LIVELIHOODS IN CONFLICT: DISPUTES OVER WATER FOR HOUSEHOLD-LEVEL PRODUCTIVE USES IN TARATA, BOLIVIA


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ABSTRACT
In Tarata (Cochabamba, Bolivia) disputes came to a head in 2002 over the rights to use water for urban agriculture from a multiple purpose water supply system (Laka Laka). The Laka Laka dam was planned to provide water for a large irrigation scheme and to meet the basic needs of domestic users in the town, but not specifically for productive water uses within the urban area. When a scheme was developed to supply water for cultivation of ‘huertas’ (small plots close to homesteads) in the town, there were violent conflicts with farmers from the irrigation scheme who were determined to protect their irrigation water rights. The paper reports the findings of a case-study to investigate the nature and causes of the conflict. It addresses the multiple uses of water and sources for domestic supply, urban agriculture and field-scale irrigation, and the potentially complex legislation, institutional arrangements, rights and expectations associated with these different water uses.

KEY WORDS
conflict, dams, domestic water supply, integrated water resources management, irrigation, urban agriculture

THE CONFLICT IN TARATA
In late 2002, Tarata was the scene of violent confrontations between regantes (irrigators) from Arbieto and inhabitants of the nearby town of Tarata (Tarateños). Both groups damaged infrastructure associated with the Laka Laka multi-purpose project: a dam and associated pipelines, canals and treatment facilities to supply domestic water to Tarata and irrigation water to Arbieto. A direct factor in the escalation of the conflict was the construction of a new pipeline by the water supply utility Servicio de Agua Potable y Alcantarillado Tarata (SEAPA-Tarata), and the Asociación Agropecuaria Tarata (AGROTAR), to convey water from the dam to irrigate huertas (homestead gardens) in the town. In order to supply water to irrigate these gardens, SEAPA-Tarata reclaimed its share of water from the Laka Laka dam, an allocation that it had not used for the previous four years. This decision resulted in intense discussions between the regantes and the Tarateños over the regulations governing the allocation of the water from the dam. When negotiations led by the Prefectura de Cochabamba (the departmental government) failed to resolve the dispute, regantes decided to take matters into their own hands. This led to two cycles of violent confrontations with the Tarateños.

At the end of September 2002 the regantes hit the streets, protesting that compromises reached with the authorities were not being implemented. Shortly afterwards in October, the regantes decided to destroy the pipeline of SEAPA-Tarata and AGROTAR that ran from the water treatment plant by the dam to the huertas in Tarata. Regantes, however, mistakenly destroyed the domestic water supply pipeline that runs between the water treatment plant and storage tanks. The mistake was made because, unknown to the regantes, the system of pipelines from the water treatment plant had recently been modified. In an article in the newspaper Opinión on 6
November 2002 the municipal authorities of Tarata declared that the *regantes* had destroyed approximately 2000 meters of drinking water piping to the town of Tarata, and that the inhabitants had thus been left without drinking water. In reaction the *Tarateños* destroyed a part of the primary irrigation channel. However, the original vandalism did not actually severely affect the main domestic water supply. As we will see later, this supply comes from groundwater and not the dam.

The conflict escalated again in December 2002 after promises from the *Prefectura* were not kept, according to the *regantes*, to remove the pipeline constructed by SEAPA-Tarata and AGROTAR for irrigation of the *huertas*. The *regantes* again took away part of the piping for drinking water supply, making the same mistake as in October. This was probably because they thought that the *Alcaldía de Tarata* (the municipal authorities) did not tell the truth about them having damaged the wrong pipes in order to mobilise the inhabitants of Tarata. This led to further confrontations between the *regantes* and the *Tarateños*, and the threat of reprisals (Los Tiempos, 28 Dec 2003).

The resulting damage to the water supply system led, the next day, to the blockading of roads by both the *regantes* and the *Tarateños*. The *regantes* protested to protect their water rights, but also because of their disaffection with the actions of the *Prefecto* (head of the *Prefectura*), and to demand the freedom of the seven *regantes* who were imprisoned after their perceived participation in the original acts of vandalism (Los Tiempos, 29 Dec 2003).

**BACKGROUND**

Tarata is located 35 km from the city of Cochabamba in central Bolivia. At the edge of the Andes, the area falls within the upper part of the Amazon basin. The dam and catchment area are located in the municipality of Tarata which is in the province of Esteban Arze in the department of Cochabamba. The nearby downstream irrigated areas actually fall within the neighbouring municipality, Arbieto. This is a productive valley, with an important agricultural tradition. The first known inhabitants, *Tiawamacota*, were pre-inca. Later, *Aymara*- and *Quechua*-cultures prospered. During the colonial period, from the late 16th century, the area became an important supplier of food for the mining area of Potosí, and Tarata became an important religious centre (Vargas, 1999). Arbieto was founded during this period. Products were made for regional and international markets, and today the area is still known for producing fireworks, pottery, crystal bottles and soap.

The climate is mild, but relatively dry (Table 1), and irrigation thus has a huge impact on agricultural production. Or as one farmer said: ¡*Cuándo no hay agua no hay una vida!* (without water there is no life). Most rain falls between December and February (Salazar & Soto, 1995). Traditionally wheat, maize, and potatoes have been the most important crops, along with alfalfa for feeding livestock. The height of the land and access to irrigation dictate which crops are grown, with potatoes important in the upper catchment, and wheat in lower areas. In Arbieto especially, higher value tree crops like peach, pear, apple and prune, flowers and vegetables are increasingly important. Most landholdings are individually owned, and vary between 0.5 and 10 ha. Relatively low returns from the main sources of livelihood in the area - 88% of people work mainly in agriculture, livestock raising or traditional craftworks – have resulted in high levels of both temporary and permanent migration to cities in Bolivia and further afield (Salazar & Soto, 1995).

**HISTORY OF WATER DEVELOPMENT**

¡Error! No se encuentra el origen de la referencia. shows a schematic illustration of the main features of the irrigation and domestic water supply systems. There are two main areas of water use: the irrigation scheme in Abanico (around Arbieto), and the town of Tarata. In the following
sections, the development of systems for field-scale irrigation, domestic water supply, and for urban agriculture (the *huertas*) are each considered.

<table>
<thead>
<tr>
<th>Table 1. Key background statistics for the study area</th>
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<tr>
<td>Pop. – Tarata municipality (1996)</td>
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<td>Pop. – Arbieto municipality (1992)</td>
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<tr>
<td>Pop. density (province, 2000)</td>
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<td>Pop. growth (province, 1976-2000)</td>
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<tr>
<td>Annual income per person (province, 1994)</td>
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<tr>
<td>Mean temperature</td>
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<td>Average annual rainfall</td>
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<td>Pot. evaporation (at Lake Angostura)</td>
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<td>Altitude</td>
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**Figure 1. Schematic illustration of irrigation and domestic water supply infrastructure**

**Field-scale irrigation**

Waters from the Calicanto River were utilised for irrigation before construction of the Laka Laka dam, albeit on a smaller scale, and in fact this was an early source of problems for the project. The preliminary proposal for the scheme failed to recognise the rights of traditional water users and these were only considered after protests. Irrigators with traditional rights to use water from the rivers that would supply the dam formed a *Comité Opositor* to lobby against the project. But one of the main aims of the Laka Laka multi-purpose project (Table 2) was to provide increased water for irrigation in the valley downstream and roughly 95% of the available yield was set aside for this purpose. Irrigation water from Laka Laka is supplied to Cabecera (22 ha) in Tarata municipality and the various *suyus mayores* (major
irrigation scheme units) of Abanico: Ladera (88 ha), Cardozo (82 ha), Mamanaca (203 ha), Prado (184 ha) and Gringo (324 ha). Within each suyu mayor irrigation water is divided between suyus menores (smaller units).

Table 2. Key statistics for the Laka Laka multi-purpose project

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<table>
<thead>
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<tbody>
<tr>
<td>Height of dam</td>
<td>32 m</td>
<td></td>
</tr>
<tr>
<td>Capacity of reservoir</td>
<td>2,600,000 m³</td>
<td></td>
</tr>
<tr>
<td>Catchment area</td>
<td>59 km²</td>
<td></td>
</tr>
<tr>
<td>Yield of reservoir¹</td>
<td>c. 6, 120,000 m³</td>
<td></td>
</tr>
<tr>
<td>Allocation for domestic water supply</td>
<td>270,000 m³ (equivalent to 195 lpd based on 1996 urban pop.) i.e. 4.4% estimated yield</td>
<td></td>
</tr>
<tr>
<td>Allocation for irrigation</td>
<td>5,850,000 m³ (in 1994; equivalent to 648 mm/ ha irrigated area) i.e. 95.6% estimated yield</td>
<td></td>
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<tr>
<td>Irrigated area</td>
<td>903 ha</td>
<td></td>
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</tbody>
</table>

Notes: ¹ Under ‘normal’ conditions at construction based upon nominal allocations for domestic and irrigation uses. Yield is declining rapidly due to sedimentation of reservoir.

From the dam a lined primary channel (4 km long and with a capacity of 560 l/s) (Ricaldez Flores, 1996) conveys irrigation water to Abanico where further lined secondary channels divide the water (controlled with movable gates) between suyus mayores. The Calicanto River (Wasamayu River in Abanico) (Salazar & Soto, 1995), Ferrel Mayu River and Pilcomayu River also convey additional water during the rainy season and are used for traditional irrigation. Wells also provide additional water within the irrigated areas during the dry season.

**Domestic water supply**

Although only around 1000 out of 1720 households in Tarata are connected to the main domestic water supply, these households do have access to a daily, 24-hour water supply with household connections. The supply is better than many other urban centres in Bolivia, and most households don’t need additional water storage to cope with variations in supply. Households that don’t have domestic water from the main system, rely upon wells or their neighbours. Consumers are charged 1 Boliviano per m³ (1 Boliviano = 0.12€) for domestic water.

Two domestic water supply storage tanks near Tarata can be filled from other: the reservoir (via pipelines with a capacity of 12 l/s (Alcaldía de Arbieto, 1998; Laboratorio de Hidráulica, 2001, Los Tiempos, 28 December, 2003); from two wells [pozos1] owned by SEAPA-Tarata (with a combined capacity of 13 l/s); or from a third source, a pipeline (capacity 3 l/s) (Los Tiempos, 29 December 2003) from the River Loro Huachana. This is a tributary of the Calicanto River upstream of the reservoir where the river water has a lower sediment load. From the storage tanks, water then flows by gravity into the domestic water reticulation network for Tarata. Treating water to drinking water standards from the reservoir was found to be too expensive (0.2 Bolivianos per m³) due to the high sediment load. As a result only the two wells have been used for the main domestic supply for the past four years, and water from both the Laka Laka reservoir and the Loro Huachana is instead used for irrigation in the urban area.

**Urban agriculture**

In Tarata a lot of families cultivate huertas, sometimes more than one in different parts of the town. Typically these are at the back or around the family home, and may be between a few square metres and 2 ha in size. Common crops grown include maize, potato and wheat, fruit trees like peach and orange, vegetables like beans and peas, and alfalfa for livestock – either for home consumption or for sale. Not all households have huertas, but the number did increase
significantly after the Laka Laka dam was built. Prior to construction of the dam, the huertas were irrigated with water from the domestic water supply system or family wells.

In the town there is now a system of pipes and earth canals to transport water by gravity to the huertas. There are also two pipelines (with capacities of 20 l/s (Northwest Hydraulic Consultants, 1995; Opinión, 6 Nov 2003)) from the treatment plant at the dam to supply water to the huertas in Tarata that were not part of the original project design. This system is managed by AGROTAR. There are five different sources of water for the huertas: 1) the reservoir; 2) Loro Huachana; 3) the main domestic water supply system supplied by SEAPA’s wells; 4) two wells belonging to AGROTAR [pozos2] but currently these don’t function; and 5) individual wells [pozos3] belonging to the owners of the huertas. Irrigation water from the reservoir supplied to the huertas costs urban farmers 0.28 Boliviano per m$^3$.

**Sedimentation of the reservoir**

After construction of the dam, a major problem emerged. Very high sediment loads turn the water in the reservoir dark red during the rainy season. As well as ruling out the use of the reservoir for ‘drinking’ water supply because of the high treatment costs, sedimentation means that the lifespan of the dam will be short and the availability of water will decline rapidly. During the 1990s the capacity was estimated to have been reduced by 25%, compared with a normal expected rate of around 10%. Attempts to flush out the sediments have not been successful (Laboratorio de Hidráulica, 2001). From an estimated supply of 5,850,000 m$^3$ for irrigation in 1994 it is likely that by 2016 the available water for irrigation will be reduced by over half to only 2,550,000 m$^3$ (Salazar, 1996). And in order to meet the allocation for ‘domestic’ water supply year round, none of this irrigation water will be available in the dry season after 2016.

**CAUSES OF CONFLICT**

The conflict in Tarata in 2002 centred on the supply of water from the Laka Laka reservoir for urban agriculture. In this section, the main causes of the conflict are examined in detail including: the definition of what ‘domestic’ use meant to different stakeholders, the sale of water rights, motives of key actors in the conflict, and weaknesses in the enabling environment in Bolivia.

**What are ‘domestic’ uses of water?**

Domestic water uses are commonly understood to include the water needs of families for drinking, cooking, washing and sanitation. But what about other water uses at the household level? Are small-scale productive uses like irrigation of small gardens, keeping a few livestock or home-based micro-enterprises like beer-making, also ‘domestic’ activities? And if so, at what scale do these kinds of productive activities become not ‘domestic’ but rather agricultural or industrial or commercial activities? Differences on these definitional issues were a key factor in the conflict at Tarata.

It is clear that SEAPA-Tarata does supply water from both the Laka Laka dam and from the Loro Huachana for the irrigation of huertas in parts of Tarata. According to SEAPA-Tarata, the water it abstracts from the dam may be used, not only for human consumption and a narrow range of domestic activities, but also for urban agriculture. A letter from the Consejo Municipal de Tarata (the city council of Tarata) and the Alcalde de Tarata (the mayor of Tarata) in the newspaper Opinión supports this view:

‘... SEAPA-Tarata will use with the goal of human consumption and for urban activities, meaning whatever use that can be given in the form of drinking water within the city limits of the town of Tarata (the centro poblado of Tarata) and other necessities of the inhabitants, which means that
the water can be used for the industry, tourism, human consumption, livestock rearing, and for irrigation of pitches, gardens, pasture or land for the cultivation of crops...’ (Opinión, 6 Nov 2003).

This view is contested by the Regantes who point to the ministerial resolution of 1993 regarding water distribution between the Asociación de Regantes del Complejo Multiple Laka Laka and SEAPA-Tarata. This resolution states that:

‘With the goal of human consumption and the established urban activities in the town of Tarata (the centro poblado of Tarata), a volume of $270,000\ m^3$ of water per year will be given, which will be administrated by the Servicio de Agua Potable y Alcantarillado of Tarata (SEAPA-Tarata)’ (Resolución ministerial no.064/93 del Ministerio de Asuntos Campesinos y Agropecuarios).

This ministerial resolution does not clarify exactly what can be considered an ‘established’ urban activity. Not resolving whether urban agriculture was an ‘established’ urban activity has clearly been a key issue in the conflict. Can a once traditional activity that had declined (cultivation of huertas) be described as ‘established’. SEAPA-Tarata aimed to revitalise these huertas to create more employment and generate more income for the Tarateños.

**Sale of water rights, and of water that does not exist**

As we heard before, to use the water from the Laka Laka dam (and from Loro Huachana) for the irrigation of huertas, the inhabitants of Tarata organised themselves in the Asociación Agropecuaria Tarata (AGROTAR) who developed an irrigation project for the huertas with help from the municipality and SEAPA-Tarata (Opinión, 6 Nov 2003). The creation of AGROTAR and the subsequent construction of the irrigation system in Tarata, was itself possibly a violation of the regulations for the multi-purpose project. The ministerial resolution of 1993 prescribed that there were to be only two organisations in charge of the administration of the water from the Laka Laka dam, the Asociación de Regantes del Complejo Multiple Laka Laka and SEAPA-Tarata.

SEAPA-Tarata sells water from the Laka Laka dam to AGROTAR. Subsequently, AGROTAR has sold acciones (shares giving a right of access to water) to Tarateños with huertas. Furthermore, some of these huertas are situated outside the city limits (the centro poblado) and are owned by people who did not work in the construction of the dam. The only Tarateños who should receive water from the Laka Laka dam are the ones who live within the city limits or who laboured in the construction of the dam. The project regulations state that SEAPA-Tarata would administer water from the dam within the city limits. However, following the construction of the dam the town has grown significantly. The centro poblado has even grown beyond the limits of the watershed of the Río Calicanto. According to the Regantes these parts of Tarata do not have a right to water from the dam, whilst it is clear that AGROTAR is selling water in these parts.

During the period when SEAPA-Tarata did not utilise water from the dam the regantes had more available water, and had started to sell rights to water that could only be fulfilled whilst SEAPA-Tarata did not utilise their share. Now that SEAPA-Tarata once again abstract from the dam there is less water available for irrigation in Abanico. The regantes have run into problems as they no longer can supply water to all the farmers to which they have sold rights or shares. A number of regantes thus do not receive irrigation water anymore even after they bought shares. Each year the amount of water available in the reservoir is also declining due to sedimentation, whilst demands on the side of the regantes have increased.
It is actually prohibited for both SEAPA-Tarata and the Asociación de Regantes del Complejo Multiple Laka Laka to sell water from the dam to persons who did not work in the construction (although rights are transferred in land and house sales). However, as well as SEAPA-Tarata and AGROTAR selling rights to water, it seems clear that the Asociación de Regantes del Complejo Multiple Laka Laka is also selling water in violation of these rules. In Abanico, farmers without shares can still buy water from the Asociación for approximately US$ 5-7 dollars per turn. It has been said that the Laka Laka dam was constructed for the irrigation of 400 hectares of land, but today are closer to 1000 hectares are being irrigated despite uncertainty over the true figures. This may be a result of sales of extra water by the Asociación de Regantes del Complejo Multiple Laka Laka, and because some regantes obtain more water than they are supposed to be allowed. In reality while an irrigation turn may allow half an hour of irrigation, in practice the plot is irrigated until it is deemed sufficient. Some farmers also ‘steal’ water to irrigate extra land. Water shortages are also aggravated by the fact that the available irrigation water is not used very efficiently.

Motives, interests and entrenched positions
Why don’t the regantes want water to be supplied for urban agriculture in Tarata? And, why is urban agriculture so important in the town? The regantes are strongly opposed to the supply of water from the Laka Laka system to Tarata for irrigation of huertas, even though this represents a small amount of water (around 5%) compared to total availability. There are several reasons for this situation. First, the regantes feel that they have more rights to the water from the reservoir since SEAPA-Tarata had not used the water for 4 years and urban water users did not participate in construction and maintenance of the system to the same degree. Participation in construction of irrigation facilities by providing labour is a normal way of creating rights over a system and the water. Added to the perceived loss of rights, the regantes are concerned that in the future the town’s demands for water for urban agriculture will increasingly threaten their interests. As sedimentation further reduces the yield of the reservoir, year round use in Tarata will also have an increasingly severe impact on the amount of water remaining for the irrigation scheme especially during the dry season. In addition to these water resources issues, there are also strong historical rivalries between the town of Tarata and surrounding rural communities that date back decades to clashes between peasants and the landowning classes.

Weak overarching legislation, and institutional frameworks
As noted above, the content of water rights associated with the Laka Laka scheme (specifically whether domestic use in the town should encompass irrigation of huertas) are unclear and contested. Confusion over the specific understanding of water rights, typical of other water resources conflicts in Bolivia, is largely a result of a vacuum in policy, legislation, decision-making and regulation for water management. A common situation in such circumstances is that irrigation farmers seek to create their own rules for water rights, such as linking these to investments made in construction or maintenance. In this vacuum, schemes such as Laka Laka struggle to find their own local solutions. And when water resource conflicts do arise there are not clear norms and procedures for institutions such as municipalities or the Prefectura to resolve the conflict. In such an environment, water users tend to seek support through other institutions and channels often depending upon the mobilisation of political support.

CONCLUSIONS AND LESSONS
The use of water from the Laka Laka reservoir for urban agriculture was in the opinion of the regantes, against the agreed rules for operation of the multiple purpose scheme. The construction
of a pipeline to irrigate *huertas* in the town and renewed use of the water from the dam by the town after a gap of four years was a direct cause of the conflict, aggravated by the lack of overarching legislation and norms, and the historic rivalry between the municipalities of Tarata and Arbieto.

The declining yield of the reservoir due to severe sedimentation is likely to lead to further pressures on the scarce water resources in the area, and potentially continued or more serious conflict, unless strong institutions are able to manage the diminishing resource and resolve the conflicting interests. Potential solutions to help minimise or resolve the existing conflict in Tarata could include better information sharing between key stakeholders (including reliable information on declining future water availability due to sedimentation), more transparency in the operations of the institutions (SEAPA-Tarata, AGROTAR, the *Asociación de Regantes del Complejo Multiple Laka Laka* and local government), general strengthening in institutional capacities to deal with conflicts, and in the irrigated areas especially, measures to introduce incentives to use water more efficiently.

Although every conflict over access to contested resources has many local characteristics, some more widely applicable lessons can be learnt from the disputes in Tarata:

- Improved domestic water supplies, in this case following construction of a reservoir and associated infrastructure, will in certain situations lead to increased water use for urban agriculture and productive uses,
- Productive water uses at the household level are, as in Tarata, rarely considered in planning. These needs should be properly considered in the project design for improved water supplies and multi-purpose projects, and the rights to water for these uses should be clearly negotiated and agreed in multiple-purpose projects.

Whether urban agriculture, or other productive uses of water around homesteads, should be explicitly encouraged within domestic or multiple-purpose water supply projects should amongst other factors be based upon: an assessment of local needs; comparisons of the efficiency, benefits and costs of productive water uses; assessment of contributions to (or disadvantages for) cost recovery and sustainability; and an understanding of whether there are particular benefits for the poor. Follow-up research based upon detailed household-level studies in Tarata has been initiated to address these wider questions.

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