Multiple Uses of Water in the Kirindi Oya Irrigation System, Sri Lanka[1]

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ABSTRACT

As water scarcity in the world intensifies, there will be an increasing pressure to transfer water from agricultural uses to municipal and industrial uses. It is not possible to predict the full impact of such actions with our current base of knowledge. Researchers, policy makers, and agency staff involved with water resources have too long focused on only one water use, either irrigation or domestic use when in fact, people have been using water in irrigation systems for many purposes. The study in Kirindi Oya showed that water is used not only for irrigating the field crop but also for livestock, fisheries, home garden cultivation, domestic uses, industries, and the environment. Agriculture, particularly paddy, is the largest consumer of water. Many other uses like fishing or bathing do not consume water, while others such as drinking and curd-pot making consume relatively small amounts of water. Because water is drawn directly from the irrigation system (canals and tanks) or indirectly (wells through groundwater recharge), there is a complementarity between these uses and field irrigation. However, when water becomes scarce, their interdependence increases and so do competition and conflict over water. This interdependence makes it very important to recognize the full spectrum of water uses in an irrigation system. Going beyond the sectoral boundaries will change our picture of irrigation systems and will have important implications not only for the management of water within the irrigation system but also for the broader water resources policy.

INTRODUCTION

Priorities for water resources allocation and development have been changing during the last decade. Irrigation, which was once seen as essential to ensure food security, is now seen as a "low-value" use of water compared to municipal, industrial, and even environmental uses. Often, irrigation no longer receives priority in the allocation of water or in funds for project development. In a growing number of cases all over the world, water is being transferred out of agriculture to meet the growing demand in other sectors like industry, often without agreement of or compensation to farmers with irrigated land and water rights. The main reason to transfer water out of irrigated agriculture is the relatively low output per unit of water combined with the fact that it is the biggest consumer of freshwater. On a global level, irrigation comprises 72 percent of the average per capita water diversions, with industrial and domestic

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[1]Paper prepared for the National Conference on 'The Status and Future Direction of Water Research in Sri Lanka,' 4-6 November 1998, BMICH, Colombo.

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uses accounting for 19 percent and 9 percent, respectively (Seckler et al.1998). However, there is a general failure to recognize that irrigation systems supply water not only for the main fields, but also for home garden cultivation, trees, and other permanent vegetation. Other productive uses include livestock, fishing, harvesting of aquatic plants, and a variety of (small-scale) enterprises like brickmaking. In addition, irrigation systems are generally a major source of domestic water supply, and can have important functions in supporting biodiversity in plants, birds, and wildlife. It is, therefore, misleading to equate irrigation with agricultural water use.

In the ongoing management of irrigation systems, the other uses and users are generally not taken into account. One can reason that most agencies dealing with water resources have only sectoral responsibilities. They deal with irrigation or drinking water or the environment. The government as a whole has responsibility for overall water use, but the implementing agencies do not have the mandate or the incentive to balance the needs of various users (Yoder 1981; IIMI 1995).

This paper argues that to ensure efficient, equitable, and sustainable water use (to reduce poverty and improve the well-being of mankind), irrigation and water resources policies need to take into account all uses and users of water within the irrigation system. The multiple uses of water in the Kirindi Oya irrigation system are examined in this paper while attention is paid especially to household water uses, competition, conflicts and complementarities within and among the different uses, and the policy implications when multiple uses of water in irrigation systems are recognized. The information presented in this paper relates to findings from a household water survey among 156 families in the study area. The survey was carried out from May to November 1997. It was essential to supplement the survey data with key informant interviews, focus group discussions, field observations, and secondary data sources because of the difficulty of obtaining accurate information from respondents and the need to understand the nature of competition and conflicts in the area.

THE SITE

The Kirindi Oya irrigation system is located in the southeastern dry zone of Sri Lanka, about 260 km from Colombo. Nearly constant year-round temperatures (26 °C to 28 °C) characterize the climate of the area. The mean annual rainfall is 1,000 mm. About 75 percent of the rainfall is received in the maha season (October to April), and 25 percent in the yala season (April to October). Evaporation is uniform throughout the year, with an annual average approximating 2,100 mm.

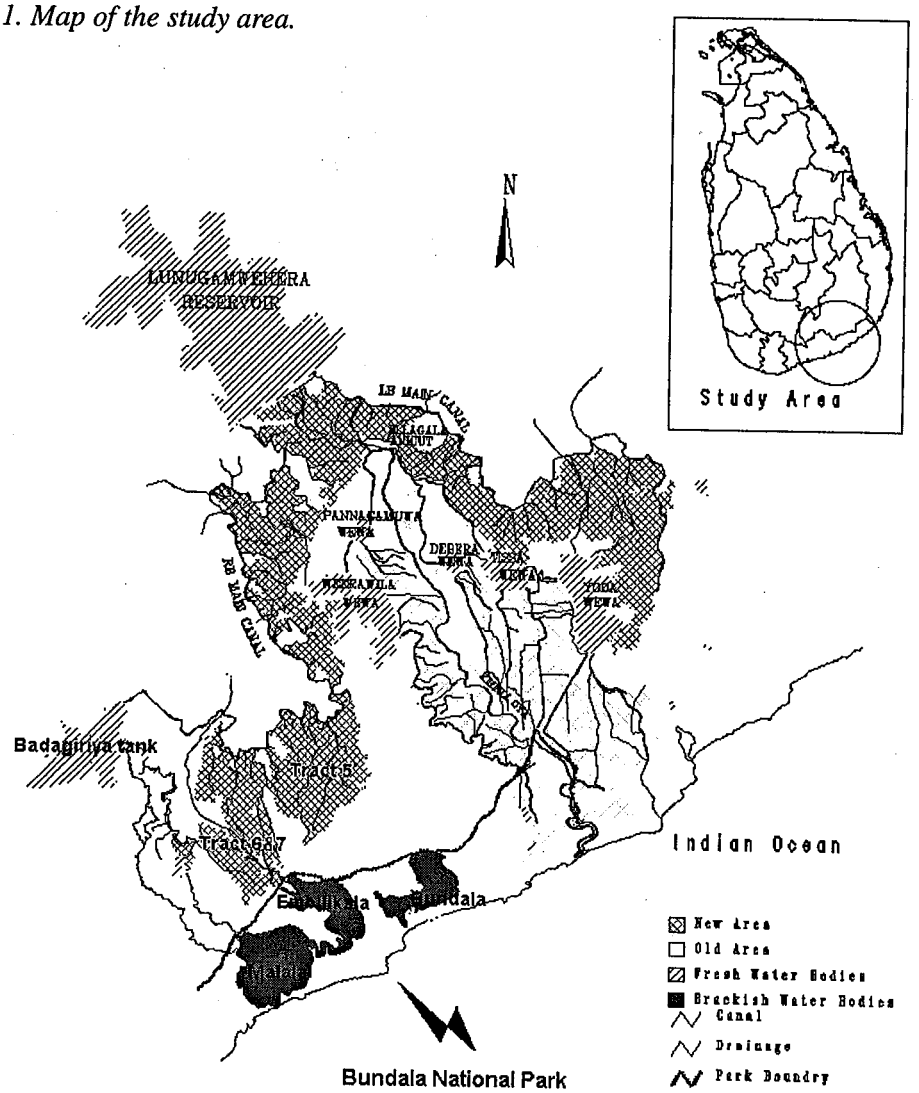
The irrigation system consists of an old area and a new irrigated area (figure 1). The five tanks under the old Ellagala system had been built over a thousand years ago. In 1987, the Lunugamwehera reservoir was constructed and the irrigable area was expanded by 5,400 hectares of newly developed lands. Besides water for the new area, the reservoir provides irrigation water to 4,200 hectares of land under the old Ellagala system and 850 hectares of land under the Badagiriya irrigation system.

USES AND USERS OF WATER IN THE IRRIGATION SYSTEM

This section describes the different uses and users of water in the Kirindi Oya irrigation system. At the end of the section, a distinction is made between irrigation and nonirrigation water sources and their different uses.

Field crop production. The most important and biggest water user is irrigated agriculture, which consists mainly of paddy cultivation. Farmers will grow other field crops (OFCs) such as chili, onion, groundnut, banana, etc., when there is insufficient water for paddy cultivation. The old areas have priority in water allocation and they receive sufficient water to cultivate 100 percent of the command area with paddy during maha and 70 percent of the command area during yala. Any surplus water is issued to the new areas, according to an

Figure 1. Map of the study area.



agreed rotation between three demarcated zones. The main irrigation source is the Lunugamwehera reservoir while approximately 300 to 400 agro-wells provide supplementary water for cultivating mainly OFCs and, sometimes, rice as well.

Home garden. Because most residents of the old area have been settled there for generations they have landscaped home gardens with fruit trees and other permanent vegetation, plus gardens producing vegetables, unlike settlers in the new area. In the old area, homesteads cover a fairly large area, in total up to 20 percent of the land area (IIMI 1995). Rainfall, wells, and wastewater from domestic uses provide the main source of water for home garden cultivation. It should be recognized that recharge of wells and other domestic uses of water originates from the irrigation system.

Livestock. The study site is a traditional buffalo- and cattle-raising area and is well known for its curd industry. After the Lunugamwehera reservoir was constructed, the traditional pasture areas of the cattle and buffalo were taken over for crop production. This resulted in conflicts between farmers and herdsmen, due to increasing crop damage by cattle, which had traditionally grazed in the same area. The main water sources for livestock to drink and bathe are small tanks that obtain their water mainly from rainfall. In dry periods, these sources dry up, and the animals are brought back to the irrigation system area mainly to meet their water requirements from the major tanks in the area and for grazing on the paddy stubble. There are no specific water sources or scheduled diversions for livestock.

Fisheries. Inland fishing is done in all major tanks and in the Lunugamwehera reservoir. In the two smaller tanks, Debarawewa and Pannagamuwawewa, fishing is mainly done for home consumption because the water surfaces of these tanks are almost completely covered with lotus and other vegetation. The fish catch is high when the water levels of the tanks and the reservoir go down. Fish are concentrated in the shallow water and are easier to catch. There are no scheduled water diversions for fisheries. It is only the water remaining after the irrigation requirements are met that can be used as a habitat for fish.

Domestic. Domestic uses include drinking and cooking, bathing, laundering, sanitation, and washing of utensils. Drinking and cooking do not need large quantities of water but they require high-quality water. With bathing and laundry it is just the other way around. Because these activities are often done in-stream a large quantity of water should be available. This water can be of some inferior quality. In the new area, a piped water supply system was constructed to supply the people with good-quality drinking water. The water is taken from the Lunugamwehera reservoir and is treated (chlorination or aerosion and sand filtration) before it is distributed to the standpipes and some private household connections. The old area also has a piped water supply system, which distributes treated groundwater and river water, but with fewer standpipes than the system in the new area. For their drinking water, people in the old area depend more on wells.

During the dry period, when no water is issued for irrigation, water is especially issued through the canals for bathing and laundry purposes once in 14 days.

Environment. The wetland system of the Bundala National Park receives drainage water from the Right Bank area and the Badagiriya system. This inflow of drainage water has upset

the salinity balance in the lagoons and has caused, among other things, a dramatic reduction in the shrimp population that, in turn, has affected 200 families whose livelihoods depended solely on shrimp farming (key informant interviews 1997). At the moment, there are no regulations about the amount of water to be drained into the Bundala National Park.

Other uses. Other users of water in the area include an army garrison, a textile factory, and a number of tourist hotels. In addition, there are a number of household enterprises, such as brickmaking, that depend on water from the irrigation system. And as a consequence of the milk-based curd industry, there are also a lot of curd-pot-making enterprises. Mud from the tank beds is used to make these pots.

Irrigation and nonirrigation water uses. Data from the household water survey were used to assess the importance of irrigation water compared with nonirrigation water as sources for different uses. Irrigation water is defined as water from the reservoir, tanks, and irrigation or drainage canals. Nonirrigation water comes from homestead wells, the piped water supply system, the Kirindi Oya river, and rainfall. It should be acknowledged, as mentioned before, that a large proportion of the well water is in fact seepage water from the irrigation system. Also, the origin of part of the water distributed through the piped water system is the Lunugamwehera reservoir. However, the water no longer flows through irrigation structures but is treated and is, therefore, classified as nonirrigation water.

The first priority water sources for different uses are showed in table 1. Rice and OFC cultivation obtain water almost exclusively from the irrigation system. Precipitation was the only source of water for *chena* (slash-and-burn) cultivation. Often, the chena areas are in the highland parts and far away from the irrigation canals and tanks. Home garden cultivation mainly depends on rainfall. Livestock is more or less equally dependent on irrigation water and nonirrigation water sources such as wells for drinking and bathing. The small number of families involved in inland fisheries completely depends upon the irrigation sources. More than half of the households prefer or depend upon irrigation water as a source for laundering, bathing, or recreational uses. Hardly any household makes use of irrigation water for drinking, cooking, sanitation, or washing utensils. Families involved in home industries depend almost equally on irrigation and nonirrigation water sources.

COMPETITION, CONFLICTS, AND COMPLEMENTARITY

In the Kirindi Oya irrigation system, water is used not only for irrigating the field crops but for may other purposes. Many of the other uses such as fishing or bathing are nonconsumptive, while others such as drinking and brickmaking consume relatively small amounts of water compared to field irrigation. Because they draw their water directly from the irrigation system (canals and tanks) or indirectly (wells through groundwater recharge) there is a complementarity between these uses and field irrigation. When water is available in the tanks and canals for paddy fields, it is also available for other uses like fishing, bathing, and curd-pot-making. On the other hand, when there is no water for irrigation, wells dry up and no water is available for domestic uses from the tanks and canals.

Table 1. The importance of irrigation water in comparison to other sources for a variety of uses (first priority water source).

Uses	No. of respondents	Use of different sources in %	
		Nonirrigation water	Irrigation water
Agriculture			
· rice	93	0	100
· other field crops (e.g., onion)	17	0	100
· chena cultivation	30	100*	0
Home garden	54	87*	13
Cattle, buffalo, and goats	20	45	55
Inland fisheries	9	0	100
Domestic uses			
· drinking, cooking, sanitation and washing utensils	156	96	4
· bathing, laundering and recreation	156	53	53
Home industry	17	41	59

* Including water from rainfall.

There is more competition and even conflict over water when it becomes scarce. From a system perspective, the different types of uses compete. However, from the household perspective, this competition is not so much between the different uses but more between different members, because all households are engaged in more than one activity involving water use. Because the household members have different responsibilities related to water use, some members may be more affected by shortages (or benefit from abundance) of water for certain uses than others.

The major types of complementarities, competition, and conflict within and between different uses are summarized in table 2. Because irrigation of field crops holds the strongest water rights and is the main water consumer, the relationship of each use to irrigated crop production is the most important form of interaction. Table 2 is based on this relationship.

The most important kind of competition and conflict over water occurs not between different types of uses but in irrigating the fields between the old area and the new area. There is an ongoing tension between the demand of farmers a) in the old area, for full paddy cultivation in two seasons, based on their historical claim to water, and b) of different parts in the new area, to receive water for paddy in at least one season. Although priorities have been set, fluctuating water availability through changing rainfall requires renegotiations of how much water each area should receive every season. In both the old and new areas there may be competition between fields to receive water for irrigation, especially when water supplies are short.

In the old area, where wells (seepage from irrigation) provide the main source of drinking water, there is a complementarity between irrigation and drinking water. In dry years however, these uses compete for water. The biggest conflict is over the water right of the National

Table 2. Conflicts, competition, and complementarity of water use in Kirindi Oya.

	Irrigated crops	Livestock	Fishing	Laundry and bathing	Drinking	Home industry	Home-gardens	Environment
Irrigated crops	-							
Livestock	-/+	x						
Fishing	-/+	-	x					
Drinking	-	x	x	-	-			
Laundry and bathing	+	-	x	x				
Home industry	-/+	x	x	x	-/+	x		
Home-gardens	-/+	x	x	x	-	x	x	
Environment	-/+	-	x	x	x	x	x	-

- = Conflicts and competition.

x = No conflicts or competition.

+ = Complementarity.

Water Supply and Drainage Board to keep the water in the reservoir at a certain level to guarantee domestic water needs via the piped water system. During yala 1992, irrigation water issues were stopped to protect domestic water needs. This resulted in serious conflicts and politicians became involved in them to settle the disputes (Brewer forthcoming). In 1995 and 1997, these conflicts occurred again. There are also potential conflicts between irrigation and drinking uses of water when it comes to water-quality issues. Due to agrochemical runoff and mineral leaching, mainly salts, from paddy fields both surface water and groundwater sources have been contaminated. Many wells in the old area contain water that is actually unsuitable for drinking purposes.

Another domain of complementarity and conflict over water use is between irrigation and the environment. Water in the irrigation system has provided a habitat for birds, especially in the Weerawila tank. Despite negative predictions, the bird population has increased since the expansion of the irrigation system. However, the enlargement of the irrigation project negatively affects the water quality of the downstream-located Bundala National Park. Two brackish lagoons have been converted into freshwater lakes due to drainage water inflow. This has had a negative impact on the number of birds and the diversity of species. Moreover, hundreds of families engaged in lagoon prawn fishing lost their main source of livelihood and had to look for other sources of income. Besides this, there are also euthrophic problems, with excessive growth of algae because of livestock dung and upstream fertilizer use.

POLICY IMPLICATIONS, CONCLUSIONS AND RECOMMENDATIONS

Where resources that sustain livelihoods are scarce, their interdependence increases, but so does competition. From this perspective it is particularly important to recognize the full spectrum of uses of water in an irrigation system and the interaction between these different uses and users. Recognition of the various uses and users of water is an important first step towards managing the system to accommodate all needs. Moreover, water management decisions often only take into account water-quantity issues. When the multiple uses of water and their interactions are considered they surface the significance of water quality, which is especially important for domestic uses, fisheries, and the environment.

Up till now, municipal and industrial uses of water have not been major competitors for water with irrigation because the Kirindi Oya irrigation system is quite far from urban centers. However, there are plans to build an oil refinery on the coast, which would require a lot of water from the Kirindi Oya system. A rudimentary analysis might suggest that the water requirements for the oil refinery could be met by improving the irrigation efficiency,[3] changing from paddy to other field crops for cultivation or a combination of these two. However, a more comprehensive view would recognize that changing the quantity and timing of water deliveries to supply the oil refinery would affect the system managers and the farmers who possibly have to switch to other field crops. It would affect the whole system. Groundwater levels, which indirectly depend on irrigation water supply, would decline and affect water availability for home gardens, drinking and cooking, and other domestic uses. Water levels in the tank would decline and affect fish production, runoff, and hence concentration of agrochemicals entering the wetlands, among other factors. This example illustrates that recognizing multiple uses of water in irrigation systems changes the analysis of intersectoral water allocation, especially for reallocation out of irrigation.

While the exact uses and users of water and their relative importance vary from one irrigation system to another, the issues identified in this study have broader implications for water management policies in Sri Lanka and elsewhere. These relate, among other things, to the allocation of water and financial resources between irrigation and other sectors; measures of water quality and efficiency of use; and mechanisms to involve stakeholders in negotiations over water use.

If irrigation systems are observed from the perspective of a multiple use, we see that men and women use water several times over. This would certainly increase the value of water use, and needs to be taken into account when irrigation system output is evaluated and when water management decisions are made. This counts especially for decisions related to the transfer of water out of irrigation systems.

Recognizing the interactions between the uses and users may also provide scope to better accommodate the various uses, thereby increasing water use efficiency. To increase the total value of productive and nonproductive uses in irrigation systems attention is necessary for

[3]Canal lining, sprinkler or drip application systems, and rotational irrigation schedules are common means to increase the proportion of water in a system that is used for crop evapotranspiration and thus increase irrigation efficiency.

water-quality issues. However, as it is difficult to develop accurate empirical measures of quantitative efficiency, it is even more difficult to measure and incorporate measures of water quality. Moreover, on the output side it is very difficult to put a quantitative value on the uses that are especially sensitive to water quality like domestic (drinking) and environmental uses. Valuing water for nonproductive uses remains an important area for future research. More case studies on multiple uses of water in irrigation systems should provide decision makers with more substantial data, and help in the design of efficient, equitable, and sustainable water management.

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