. The phase 1 of the project, (Kala Oya, Abanganga) covers 132,000 acres of existing lands and 91,000 acres of new lands.⁽¹³⁾ A monitoring programme was initiated in 1978 to check the quality of irrigation waters in the system H of the Mahaweli diversion scheme.⁽¹²⁾ The block 302 of the system H of the Mahaweli development scheme was selected for this purpose. It was

reported that there is a remarkable increase of Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) values, especially, in the drainage waters in April and in November. This coincides with the Maha and Yala harvesting seasons of the system H. Usually, a heavy rainfall leads to the decrease of these values significantly. Balalu Wewa is the reservoir which supplies irrigation water to Block 302 through the left Bank Canal (L.B.C.). Seasonal variation of the filterable residue and total residual contents of waters from Balalu Wewa, Left Bank Canal and at the beginning of D₁ Channel of Block 302 shows similar trends. It is seen that there is an increase in the filterable residue as well as the total residue of the irrigation waters in April 1978 and 1979. The Maha harvest starts in March and ends in April. During this period the water supply to the field being completely cut off and consequently, as a result of rapid evaporation of the existing water, the filterable residual content increases.⁽¹²⁾

The knowledge of the quality of irrigation water is important in judging its suitability for irrigation.

Suitability of irrigation water depends upon several factors associated with characteristic of water; soil, plant and climate.

It is difficult to suggest a single water quality criterion because of the interaction of several factors. The degree of adverse effects on soil properties is mainly related to the chemical composition of irrigated water. The adverse effect of water of poor quality on soil-plant system depends upon the total salt concentration, relative proportion of sodium to other cations, boron concentration and bicarbonate content. Waters of low electrical conductivity are generally composed of higher proportion of calcium, magnesium and bicarbonate ions whereas those of high electrical conductivity contain mostly of sodium and chloride ions.^(14,15,16) The relative proportion of sodium to other cations is determined by the sodium adsorption ratio (SAR) (Equation (1)). Any increase in the SAR of irrigation water increases the SAR of the soil solution, which ultimately increases the exchangeable sodium by the soil leading to the loss of soil permeability.

Table.1: FAO Guidelines for interpretation of water quality for irrigation^(8,9).

Irrigation problem	Degree of problem		
	No Problem	Increasing Problem	Severe Problem
Salinity (affects crop water availability) ECw (mmhos/cm)	< 0.75	0.75 - 3.0	> 3.0
Permeability (affects infiltration rate into soil) ECw (mmhos/cm)	> 0.5	0.5 - 0.2	< 0.2
adj. SAR (or ESP)			
Montmorillonite (2:1 crystal lattice)	< 6	6-9	> 9
Illite - vermiculite (2:1 crystal lattice)	< 8	8 -16	> 16
Kaolinite - sesquioxides (1:1 crystal lattice)	<16	16 - 24	> 24
Specific toxicity (affect sensitive crops)			
Sodium (adj. SAR)	<3	3 - 9	> 9
Chloride (meq/dm ³)	< 4	4 - 10	> 10
Boron (mg/dm ³)	< 0.75	0.75 - 2.0	> 2.0

$$\text{SAR} = \frac{\text{Na}^+}{\sqrt{\text{Ca}^{2+} + \text{Mg}^{2+}}}$$

where ionic concentration of each is in mmol dm⁻³ (1)

The degree of adverse effect on soil properties and crop growth is mainly related to composition of irrigation water. Food and Agriculture Organisation of the United Nations (FAO) forwards the guidelines given in Table 1 to evaluate water quality for irrigation using the problem approach. If the SAR value of the irrigation water is low there will be adsorbed calcium and magnesium ions on the soil exchange surface. If the adj. SAR is high most of the exchangeable sites which are initially occupied by calcium and magnesium ions will be occupied by sodium ions (Figure 3). However, two sodium ions are required to balance the charge initially balanced by a single calcium or magnesium ion. This results in the spread of charge distribution over the entire surface area.

The decrease in soil permeability is a result of an enhanced particle interaction with enhanced swelling and the development of diffused

electrical double layers. This leads to partial blocking of conducting pores of the soil thereby reducing the infiltration rate or downward entry of water. Therefore, the soil permeability is decreased due to the enhanced adsorption of sodium ions. Kalawewa is a reservoir constructed by King Dathusena (6th Century A.D.) by

for the shift is a crop failure due to the lost of soil permeability. The administrative failure during the period 6 - 9 century resulted the poor water management which ultimately led to the crop failure. The continuous irrigation with poor quality water and consequent crop failures affected the agricultural economy in the

Table 2 : Drinking water standards (WHO)

Criterion	WHO Recommended Limit	International Acceptable Limit	Tolerance Limit
Total residue, mg dm ⁻³	500	1500	-
Turbidity, NTU	5	25	-
Alkyl benzene sulphate mg dm ⁻³	0.5	1.0	-
Arsenic (As) mg dm ⁻³	-	-	0.05
Barium (Ba) mg dm ⁻³	-	-	1.0
Cadmium (Cd) mg dm ⁻³	-	-	0.01
Calcium (Ca) mg dm ⁻³	-	200	-
Carbon: chloroform extract, mg dm ⁻³	0.2	0.5	-
Chloride (Cl) mg dm ⁻³	250	600	-
Chromium(Cr(VI)) mg dm ⁻³	-	-	0.05
Copper (Cu) mg dm ⁻³	1.0 - 2.0	1.5	-
Cyanide (CN) mg dm ⁻³	-	-	0.2
Fluoride (F) mg dm ⁻³	1.5	1.0 - 1.5	-
pH	6.5 - 8.5	6.5 - 9.2	-
Iron (Fe) mg dm ⁻³	0.3	1.0	-
Lead (Pb) mg dm ⁻³	-	-	0.05
Magnesium (Mg) mg dm ⁻³	-	150	-
Manganese (Mn) mg dm ⁻³	0.1 - 0.5	0.5	-
Nitrate (NO ₃) mg dm ⁻³	50	45	-
Phenolic compounds (as phenol) mg dm ⁻³	0.001	0.002	-
Selenium (Se) mg dm ⁻³	-	-	0.01
Sulphate (SO ₄) mg dm ⁻³	250	400	-
Zinc (Zn) mg dm ⁻³	3 - 5	15	-

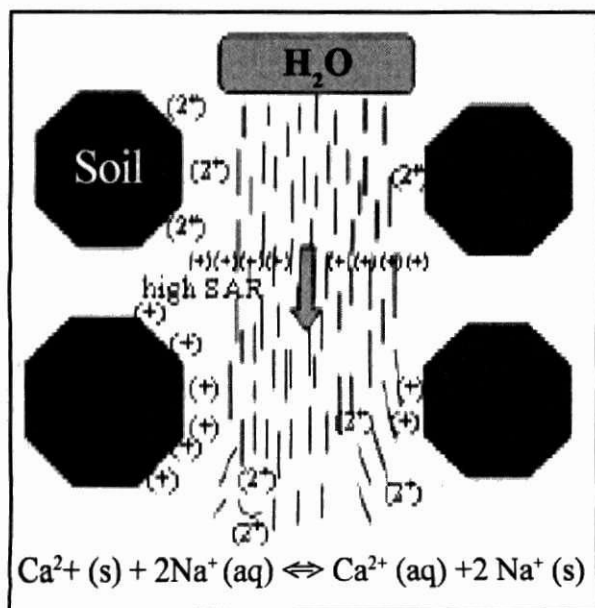


Figure 3 : Illustration of the loss of soil permeability if waters of high SAR are used for irrigation

building a dam across a stream (presently Dambulu Oya - Kala Oya). He may have constructed this to fulfil his wishes and may have gone against the opinion of his advisors in making the decision. Three or four hundred years after the continuous use of Kala Wewa waters for irrigation, the Anuradhapura kingdom was shifted to Polonnaruwa. One could attribute reason

Anuradhapura area resulted the shift of the kingdom to Polonnaruwa in the 10th century.⁽¹⁷⁾

The recurrence of large-scale crop failure can not be ruled out today. However, it is now impossible to shift the population in the affected area unlike in the 10th century. A possible crop failure today will lead disasters and the destruction of the development achieved during last two decades.

A proper water management programme guided by the results of continuous monitoring programme and water quality criteria undoubtedly, prevent such disasters.

7. Potable Water Quality

The healthy living is directly related to the availability of potable water of suitable quality. Groundwater is the main source of drinking water for about 60% Sri Lankans.⁽¹⁸⁾ The water in the reservoirs, rivers and streams also provides drinking water for healthy life. River water is the main source of water in water supply schemes to many cities in Sri Lanka. In the past, the reservoirs (Wewa) also supplied drinking water during long droughts. Hydro-geological study shows that the nature of rocks affects the quality of groundwater. The groundwater in some areas of North-Central Province contains excessive amounts of fluoride.⁽²⁾ The health effects of these have been studied extensively.^(19,20) It is generally assumed that water is purified and becomes suitable for drinking by boiling. Boiling only makes the harmful pathogens inactive and occasionally reduces hardness due to the precipitation of calcium/magnesium carbonates. However, boiling cannot remove the ions listed in the WHO guidelines (Table 2).⁽⁴⁾

The concept "Respect Water" helped the ancient Sri Lankan to re-use water without any adverse effect. It is now clear that the re-use of water today in domestic, agriculture and industrial spheres will lead to adverse effects. This is true for irrigation waters (the increase of SAR values and subsequent

loss of soil permeability). It is also applicable to potable and industrial waters as well. A requirement thus arises to carry out continuous monitoring of water quality of all spheres of human activities. It is essential to incorporate 'Water Quality' in school curricula, and water quality testing can become a part of school projects.

8. Conclusion

The operation of the "water cycle" in the earth is affected and will be affected due to anthropogenic inputs. The regular monitoring of the quality of water in all parts of the island will be helpful to take timely remedial measures leading to a meaningful integrated development in the 21st century. It is suggested that the water quality testing should be carried out at provincial levels even as a part of school curriculum. The data, even though may not be very accurate, will be useful in the water management programmes.

It was revealed that the per capita availability has declined to alarming levels affecting the future generations. To maintain the sustainability without curtailing the current human needs, it is essential to develop technologies on the reuse or recycling of water, effluent treatment processes, etc. (Figure 4). The development of such technology is impossible without the scientific knowledge on the water bodies. The immediate requirement is to assess the

availability. The recycling of water should be a law.

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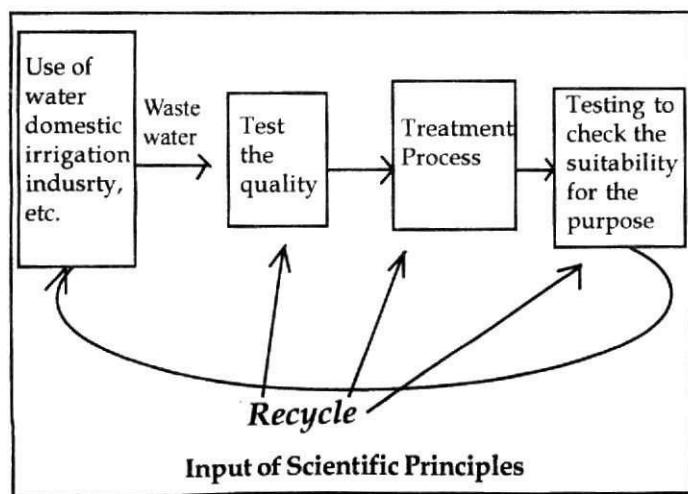


Figure 4 : Recycling of water

water quality and its seasonal variation by monitoring programmes and subsequent use of scientific principles to monitor the sustainability without a decrease in the per capita

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