WORKING PAPER 61

Anicut Systems in Sri Lanka

The Case of the Upper Walawe River Basin

François Molle, Priyantha Jayakody
Shyamalie de Silva

With the Collaboration of
The Staff and Students of the
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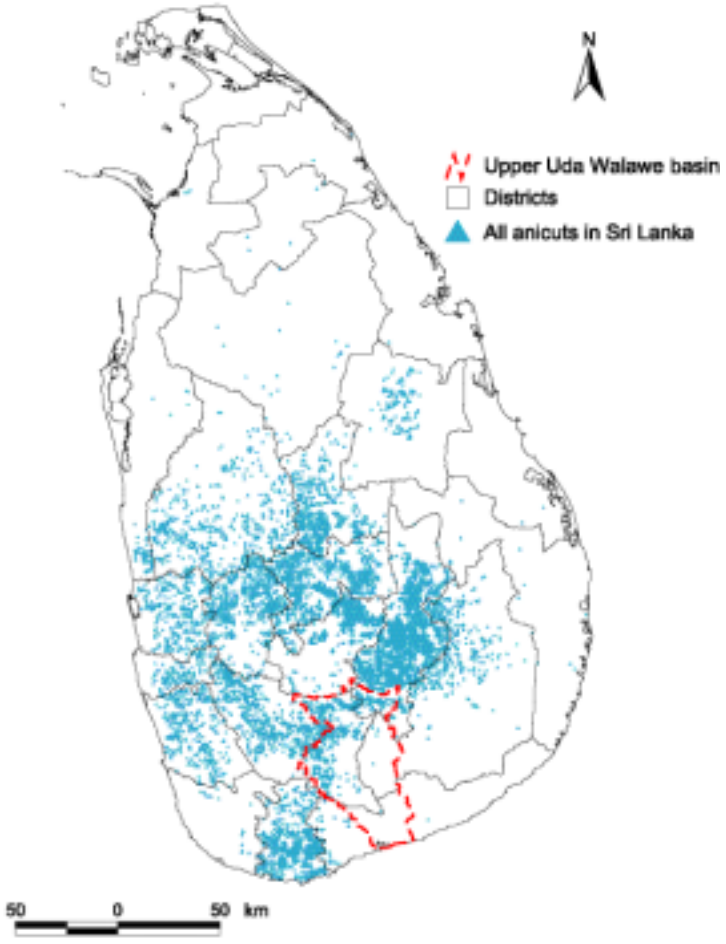
Contents

Introduction

In the mountainous part of Sri Lanka there are numerous run-of-river systems known as *amunas* (anicuts). As in all parts of the world, people have long discovered how to capture streams by constructing weirs or making notches in the riverbanks to divert water to lateral canals that feed field terraces or small alluvial plains.

Sri Lanka is famous for its numerous and ancient small tanks. However, these tanks occupy only one part of the island. Anicuts also constitute a very prominent feature of water use in the island, as shown in figure 1. The map is drawn from a first inventory of tanks and anicuts in the island carried out by the Department of Agrarian Services (DAS), which identified 12,353 anicuts.[1] It shows the location of the Uda Walawe basin, which comprises approximately 750 anicuts that serve an area of around 6,550 hectares (13,000 acres) cultivated by 20,000 farmers. These numbers are sufficient to demonstrate the importance of anicuts in the irrigation sector of Sri Lanka, despite the limited attention they receive from analysts and researchers.

Figure 1. Anicuts in Sri Lanka.



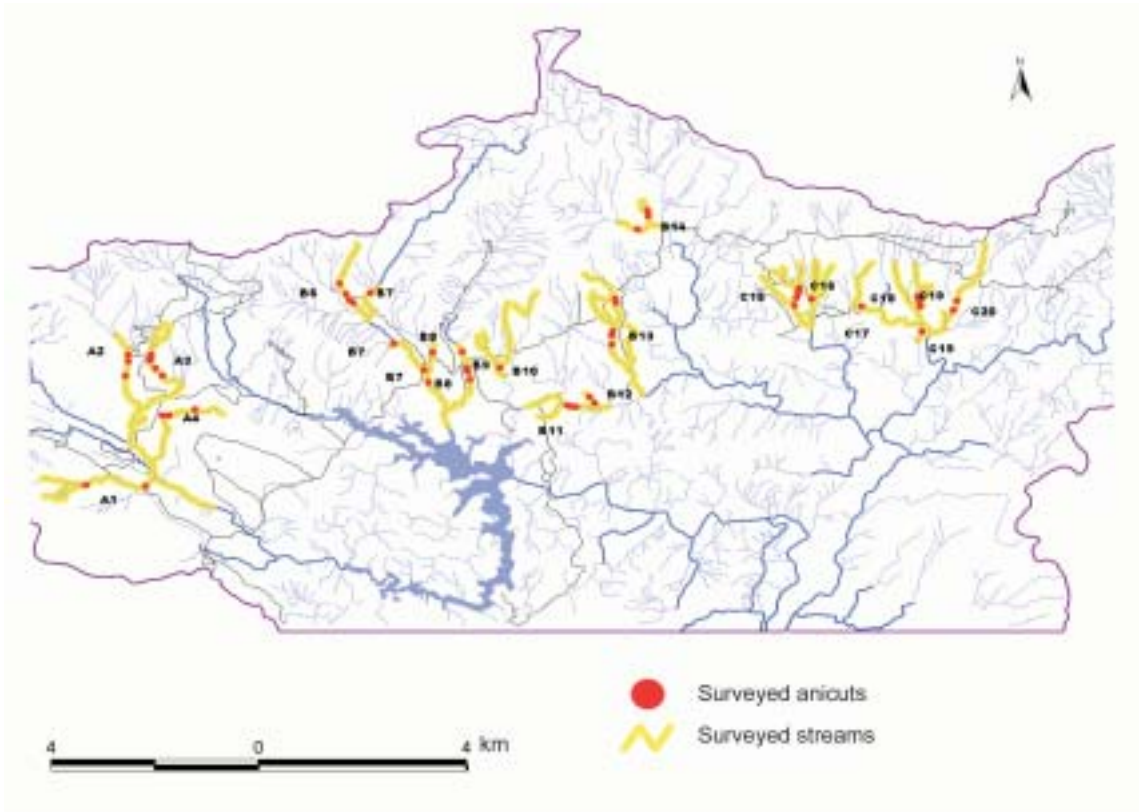
Source: Department of Agrarian Services.

[1]This first inventory is being revised and improved. It is clear from the map that the survey has not been homogeneous across districts, as well exemplified by the contrast between Matara and Galle districts.

This exploratory study was designed to capture the main features of agrarian change in the upper part of the basin that depends mostly on anicuts. These anicuts amount to 59 percent of the total basin anicuts in terms of numbers, but to only 43 percent in terms of irrigated area. They are generally very old (the history of some of them goes back to 2000 years; see below) and obviously, many changes have occurred during this time. The study does not allow the reconstitution of all past transformations but offers some insight on recent changes: changes in population pressure over resources and changes in hydrology, crop choice, livelihoods and collective action. The analysis is based on exploratory surveys carried out by the authors and by students of the University of Sabaragamuwa and is not a detailed or in-depth investigation of agricultural systems in the Upper Walawe basin. However, it provides a useful outline of the situation in this part of the basin.

Altogether 25 streams, with 120 anicuts, have been investigated. For each stream, between two and five anicuts were examined in more detail by interviewing key informants (particularly, elderly people) and farmers in the fields. Therefore, it would be tedious to present here the findings of all these surveys separately. Rather, we have chosen to review a range of salient issues and, for each of these, attempted to draw a general picture from our observations, also providing examples of specific situations to illustrate both common trends and the diversity of situations. Figure 2 indicates the portions of the streams that have been surveyed (the numbers indicated will be used hereafter in the description).

Figure 2. Streams surveyed with their numbers.



The Walawe Basin and the Study Area

Main Physical and Human Features

The Walawe river basin is the largest basin in southern Sri Lanka and covers a total area of 2,442 km^2. The basin spreads over the Ratnapura, Badulla, Moneragala and Hambantota administrative districts. The Walawe river originates in the southern edge of the central uplands of the country and flows southward, reaching the sea at Ambalantota. The upper Uda Walawe basin is a mountainous area with a maximum elevation of 2,395 m and, together with the western fringe of the basin, it constitutes the "water tank" of the basin. Indeed, annual rainfall varies from close to 4,000 mm in the higher parts of the basin to around 1,000 mm in the southernmost part. Three-quarters of the basin lies in the dry and intermediate zones. Average daily evaporation is 6 mm in the dry seasons and 4 mm in the wet season. The average relative humidity is 70–82 percent and the average annual temperature is 27.5 °C.

Figure 3 shows how the upper catchment topography is characterized by a steep terrain drained by north-south streams on which anicuts have been constructed. The three westernmost streams (Walawe *ganga* [river], Denagan *oya* [stream] and Belihul oya) feed into the Samanalaweva dam, which is used mostly for energy generation and regulation of the flow to downstream irrigated areas. The dam has been in operation since 1992 and its construction has resulted in the displacement of local populations, albeit in limited numbers.

Figure 3. 3-D model of the Upper Walawe catchment.

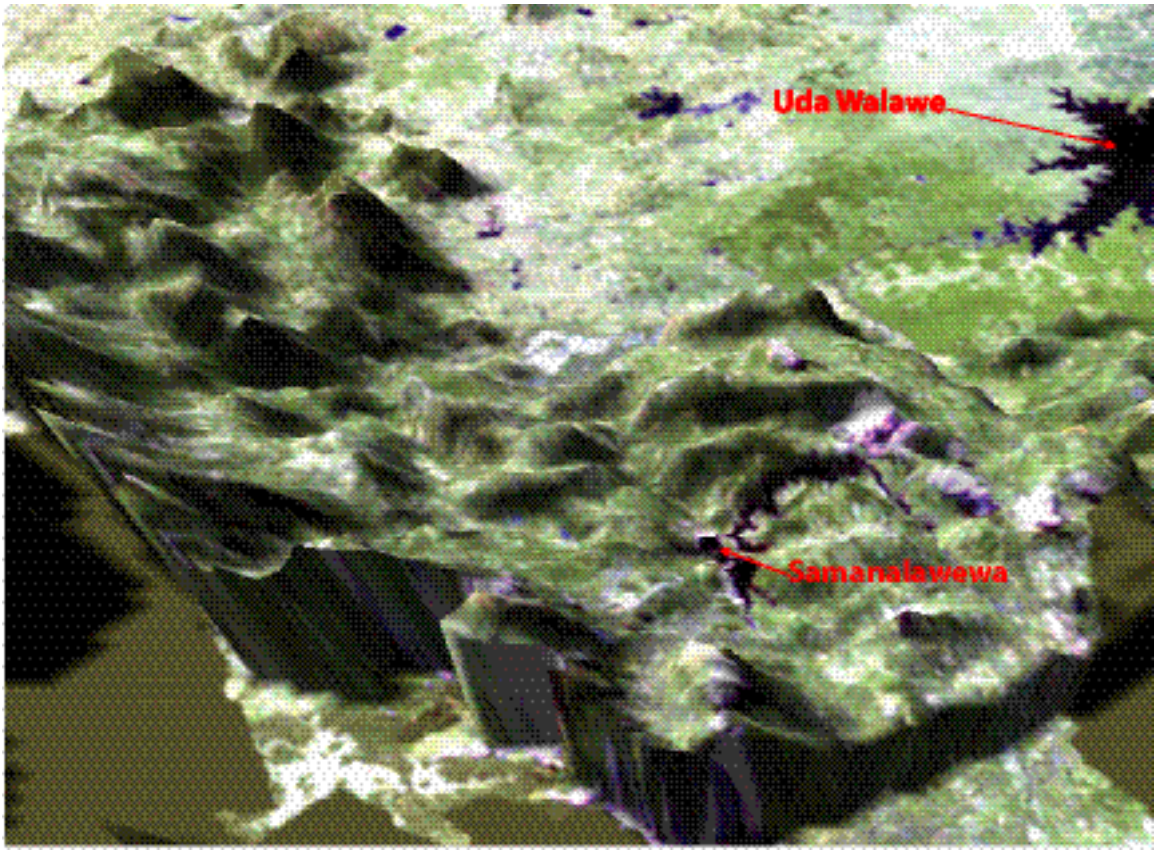
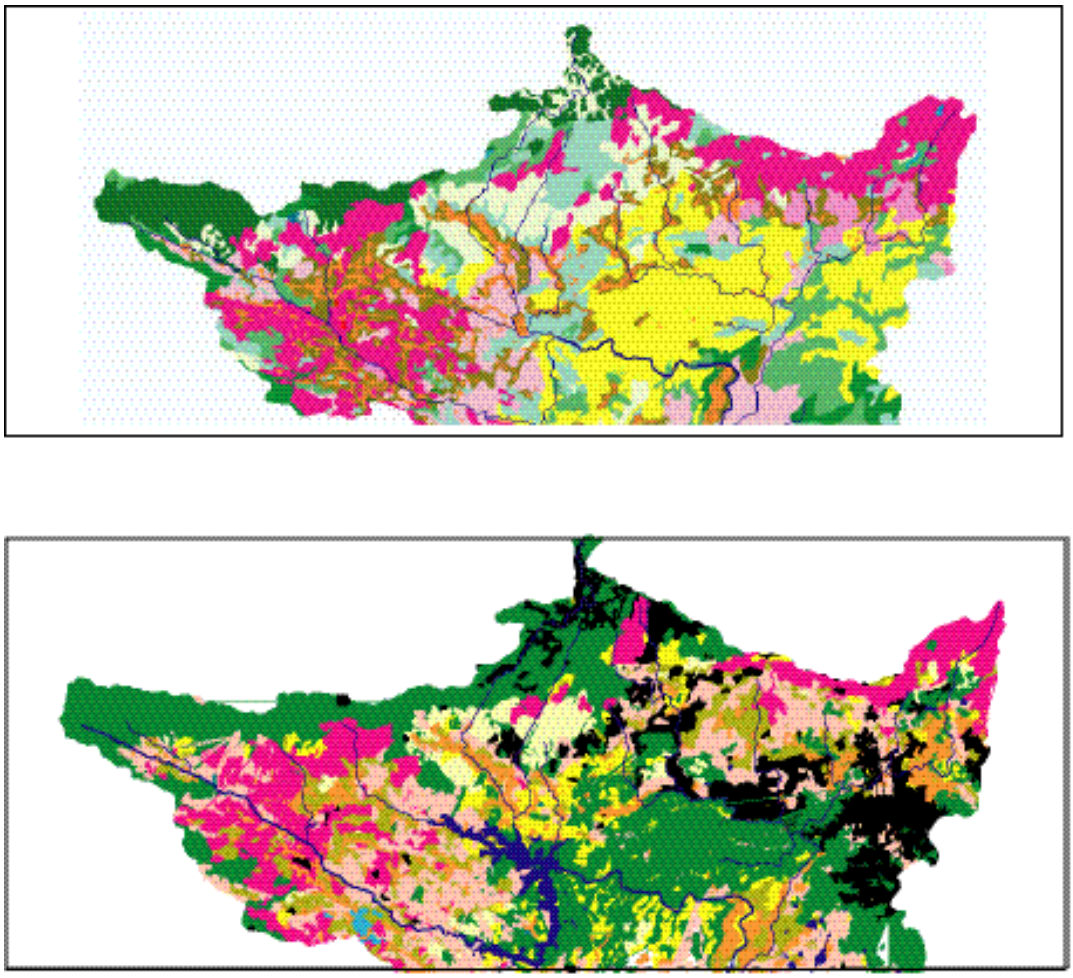


Figure 4. Land use (1956 and 1985).



The vegetation of the upper basin is quite varied and includes areas afforested with pines, secondary thick forests, tea estates, grasslands, bushlands, *chena* (shifting cultivation) lands, paddy fields irrigated by anicuts, etc. Figure 4 provides an idea of the land cover in both 1956 and 1985. Although the categories of land use and the basin boundaries do not fully correspond, it can be seen that tea plantations have shrunk, and that afforestation has spread. On the eastern part, rubber plantations have disappeared and a large area of paddy cultivation has emerged. A large part of the area between Kaltota and Samanalaweva has shifted from Savannah to forest.

Anicuts, and their corresponding irrigated areas are, of course, located along the various streams coming down from the mountainous fringe towards the center of the basin. Figure 5 shows the location of the anicuts.

The population in the upper basin tends to be concentrated along both waterways and roads, and villages are more of the ribbon type than of the cluster type. Population densities (175 persons per km^2) are lower than the basin average (244 persons per km^2) but this is because of the large portion of the land under state reservation or on too steep a slope to be cultivated. Table 1 indicates the area and population of the basin and its upper part.

Figure 5. Anicuts in the Upper Walawe catchment.

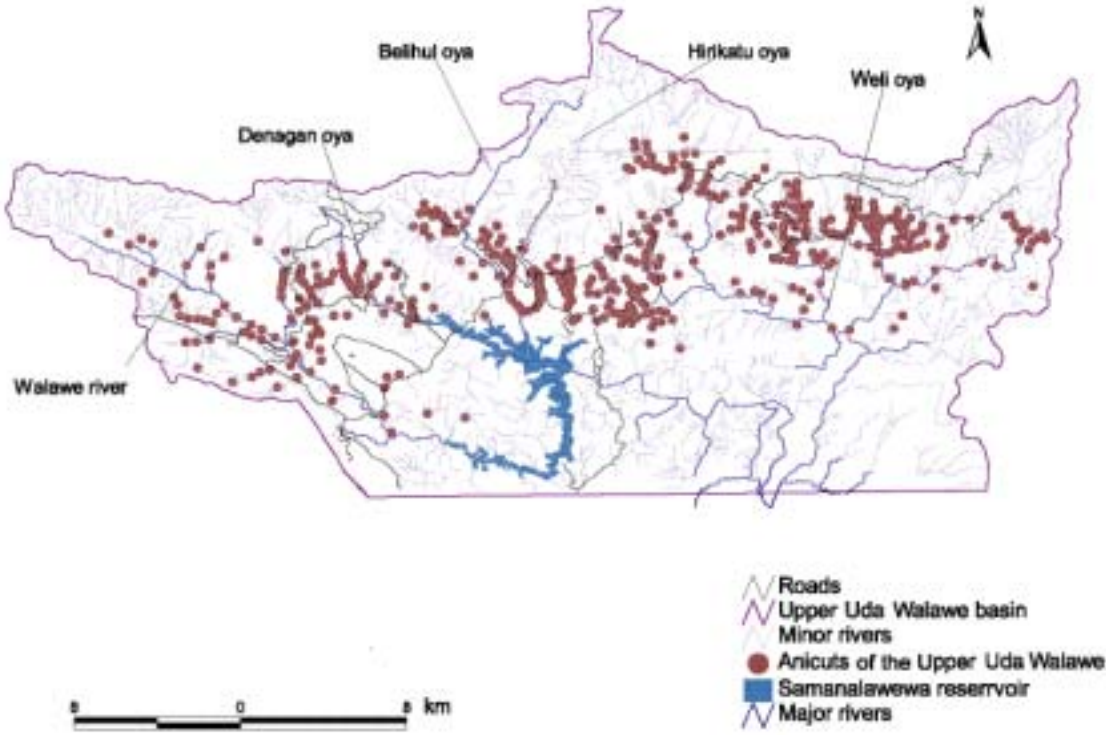


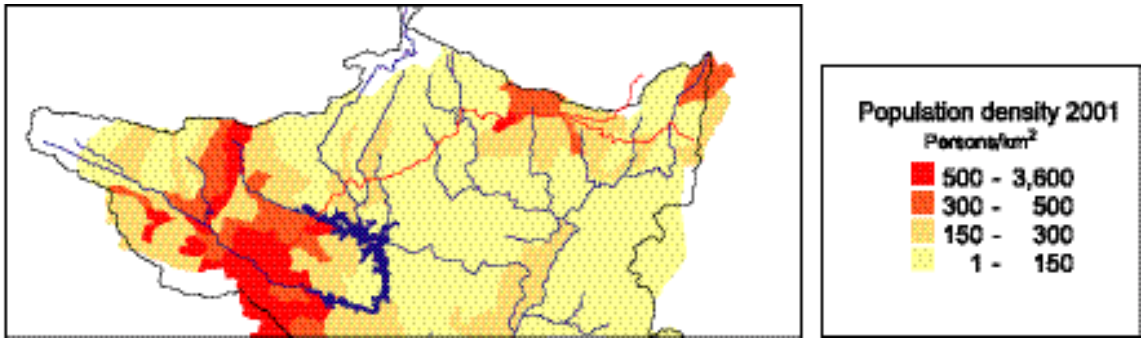
Table 1. Population in the basin and study area (Census, 2001).

Basin	Population	Population (% of basin)	Population density (persons/km^2)	No. of GNDs	Area (km^2)
Upper Walawe	156,577	26	175	121	894
Walawe basin	596,144	100	244	406	2,442

Note: GNDs = Grama Niladhari Divisions (lowest government administrative divisions).

Figure 6 shows the density of population in the area. Unsurprisingly, both the Balangoda and the tea plantation areas stick out, with densities over 300 persons/km^2.

Figure 6. Population density (Census, 2001).



Historical Background

The history of man's settlement in the Balangoda city, which straddles the western boundary of the Walawe river basin, and its surrounding valleys, goes back to 6,500 years (Deraniyagala, undated). The area now submerged by the Samanalawewa dam, for example, was a prehistoric campsite. Sri Lankan legends, as well as Valmiki's Ramayanaya, report that King Ravana, who lived in this area around 1500 BC and ruled part of Sri Lanka, resided in the Walawe basin before departing to India to capture Rama. He ended up by bringing back from his campaign Sita, wife of Rama, and hid her unmolested in some parts of the Walawe basin, which fact is attested to by much archaeological evidence and many locational names (Witharana 1992).

Historically, Sri Lanka was divided into three main parts: *Ruhuna*, *Maya* and *Pihiti* for convenience of rule. The Upper Walawe basin was located at the ill-defined boundary of ancient Ruhuna and Malaya (central highlands) (Juleff 1996). It was closely connected with Magama (now Mahagama), which was the capital of Ruhuna (Collins 1932). While King Dutugemunu (161–137 BC) was residing in Ruhuna and Malaya, and later in Anuradhapura, he developed paddy fields extensively in the southeastern part pf Sri Lanka, including anicut-based irrigation systems upstream of Walawe. At the time King Walagamba (104–76 BC) had taken refuge in Malaya he developed anicut systems also upstream of Walawe. (Ghanawimala 1942; Narada 1992). In the Kandyan period (1524–1815) there were also significant migration and settlement in the area (with the founding of several temples). Kaltota, located 14 km southeast of the Balangoda town, was an ancient kingdom, which developed in parallel to the Anuradhapura kingdom around the second century

BC (Narada 1992). According to the *Sabaragamuwe Parani Liyavili*[2] (collection of old documents of Sabaragamuwa) Kaltota was the most developed city of Sabaragamuwa (Ghanawimala 1942). The area that lies between the Samanalawewa dam and the Kaltota irrigation scheme, a few kilometers downstream, has yielded many ancient artifacts. In particular, a unique wind-powered iron-smelting furnace was unearthed, which used the high-velocity winds during the southwest monsoon capable of producing high-quality steel that was supplied to the Islamic world for sword-making from the third century BC to the twelfth century AD (Juleff 1996).

One of the most significant irrigation works of the Upper Walawe basin was the *depa bandi amuna* (anicut that diverts water to two sides) on the western edge of Kaltota, constructed at the place where Belihul oya meets the water of the *Doowili ella* waterfall. The left bank canal, which had been excavated down to Hambegamuwa, provided water to several cascade networks, which consisted of 138 tanks and 18 anicuts (Narada 1992).[3] There is evidence to assume that the area from Kaltota to Magama from the east and Embilipitiya from the south was a single field and developed as one area. Handagiriya, or Sandagiriya, presently called Katupath oya gama and located in the north-western corner of Uda Walawe National Park, was the center of the ancient Kaltota kingdom. The ruins show evidence of many tanks that have functioned in this area, out of which only five are still in use (Medhananda 1992). It was a prosperous area from the second century BC to the fifteenth century AD and was later almost deserted. In 1622, in the reign of King Senarath, Kaltota was a storage village whose population had declined drastically, probably because of repeated attacks from enemies (Ghanawimala 1942, 1967; Narada 1992). Despite some settlement and rehabilitation works in 1885, the population was still sparse in the middle of the nineteenth century when C.H. Collins, Government Agent of Sabaragamuwa, reported that Sandagiriya was a thick jungle area infested with malaria and populated with only 18 persons when he visited it (Abeyratna n.d.). Collins (1932) also noted that "Ratnapura Bintenna colony [Kaltota] appears to have been as much advanced at the time as any other parts of the island… settlers had a full knowledge of irrigation engineering as practiced in the country at the time".

All this historical evidence confirms that the beginning of the establishment of these settlements, tanks and anicuts, took place at least two centuries before the Christian era. Since it is not possible to identify the origin of most anicuts, the questionnaires that we used included the question of whether the construction of these anicuts was dated from the time of kings, from the time of the British rule, or during Post-Independence. The following table shows the distribution of our sample according to the period of construction. It shows that 66 percent of the anicuts were constructed during the time of kings and that this predominance of old anicuts is even higher when expressed in terms of irrigated area (85%). This suggests that the most easily accessible locations, including scattered wider alluvial plains, had been brought under cultivation first, much earlier than the British period.

[2]Registers of persons liable to regular services, kept in the hands of the chiefs of the provinces, villages and departments.

[3]This canal is still visible and follows a contour line at an elevation of around 400 feet (Mendis 1993).

Table 2. Distribution of sample anicuts,

Period	Number of anicuts	Proportion of anicuts (%)	Total area (ha)	Total area(%)
Time of kings	19	66	1,247	85
British rule	8	28	194	13
Post-Independence	2	7	26	2

Description of the Anicuts

Construction

It is hard to derive a clear sense of how anicuts are successively added to a given stream. Does construction tend to start in upstream parts and then proceed downstream? This would be consistent with the notion of water rights that give priority to the first established, since downstream appropriators do not impinge upon others' rights. But it may also be the case that since water is plentiful further upstream development does not affect existing ones, or that these new anicuts are constructed by the downstream settlers themselves, or their relatives. Evidence from the survey shows that anicuts constructed in the British period tend to be situated downstream of already existing ones, but there are a few counterexamples, particularly of small anicuts in smaller streams.

In some cases, there is even transfer from on-stream to the neighboring ones. This is the case with the Belihul oya, from which a major anicut and a canal take water to the adjacent river, itself a tributary of the Belihul oya with a much less catchment area but with a better and larger potential irrigated area. In the Ranmudu oya, two anicuts bring water to the nearby Gurumati oya where two small anicuts are located. This diversion is used only when the Ranmudu oya has excess water (A3).

The anicuts supply the two banks of the river or a single bank, depending on the topography and the availability of water in the streams. The command area is generally located close to the anicut, further downstream but, in some cases, a flat topography and the lack of adequate land dictate that the diversion point be located a few hundred meters upstream of the irrigated area. In most cases, farmers themselves have built these anicuts. In some areas, these are made by just placing a few stones or logs across the stream to divert the water. In the recent past, most of these anicuts were rehabilitated under various programs launched by NGOs as well as by the government, including the Samurdhi Program and two major projects in the 1980s: the Integrated Rural Development Project (IRDP) and the Village Irrigation Rehabilitation Project (VIRP). The largest ones are managed and maintained by the DAS (and in some cases by the Irrigation Department). Under these programs the diversion weirs were made out of concrete and canals were sometimes lined. Due to rehabilitation, farmers experienced benefits as well as problems. Before rehabilitation, the weirs used to be washed out during the rainy season, but now they need not be repaired every year, and the anicuts are more reliable. The conveyance efficiency and diversion increase, allowing farmers to expand their command areas. This may affect downstream anicuts, as more water is diverted by upper anicuts and return flows are reduced. As is the case in most communal run-of-river systems, the reduction of maintenance work has also weakened the cohesion of the group derived from the necessity to rebuild the weir structure every year.

Landownership

In general terms, most farmers cultivate very small plots and the average size generally varies between 0.2 and 0.6 hectare (0.5 and 1.5 acres). There are, however, several exceptions to that situation. In a few cases, some land concentration has occurred, often because a local businessman[4] or moneylenders have acquired land given as collateral to loans (e.g., Mr. Hantha, a gem businessman in A5/2). In another anicut (A2) command, there is a large landowner (also the owner of a tea factory) who inherited the land from his father who had bought it from other villagers.

In all cases, these large landowners hardly own more land than one family can farm by itself. Some exceptions can be found in the eastern part of the study area, in the Diyakanna oya catchment (C20), where it seems that colonization has been different and seems to have been partly of the plantation type. In fact, some "large-scale" commercial farms can be found in the area, but these are not irrigated farms: the largest landowner resides in Colombo and has 26 hectares (64 acres) of rubber with pepper intercropped, while another property of 10 hectares (25 acres) is planted to tea and pepper. In C19, one man owns 36 hectares (90 acres), including rubber, tea, pepper and paddy land. These lands, however, mostly comprise upland areas. The conclusion is that, in general, land in anicut systems has been fragmented and has rarely been significantly concentrated in the hands of a particular individual. The "biggest" landowners, or considered as such by local farmers, generally have between 2 and 4 hectares (5 and 10 acres), which are not much in absolute terms but may sometimes make up one-third or more of the anicut command area. In contrast, nonirrigated lands are sometimes held by middle-size commercial farmers, especially in the eastern part. It is apparent that land division at inheritance also works against land concentration; for example, a former "large" landowner in the A2 area had 6.1 hectares (15 acres) but today his land is divided among his children.

The small size of the family plots suggests that land division has long reached a level where further division among heirs is unsustainable. While, despite variations, the cultural norm would tend to favor equal division amongst heirs, it is apparent that this custom is severely constrained and has given place to several alternatives:

- The most important one is the system of *thattu maru*, whereby the children of the landowner get access to the land in turn, often waiting several years before having the right to cultivate for one season[5] (A1, A2). In addition, whoever cultivates must give a certain amount of rice (e.g., 2 bushels) to his siblings.

- The youngest son receives the house and the others a portion of the land (in case there is no land asset, the younger son/daughter would also receive the house and would take care of his/her parents in their old age).

- Land is given to one particular offspring, to the daughter (daughters) as dowry (dowries), or to the son who engages in farming (when other siblings opt to move out of agriculture).

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[4]For example, P.D.M Yaparathna Bandara has 8.1 hectares (20 acres) of land in the Belihul oya Maha anicut (B7); Kalupahana Piyasena owns 4.0 out of the 16.2 hectares (10 out of the 40 acres) of the Mahawela anicut (B13/4).

[5]A 55-year old interviewee said he had cultivated only twice in his lifetime!

The proportion of tenants is variable but often very high (two-thirds or more), although data from the DAS relative to a total of 60 anicut commands point to a tenancy rate of 48 percent. This reflects not only a skewed distribution of land and the importance of land belonging to temples/ *devalas* (shrines constructed to worship deities), but also the fact that some landowners have moved to other activities and released land to the rental market. Because of the small size of the anicuts, it can be hypothesized that most rental arrangements are done either directly with temples or between relatives, but this needs to be substantiated by more in-depth investigation.[6] The land rent is still paid in kind, generally between 8 and 10 bushels.

Temples and devalas[7] were major landholders in the past and still retain some rights in many places, such as in A3/5 and A5/4, where most of the land belongs to the temple, or in A4/2, where Morahala was a *viharagama* (temple land), given by Parakramabahu VI (1418- 1458) to the Saman devalaya of Sababaragamuwa. The Morahala temple also owns 2 hectares of land, donated by a *radala* (high-class) landowner. Religious offerings, such as land, add to whatever other historical rights the temples have retained.

Some legends also point to the way land was formerly gifted by kings. In B14, in the reign of King Sriwikrama Rajasinghe (1797-1815), a rebellion occurred near the Kalupahana bridge. Mudliyar Weerakoon suppressed it and the king rewarded him with the land of the area (Weerakoongama). Oral tradition has it that a king had visited the area in C20 and donated its paddy land to the Eria Kadura family. In A4/1 and 15/1, the totality of the land earlier belonged to one *radala* family called the Rathwatta[8] family. This family had received the land from the king (*nindagama/bandara idam*, or feudal land) and the harvest was divided into three portions: one for the king, one for the landlord and the remaining part for the farmers. The farmers were eventually given the land after the 1956 agrarian reform (on condition that they contribute labor to some public works).

In Soragune (C15-16), there is a very old devalaya (Soragune Kudakatharagam devalaya), which owns large tracts of land where people have settled. The devalaya was destroyed by the Dutch but was reconstructed and is still serves its old purpose. According to historical records (inscription of the devalaya) Kudakatharagam devalaya was constructed by a *yapa* (a ruler of a small province) who was seeking the blessing and protection of god Katharagama while he was away, living in the Uggal Aluthnuwara palace.

In several cases, too, farmers received the ownership of land through public redistribution. Under the Irrigation Ordinance of 1946 some tenants received land (but still do not have deeds for the land: A4/1), while some tenant cultivators or even migrants benefited from the Agrarian Service Act of 1979 (A1, A2). In B11, too, the upper part of the land was given to farmers as *Jayabhoomi oppu* (Jayabhoomi land deeds) under the Land Reform Act of 1972. In the lower Belihul oya catchment, after the Second World War each farmer received the ownership of 0.4 hectare (1 acre) of land (for paddy cultivation as well as for building a house) through the LDO scheme (Land Development Ordinance of 1935, implementing the distribution of some public land), as well as Rs 1,500 to build a house.

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[6]Based on the often-heard statement “we are all relatives” in the anicut command.

[7]Buddhist temples are now distinguished from devalas but the distinction may not have been so clear in ancient times.

[8]The Rathwatta family is one of the most famous feudal families in the area, to which Mrs. Sirimawo Bandaranaike the first woman Prime Minister belonged.

In B10, only 3 out of 20 families are cultivating their own land. The owners live in the Muttetuwegama area and cede their land to migrants from Badulla, Hambantota and Tangalle, and the population there is said to be still on the rise because of the good climate and the availability of water resources. In C17, a hundred families cultivate land that used to belong to an Indian owner who sold it before the Land Reform Commission (1972) came into effect. These farmers came from various places, as distant as from Matara. In C18, a rubber plantation of the British period was neglected by their (absentee) owners; after Independence the rubber trees were eventually cut down (for fuelwood) and the land given to people as Jayabhoomi oppu after 1972. Some Tamil workers remained in the area and the people developed their anicuts.

All these examples show that the origin, settlement and acquisition of landownership are extremely varied from one place to another. Most of the lands in the time of kings seem to have been feudal lands or to have belonged to devalas but their ownership has gradually passed on to the hands of local people[9] through the 1935 LDO, the 1946 Irrigation Ordinance and the 1972 Land Reform Act (Ellman et al. 1976). However, tenancy remains quite high, showing that these reforms have not been fully effective and that many villagers endowed with land are not engaged in agriculture and rent out their plots. A more detailed analysis is needed to confirm this.

Water Status

All the surveys show a clear (and expected) relationship between the position of the anicut along the stream and its water status. Usually, upstream anicuts have plentiful water in both *maha* (wet season from May to September) and *yala* (dry season from November to March). As we go down along the streams, anicuts are likely to experience some water shortages in some dry spells, while those situated further downstream may not have enough water to cultivate the full area during yala (B12/3). Of course, this general situation is altered when significant tributaries join the main stream. Such a counterexample can be found in C15, where the topography does not allow for much expansion of the irrigated land and where springs and lateral streams tend to increase the available water as one goes downstream.

Strikingly, almost all interviewees argued that rainfall and water discharges have declined, especially during the last 10 years. These statements are, of course, qualitative and judgmental and may have been influenced by the recent drought periods of 2001-2002. However, the unanimity and the periods indicated for such decline suggest that this diminution can be considered as a credible and crucial evolution of the hydrological regime. Other induced changes in crop choice and collective action also strongly support this hypothesis (see below).

In the Belihul oya area, for example, farmers estimate that the flow at the Maha anicut is only half of what it was in 1990. In several areas (B12), springs that provide domestic water are reported to have decreased, or even dried up in 2001, with the decline of conservation forests. In A5/3, during some acute water shortage, water was diverted from the main rivers into tea land and the downstream anicuts were affected to the point that some crops have been lost. In A3/5, there is not enough water in the dry season and farmers have to face a severe water shortage. The farmers located at the tail end of the system get a smaller amount of water. All streams are

[9]The 1972 Land Reform Act, which limited land-ownership to a maximum of 20.243 hectares (50 acres) per person, did not consider those lands managed by the Commissioner of Buddhist Affairs. Although the government did not acquire these lands, villagers who had been cultivating them for ages were, in most cases, granted implicit ownership but they were generally not issued deeds.

said to undergo discharge reduction and this reduction is said to have surfaced between the last 5 to 15 years, with a clear aggravation during the 2001–2002 dry period.

The reasons given by farmers for such a trend are diverse. Flows are said to have decreased in the rivers for the following reasons:[10]

1. The plantation of pines in the upper parts of the catchment (B6, B13, B14, etc); like eucalyptus this alien vegetation is known for its high extractive capacity and is not well accepted by local villagers.[11] It is said to reduce the groundwater level and base flows in the dry season (B13); these pines were introduced in the early 1970s.

2. Deforestation, destruction of forest cover for logging, chena cultivation, fuelwood for tea factories, timber for construction; fires are kindled by people raising animals and willing to expand pastures for them (e.g., A5/3), or by hunters chasing away animals to ambush them.

3. The reduction of rainfall (also sometimes ascribed by villagers to deforestation: A1).

4. Expansion of tea estates. In a village of the A5 area, it is believed that change in runoff patterns comes from the use of the reservation area for tea cultivation. In the British period there used to be a separate land called "ground land," but it has now been taken up for cultivation.

5. Abstraction by the tea estate or commercial farms (A5/1;C16). The possible changes in water use in the upper anicuts are never mentioned.

There is an apparent contradiction between the first two points, as both afforestation (planting commercial trees in natural open land) and deforestation (of primary or secondary "natural" forests) are held responsible for the decline in runoff. This issue has been at the core of the "pinus controversy" of the 70s and 80s in Sri Lanka (Starkloff 1998a, b). The likely explanation is that while natural forests tend to increase infiltration of rainfall into the soil, and reduce transpiration—and thus the base flow to the river—in the dry season, pines intercept more rainfall, extract water from deeper soil layers and are an extremely water-consuming species, thus increasing the water uptake by vegetation and reducing the runoff coefficient.[12] Likewise, but this is probably more prone to local variations, the land exposed by the clearing of forest would develop a harder superficial layer that increases runoff in times of rain at the expense of infiltration and base flows (Elkaduwa and Sakthivadivel 1999). While this latter phenomenon is still controversial there is little question that the afforestation with *Pinus caribaea* has disrupted the catchment hydrology, as widely observed in the upper Mahaweli (Starkloff 1998b) and elsewhere (Scott et al. 2003).

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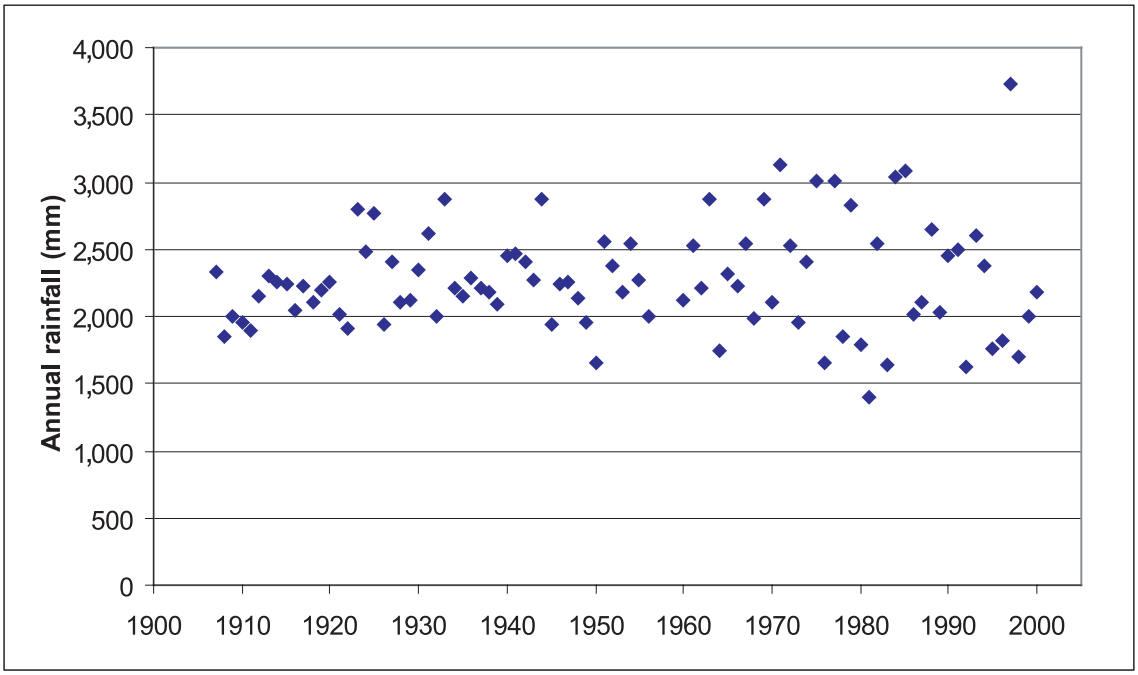
[10]Some anecdotic "irrational" reasons are also observed. For example, in A5, a small-scale hydraulic power station is to be established in this area but the project is opposed by the farmers who believe that the production of electricity would entail a reduction of the water flow in the river.

[11]Strikingly, we even met a villager who acknowledged having set fire to pines one day earlier; he expressed his strong feeling against these trees, saying that they are alien species, creating a kind of shade and micro-climate that people did not like, and which dried up the streams. Other villagers explained that these fires were mostly set by people who own animals and are looking for expansion of pastures.

[12]This has been recognized in South Africa, where such industrial plantations are considered as "water users" and taxed as "runoff-reducing activities."

Rainfall is also almost unanimously believed to have declined during the last two or three decades. Series of rainfall data from Balangoda (figure 7) do not really support this claim. Several informants underlined the fact that it is rather the unpredictability of precipitations that has been on the rise. An exception to this is that some people in Soragune (C16) think that rainfall has increased after the construction of the Samanalaweva dam.

Figure 7. Annual rainfall in Balangoda.



Wells are rare in the area. Domestic water is in general diverted from springs, often through pipe systems, which seem to have spread to almost all localities in the past few years. In the A1 area, however, a project of 10 tanks has been funded by a few foreign organizations, and people are using shallow wells as well. Recently, these wells have been polluted by the toilets of villagers and most houses now use tap water coming from the school premises. In B10, villagers have organized a *shramadana* (collective voluntary work) campaign to build a pipe system. In some areas (e.g., A4), villagers do have wells for domestic water but many dried up during the 2001 drought. The agro-wells in B11 and C17 were reported to be dry in August every year.

The problem of excess water was found only at A4. The lower parts of the command area were flood-prone and usually irrigated only in yala. The reduction of the flow in the river in the last 15 years happened to be beneficial in that respect and part of these fields could be brought under cultivation during maha as well. Two tanks are supposed to store part of this excess flow but they are not functional any longer.

Soil erosion is also a recurrent problem associated with land cover change (Elkaduwa and Sakthivadivel 1999). Several villagers reported that the improper management of tea plantations, particularly by smallholders, was resulting in land degradation and solid transport, a phenomenon observed in other parts of the country (Illukpitiya 1999). Occasionally, landslides occur, such as the one that recently cut the Balangoda-Badulla road (see bottom left photo).

Land Use and Crop Selection in Irrigated Areas

Rice is the main irrigated crop under the anicut commands. Until around 1970, only one crop of a traditional variety, with a long growing period, was cultivated. With the spread of non-photosensitive High-Yielding Varieties, double-cropping was quickly adopted since, in most cases, water supply was sufficient to supply two crops per year.

Other crops, however, have also gradually appeared in the irrigated areas, mostly during yala. Most commonly, farmers have grown bean, tomato, onion, chili, pumpkin (B7), maize (B8), cabbage (B14), aubergine (B7, C16, C18), okra (C18), snake gourd (A4/4), sweet potato (B8), cowpea, green gram (B11), or other crops such as radish and *leema* (vigna cylindrical) on a small scale for home consumption (A1). Tomato has been a very popular crop in the last decade and some areas (A2, A3, A5) have very suitable conditions of soil and climate for its cultivation. Sometimes it has been the main source of local income in recent years (B8, Belihul oya catchment). In addition, the market for tomato, although unpredictable, is said to be quite good because of the high demand for it at the Manning Market in Colombo. Traders pick up the product at the farm gate and transport it to Colombo,[13] or to wholesalers at Bandarawela (B10); other products are sent to the Balangoda market (B7/3) or to the Haputale market (C16). The expansion of tomato cultivation in the wet season is constrained by fungi problems.

The shift to other field crops (OFCs) was due to two factors. The first (in 20% of cases) is the low profitability of rice, due to low selling prices and high production costs. In some cases, farmers even reduced rice production to the point that they had to buy rice for their own consumption, but there is a general reluctance to do so and they tend to first produce whatever rice is necessary for the family and then to allocate the rest of the land to cash crops. The second is the decrease in water supply, which precluded the growing of rice in yala (80% of cases). While farmers in most anicut commands tackle the reduction in supply by shifting to OFCs or by letting part of the land fallow, the farmers in the B20 area resort to the BG300 rice variety, which has a cyclic duration of only 3 months.

Although most of this conversion of paddy land into OFC land is fairly recent (since 1985), it would be incorrect to think that vegetable cultivation started only in recent times. Indeed, in the 1940s, farmers in B7 began to grow vegetables during yala (aubergine, tomato, chili, etc.), but this was mostly for local consumption. In B8, B14 and C17 too, such cultivation has been practiced for four or five decades.

The land under cultivation in the irrigated areas is often reported to have declined in the past years because of the construction of houses. Ricelands are also converted into home gardens.

Our focus on the anicuts should not suggest that agriculture in rain-fed areas is negligible. In some areas, mainly in the eastern part (C15-16-17-18), upland agriculture takes precedence over irrigated crops. Villagers have a few acres of upland or home gardens and draw revenue mostly from cinnamon, pepper (sometimes intercropped with tea), areca nut, clove, and several fruit trees; for their consumption they grow mostly jackfruit, breadfruit, orange, banana and mango. In C17, people have from 2 to 2.4 hectares (5 to 6 acres) and they do mostly chena cultivation. They also cultivate sugarcane, make sugar honey and jaggery (and need fuel wood, which has depleted the surrounding forests, brought erosion problems and has affected springs). A rose plantation has sprung up in this area and it is reported that water from the river is used for this plantation.

[13]In B7, this is taken care of by the richest and largest landowner of the area.

Chena cultivation used to be popular but has now widely disappeared because of the pressure on land resources. In A1, some of this former chena land has been reserved for state forest plantation. People feel that this has decreased the amount of land available to them. They also ascribe to this plantation the increase in damage from wild boars that have forced farmers to guard their chena fields during the night (B7), and even to abandon their fields (A1). In the western part (A2, A4), chena cultivation was seriously curtailed as early as the 1930s, when the British expanded tea plantations,[14] while in the Diyakannaoya area (B20) chena cultivation disappeared in 1975. Some of this earlier chena cultivation land has been turned into tea land, not by tea estates but by peasant farmers who, incidentally, sell their tea leaves to the Pinnawala factory (B6) or other factories (A3/2). This is said to provide these farmers a fair income. It was only at B14/2 that chena cultivation was reported to be on the rise, presumably at the expense of reservation forests.

In the A1 vicinity there used to be 20 hectares (50 acres) of forest but this land cover has now dropped down to 4 hectares (10 acres), a part of it having been planted with pines and the greater part turned into a tea plantation (A1, A2). Other nearby areas, planted to tea in British times, have later been planted to sugarcane by the villagers. This crop has now drastically declined because it must be transported to the factory down at Uda Walawe, which is costly and affects its economic profitability.

Home gardens are everywhere and they are of great importance for the provision of fruits, vegetables, medicinal herbs, spices, flowers, etc.

Livelihoods and Economic Diversification

Many farmers growing rice in the areas served by anicuts could still be considered mainly as farmers but economic diversification is also quite high, especially at the household level. Alternative economic activities are similar to those observed in other parts of Sri Lanka (Marzano 2002; Van der Molen 2001).

A large number of girls have migrated to factories in the free trade zone of Biyagama (A2) and commute to Balangoda (A1, A4), Bathgama (C17) and Diyathalawa factories (C16), or elsewhere (B7, B14). There is also a garment factory in Rye Wattha, which employs youth from the surrounding areas. In A2, young men have joined the army in considerable numbers or gone to the cities for various types of employment (e.g., B7, B14, C16).

A large number of villagers in A1 and A2 are reported to do carpentry and masonry, which are quite popular occupations among the youth. People are commuting to Balangoda and Ratnapura. A very significant employment opportunity in the area is work in a tea estate: In A1, farmers are said to have become workers, plucking tea at the Allearawa estate. In A2, 100 people work in the Blue Mountain tea factory. Many people are also employed in the Belihul oya (B7) and the Black Wood (C20) factories.

Some villagers are employed locally in government jobs (such as being nurses, teachers, police officers, etc.), as well as being drivers, bakers, or rice mill workers; some have opened boutiques or have found occupation in the University of Sabaragamuwa.

In A2, a vocational training center was established 15 years ago, in order to bring in and disseminate new skills and support the creation of jobs.

[14]There are indications that some of this tea also supplanted earlier rubber plantations (A2).

Illegal timber extraction is also locally significant (A3, C17) while activities like sand collection and gem mining are very site-specific (A1/2; A4/2; B11); other common activities include the production of illicit liquor and toddy.

Population and Migrations

It is difficult, of course, to account for early migration flows into the area. A major migration movement in the nineteenth century was that of Tamil people brought by the British, especially in the early 1830s for tea cultivation (Madekkanda estate).

While the area, particularly the vicinity of Balangoda and Kaltota, has been settled for a very long time, population growth and pressure over resources have become critical in the twentieth century. The Maha anicut of Belihul oya, for example was constructed at the time of King Mayadunne (1521-1581 AD) and was reported to serve only 80 families in 1900. A family in the early part of the century would easily farm an area of between 2 and 4 hectares (B7). With the growth of population the area expanded and the anicut is now said to supply water to the land of 1,500 households (interviews in B7). This increase makes up for both natural growth and the inflow of migrants from the Balangoda area; in particular, some farmers received land at the time of the land reform. In the A4/2 area, there were only a few families 50 years ago, but it is now home to around 90 families. In A2, there were only 150 to 200 families in the 1940s, while there are now about 500 families; but no migration is taking place at the moment.

In several areas (B6, B12, C19), most people, including youth, are engaged in agriculture (tea, paddy, OFCs; banana in C19) and migration for economic reasons is said to be very limited. In contrast, in other anicut areas many of the youth work in factories or have migrated to cities (A4, B14, C18, C20) like Balangoda, Ratnapura and Colombo.

The interviews have yielded a series of hints on some of the migration fluxes into the area. In A2, early migrants came from Kalutara and Maggona to engage in trade. Another village has been settled in the late nineteenth century by Christians migrating from Beruwala and Maggona, also for trade. Some people from Embilipitiya and Galle are also said to have moved in for diverse motives (opening boutiques or because of marriage) (A1). A reverse flow was observed late in the 1950s when villagers of the area (A1, A2) migrated to Kaltota or Madabadda, where some land was made available and distributed through the land reform implementation. More intensive settlement in this area had been earlier constrained by the prevalence of malaria. Some (A3/4) went to Uda Walawe when the Mahaweli Authority distributed land, but some of them later returned to the village because they found that the land they had received under the land reform implementation was too far away from their village.

One family in A5/4 and several others in B13/2 migrated to these areas because of the construction of the Samanalaweva in early 1992. The command area under the main anicut on the Belihul oya (Deyiyange amuna) was also increased by 20 hectares to accommodate settlers displaced by the construction of the dam. The tank submerged around 800 acres of the land of Uggal Aluthnuwara Kataragama devalaya and many people who provided services to the devalaya were sent to the Mahaweli area (Gunasena n.d.).

In the study no evidence of significant emigration to foreign countries was found.

Water Management and Collective Action

There is a clear-cut correlation between the water regime and the type of water management in the command areas of the anicuts. When water supply is satisfactory, continuous free flow is the rule. Return flows are high, since a great advantage of such mountain irrigation schemes is that all the excess water is quickly returned to the river, incurring very few losses. When water gets scarce, farmers, as expected, set up some kind of rotational arrangement (*mura*). This arrangement can be simple (e.g., 3 days for each of the two canals), but can also be more elaborate, with a certain amount of time allocated to each plot (or each farmer) (3 hours per acre in A3/4; 6 hours per quarter of an acre in B14; time according to plot size and location in A4/2, etc.). In rare cases, as in A2, the corresponding schedule is kept in written form. In C17, the arrangement follows the traditional *bethma* system, whereby all farmers will have access to some plot close to the anicut, proportionally to their land area.

The schedule is commonly set up by the Farmer Organization (FO). When the scheme is not too large, farmers enforce and manage it by themselves; in larger schemes a person is responsible for monitoring and enforcement, either someone appointed by farmers or a *govi niyamaka*[15] (government agricultural agent). Earlier, a *Gamarala* (traditional leader at the village level) handled water-management activities using traditional norms and principles. In 1917, during the British period the authority for water management was handed over to the *vel vidane* (village-level irrigation officer first selected from the community but later appointed by the government) (see Weerawardena 1986). The *vel vidane* wielded great authority, and punishments were often severe (A1); in some places, villagers recall that the *vel vidane* would severely punish any wrongdoing in water management even "if they broke a branch of some valuable tree" (B7). Later, responsibility was shifted to government agents, who bore different names from one reform to the other: the *palaka lekam*, *waga niladhari* (cultivation officer), and *grama niladhari* (lowest-level government administrative officer, B7).

Likewise, before FOs were established in 1992, the government had established similar successive organizations: *govi samithi* (farmer organizations), *govi samaja* (farmer societies) and *govi sanvidhana* (farmer associations), (B6).

Allocation among users of the same stream sometimes gives way to collective negotiations and agreements, such as in the case of Belihul oya. Villagers beat "*andaberaya*" and get all the groups along the river to negotiate. Conflicts are rare but an exception is the pumping of water from the Kirikali oya to convey water to the University of Sabaragamuwa and its vicinity. Local farmers have tried to blast or to obstruct the pipe in the past, and it is to be feared that the conflict will reappear at the next drought (especially because domestic water needs are on the rise).

There is also one case of "federation of anicuts" or, rather, of a set of 20 anicuts, which are controlled by the *Ekamuthu Govi Sanvidhanaya*, an association that comprises 250 families in the C19 area and that manages two *wasams* or regions. In C16, the Soragune village has a population of 600 (142 families) and it gets water from two streams that serve 15 anicuts and 50 acres. In case of water shortage, the upstream anicuts are not served. The "adviser" of the organization is the monk of the temple. In B11, an FO controls three successive anicuts and devises allocation rules if the need arises.

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[15]A specific amount of time is allocated to each farmer by the Chairman of the *Govi Karaka Sabha*, or the Agricultural Officer of the Divisional Secretary (A5/1). When water gets scarce a rotation is organized by the *Palaka Lekam* (Secretary of the Cultivation Committee) (A5/3).

Apart from these examples, there is generally little interaction between anicuts, even if they are water-short and obviously dependent upon how much water is used upstream. An exception to this is the set of anicuts on the Gima ela river, a branch of Walawe (A4), where some discussions take place in case of water shortage.

In addition to water management, the FOs usually perform the maintenance of the anicuts and the canals, as well as other tasks, such as setting up fences around the fields. Most often, the responsibility of the *ela pollas* (canal reaches or lengths) rests with the various water users. In other cases, the dredging of canals is done through *shramadana* and there are provisions to fine those who shirk work. The FO is also instrumental in keeping contact with related government institutions such as the Department of Agriculture (B14, A4/2), or NGOs (JAICA, IRDP). In a few cases, the FO is also involved in the supply of seeds and small trees (A2, B10, C17) and in providing credit facilities (A3/4, B14/3) or fertilizers (B13/4) to members. In A2/3, the FO is quite effective and was given sprayers[16] by the DAS. In B10, the FO is led by a reputed leader and it was instrumental in setting up a domestic water project. In B11, the FO manages three anicuts, levies high fees (Rs 60/month) and engages in subcontracting with a profit margin of 5 percent.

In B9, existing organizations often revolve around temples, e.g., *dayaka sabhawa* (association of laymen that helps in finding finance for, and organizing activities of, the temple) and *awamangala samithi* (association of villagers that donates money and helps bereaved families to bury or cremate their dead). The Tea Small Holders Association provides an example of vocational association, under the auspices of the government.

The FOs normally elect their board members every year, as stipulated by state regulation, but there were two cases where elections were said to be held every 3 years (and others where they were said to be held every season). The membership fee, however, is even much more variable. While the annual fee is often low (between Rs 5 and 12), it can also be monthly and reach Rs 60 to 120. In A3, the fee is 12 kilos of rice every year. The entry fee is also variable.

The overall impression derived from the surveys is that collective action is rather efficient in maintaining the anicut and the canals, as well as in managing water, when the needs arise.

Other Problems and Aspects of Rural Life

Villagers in the Upper Walawe river basin face several problems, other than that of water resources. The lack of transportation was often cited as one of the main constraints; it must be noticed, however, that the topography of the area is not favorable to the development of a dense network of roads. Another problem, with specific occurrences, is that of landslides; because of such a risk, 80 farmers in A5/4 have been warned to relocate their houses. Basic health services are available locally but not in some places (like C17), where villagers have to travel 8 miles to find a dispensary. Education is widely available but it is apparent that wealthier families send their children to schools in Balangoda, while “only poor people’s children go to village schools.” Domestic water supply by a network of pipes is now available in most villages. Electricity is still not reaching several villages. Despite the lack of these items, the villagers consider their standard of living to have increased.

[16]This sprayer is rented at Rs 20 by day; the FO could earn Rs 5,000 and buy a new sprayer.

Another very serious problem mentioned earlier is the destruction of crops by wild boars (A1, A3). This may be so severe as to force farmers to let their land fallow (A1/1, A3/2). Some associate the increase in the number of these animals to the reduction of their habitat, in particular the reduction caused by the construction of the Samanalaweva dam and the felling of reservation forests. Monkeys and birds can also cause significant damage (A5, B8). Strong winds are experienced in some months (B6/6, B7), which preclude growing certain types of crops (for example banana, which is also affected by diseases, B7a).

The importance of water in the life of peasants is attested to by several legends[17] and customs. In the Boltube Saman devalaya[18] (A2) there is a flag called *ravana kodiya* and it is believed that if the flag is taken away it will rain heavily. There is a *perahera* (religious procession), which ends with a "water- cutting ceremony" at Wallahun ella, a small pond in the upper part of the Boltuba oya supplied by two springs that are believed never to dry.[19] When water gets scarce, farmers in B7 go to the "Bo tree" in the village and perform a ceremony to ask for rain.

Synthesis

The upper catchment of the Walawe basin has been the site of very early human settlements, and kingdoms had been centered around cities, such as Balangoda or Kaltota, which developed from the second century BC to the fifteenth century AD. The region then declined and it was sparsely populated when the British established tea cultivation in the area (which expanded around 1930), with a large forest cover, numerous wild animals, very limited communication facilities, chena cultivation and rice grown under the anicut commands, and a population drawing its subsistence from forest products. Only salt and a small variety of spices came from outside the area. Thus, despite the limited population, the most favorable locations for anicuts, where farmers could cultivate several acres of rice, were exploited.

Most farmers under the anicut commands farm small areas, typically from 0.1 to 0.6 hectare. The rather high, but irregular, rate of tenancy shows that in some anicut commands landownership has been partly retained by influential families, acquired by wealthy local people, or remained under temples and devalas. But it also shows that many who have inherited land may have chosen not to farm and rented it out to relatives. Altogether, land concentration rarely exceeds 1.5 hectares of irrigated land.

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[17]A legend is reported concerning the Ranmudu oya: King Mayadunne had gone to war and had left seven spouses, telling them that a white or a black flag would be raised depending upon winning or losing the war. The king won the battle but the black flag was mistakenly raised and the king's wives jumped into the Ramudu ella and drowned themselves. However, this is a common legend in Sri Lanka regarding some other kings and the "seven wives" of each such king.

[18]The origin of this devalaya is obscure, i.e., whether King Surya during the Seethawaka reign, or King Yapa Bandara helped build it. But it has been developed and rehabilitated in course of time and it has served as a depository for the valuables of Ratnapura Saman devalaya when Ratnapura was under attack. There are nearly 50 groups of people doing duties of the devalaya but earlier there used to be up to 99 such groups. Following the the Katharagama perahera (a religio-cultural procession) another perahera connected to this devalaya starts, which lasts 15 days (Ghanawimala 1942).

[19]One of these sources has been tapped for domestic use but the villagers have opposed the tapping of the second source considered as sacred.

A striking finding of the survey is the very high diversity of situations. From one anicut to the next, it is not only the water status that may change but also other fundamental features. For example, in the C19/1 anicut area, most people including youth are engaged in agriculture; in the neighboring C19/2 anicut, however, out-migration is quite high and people tend to seek job opportunities outside the area. Some activities are extremely localized, a good example being gem mining. Wild boars may severely affect a particular area, but not neighboring ones. At a wider subregional scale, the upper catchment also displays a notable heterogeneity: the western part is composed of small farms and forests, and chena lands have disappeared to a great extent, partly to the benefit of tea cultivation. Population density is quite high and out-migration to cities as well as to work at Balangoda and local factories is frequent. In the Central part, the Belihul oya catchment has successfully occupied a niche in tomato production that has brought significant wealth to the area, as recent and modern housings that have popped up in the area bear witness to. The eastern side relies more on uplands and home gardens and on products like pepper, cinnamon and sugarcane, which have had more economic significance than rice.

This shows how opportunities to diversify and intensify agriculture can contribute to supporting a growing population and to limiting out-migration. When this is not possible (or does not occur) it is crucial that other activities in other sectors are provided, locally or otherwise. People are forced to be quite mobile in their search for opportunities and this is reflected by the permanent inflow and outflow of a portion of the population. Despite a willingness to diversify to cash crops there is a reluctance to jeopardize the household food security and to convert paddy land whose produce is consumed within the household.

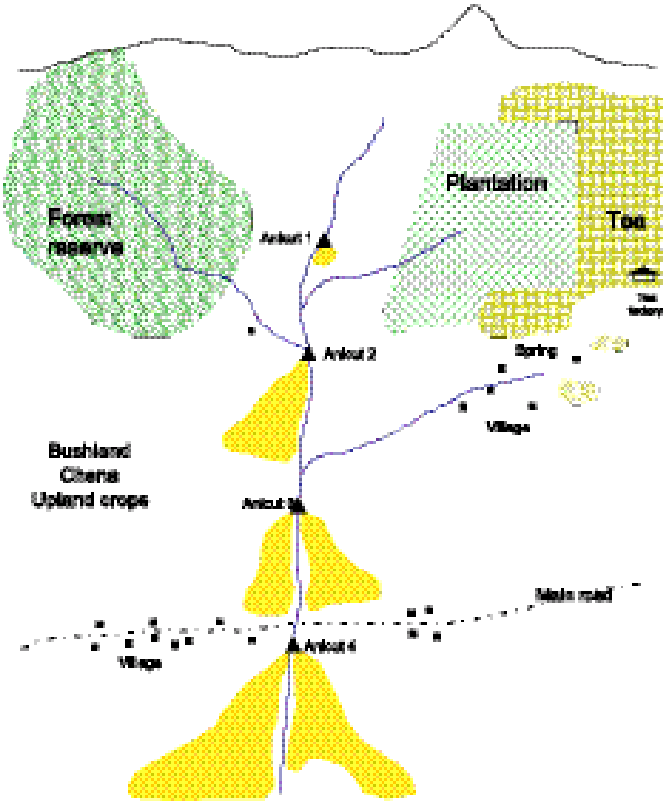
Although some catchments still enjoy a rather good water supply, it seems beyond question that river flows have declined, especially in the last 15 years, and that this decline has been aggravated in the last 5 years. This is generally blamed on both the disappearing of forest cover and the plantation of pines. This decline has had very clear implications on water management in the anicuts. The following figure of a typical catchment allows us to synthesize the most common situation (figure 8).

The uppermost parts of the catchment have small anicuts, typically 2 to 6 hectares, which receive an abundant supply in both seasons but which cannot be easily expanded because of topography and soil constraints (anicuts 1 and 2). Villagers may complement their income by planting a few patches of tea, working in estates, clearing remaining forests, etc. In anicut 3, water is likely to get scarce in the dry season and this spurs a shift towards OFCs and a rotational arrangement for water distribution in yala. The proximity of the road eases commuting to Balangoda, to schools and to daily work. Anicut 4 is situated in the downstream part and may be larger, since it commands larger valleys or land with much less slope. Water problems force rotations to be extended to maha and some areas may be left fallow in yala, while OFCs get spread.

Beyond this diversity of situations, the overall impression derived from this reconnaissance study is that population pressure over land and water resources is already quite high. Chena cultivation has almost disappeared and expansion is constrained by pinus plantations and forest reserves. Intensification has consisted in the generalization of double-cropping and the adoption of cash crops sold to urban markets. The identification of “niches” other than the successful case of tomato would mean a lot for the economic development of the region. Population density is regulated through out-migration and it goes without saying that maintaining a minimum supply of job opportunities in other sectors (or abroad) is vital to counter poverty. Water efficiency is almost optimal, due to direct return flow to the streams, and water management/maintenance appears to be quite good, leaving little scope for improvement in these areas. The importance of anicuts, however, is still considerable with regard to rice production and food self-sufficiency and they

support a significant portion of the rural population. Challenges for the future revolve around the interlocked issues of land cover, hydrological regime and population pressure, which will remain shaped by the evolution of the wider economy.

Figure 8. Typical layout of a sub-catchment.



Pictures of anicuts and related issues

A small stone-made anicut

A medium-size concrete anicut

Terraces on the Belihul oya

OFCs and rice cultivation

Landslide problems

Cinnamon

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