Use of Water for Protecting Ecosystems

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In nature, water belongs to the ecosystems in which it is an integral part. Therefore the best man can do for ecosystem conservation is to see to it that his development activities are in maximum harmony with nature, keeping water extraction from the ecosystem to as low as critically necessary. This is particularly so if the primary source of water is local rainfall, as is the case in Ruhunu basins.

The break down of land uses in the study area is as follows; forest and scrub 50%, chena (rainfed seasonal cropland) 22%, irrigated paddy 8.5%, home gardens 12% (some in irrigation schemes and others rainfed). How rain water is being shared among major uses is; agriculture (presumably irrigation) 45%, wild life 9.3%, forest (and scrub) 9%, groundwater recharge 10.3%, and escape to sea 10.3%. Among the above, water uses for irrigation and for wildlife parks are designed uses, while the others are mere incidental happenings. Water use for rainfed farming has not been reported.

2. Pressures

Pressures felt by the ecosystem in the field of water use are as follows:

2.1 Uncoordinated pursuit of the two main farming systems; irrigated and rainfed, in a non complementary way

Irrigated paddy farming on transformed land has expanded with strong policy support and liberal access to land, water and capital resources, while rainfed farming has been going on as a people's practice, fallen out of favour with the Government and hence without policy support. This is a serious threat not only on the ecosystem, but also on food production as evident from heavy dependence on imports for national food security.

In the middle and lower parts of the Ruhunu basin, where both irrigated paddy farming and rainfed farming are common, local rainfall satisfies potential evapotranspiration only from October to December, and in the rest of the year there is a rainfall deficit, which is as high as 115 mm per month from June to September. See Table 1.

Table 1. Monthly balance between potential evapotranspiration and rainfall for the middle and lower parts of the study area (Generalized from data provided by Jayatillake 2002).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Potential ET mm	150	150	150	150	175	175	165	165	165	165	165	165
Rainfall mm	150	150	150	75	75	75	100	100	50	50	50	50
Deficit mm	0	0	0	25	100	100	65	65	115	115	115	115

Natural ecosystem adapts to water deficit in dry months by checking actual evapotranspiration. Water use for rainfed farming is largely limited to October – January, and hence is closer to

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nature. Irrigated agriculture extends to the water deficit months and the deficit is met with water extracted from elsewhere.

2.2 Impact of large scale irrigation development on coastal lagoons and lowlands

The impacts consist of uncontrolled discharge of drainage water in larger volumes and for longer periods than normal, flash floods from heavy rains, and reduced dry weather supply to them in normal dry periods and during droughts. The latter two are due to elimination of traditional tank system for major irrigation development.

2.3 Ecosystem conservation not being a land development objective

The first step in government sponsored land development for irrigation (the biggest land based development activity in the country) has been to remove the vegetation and organic debris from the whole land. Even the ongoing irrigation rehabilitation is limited to tank and command area, leaving watershed management largely unaddressed.

2.4 Limited attention to procurement of traditional forest supplies, by the people

The people have been procuring their water, timber, fuel wood and other forest products including food from the ecosystem, with minimum interference, some of which have been even constructive eg. rural habitat development. The modern development policy has dissociated people from the forest and from the ecosystem.

2.5 Species/resources conservation vs of ecosystem conservation

The prevailing conservation policy focus is mainly on individual floral/faunal species or specific resources like soil and water, and that on ecosystems is marginal.

2.6 Interrelationships between institutions and people

Both policy and legislation tend to bring about mutual reservation and fear between the institutions and the people, instead of the desired understanding. Regulations tend to be more restrictive than formative, some being even stifling and counterproductive.

3. Status

As discussed above the pressures on ecosystems come largely from policy promotion of production efforts in isolation (from conservation concerns). It makes it necessary for discussion on status to start with forest, the major victim of development.

3.1 Decline in forest cover due to clearing for development

The present forest and scrub cover in the Ruhunu Basin, is 1418 Km^2 and 1312 Km^2 respectively. Estimated loss of forest/scrub since 1960 appears to be more than 543 Km^2 (Walawe 370 Km^2 and Kirindi 173 Km^2) for large irrigation projects, two sugar projects, and associated rainfed farming.

3.2 Underutilization of lands developed for irrigation

This is due to developing more land than possible to be cropped. Addition of Akkarawela to Puranawela in village tanks is a clear example. In the premier irrigation scheme, Uda Walawe out of the total extent of 14883 ha developed, the extent irrigated in any season seldom exceeds 75% (Department of Census and Statistics, 2001), worse in Lunugamwehera. Even after starting irrigation rehabilitation since late 1970's, on a national basis, the level of underutilization of developed paddy land stands at 25% in Maha and 58% in Yala. The national scale ratio between paddy production in Maha and Yala seasons which was 64% : 36% in 1951/52 remains almost the same at 63% : 37% for 1994/95 (Dept of Census and Statistics, 1997). Leaving deforested and bench terraced land, without designed use is a threat on ecosystem health.

3.3 Rainfed farming not considered a development option

Suppression of rainfed farming n favour of irrigation, started by the colonial rulers for reasons including political continues to date. As a result rainfed farming has to manage without policy support, and access to technology for stabilizing it. Despite constraints, many farmers including those in water stressed irrigation projects take advantage of the high rainfall of about 500 - 700 mm in the Maha season to raise a rainfed crop. Panabokke (2001) shows that on minor tanks in Malala basin rainfed seasonal cropping in the upland is more reliable than irrigated paddy farming in the tank command area. Rainfed uplands farmed without access to technology have suffered soil erosion and land degradation which are serious ecosystem management problems eg. Weli Ara and Uda Mattala upland settlements. Increase in runoff rainfall ratio in Kirindi Oya basin as measured at Lunugamwehera from 15% in 1954 to 35% in1974 could be due to such upland degradation (Dharmasena, 1994).

Though World Food Summit Plan of Action of 1996 suggests development and optimal allocation of investments to **both high and low food production potential areas,** it has not been able to prompt Sri Lanka to rethink her policy prejudice against rainfed farming as evident from the most respected and valued rainfed food crop, Kurakkan, being left out of the list of crops taken up for attention under Food Security studies (MALF undated).

3.4 Scarcity of timber and fuel wood for use by the people

The problem is acute. Tea estate labour use tiny tea prunings for fuel wood, and settlers in Sevanagala use equally tiny twigs of Lantana camara (Gandapana). Production of fuel wood has not been a development objective. Similarly growing of timber by the people as an economic pursuit is rare due to restrictive and even counterproductive regulations. Fuel wood continues to be the main cooking fuel in the basin, and available forests including Bundala National Park are being exploited by fuel wood collectors.

3.5 Status of water availability in the ecosystem

Stabilizing individual inland catchment hydrology over the climatic year for ensuring availability of water for settlement use in the dry seasons has been a major traditional practice. In the coastal belt this has taken the form of storing water in coastal valleys in a cascading system of three adjacent ponds for drinking, bathing and washing, in that order down the cascade, eg Kahandamodera, Atulla. In the traditional systems, seepage of water into the ground water was not considered a net loss from the system as it recharged ground water resource. Though these traditional water management measures and principles are now in little use, concern for social and environmental water needs as an irrigation management responsibility is emerging (Merrey 1998).

Domestic wells located outside irrigation schemes is purely ecosystem dependent, and they tap the ground water in the regolith (shallow ground water). Depth to water level in such wells in Handapanagala, Hambegamuwa, has been receding from about 240cm in 1970's to about 600 cm in 1996. Trees like jak and coconut have shown signs of failure since around 1985. These are attributed to increasing soil drying due to rainfed farming without conservation and indiscriminate sinking of tube wells. Strong correlation ($r = 0.78$) between shallow ground water depletion and the number of tube wells has been established for the Walawe basin (Senanayake 1998). Though denied earlier, that shallow ground water could be at risk due to pumping from deeper down from tube wells is now being accepted (Wickramage, personal communication). This shows that absence of measures to recharge ground water by upland management is a major management deficiency.

3.6 River water flow

Traditionally runoff/concentrated flow interceptors across lower and middle order valleys and anicuts across main rivers have been common as conservation and development interventions. Recently large dams have been constructed across main rivers.

Both flood flow and baseflow in rivers have declined (but plausible information is not available) after construction of large reservoirs. Available indirect information showing reduced river flow after construction of Uda Walawe reservoir include the following; breaching of the spit at Walawe estuary has been rare making the estuary more closed, entry of sea water into the river is spread over a longer period than before and extending too far up the river, beyond Ambalantota compelling the WS&DB in 1997 to install an additional pumping station at Bolana, 4 km upstream from the previous pumping site located at Ambalantota. The Bolana site is for use at those times when the river salinity level at Ambalantota is too high for drinking. See Tables on water quality for details.

Downstream Kirindi Oya has been facing similar problems after the construction of Lunugamwehera reservoir. However data is not available except on water quality which are discussed in separately, yet without baseline information. Flow in Menik Ganga has been only marginally arrested.

There is no policy attention on ensuring minimum base flow in rivers even at the present, and the continuing effort to save irrigation water by reducing losses (seepage, percolation) and for increasing cropping intensity aims at reducing it further. It is important to not to forget that the sand dunes in the area owe a lot to sand supply to the sea from Walawe Ganga.

The case of Karagan Oya which drains into Karagan Lewaya is a clear example of negligence of those systems that are too small for large reservoirs. Its village reservoirs and ponds remain unmanaged causing frequent flooding of Hambantota town located on its downstream and severe domestic water scarcity for the settlers on the catchment. Therefore it is necessary to undertake catchment water conservation for supporting ecosystem conservation and stabilization of catchment hydrology for other economic purposes even if large scale irrigation is not feasible.

Fishkill in upstream of Uda Walawe reservoir is attributable to river flow interception without measures for stream flow management. There is large scale death of young fish in ponded water on streams leading to Uda Walawe reservoir in the Maha season. The direct reason is sudden rise in water level in the reservoir with heavy rain and sudden drop in upstream flood level due to opening of sluice gates for releasing the flood waters. With rising water level the fish move up on the headed up streams behind the reservoir, but get trapped into isolated pockets left on the stream channels as the water level suddenly drops. The fish gets trapped in such large numbers that they soon die of overcrowding and suffocation, even before the ponds dry up.

3.8 Quality of water

Rain water is of good quality. Being a water deficient zone, salt concentration is the most common natural source of water quality decline. It is measured as electrical conductivity. Surface water in village tanks and in large reservoirs in the Maha season and at other times of occasional heavy rain is within class I (electrical conductivity less than 0.275 dS/m), but the quality declines with advancing dry weather, through irrigated fields during use from supply to drainage, and down the land gradient. In irrigation systems the decline in quality is generally to class II (0.275 – 0.750 dS/m) in wet weather and even to class III (0.750 – 2.25 dS/m) specially in dry weather.

The quality of shallow ground water, which has been the common source of domestic water has also suffered, specially in the coastal area largely due to irrigation backflow, villages affected being Hungama, Koholankala, Pallemalala and Bundala. Wells in the Walawe basin show a gradual rise in salinity from upstream to downstream , from wet weather to dry weather, and from within irrigated command area to outside from it.

Table 2. Water quality data in Walawe basin (Nippon Koei 1995).

Location	Salinity dS/m		Fluoride mg/l	
	Nov. 1991	July 1992	Nov. 1991	July 1992
LB sluice of Uda Walawe reservoir	0.115	0.179	0.23	0.25
River at Liyangastota	0.207	0.328	0.34	0.49
River at Ambalantota	0.236	0.885	0.37	0.51
Well close to irrigation command	0.395	0.1906	0.29	1.3
Wells far out of LB command	0.738- 0.1945	0.899- 0.1814+	0.85-6.90	1.5-9.2

Salinity level of water (averaged for one year) in the majority of wells in the undulating plain in Kirindi Oya basin under the KIOSP is in the range 0.250 to 0.750 dS/m (Class II) while that in the alluvial plain is within 0.750 to 2.250 dS/m (Class III). (Matsuno, Elkaduwa and Shinogi undated). Regarding stream flow water quality, average salinity over a year (in 1997) of Kirindi Oya water 10 km up from the estuary (near Telulla) has been 0.9 dS/m very close to 1.0 dS/m, the value reported close to the estuary. Extreme high values for dry weather for the two stations are about 1.1 dS/m and 1.3 dS/m respectively. (Matsuno, Elkaduwa and Shinogi undated). Higher salinity levels close to the estuary could be due to intrusion of sea water and /or leaching of soil salinity from soil to incised river channel.

Local residents say that water quality in some tube wells has deteriorated over the years. Fluoride toxicity symptoms in the form of stained teeth are evident on children and teenagers who have been most exposed to tube well water in their childhood. Adults who did not have tube wells when they were young do not have the problem. Salinity values of tube well water in Hambantota district between Walawe Ganga and Kirindi Oya has been more than 3.0 dS/m for the dry mantled plain, and 1.5 to 3.0 dS/m in alluvial plain and in mantled plain closer to irrigation projects (CEA, 1966).

Ruhunu basin being an agricultural area, agrochemical contamination of surface water is being feared. Analytical information on it is scarce, except for recently initiated efforts by NARA, for the coastal waters. Recent efforts of the Department of Agriculture to reduce the use of pesticides for crop protection by promoting the use of cultural practices as well for pest management have been successful with the paddy farming for which, according to agriculture extension officers, pesticide application rates have come down

Disposal of paper factory effluent to Walawe Ganga has been a long standing issue. Effluents are of two types. Washings of straw amounting 18,000 l/d is relatively harmless. Cooking of straw in caustic soda produces an effluent in volumes of about 10,000l/d, which contains lignin and caustic soda. It is stored in ponds and released to the river at intervals. Contaminated river water has been found to have the following analysis; high COD and BOD, pH 10, NaOH per liter 2.2 g. (Nippon Koei, 1995). This problem has made it necessary to restrict discharging of the black liquor to some fixed days in the week so that pumping of water from Walawe Ganga at the Bolana could be done on days when the river water is least contaminated.

Discharging of sugar factory effluent from Sevanagala factory. An effluent called slop or stillage (136382 l/d) which is rich in calcium salts, yeast, and containing nitrogen and potassium is temporarily stored in pond and discharged into Walawe Ganga. (Nippon Koei 1995).

Recently reported faecal contamination values for coastal waters range from 0 in Karagan Lewaya possibly due to due to high salinity to 120 at the outlet of Kalametiya lagoon, which is a bathing spot and near shore fish landing site (NARA 1999).

Table 3. Biological water quality in the coastal area of the Ruhunu basin.

Location	BOD mg/l	Faecal coliform cells/100ml
Kalametiya lagoon	8.1	120
Kachchigal Ara inlet	6.7	100
Walawe ganga (Ambalantota bridge)	6.9	50
Karagan Lewaya	3.4	0
Malala Ara	6.4	70
Malala lagoon	3.7	10
Bundala lagoon	9.0	60
Kirindi Oya	6.5	20
Kirinda Fishery harbour	10.1	30

3.9 Drought impacts

Impacts of comparable droughts are becoming increasingly intense , because of forest felling, misuse of water, and indiscriminate drilling of tube wells (Social Services Department, 2001). The drought in 2001 was very severe and prompted provision of relief (water and food) to the residents in Lunugamwehera, Tanamalwila, Sevanagala, and Suriyawewa and Hambantota DS divisions. More than 52,000 families in Hambantota district were affected. Many wild animals, particularly deer and elk either died directly due to thirst or becoming easy victim to traps laid by the people. Dry weather fires, whether incidental or set by the people for generating tender grass forage for their cattle or for enabling easy hunting are common, particularly in the Walawe National Park.

While on the subject droughts it must be mentioned that there are no preparations for capturing water from very high rains as all the existing tanks spill when such rains occur. On January 29, 2001 few months prior to the area was in the grip of a severe drought, Hambantota received a rainfall of 151.1 mm.

When droughts hit in the Bundala National Park and other coastal wetlands in the wintering season, which is also the wet season the impact is drastic on the wetland bird population most of which are aquatic and includes the migrants who come for wintering. The 2001/02 Maha season was such a season, when there was little local rain and KOISP did not have sufficient water to issue to RB tract nos. 5, 6 and 7.

3.10 Coastal lowlands

The coastal lowlands in the Ruhunu basin consists of the estuaries and associated lowlands of the three main rivers, and the lagoon studded wetlands between them. Most lagoons are open to the sea through a sand barrier dune. Some lagoons receive local stream flow. The distribution of lagoons from west to east and their extents in ha are as follows; Kalametiya (604), Lunama (192), Paybokka (small), Sittakkala (75), Karagan Lewaya (355), Maha Lewaya (184), Koholankala (210), Malala (437), Embilikala (430), Bundala (520), Dorawa, Kirinda, Angunakolawala, Atulla, Palatupana Lewaya (160), Palatupana Goda Kalapuwa (18), Wilapaluwala, Uraniya, Buttuwa, Gonalabba (15).

Most lagoons have had a sequence of two or even more man made earth bunds across the valleys opening to them for storing fresh water in ponds both for conserving fresh water and for keeping the lagoons brackish. These ponds have suffered damage possibly due to poor awareness on their significance, except in rare locations like Palatupana tank above Goda Kalapuwa.

Coastal lowlands located downstream of irrigation projects; Kalametiya-Lunama below the Walawe Project, and Bundala Ramsar wetland located below KOISP are affected by irrigation backflow during cropping seasons, by flashfloods between cropping seasons due to removal of traditional flood detention tanks during development in the upstream, and also by denial of the lowland share of water in drier than average Maha seasons.

The symptoms of coastal lowlands affected by irrigation development in immediate catchments are of two types. One is due to increased entry of water and the other due to reduction of supply. Increased entry has raised the ground water table in dry weather which has increased soil salinity making the soil too saline for cropping in the Yala season and has caused the natural vegetation associations eg. Divul - Maliththan to give way to aggressive salinity resistant species, eg. Prosopis Juliflora. In wet weather or when irrigation is on in the immediate catchment, the wetlands get flooded more and longer than before, which makes paddy farming difficult. During such periods the affected lagoons become fresh water lakes seriously affecting the typical brackish water shell fish species, and associated fishing industry (Jayakody and Jayasinghe 1992). Flood outflows subsequently constructed for easing the above problems in Kalametiya and Malala lagoons in 1985 and 1996 respectively have reduced flooding but has interrupted the shellfish biodynamics and hence worsened the plight of the fishermen.

Accurate information on the extent of paddy lands abandoned is not available, rough estimates being about 100 ha in Kalametiya, four village tanks and associated paddy lands in Koholankala and Pallemalala. As discussed under water quality, salinity of well water has risen in Hungama, Koholankala, Pallemalala, and Bundala.

3.11 Ecosystem management

3.11.1 Ecosystem diversity

The study area within its bounds holds the maximum diversity of geomorphological divisions found in the country and hence the widest diversity of ecosystems. This is reflected in the wide diversity of natural vegetation types within it as shown in Table below.

Table4 . Distribution of natural vegetation types within major geographical divisions in Ruhunu basins.

Type	Geographical distribution		
	Coastal	Inland peneplain	Submontane/Montane
Tropical Thorn Forest	+	+	
Tropical dry mixed evergreen forest – Manilkara community	+		
Tropical dry mixed evergreen forest – Mixed community		+	
Villu (lowland seasonal flooded grasslands)	+	+	
Mangrove	+		
Riverine forests or gallery forests	+	+	
Sand dune and beach Vegetation	+		
Salt Marshes	+		
Sea Grass Beds	+		
Moist evergreen forest		+	
Tropical moist semievergreen forest		+	
Fernland			+
Savannah		+	+
Wet Patana and upper wet patana			+
Tropical montane forest			+

There has been no organized attempt to conserve this overall diversity as one totality.

3.11.2 Ecosystem management institutions

Ecosystem in a given area must be seen as a spatial spread over the whole area and covering all the ecosystem components, including the local people, which must be managed in a collective and integrative effort by all stakeholders. However under the existing system of ecosystem management, two agencies; Forest Conservation Department and the Department of Wild Life Conservation have been assigned the responsibility. These two agencies operate in land areas specifically demarcated for the purpose, largely by protecting the species and resources within them from damage from the people. Any organized ecosystem management widely applied outside the protected areas is limited to application of forestry and wild life regulations, which tend to marginalize people from ecosystem conservation, than involve them. Most criticized deficiency in maintenance of Protected Areas has been the policy of policing by the staff and antagonism to participation and collaboration (Laurie and Miththapala 1994). As discussed earlier the emphasis of conservation by these two departments is largely on identified species and not on ecosystems.

Other isolated ecosystem management activities include management of coastal zone, and river/tank reserve by Coast Conservation Department, and Irrigation Department respectively.

Their attention is more on conservation of resources. Department of Agriculture has had a soil conservation division and is still mandated to undertake the task of soil conservation, but does not have a program to cover the basin.

There are no ecosystem management programmes which objectively involve the people or government agencies representing sectors like agriculture, irrigation, fishery, local government. Norms for day to day management of life and economy of the people and society, are often not based on understanding of value of ecosystem goods and services. eg the common practice applied by the modern society for handling waste is not to manage it but to throw it out of the waste generator's sight.

Spatially the largest extent under ecosystem management in the basin falls within the Protected areas of the DWLC. They are discussed below:

Yala National Park located on the downstream parts of Menik Ganga valley and east of it is the largest operational wild life park in the country. The park is managed by a park warden and visitor service facilities are available. It has been studied under the GEF project and five management zones have been proposed (Panwar and Wickramasinghe 1997). Due to water scarcity for animals the park is generally closed for visitors in August -September.

Bundala National Park is the only Ramsar wetland site in Sri Lanka. This lagoon studded wetland is reputed as a migratory bird visitation site. Managed by park warden and has visitor service facilities including camping sites. Maha, Koholankala, and Bundala (partly) lagoons have been turned into salterns for salt manufacture. Irrigation backflow from KOISP has raised the dry weather water table reducing the brackishness of lagoon waters and spreading soil salinity, adversely affecting lagoon fish fauna and floral diversity and biomass on the ground. It is being overexploited for commercial tourism. Details are discussed in a section below. Its ecosystem situation is discussed in detail in a later section.

Uda Walawe and Lunugamwehera National Parks have been declared for both wild life and major reservoir protection. They include and encircle the respective reservoir. Uda Walawe is being exploited for tourism to the point of affecting the conservation interests of its elephant fauna, specially during August- September when Yala National Park is closed because of water scarcity. It has an elephant orphanage which is experimenting on raising orphaned elephant calves and releasing them back to the jungle. Lunugamwehera is not exploited for tourism.

Horton Plains National Park, located on the northern border of the basin, is also heavily used for tourism. Main accesses to it are from outside the Ruhunu basins.

Other Protected Areas coming under the control of the Department of Wild Life Conservation are; Kalametiya-Lunama Sanctuary, Wirawila-Tissa Sanctuary, Nimalawa Sanctuary, Madunagala Sanctuary, Katagamuwa Sanctuary.

The Forest Department is in charge of the forests outside the National Parks. These include the natural forests consisting of forest reserves. They include Nature Reserves, village forests and planted forests. Peak Wilderness Nature Reserve is located west and southwest of Horton plains, and it covers mainly montane and submontane forest, on the upper slopes of the Southern Escarpment. Village forests are largely exploited by the people for farming. Planted forests include Casuarina on the coast at Godawaya and Hambantota, Eucalyptus camuludensis and teak on the inland peneplain, and Pinus and other Eucalypus species in the montane zone.

The Coast Conservation Department has demarcated a Coastal Zone which is 300 m wide on the land from the coastal tree line. Within it is demarcated a setback distance which ranges from 50m to 125 m (according to the vulnerability level of the coast).

The names, and extents of the DWLC managed Protected Areas in the Ruhunu basins are given in Table 5.

Table 5. Protected Areas in Ruhunu Basin under DWLC.

Watershed	Name	Extent ha	Other information
Menik Ganga and east of it	Yala National Park		Extends beyond Menik Ganga to Kumbukkan Oya
	Yala Strict Nature Reserve	28904	
	Block 1	14100	Most visited by tourists
	Block II	13679	
	Blocks III-V	70121	
Malala, Weligatta, Kirindi Oya RB	Bundala	6216	Overused for commercial tourism
Walawe	Uda Walawe National Park	30821 ha.	
Walawe watershed with Mahaweli	Horton Plains National Park	3162 ha	Overused for commercial tourism
Kirindi Oya	Lunugamwehera National Park	23,000 ha	Not used for tourism. Treated as replacement P.A. for Wirawila – Tissa which is fading in significance as Sanctuary
Kachchigal Ara fed by Walawe	Kalametiya – Lunama Sanctuary	712 ha	Highly disturbed by irrigation backflow
Walawe	Mandunagala Sanctuary	138 ha	Forest hermitage and close by hot springs
Kirindi Oya	Wirawila -Tissa Sanctuary	4170 ha	Due to pressure of development has lost significance as sanctuary
Kirindi Oya	Ravana Ella Sanctuary	Small	Tourist attraction
Atulla – Palatupana	Nimalawa Sanctuary	1065 ha	Forest hermitage
Menik Ganga	Kataragama Sanctuary	800 ha	Heavily visited Kataragama shrine
Menik Ganga	Katagamuwa Sanctuary	1010 ha	Adjacent to Kataragama
Malala Oya	Pallemalala Sanctuary	Small adjacent to Bundala NP	Virtually absorbed into Bundala National Park

3.12.3 Divergence in ecosystem management and development policies

In the development sector/s, policy focus has been on production, with little attention to conservation, not even as a means for production. In the conservation sectors; forest and wild life, the main focus has been exclusive conservation except for commercial tourism. Sustainable management of wild life with managed ranching, systematic culling etc. are not even tolerated for discussion.

3.11.3 Biodiversity management

Biodiversity is considered under natural biodiversity and agro-biodiversity.

3.11.3.1 Natural biodiversity

Conservation of natural biodiversity has not been a development objective, and hence it has declined. This is clearly evident from loss and degradation of riverine forest consisting of Terminalia arjuna (Kumbuk), Berrya cordifolia (Halmilla), Barrigntonia racemosa (Diya Midella) etc. from along Walawe Ganga, Malala Oya, and Kirindi Oya, particularly in irrigation schemes, while it is superbly preserved along Menik Ganga within the Yala National Park. The intensity of loss of natural biodiversity increases in the following land use types in the same order; Strict Nature Reserves, National Parks, Sanctuaries, Reserves, Rainfed Settlements and associated minor tank settlements, settlements in large irrigation schemes, irrigated command area in large irrigation schemes.

3.11.3.2 Agrobiodiversity

Agrobiodiversity has been gradually narrowing down with modernization to rice as the almost exclusive food crop. Tree crops like Jak and coconut are becoming increasingly difficult to grow on rainfed uplands away from major irrigation projects or tanks, and easier to grow in stable irrigation schemes. Local yams both collected from village forests and grown in home gardens are becoming scarce and indigenous knowledge on them is fast disappearing. Upland cereals are becoming rare because of inadequate policy attention, and declining soil fertility.

3.11.4 Development impacts on use of water for ecosystem management – deterioration of Bundala Wetland as a case in point

From above observations clearly point to the fact that development projects, which in the study area has been largely for irrigation development, have been undertaken with little regard to impacts on the ecosystem, and this has to be remedied if the ecosystem is to receive its due share of water. This fact is better documented for Bundala National Park because it is a wetland of international recognition. Introductory information on Bundala Wetland were discussed in sections 3.9, 3.10 and 3.11. Additional information is presented below.

Bundala wetland suffers in many ways due to development of its immediate catchments for irrigation. Uncontrolled flow of surplus drainage, flash floods, aggravated drought impacts, increased grazing pressure from cattle, loss of brackishness of lagoon waters, change in aquatic species, loss of riverine forest are some of them. Above changes have been reported to have adversely affected the wild life particularly the birds in the wetland. Due to pronounced drought in 2001/02 winter season birds were reported to be very scarce within the park. Reduced brackishness of water has reduced the shrimp population, which is the favoured food of many birds. Herbivorous mammals suffer from reduced forage due to flooding and overgrazing by feral cattle.

Reputation of Bundala wetland is as a bird habitat, particularly for water fowl, and for winter migrants. Total number of birds recorded is 197 species of which 139 are resident, and 58 winter visitors. At a time as many as 20,000 migratory shore birds have been observed. The resident birds include herons, egrets, pelicans, cormorants, teals, storks, and stilts, and the migratory birds consist of stints, sand pipers, plovers, terns, gulls, ducks, and flamingos.

3.12 Policy and institutional preparation to ensure health of ecosystems by 2005 and improve health of fresh water ecosystems by 2015

Constitution requires the state and the citizens to protect the ecosystems/environment.

There are over 40 state institutions with diffused jurisdiction and uncoordinated action. Therefore a Water Management Authority was proposed in 1985, but not instituted yet. Instead National Water Secretariat has been established, but it is housed in the Ministry of Irrigation, which for decades has been using the lion's share of water in the country.

Protection of fresh water is limited to few legal instruments. Ground water is not covered by law. Point source water discharge eg from factories, is covered by law, namely EPL.

Nonpoint source discharges eg runoff, irrigation backflow are not covered by law.

Environmental Impact Assessment applies for 52 listed projects. EIA is applied on them when they are bigger than a specified dimension except when they are within close proximity to Protected Areas. EIA on 19 of the listed items are administered by Local Government Bodies. A major limitation is absence of skills for applying EIA.

Lot of ecosystems initiatives have been made eg NEAP, CZMP, National Forestry Policy, New Forestry Master Plan, Biodiversity Action Plan. Except for few eg CZMP most are mere administrative initiatives. CZMP has already embarked on the implementation of coastal resources management in the Hambantota district.

Public participation in development and conservation was identified as a critical need as early as 1990, yet there is no clear legal provision for it. Community/public participation as is applied by Government institutions/banks/NGOs today is not yet very different from the conventional "you participate in my programme" approach. It does not mean that exceptions are not there as in the case of UWMP which implements a policy of community forestry that allows 75% of the timber yield to the participating people.

Deregulation of restrictive forestry policies is being slowly approached. Now it is possible for land owners to fell and use hardwood timber within the premises except few identified species like Jak, though transport is yet under strict control. It is hoped that this facility will be an incentive for people to plant trees, evidence of which is already there. Tea Small Holders Development Authority has started an afforestation program in degraded tea lands in 2002.

Since initiation in 1980, CEA is strengthening and consolidating. Head office has been established at Battaramulla, and branch offices opened at Matara and Matale. Every DS divisions has been provided with an Environmental Development Assistant. Local Governments have been empowered to handle EIA on 19 of the listed items.

Forest, Wild Life, and Environment sectors, which have been often segregated under different ministries have been recently (2001 end) brought under one Ministry. But Agriculture and Irrigation are yet separate.

4. Indicators

From the above information it is clear that if ecosystem is to be allocated a fair share of waters it is necessary to save on water demand for irrigation without jeopardizing food security. For this to be possible we have to opt for the most rational system or combination of systems for producing food with the highest water use efficiency. The two systems available for food production; irrigated, and rainfed must be tested under equitable conditions for their water use efficiency.

4.1 Water use efficiency for food production

What is now being used in irrigation projects is cropping intensity, the target of which is 2 crops per year with no consideration for the amount of water used, and hence is more a measure of water availability than water use efficiency. In water surplus Mahaweli systems B and C the value of 2 is being realized, but in water deficient Uda Walawe it is about 1.4 and in Lunugamwehera even less.

Any test of water use efficiency has to begin with rain water which is the primary source of irrigation water in Sri Lanka and for which there are claimants at where the rainfalls who practice rainfed farming. This is not the case, say in Punjab, where the primary source of irrigation water is thawing snow from uninhabited mountains. Therefore in Sri Lanka rainfed farming too must be brought into the equation. Irrigation and rainfed farming as they are practiced today are not comparable because of wide disparity in policy support to the two systems.

Irrigation in Sri Lanka has been heavily supported and funded. Under the Mahaweli development project, the cost of development of a hectare of irrigable land and settling a family to farm it has been U.S. 35,000.00, at 1985 prices. No institutional support or funding has been made available to rainfed farming. Therefore before applying the water use efficiency test it is very important to provide some minimum development support to rainfed plots for at least three years for them to be rehabilitated from damage suffered over long years of marginalization.

The proposed criterion for assessing water use efficiency must be;

Kg of food produced per cubic meter of rain water/ha/ season

It can be applied as its is for rainfed farming.

For applying it for irrigation it must be modified to express two additional things. One is the conversion rate of rain water to irrigation water as at farm gate which can be even 5:1 or more for minor tank irrigation for Maha and even higher in Yala. The other is the extent of land committed to irrigation (inundated land + command land, taking command land as one) which is 1.16, 1.25, 1.16 and 1.06 for Walawe, Malala, Kirindi and Menik basins if all the developed land is cropped, and higher if less land is cropped which is often the case. Therefore for irrigated lands;

$$\frac{\text{Kg of food produced per cubic meter of irrigated water/ha/season}}{\text{Liters of rain water needed to make one liter of irrigation water applied in the season} \times \text{Total land committed to irrigation in the season}}$$

If an evaluation of water use efficiency for food production is done on the basis of the above indicator it will enable allocation of water (and land) for the most appropriate combination of food production under irrigated and rainfed for a given sub basin or part thereof, which in turn will enable better provision of water for protecting ecosystems.

If the above indicator can be applied effectively for allocating water for food production, that alone will ensure better availability of water for ecosystem management.

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Acronyms

COD	:	Chemical oxygen demand
CZMP	:	Coastal Zone Management Project
BOD	:	Biological oxygen demand
DWLC	:	Department of Wild life Conservation
KOISP	:	Kirindi Oya Irrigation and Settlement Project
NEAP	:	Upper Watershed Management Project
WS&DB	:	Water Supply and Drainage Board.

Summary

(of paper on use of water for ecosystems under WWAP, J. Handawela)

In nature, water belongs to the ecosystems in which it is an integral part, and to that extent water is extracted for development the ecosystem suffers, particularly so when the primary source of water available is rainfall which has to be renewed every year.

In Sri Lanka both the use of water for food production and institutional arrangement s for ecosystem conservation continue to be skewed towards extremes without equitable distribution of responsibilities among potential players.

Water for food production is being allocated largely for irrigation based on the colonial time decision that irrigation was the only reliable form of food production and rainfed farming was ineffective and inefficient. This poses many interlinked threats on the ecosystems, and they are:

- At present irrigation consumes 94% of extracted water.
- Village tanks remain without proper management and effective utilization because they cannot be used for primarily for irrigation and they are not given the most needed repair which is desiltation because desiltation only enhances the so called dead storage which keeps the people and village livestock alive over the dry months, but is of little use for extraction for irrigation.
- Rainfed farming has been branded as primitive and unproductive and hence denied policy support and access to technology.
- Soil drying is increasing in areas not served by major irrigation because of rainfed farming practiced there without technology and indiscriminate digging of tube wells. This has also forced the people to drink fluoride contaminated deep ground water.
- Substantial extents of land developed for irrigation remain unutilized to the tune of 25% in the Maha season and 58% in the Yala season.
- Excessive drainage flow from irrigation projects to downstream coastal wetland systems including the Bundala wetland which is the only Ramsar site in Sri Lanka is threatening the sustainability of the wetland ecosystems.
- Biodiversity, including the riverine forest has suffered, and agrobiodiversity has narrowed down with expansion of irrigation.

Assessment of long term performance of the food production sector in the country shows that sel sufficiency in food has been ever elusive, double cropping in full command area even in th better resource endowed Uda Walawe scheme has not been able to be realized, and the country' food security heavily depends on imported wheat.

Modern scientific knowledge shows that integrated watershed management where not only th irrigation schemes but also the catchments areas are managed for crop production unde integrated watershed management on a mutually complementary manner is far more productiv and less threatening on the ecosystems, than concentrating on irrigation as the sole system of foo production.

When it comes to institutional arrangements for ecosystem conservation, it can be sad that tl task of conservation is vested largely in the Department of Wild Life Conservation and the Fore Department which cover mainly demarcated uninhabited areas. Those government institutio departments, which are production oriented have had little responsibility in conservatio

Restrictive conservation regulations have tended to keep people away from conservation instead of inviting them to join in the effort.

Conservation as such has been focusing on plant and animal species and to specific resources like soil and water, and not on ecosystems and sociocultural systems.

From among the above two skewed relationships, that on food production has the biggest impact on allocation of water for ecosystems. Therefore a common indicator that is valid for all forms of food production that uses rain water directly or after extraction is proposed for assessing water use efficiency for food production. In its fundamental form;

Kg of food produced per cubic meter of rain water/ha/ season

it can be applied for rainfed farming which uses direct rain water when it rains and where it rains. For irrigated food production, additional factors come in to account for water losses encountered in water extraction and transformation, and to account for the land committed to storing the water in addition to the land cropped, as shown below;

$$\frac{\text{Kg of food produced per cubic meter of irrigated water/ha/season}}{\text{Liters of rain water needed to make one liter of irrigation water applied in the season} \times \text{Total land committed to irrigation in the season}}$$

It is important to propose one pre-condition which is the need to provide at least three years of effective and efficient rehabilitation of rainfed farmed lands which have suffered damage from years of marginalization, before applying the indicator on them.