Spatial Variation of Water Supply and Demand in Sri Lanka

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Introduction

At an aggregate level, Sri Lanka, the so called 'tear drop' island in the Indian Ocean, has a rich freshwater endowment. In a geographic area of 65,000 km^2, Sri Lanka is blessed with 103 small and medium rivers, collecting about 52 billion cubic meters (bcm) of annual surface runoff. In per capita terms, the annual runoff in 2001 was 2,799 m^3, which willl decrease to about 2,232 m^3 by 2050. Thus, Sri Lanka is well within the generally accepted national water scarcity threshold of 1,700 m^3/person suggested by Falkenmark et al. (1989). However, underneath the aggregate statistics, there lies a stark spatial and temporal variation of water supply, which is generally a common feature in countries with arid to semi-arid to humid tropics (Amarasinghe et al. 2005). In fact, Sri Lanka's freshwater availability varies significantly across river basins and seasons.

Monsoonal weather patterns have a major influence on the spatial and temporal variation of water availability within the country. The wet-zone districts with only 23 % of the land area account for 51 % of the annual surface runoff, and in the yala season (April-September), they account for 81 % of the surface runoff (Amarasinghe et al. 1999). Only the north-east monsoon from October to March (maha season), influences rainfall patterns in the dry-zone, leaving large parts with severe water shortages in the yala-season. In fact, as many as 49 small river basins are mainly seasonal, where the yala-season contributes to less than 15 % of the annual runoff.

In addition to low availability, water-use patterns in agriculture also aggravate water stress in river basins. In 1991, a large part of the dry-zone in Sri Lanka was under severe seasonal water stress (Amarasinghe et al. 1998). Many drivers including demographic patterns, economic growth, and consumption patterns, which contribute to an increase in water demand, have changed significantly since the early 1990s. So has the associated water stress.

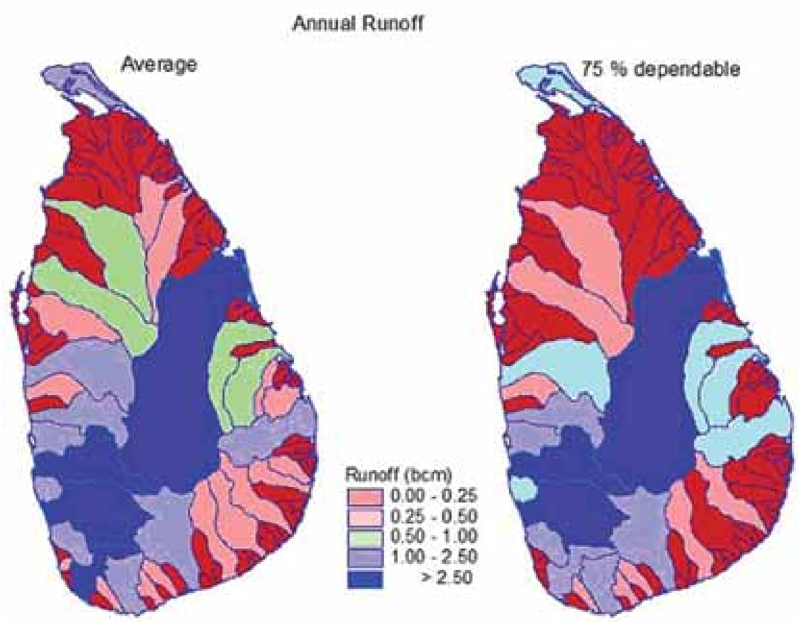
This paper discusses spatial variation of water supply and increased demand situation in Sri Lanka in recent years and assesses regional and seasonal water stress.

Water Supply

Renewable Water Resources

Generated from bi-monsoonal rainfall patterns, renewable fresh-water resources of Sri Lanka vary significantly across river basins and seasons. Of the 103 river basins, 12 river basins with 46 % of the geographical area generate 72 % of the total renewable water resource (TRWR)—(Figure 1). These river basins, which receive rainfall from both monsoons, are perennial. Each generates more than one bcm of annual runoff.

Figure 1. Surface runoff of Sri Lanka's river basins.



Source: Amarasinghe et al. 1998

Draining into the sea from the west and south-west, the Kalu, Kelani, Gin, Bentota, and Nilwala river basins have only 13 % of the land area, but account for 30 % of the population and 38 % of TRWR. The agriculture in these river basins is mainly rain-fed, and dominated by plantation crops such as rubber, coconut and tea. Draining into the sea from the east, the Mahaweli, the longest river and the most important for irrigated agriculture in the island, contains 17 % of the area, supports 17 % of the population and carries 19 % of TRWR. The basin of the Gal Oya River which flows east, known for its irrigated paddy production, has 3 % of the land area and 2 % of TRWR. The Jaffna Peninsular, which mainly uses groundwater for agriculture requirements, accounts for 2 % land area, 3 % population and 2 % TRWR.

Water availability across space varies significantly even within some water-rich basins, most importunately in the Mahaweli River It starts from the central hills and cuts across many agro-climatic regions on its way to the sea from the east. The Central Province, located in the wet- to intermediate zones, intersects 43 % of the Mahaweli Basin, and generates 57 % of its annual runoff. In contrast, the North-Central and Eastern provinces in the dry-zone have 27 % and 13 % of the basin area, respectively, but generate only 19 % and 7 % of the runoff. Much of the agriculture in the latter two provinces depends on irrigation from the water diverted from the up-stream of Mahaweli.

The majority of the remaining 91 basins, which mainly receive rainfall from the north-east monsoon, are mainly seasonal. As many as 71 basins located in coastal regions generate less than 0.25 bcm runoff. Of these, 48 basins generate more than 85 % of the runoff in the *maha* season (October-March). Furthermore, 16 of these basins get more than 75 % of its runoff in the *maha* season. Regionally, 20 small basins mostly in the Northern Province have 8 % of the total land area, but account for only 1 % of the TRWR; 26 basins mostly in the Eastern Province have 8 % of the total land area and 5 % of TRWR; 17 basins, mostly in the Southern Province, have 5 % of the land are and 5 % of TRWR.

In fact, the TRWR of 75 basins, including Mahaweli and Gal Oya, have significant seasonal variation where rainfall in the *maha* season contributes to two-thirds of the runoff. Intra-annual variation in water availability is the major constraint for productive agriculture in these basins. Thus, storing water for irrigation in the *yala* season (April to September) is essential in many river basins.

Dependable Runoff

Water storage is even more important due to inter-annual variation of TRWR. The 75 % probability of dependable runoff is only 83 % of the average TRWR (Table 1). Mahaweli has exactly 83 % of dependable runoff, mainly because of its origins in the wet-zone. But many of the river basins that flow to the sea from the north-west to the south (in a clock-wise direction) with their watershed in the dry-zone have much less dependable runoff. Water availability of these basins, especially in the *yala*-season during dry years, is very low. Thus, in the presence of increasing intra- and inter-annual variability of rainfall due to climate change, water storage in these basins becomes very important.

Table 1. Runoff estimates of Sri Lankan river basins.

ID	River Basin(s)[1]	Annual runoff (km^3)			Per capita water resources (m^3)			
		P75[2]	P50[2]	Average	Total	*Maha*	*Yala*	*Maha*-% of total
1	Kelani Ganga	5.3	5.6	5.7	2,085	882	1,203	42
2	Bolgoda Lake	0.9	1.0	1.0	670	292	378	44
3	Kalu Ganga	6.9	7.6	7.9	5,385	2,400	2,985	45
4	Bentota Ganga	1.6	1.7	1.8	4,272	1,921	2,352	45
5	Bentota - Nilwala	3.4	3.8	3.9	3,374	1,590	1,785	47
6	Nilwala Ganga	1.3	1.6	1.7	2,768	1,420	1,348	51
7	Nilwala-Walawe	0.9	1.1	1.1	2,421	1,304	1,117	54
8	Walawe Ganga	1.6	2.1	2.1	3,228	1,851	1,378	57
9	Walawe-Krindi Oya	0.3	0.3	0.3	3,970	2,387	1,583	60
10	Kirindi Oya	0.4	0.4	0.5	2,753	1,826	927	66
11	Krindi Oya- Manik Ganga	0.0	0.0	0.0	2,051	1,375	677	67
12	Manik Ganga	0.2	0.3	0.3	2,382	1,633	749	69

(Continued)

Table 1. Runoff estimates of Sri Lankan river basins *(Continued)*.

ID	River Basin(s)[1]	Annual runoff (km^3)			Per capita water resources (m^3)			
		P75[2]	P50[2]	Average	Total	*Maha*	*Yala*	*Maha*-% of total
13	Manik Ganga-Kumbumkan Oya	0.1	0.1	0.1	3,910	2,987	922	76
14	Kumbukkan Oya	0.4	0.5	0.5	3,610	2,952	657	82
15	Kumbukkan Oya-Karanda Oya	0.5	0.6	0.7	15,016	13,026	1,990	87
16	Karanda oya-Gal Oya	0.4	0.5	0.6	5,775	5,198	577	90
17	Gal Oya	0.9	1.1	1.3	2,623	2,453	170	94
18	Gal Oya-Mundini Aru	0.5	0.7	0.8	1,670	1,596	74	96
19	Mundini aru+Miyangolla	0.7	0.9	1.0	8,342	7,970	372	96
20	Maduru Oya	0.5	0.7	0.8	4,701	4,231	470	90
21	Maduru Oya-Mahaweli Ganga	0.2	0.2	0.2	26,714	20,286	6,428	76
22	Mahaweli Ganga	8.1	9.1	9.7	2,836	1,905	931	67
23	Mahaweli - Yan Oya	0.3	0.5	0.5	3,186	2,863	323	90
24	Yan Oya	0.2	0.4	0.4	3,271	2,928	343	90
25	Mee + Ma Oya	0.2	0.3	0.3	5,254	4,683	571	89
26	Ma oya- Kanakarayan Aru	0.2	0.3	0.3	1,945	1,710	236	88
27	Kanakarayan Aru	0.1	0.2	0.2	3,248	2,816	432	87
28	Kanakarayan Aru-Parangi Aru	0.2	0.2	0.3	2,396	2,058	338	86
29	Parangi + Nay Aru	0.2	0.3	0.3	2,103	1,790	313	85
30	Aruvi Aru	0.4	0.6	0.8	2,167	1,837	330	85
31	Kal Aru-Modaragam Aru	0.1	0.2	0.3	2,686	2,233	453	83
32	Wilpattu+Kala Oya	0.3	0.5	0.7	1,624	1,334	291	82
33	Moongil oya+ Rathambala Oya	0.2	0.3	0.4	875	680	195	78
34	Deduru Oya	0.8	1.0	1.1	1,290	872	417	68
35	Karabalan Oya + Maha Oya	0.4	0.5	0.5	1,170	680	491	58
36	Maha Oya	1.3	1.5	1.5	1,576	827	749	52
37	Attanagalu Oya	1.2	1.3	1.3	1,046	473	573	45
38	Jaffa Peninsula	1.2	1.2	1.2	2,021	1,672	349	83
	All basins	42	49	52	2,513	1,522	992	61

Source: Amarasinghe et al. 1998

Notes: [1] Shaded rows include more than one river basin
[2] P75 and P50 runoff estimates are based on 75 % and 50 % dependability rainfall

Water Storage

In spite of large intra- and inter-annual variation of rainfall, Sri Lanka's storage capacity is very low at present. By 1996, Sri Lanka had developed about 6 bcm of storage capacity. This translates to a per capita storage of only 291 m^3 in 2005. However, this capacity is very low, compared to 5,961 m^3 in the U.S.A., 4,717 m^3 in Australia, and 2,500 m^3 in China. Like Sri Lanka, many of these countries have large arid to semi-arid climate areas. Water security through higher storage was a crucial base for early economic development in many developed countries (Kumar and Shah 2008). Thus, low storage capacity resulting in economic water scarcity could be a major constraint for economic development in many parts of the island in the future.

However, many of the potential sites for large surface storage in Sri Lanka are already exploited. Moreover, social and environmental concerns for new, large storage structures are also increasing. Thus, increasing natural groundwater recharge by exploiting the resource in the non-rainy seasons, or through artificial groundwater structures in the rainy seasons could increase the storage capacity much more. This could facilitate the rapid diffusion of groundwater use in the dry-zone (Kikuchi et al. 2001), thereby generating spatially distributed benefits to a large rural population in the dry-zone.

Water Demand

Irrigation is by far the highest water use sector in Sri Lanka, accounting for 92 % of the water withdrawals in 1991 (Amarasinghe et al. 1998), and still is high at 90 % in 2000 according to FAO estimates (FAO 2008). There are no exact estimates of water withdrawals for the domestic and industrial (D&I) sectors or for the project efficiency of irrigation at present. Assuming 10 to 15 % of D&I water use and 35 % irrigation efficiency, total water withdrawals in Sri Lanka in 2005 could range from 13.3 to 12.6 bcm (Table 2). This is about a quarter of the TRWR at present.

Table 2. Total water withdrawals in Sri Lanka in 2005.

Water withdrawals in 2005 (million cubic meters)	Project Irrigation Efficiency		
	35 %	45 %	55 %
Irrigation withdrawals for paddy	10,634	8,271	6,767
Irrigation withdrawals (IW) for all crops	11,314	8,877	7,325
Total water withdrawals (TW) (IW at 85 to 90 % of TW)	12,572- 13,331	10,134- 10,873	8,582- 9,322
% of total withdrawals	24.1 - 25.5	19.5 - 20.9	16.5 - 17.9

Source: Authors' estimation

Irrigation Withdrawals

Irrigated Area

We considered 12 crops or crop categories for estimating irrigation withdrawals (Table 3). In 2005, gross crop area (GCA) was 1,945,000 ha. The dry-zone districts account for two-thirds of the GCA (Annex 1). Within this, the Eastern, North-Western and North-Central provinces account for 46 % of the GCA.

Table 3. Cropped area (1,000 ha) in 2005/06.

Crops or crop categories	Irrigated crops			Rain-fed crops			Total		
	Maha	*Yala*	Total	*Maha*	*Yala*	Total	*Maha*	*Yala*	Total
Paddy	423.5	276.3	699.9	162.4	37.9	200.3	585.9	314.3	900.2
Maize	0.0	0.7	0.7	23.5	3.7	27.2	23.5	4.4	27.9
Other cereals	0.0	0.1	0.1	4.7	0.9	5.6	4.7	1.1	5.7
Pulses	0.0	0.8	0.8	18.2	6.4	24.7	18.2	7.2	25.5
Oil crops	1.4	2.8	4.1	10.3	7.9	18.2	11.6	10.7	22.3
Roots and tubers	0.0	4.3	4.3	21.1	16.9	37.9	21.1	21.2	42.2
Vegetable	3.8	5.5	9.3	43.4	28.7	72.1	47.2	34.2	81.4
Total seasonal crops	428.7	290.5	719.2	283.6	102.4	386.0	712.2	393.1	1,105.2
Fruits			7.4			91.8			99.2
Sugar			17.4			-			17.4
Cotton			-			0.0			0.0
Tea			-			212.7			212.7
Rubber			-			116.5			116.5
Coconut			-			394.8			394.8
Total	428.7	290.5	744.0	283.6	102.4	1,201.8	712.2	393.1	1,945.8

Irrigation covered 38 % or 744,100 ha, of the GCA of Sri Lanka. The dry-zone districts account for 91 % of the gross irrigated area (GIA). Two-thirds of the GIA are located in Eastern, North-Western and North-Central provinces. Over 80 % of the GCA in Ampara, Manner and Polonnaruwa districts are irrigated.

Among the irrigated crops, paddy is the dominant crop. In 2005, paddy accounted for only 46 % of the GCA, but accounted for 94 % of the GIA. Of the total paddy area of 900,000 ha, 78 % was irrigated. Dry-zone districts account for 80 % of the gross rice area, and 91 % of the irrigated rice area. Within the dry-zone, the Eastern, North-Western, North-Central and Southern provinces account for 77 % of the irrigated rice area.

The irrigated area of other seasonal crops is very small at present. Only 44,000 ha of non-paddy crops are estimated to be irrigated at present. This is only 14 % of the non-plantation, non-paddy crop area. Much of the irrigation of these crops is in the *yala* season.

Plantation crops such as tea, rubber and coconut occupy a large part of the cropped area. As much as 38 % of the GCA is under tea, rubber and coconut. These crops are considered to grow under rain-fed conditions.

Net Irrigation Requirement

We estimate the monthly net irrigation requirement (NIR of different crops for two seasons. NIR is the product of crop coefficients and the difference of potential evapotranspiration and effective rainfall. For details we refer to Amarasinghe et al. 2005. Details of the seasonal paddy area are available at the DS Division level (GOI 2008), and therefore, for paddy, we estimate

NIR at the DS division level. Other crop areas are only available at the district level. Here, first we estimate the average NIR (in mm) for the districts based on DS division data, and then multiply from the district area to get the total NIR. The NIR estimates at district level are given in Annex 2.

Irrigation Efficiency

A systematic assessment of irrigation efficiencies across regions is not available. Estimating irrigation withdrawals in 2000, FAO-AQUASTAT assumed project irrigation efficiency to be at about 35 %.

Irrigation withdrawal is the ratio of NIR and irrigation efficiency. We estimate irrigation withdrawals under three irrigation efficiency scenarios (Table 4), where 35 % is perhaps closest to the reality. Efficiencies of 45 % and 55 % show the extent of reduction in water withdrawals possible with improved efficiency scenarios.

Table 4. Irrigation withdrawals.

Provinces/ Districts	Irrigation withdrawals at project irrigation efficiency 35 %, 45 % and 55 %								
	Total			Rice – major irrigation			Rice – minor irrigation		
	35 %	45 %	55 %	35 %	45 %	55 %	35 %	45 %	55 %
Sri Lanka	11,314	8,877	7,325	8,076	6,281	5,139	2,558	1,990	1,628
Wet-zone	716	557	456	314	244	200	393	305	250
Dry-zone	10,598	8,320	6,869	7,762	6,037	4,940	2,166	1,684	1,378
Provinces[1]									
Western	0.6	0.6	0.6	0.2	0.2	0.2	2.1	2.1	2.1
Central	4.8	4.7	4.7	3.1	3.1	3.1	10.4	10.4	10.4
Southern	7.9	7.8	7.8	9.3	9.3	9.3	5.4	5.4	5.4
Northern	6.1	6.1	6.0	5.5	5.5	5.5	5.7	5.7	5.7
Eastern	24.4	24.2	24.0	32.4	32.4	32.4	5.5	5.5	5.5
North-western	13.3	13.2	13.0	6.9	6.9	6.9	33.5	33.5	33.5
North-central	31.5	31.2	31.0	36.3	36.3	36.3	21.9	21.9	21.9
Uva	9.1	9.9	10.6	5.1	5.1	5.1	9.7	9.7	9.7
Districts[1]									
Colombo	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.4
Gampaha	0.3	0.3	0.3	0.0	0.0	0.0	1.2	1.2	1.2
Kalutara	1.6	1.6	1.6	1.2	1.2	1.2	3.2	3.2	3.2
Kandy	2.5	2.5	2.5	1.6	1.6	1.6	5.1	5.1	5.1
Matale	0.6	0.6	0.6	0.2	0.2	0.2	2.1	2.1	2.1
Nuwara Eliya	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Galle	6.7	6.7	6.6	8.3	8.3	8.3	3.2	3.2	3.2
Hambantota	1.2	1.1	1.1	0.9	0.9	0.9	2.1	2.1	2.1
Matara	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0

(Continued)

Table 4. Irrigation withdrawals *(Continued)*.

Provinces/ Districts	Irrigation withdrawals at project irrigation efficiency 35 %, 45 % and 55 %								
	Total			Rice – major irrigation			Rice – minor irrigation		
	35 %	45 %	55 %	35 %	45 %	55 %	35 %	45 %	55 %
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Wet-zone	716	557	456	314	244	200	393	305	250
Dry-zone	10,598	8,320	6,869	7,762	6,037	4,940	2,166	1,684	1,378
Districts[1]									
Jaffna	1.8	1.8	1.8	2.4	2.4	2.4	0.2	0.2	0.2
Kilinochchi	1.2	1.2	1.2	1.4	1.4	1.4	0.7	0.7	0.7
Mannar	1.2	1.2	1.2	1.1	1.1	1.1	1.4	1.4	1.4
Mullaitivu	1.3	1.3	1.3	0.5	0.5	0.5	3.3	3.3	3.3
Vavuniya	15.5	15.3	15.2	21.0	21.0	21.0	1.9	1.9	1.9
Ampara	4.8	4.8	4.7	6.2	6.2	6.2	1.6	1.6	1.6
Batticaloa	4.1	4.1	4.1	5.2	5.2	5.2	2.0	2.0	2.0
Trincomalee	10.5	10.5	10.4	5.3	5.3	5.3	28.5	28.5	28.5
Kurunegala	2.7	2.7	2.7	1.7	1.7	1.7	5.0	5.0	5.0
Puttalam	16.1	16.0	15.9	15.5	15.5	15.5	19.5	19.5	19.5
Anuradhapura	15.4	15.2	15.1	20.7	20.7	20.7	2.3	2.3	2.3
Polonnaruwa	3.6	3.6	3.6	3.2	3.2	3.2	5.0	5.0	5.0
Badulla	5.4	6.2	7.0	1.8	1.8	1.8	4.7	4.7	4.7
Moneragala	0.3	0.3	0.3	0.0	0.0	0.0	1.5	1.5	1.5
Kegalle	1.9	1.9	1.9	1.3	1.3	1.3	4.3	4.3	4.3
Ratnapura	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.4

Source: Authors' estimates

Notes: [1] Area values at provincial and district levels are given as a percent of Sri Lankan total

Irrigation Withdrawals

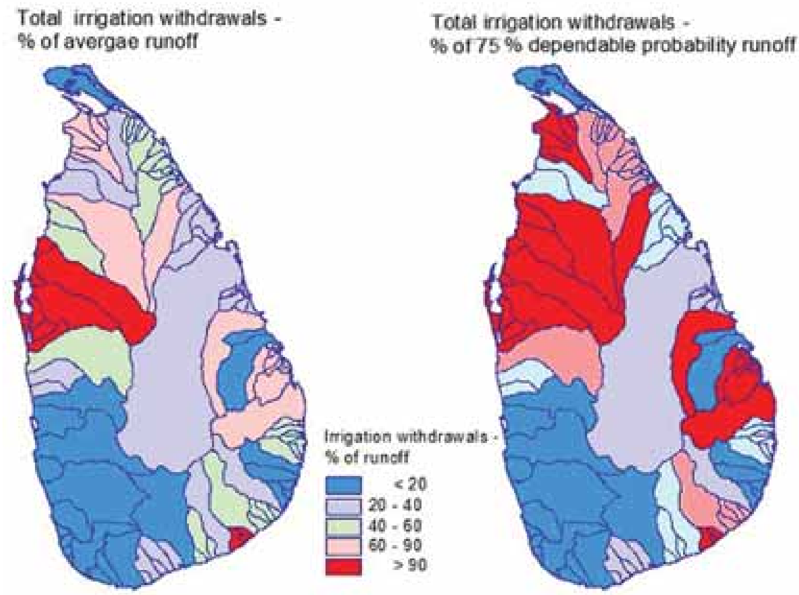
The total irrigation withdrawal in 2005 was 11.3 bcm, which is about 22 % of the TRWR. Given the larger irrigated area and greater irrigation requirements, the dry-zone districts account for 94 % of the total irrigation withdrawals. The Eastern, North-Western, and North-Central provinces and Hambantota in the Southern Province account for 76 % of total withdrawals.

Paddy in major irrigation schemes, of which many are located in the above four regions, accounts for 71 % of total irrigation withdrawals. Paddy in minor irrigation schemes accounts for another 23 %. Non-paddy crops account for 6 %.

Irrigation Withdrawals as % of TRWR

Figure 2 shows the river basin wise irrigation water withdrawals in comparison to their total water resources. This indicates that many basins withdrew large parts of their water resources

Figure 2. Irrigation withdrawals as a percentage of TRWR and of the 75 % dependable runoff.



for irrigation. Most of the water-scarce basins are located in the dry-zone. Of the 38 river basins or group of basins, 9 basins withdraw more than 60 % of the TRWR. This number increases to 16 basins when irrigation withdrawals are compared with 75 % dependable runoff. The latter is a realistic comparison in terms of long-term water resources management planning.

However, a large part of irrigation withdrawals recharges groundwater. But in Sri Lanka, reuse of this water in terms of groundwater withdrawals is negligible at present. Unlike in other South Asian countries, conjunctive water use in major irrigation command areas in Sri Lanka is almost non-existent. Only a small part of minor-irrigation schemes located in the North-Western Province has groundwater irrigation in the command areas (Kikuchi et al. 1998).

Thus, most of the water withdrawn for irrigation can be considered as primary water withdrawals (Seckler et al. 1998). Hence, many river basins are already physically water- scarce, where even irrigation water withdrawals are a significant part of the TRWR. A physical scarcity will exacerbate the situation in many basins if domestic and industrial water withdrawals (10-15 %) are also taken into account. This situation is very severe in water-scarce basins in the dry-zone, and can be further aggravated if estimates of utilizable water resources exclude environmental water needs.

At present, environmental water needs are not factored in the estimation of potentially utilizable water resources (PUWR). But, if the hydrological variability and the status of current development are considered, the environmental water demand of many river basins in Sri Lanka could be about 15-30 % of the TRWR (Smakhtin and Anputhas 2008). If this amount is subtracted from TRWR for estimating PUWR, many of the basins in the dry-zone could fall into physical water-scarce category. In theory, there is hardly any water available in these basins for further development. Thus, meeting future water demand for food production, in the presence of increasing demand for domestic, industrial and environmental water needs, is indeed a challenge.

Meeting Future Water Demand

What options are available for Sri Lanka in meeting future water demand? At the present rate of growth, Sri Lanka's population will peak in the early 2040s, with an addition of 15 % to the population (UN 2006). If the present self-sufficiency levels of different crops are to be maintained and the present level of crop productivity persists, the irrigation demand for meeting food demand for this maximum population could increase by at most 15 %.

Increasing Irrigation Efficiency

Given the high level of water development for irrigation, increasing irrigation efficiency is one of the feasible options available for meeting future water demand.

If irrigation efficiency is increased to 45 % from the currently assumed level of 35 %, the irrigation demand shall decrease by 22 % (Table 4). The major irrigated areas will contribute to 78 % of the reduction in demand through this level of efficiency increase.

If irrigation efficiency is increased to 55 %, irrigation demand will decrease by 35 %. Decrease in irrigation demand in such a scenario is more than 3.9 bcm, which is equivalent to about 32 % of the total water demand.

Such scenarios of efficiency growth show that if the currently developed water supply is properly managed, only a part of these water savings is adequate for meeting future irrigation demand.

Conclusion

The spatial and seasonal variability of water supply and demand are causes of regional water scarcities in Sri Lanka. Dry-zone districts, comprising 75 % of land area, contribute to only 49 % and 29 % of the *maha* and *yala* season runoff. But, equivalent to half of the water consumed for food production in the dry-zone is transferred as virtual water to the wet-zone. Thus, many river basins in the dry-zone are already facing severe physical water scarcities.

However, the water use efficiency of the developed water resources is very low at present. Due to the low level of reuse of groundwater return flows, significant scope exists for increasing irrigation efficiency. An increase in irrigation efficiency by 10-20 % could reduce irrigation demand by 22 % and 35 %, respectively. The water saved by increasing water use efficiency could meet a large part of the additional water demand in the future.

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Annex 1. Cropped in area (1,000 ha) in 2005

Provinces and Districts of Sri Lanka	Gross cropped area in 2005 (GCA)[1]	Gross irrigated Area (GIA) in 2005									
		Total (GIA)	GIA % of GCA	Rice cropped area (RCA)	RCA % of GCA	Irrigated area (RIA)	RIA % of GIA	Major irrigation		Minor irrigation	
								Maha	*Yala*	*Maha*	*Yala*
Sri Lanka	1,946	744	38	900	46	699	94	281	217	129	49
Wet-zone	638	67	11	152	24	65	98	10	8	26	8
Dry-zone	1,308	677	52	748	57	634	94	271	209	113	41
Provinces											
Western	9	1	4	4	23	1	100	1	0	3	3
Central	10	6	23	6	26	6	95	4	4	13	14
Southern	12	8	27	11	42	9	99	9	11	5	9
Northern	5	6	51	6	65	5	83	7	3	8	2
Eastern	13	23	70	24	86	25	100	31	36	5	6
North-western	18	13	28	14	36	13	93	7	7	29	40
North-central	15	30	77	24	76	31	97	36	34	25	15
Uva	9	9	39	6	32	7	71	6	6	11	11
Sabaragamuwa	10	3	13	5	20	3	96	2	2	7	14
Districts											
Colombo	1	0	6	1	23	0	100	0	0	1	0
Gampaha	3	0	4	1	16	0	100	0	0	1	0
Kalutara	4	0	4	3	30	0	100	0	0	1	3
Kandy	3	2	24	2	31	2	97	1	2	4	5
Matale	3	3	38	3	42	3	91	2	2	6	6
Nuwara Eliya	4	1	10	1	10	1	100	0	0	4	3
Galle	4	0	0	2	28	0	100	0	0	0	0
Hambantota	5	7	50	6	52	7	99	8	9	3	4
Matara	3	2	18	3	41	2	100	1	1	2	4
Jaffna	1	1	27	1	45	0	0	0	0	0	0
Kilinochchi	1	2	45	2	76	2	94	2	2	0	0
Mannar	1	1	84	1	84	1	100	3	0	1	0
Mullaitivu	1	1	45	1	62	1	87	1	1	2	1
Vavuniya	1	1	64	1	58	1	88	1	0	5	1
Ampara	7	15	81	13	85	16	100	20	25	2	3
Batticaloa	4	5	48	7	86	5	99	6	7	2	2
Trincomalee	2	4	72	4	86	4	100	5	4	2	2
Kurunegala	14	11	28	12	39	11	95	5	5	25	33
Puttalam	4	3	27	2	23	2	83	2	1	4	7
Anuradhapura	9	16	69	13	68	16	96	18	13	24	11

Polonnaruwa	6	13	88	11	89	14	100	18	22	1	3
Badulla	5	4	35	4	36	4	93	4	4	7	6
Moneragala	4	5	43	3	28	3	50	2	2	5	5
Kegalle	4	0	5	2	18	1	100	0	0	2	3
Ratnapura	6	3	18	3	22	3	96	2	2	5	11

Source: GOSL 2006

Notes: [1] Gross cropped area includes seasonal crops (rice, maize, other coarse cereals, pulses, oil crops, roots and tubers and vegetables), perennial crops (fruits, cotton, tea, rubber, and coconut)

Annex 2. Net irrigation requirements of different crops

Provinces/ Districts	Net irrigation requirement (NIR) in million cubic meters											
	All crops		Rice irrigation requirements									
	Total TNIR	Seasonal crops - % of TNIR	Total RNIR	RNIR- % of TNIR	Major irrigation *Maha*	Major irrigation *Yala*	Major irrigation Total	Major irrigation Total % of RNIR	Minor irrigation *Maha*	Minor irrigation *Yala*	Minor irrigation Total	Minor irrigation Total % of RNIR
Sri Lanka	2,560	93	2,322	91	481	1,334	1,814	78	267	240	508	22
Wet-zone	118	98	115	97	19	39	57	50	25	32	58	50
Dry-zone	2,442	93	2,207	90	462	1,295	1,757	80	242	208	450	20
Provinces												
Western	11	100	11	100	2	1	3	29	7	1	8	71
Central	105	97	96	91	12	38	50	52	18	28	46	48
Southern	192	99	189	99	66	97	163	86	14	13	27	14
Northern	169	89	132	77	54	48	102	78	24	6	30	22
Eastern	620	100	617	100	77	511	588	95	8	21	29	5
North-western	341	95	312	91	52	75	127	41	98	88	185	59
North-central	819	99	792	96	187	490	676	85	68	47	116	15
Uva	263	53	134	51	26	62	88	65	23	24	47	35
Sabaragamuwa	41	95	39	95	7	12	18	47	8	13	21	53
Districts												
Colombo	2	100	2	100	0	0	0	10	2	0	2	90
Gampaha	4	100	4	100	2	1	3	63	1	0	2	37
Kalutara	5	100	5	100	0	0	0	5	4	1	4	95
Kandy	34	100	33	96	3	17	20	60	4	9	13	40
Matale	61	95	54	87	8	20	28	52	12	14	26	48
Nuwara Eliya	9	100	9	100	1	2	2	23	2	5	7	77
Galle	0	100	0	100	0	0	0	0	0	0	0	100
Hambantota	169	99	166	99	60	89	149	90	9	8	17	10
Matara	23	100	23	100	6	8	14	61	4	5	9	39
Jaffna	26	48	0	0	0	0	0	0	0	0	0	0
Kilinochchi	51	97	48	94	13	34	47	98	1	0	1	2
Mannar	28	100	28	99	24	0	24	87	4	0	4	13
Mullaitivu	32	95	30	93	10	12	22	74	5	3	8	26
Vavuniya	32	96	25	79	7	2	9	34	14	3	17	66
Ampara	389	100	387	100	41	336	377	97	2	8	10	3
Batticaloa	122	99	121	99	12	101	113	93	2	7	8	7
Trincomalee	109	100	109	100	24	74	98	90	5	6	11	10
Kurunegala	267	98	253	95	38	58	96	38	84	73	157	62
Puttalam	75	85	59	78	14	16	31	52	13	15	28	48

Anuradhapura	413	99	386	93	114	170	284	74	66	36	102	26
Polonnaruwa	408	100	406	100	73	320	392	96	3	12	14	4
Badulla	84	96	76	91	12	42	55	72	9	13	21	28
Moneragala	180	33	58	33	13	20	33	57	14	11	25	43
Kegalle	6	100	6	100	0	0	0	0	3	3	6	100
Ratnapura	35	94	33	93	7	12	18	56	5	9	14	44

Source: Authors' estimates