

Article: **The Outflows of Coatepeque**

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## Is it over for the lake?

### The Outflows of Coatepeque

(First submission)

by **Tomás Guevara**

**Coatepeque Lake, which is shared among the municipalities of Santa Ana, El Congo and Izalco, is undergoing an alarming reduction in water levels, as has not been seen in the past 40 years. Starting today, Revista Dominical is beginning a series of publications with the aim of understanding the reasons behind this phenomenon, that has placed on alert the local inhabitants of the basin and the State institutions in charge of supervising this water resource.**

The cliff that once served David Ramirez as a seat from which to throw the line and hook one or another mojarra fish from Coatepeque Lake, is now far away from the shore. It would seem as if he were telling an old man's tale, when in reality he is only referring to five years back, when the lake was two metres deeper. This was considered for many years its normal depth, as much in the dry season that tended to bring low tides, as when it recovered its higher levels during the rainy season.

Measurements taken of the lake in the 1980s indicate that it was 114 metres deep, with a breadth of 24.8 square kilometres. These figures have changed, in light of the bare supporting poles of the docks of the 560 houses constructed along the edges of the shoreline.

On the wooden planks supporting the piers, there remain the stains of the chemicals in the water of at least the last three years.

At first, the 2001 earthquakes were blamed for this phenomenon, since it was at that point that the recession of the lake began to reach alarming levels, some two metres less; although folk wisdom holds that the levels began to descend in the 1970s.

The Ministry of Agriculture and Livestock was the last state institution to carry out a hydrological study of Coatepeque Lake in which the amount of water used and that received from rainfall were balanced. The study dates to 1973.

#### **Before speaking, one must take measure**

For now, it is difficult to ascertain the amount of rainfall that the lake and its basin have received in the last few years, because the meteorological station in charge of registering this data was dismantled in the 1980s.

And this is the first issue that needs to be addressed by the Hydrological Division of the National Service of Territorial Studies (SNET), in order to give estimates of what could be happening.

This is where local knowledge predominates in the sharp voice of Germán Molina. "No, man, the thing is that we are finishing off the lake, so much water is pumped into the fields, and more pipes that draw water to the cantons," says the employee who arrived 35 years ago to work in a field alongside the lake.

Its measurements indicate that at the beginning of the 1970s, the water reached certain walls that now stand at some 20 metres from the actual shoreline. However, he emphasises that the greatest level reductions have occurred during the last three years.

#### **Hope in the cycle**

The concern over the outflows of water is placated by emerging testimonials from elderly locals, that tell of the years when the water level was very much below where it currently stands.

The information provided by the Coatepeque Lake water study carried out by the Ministry of Agriculture and Livestock indicates that the period of greatest growth of the water reserve was during the first years of the 1960s.

The rise was so steep that many houses were flooded over, and some property owners had to hire boats to remove building materials and pillars from their ranches submerged in the water.

There began an era of new constructions at a “sure” distance, in case the water levels continued to rise. These same houses have now had to expand their gardens in search of the lakeshore.

Considering the threat that the water would continue to rise until flowing over the edges of the lake, which is at some 1,700 metres above sea level, there was thought of constructing a drainage pipe that would empty waters into the Zapotitán Valley.

As planned, the construction of the tunnel started to the southeast side of the basin, but an impenetrable rock mass prevented passage, after a second attempt a few metres away from the first site. The remains of this project were finally covered up some nine years ago by the current owner of the lot.

Doña Érida Cartagena, who comes down from the summit of the basin to use the lake water, comments that the rise of the waters in the 1960s left the old street that ran alongside the lake underwater, from where there now begin to emerge the tops of the posts of the its old electrical wires.

These facts provide hope to the technicians of the National Service for Territorial Studies (SNET), who are in charge of studying what is happening with the lake. “This information that we have up until the 1970s indicates that the lake has periodic cycles of growth and descent in its water levels,” says Ana Deysi López, Director of the National Hydrological Service.

However, it will require measuring a new balance to establish the current situation. The formula is simple: we will need to measure the amount of rainfall into the lake, and subtract from that the amount of outgoing water by way of evaporation, by way of feeding into other water bodies, such as the Sucio River, and the amount that the local population of the area uses.

However, the rainfall of the winter of 2003 in the basin – that covers all of the mountains around this crater of volcanic origin (see side note) – will only reach the underground water table of the lake in some 10 years, affirms geologist Carlos Pullinger of SNET.

According to specialists, there are three factors that have to be taken into account in order to understand the considerable reduction of water in Coatepeque.

In the first place, we cannot disregard the fact that the 2001 earthquakes could have opened up underground cracks in the lake. However, it is nearly impossible to test this hypothesis, considering the scarcity of technical resources available.

Secondly, the water levels of the Sucio River have not been measured, being the only natural outflow of the lake.

A third factor is making a priori calculations on the amount of water entering the water table. And finally, taking inventory of how many barrels of water are extracted daily for domestic and agricultural use.

For example, among the 560 houses that surround the lake, the technicians of the Coatepeque Foundation calculate that some 25 barrels daily are used to water gardens, only half of which return to the underground water table, another part of which evaporates, and the rest is absorbed by the plants.

To this, we must add the amount of water that is released from six hydraulic plants pumping water towards receiving tanks on the foothills of the volcanic complex of Santa Ana.

### **Damp Numbers**

It was the afternoon of Thursday, 15th of April. We went aboard a boat on Coatepeque Lake to see in situ the cause for alarm of the inhabitants of the area and the environmental authorities who undertake to study the balance between the states of this impressive water resource.

Once within the lake, tossed about by the breeze and waves, we followed along the breadth of the lake in search of cracks that the neighbours indicate are responsible for the descending water levels.

The first indicator that lit up the yellow alert light was the precariously dry state of the wooden docks, as well as their rafters that are now reaching their highest points of exposure.

Many did not know that near the island of El Cerro, also known as Teopán, was the small hill of San Juan, that is now a settling point for visitors coming to install their baited fishing lines.

The boat entered all the way until reaching the small streams formed by the natural waterways and others formed by resident owners in order to remain close to the water. From here, several outgoing pipelines could be seen gathering water for pools and cisterns.

### **Watch those Tanks**

But the neighbours point out the six pumps that supply six farms and some 20 villages in the surrounding cantons, as well as two perforated wells within the basin that drain water out to 10 houses and as far away as the district of El Congo.

The person in charge of the Pozo del Guineo project, Juan Pablo Martínez, says that the 420 gallons of water per minute generated by the pump, at a rate of 10 hours per day, by conversion, add up to six thousand barrels daily.

The water rises to the capturing tank, and then by gravity tosses out the vital liquid – without sanitary processing – to the cantons of El Guineo, San José, el Rodeo, Siete Príncipes, and beyond, to the municipality of El Congo. In summary, Juan Pablo says that they rationally supply some 1,500 plumbing systems, with an average of three families per faucet.

Then the eye turns to the managers of the communal project of La Vuelta de Oro, with a well that pumps close to one thousand barrels daily to the canton of Los Arados, from which an average of some thirteen thousand inhabitants receive their water supply, according to Don Marco Coto, the person in charge of the pump.

The remaining pumps (see the informational graphics) drain water to farms and cooperatives of the reform sector outside of the basin. The use that people give to this water is always for domestic purposes.

In the face of alarm, the time comes to look for responsibilities. David Ramirez, of the Coatepeque Foundation, is in charge of taking a census of the houses and the number of barrels used by each one for irrigation during the summer season. He has already established some calculations and offers figures that can only be alarming. Out of a total of 560 residences, each one spends an average of 25 barrels per day, that comes to a total of fourteen thousand barrels daily, of which only half will return to the lake.

Suggestions have already begun to emerge to assuage the problem. Don Diego Chirino, ex-president of the community of El Estoraque, who also drains water from the lake, suggests that farms could just water three times per week and the vegetation would not dry up. “The majority leave the sprinklers running all day long,” he says.

As these damp numbers begin to jump out at us, we need to calculate the amount of water coming in during winter, and that which is still hidden in the basin under the blue waters of the Coatepeque.

#### **Photograph:**

The dock and viewpoint of Lake Coatepeque's only hotel has been left on dry land. In the 1970s, the water used to come up to the restaurant's open terraces, which now stand over thirty metres above the water. Some houses have had to extend their gardens and construct new docks.

## **The Cave of the Explosion**

#### **SUMMARY:**

The volcano of Coatepeque, that is the older brother of its same generation sibling, the Santa Ana, and father to the rest of the volcanoes that make up this eruptive complex, underwent a fierce period of metallurgic activity that concluded with a great explosion, leaving an enormous hole of more than 20 kilometres radius and some two (kilometres) deep, beginning a long process of capturing of rainwater and underground water that eventually transformed itself into a lake.

#### **NOTE:**

From the top of the Santa Ana Volcano, at 2,381 metres above sea level, the restless blue mirror of the Coatepeque resembles a creation of the gods, made to meditate upon themselves. As blue as the sky that clothes it, Coatepeque Lake shows off its waves from some two kilometres of depth and some twenty wide, if one were to cross it in a straight line from one end of the basin to the other.

From above, this impressive resource, product of the rich volcanic heritage of the territory of El Salvador, takes on one of the most capricious forms that the human imagination can muster. It is difficult to avoid getting the impression that one is standing before a gigantic pot that is half-full.

In effect, after a long and critical period of volcanic activity some 55,000 years ago, Coatepeque had a mega-eruption that geologists call “Plinian,” to commemorate Latin American naturalist, Cecilio Segundo Plinio, who described the eruptions of the Vesuvio (Italy) in the year 79 A.D., when it buried Pompeii.

The Plinian eruption that took place in Coatepeque is characterized by the explosion of the volcano and the expulsion of its material over long distances, which caused great cataclysms and a radical transformation in the geography.

From this explosion, there remains a crater, which, with the passing of time over several thousand years, began to capture rainwater and underground water until it transformed itself into the major body of water that is today considerably losing its content levels.

The explanation offered by German geologists Helmut Meyer-Abich and Howel Williams, in their work “The Volcanic History of Coatepeque Lake and its Surroundings,” written in 1954 under the auspices of the Tropical Scientific Research Institute (Instituto Tropical de Investigaciones Científicas) of the

University of El Salvador, is the most important scientific reference available to understand this water resource of a volcanic nature.

### **Times of Tranquility**

Even though Coatepeque Lake forms part of the Volcanic Complex of Santa Ana, that encompasses the volcanic ensemble of San Marcelino, Cerro Verde and Izalco (which can be observed in the satellite image illustrated on this page), danger of its eruption does not generate concern.

The vulcanologist, Carlos Pullinger studied this volcanic complex in order to obtain his Master's Degree in Geology at the Technological University of Michigan in the United States of America.

Pullinger's theory sustains that both the Coatepeque and the Santa Ana are two masses from the same period, and that both have undergone large eruptions that have affected the geography of the area.

However, Coatepeque as a volcano does not show signs of any further activity, considering that, according to the geologist's theory, the displacement of the underground magma, some 18 kilometres deep, has run in a southwesterly direction, in the direction of Izalco and beneath the Santa Ana.

In this sense, it is difficult to separate the Coatepeque study from the rest of the volcanoes that comprise the complex. Nevertheless, the site awakens a certain fascination for the rawness with which it demonstrates evidence of its fierce past.

Helmut Meyer-Abich and Howel Williams studied the rock deposits located along the bottom of the lake in order to analyse the age and nature of the material, as well as the differences among its sides, as clear indicators in distinguishing the lava rock of the Coatepeque and that of its siblings.

These specialists also traced maps along the breadth of the floors towards the interior of the crater. In its area to the south, there is a valley covered with fresh earth, that has to some extent altered the underground activity.

Although from the top, the impressive mirror of water appears to be a caprice of the ego of the gods, from the surface of the blue waters, its colossal eruptive past is evident: a pot of water half-full that once reached its higher moments in the decade of the 70s, when it surpassed 115 metres in depth and generated concern over its rising levels, and that now sets off the green light for its descent.

### **Illustrative box:**

#### **PALLIATIVES FOR CLEANSING**

The polluted waters of Coatepeque Lake were among one of the first problematic symptoms that put on alert the farmowners located in the basin. By the end of the 1990s, people could see the problems coming.

A study carried out in 1997 indicated that close to one thousand persons came to wash their clothes and domestic utensils directly in the lake. Pollution both from dirt and from chemical agents was evident.

In 1996, the Coatepeque Foundation proposed a project for the construction of public washing facilities away from the lake.

To date, 12 modules have been constructed, that are used by an average of 900 persons.

The project was financed by a private enterprise, that established of the structure.

However, users must pay a fee to cover electrical energy costs incurred by the water pumps and persons administering the facilities, and communities have established the fee at \$0.80 per wash.

Those users who refuse to use the washing facilities represent a minimal group of people, says David Ramírez, technician of the Coatepeque Foundation. Rebellion against using the facilities tends to be worse among those who arrive from outside the basin.

The Foundation surged from the need to protect this water resource, and it is now proposing new strategies on the use of the lake, especially in the face of the alarming rate of descent in its water levels.

## **Coatepeque, the Polluted Surface**

( Second submission)

by **Tomás Guevara**

**Coatepeque Lake is the water supply source for some 20,000 persons who live within and beyond the surrounding basin. In addition to an alarming descent in the water level of this body, from which 21,000 barrels of water are extracted daily, there are pollution problems with this**

## **natural resource.**

As the water trickles on the shores of Punta Arena beach in Coatepeque, the trash floats by and coming onto the land, spoils this enchanting natural scenery. A detergent wrapper competes with an empty bag of candies to reach the shore, but a plastic soda bottle is the first to touch land, pushed forward by the currents.

Together with the lake, and just a few metres from this scene, Doña Reyna Ramírez, who comes down to the shore every so often from the canton of Santa Rosa, washes her family's weekly laundry. Close by are some ten women chatting while using rocks as washing utensils to rinse away the dirty foam from their washing.

Silently, a spot of soap disperses over to the edge of the lake, to the whim of the water's movement – and the women continue their "normal" activity while their children bathe in the lake.

Reyna allows herself a break from the chores and comes out of the water to comment that the drought in the canton of Santa Rosa doesn't leave them with any other option than to come and do their washing at the edge of the lake.

### **Pangs of Conscience**

The water that the washerwomen's families drink is the same water in which they do their washing. Reyna knows this. "We are aware that polluting the lake is a wrong that we commit against ourselves, but what else can we do if we have no water at home?" she says.

The 12 washer modules ordered for construction by the Coatepeque Foundation are not within everyone's reach. These potential users all agree that to pay one dollar to wash one basketful of clothing is too high a price for their family budget.

But this is the way that the cards are dealt. David Ramírez, Technician of the Foundation in the area, comments that this measure has at least reduced the amount of washerwomen along the shores of the lake by about 80 per cent over the last four years.

To the personnel in charge of Sanitation in the Health Unit of the lake, there is no other option but to urge the population to boil the water before drinking it. However, timber has become scarce, since most of the basin has been deforested.

With this somber panorama, the survival of Coatepeque Lake as a rational alternative for human consumption has become critical. The high density of the population and the lack of a management plan for this water resource begin to present a problem.

The Head of Research on Water Resource Pollution of the National Service for Territorial Studies (SNET), Zulma Mena, says that a comprehensive study on the pollution problems of Coatepeque could shed light towards finding urgent solutions and alleviating the problems.

### **Everything that Goes Down**

But Coatepeque's pollution is not only due to detergents and trash left by the people along the shores. A study carried out by U.S. Geologist Molly C. McCutcheon of the University of Ohio in the United States of America in 1998, entitled "Volcanic and Anthropogenic Pollution in Coatepeque Lake" brought samples of the lake water under the laboratory lens of the Department of Science and Geology of the North American institution.

The results take off in various directions, pointing to several sources of pollution. Some abnormal elements found in the water – sulfur, boron and acids – are not noxious to human health in the quantities detected, and they come from the very volcanic nature of the basin.

However, other components point directly to the pollution caused by human beings. Among these, McCutcheon found hydrocarbon residues (gasoline) and motor oil. These wastes proceed from some 500 boats that go out periodically from the docks of the houses along the lake.

Another source of pollution described in detail by the North American was the presence of fertiliser and pesticide residues. These in their majority proceed from the local maize and grain farms and the country houses forming part of the basin, but also from the fertiliser used in home gardens.

From these samples, detergents and solid wastes also floating in the water did not escape their attention. If the presence of these toxins has not yet caused a state of alarm for Coatepeque, the geologist left open the speculation that these quantities found could sky rocket if regulations are not placed on the human exploitation of this water resource.

Luck has been kinder to Coatepeque than to its fellow lake, Ilopango, from which some four years ago, several tons of hospital waste was extracted, that had proceeded from the metropolitan area of San Salvador.

### **Water that One Shouldn't Drink...**

Even though the water from Coatepeque supplies some 30 thousand people within and around the basin, there is no laboratory proof that certifies the quality of the water as suitable for human consumption.

The Coordinator of the Protection Committee for Water Resources of the National Administration of Aqueducts and Sewage Systems (ANDA), Rubén Alemán, assures us that the institution maintains control over the quality of well water that supplies the network.

In Coatepeque, however, their presence is nil, since there is an abundance of community projects on water supply financed by non-governmental organisations. Only in certain cases, some samples are analysed by petition of the community.

No one has certified the water quality in Coatepeque recently. Meanwhile, Reyna Ramírez and her fellow washerwomen won't deny the fact that the water they drink is somewhat salty, but that nonetheless, necessity requires them to quench their thirst.

### **(Illustrative box)**

#### **AQUATIC BROOMS**

By Latin American standards, on the subject of lakes, Coatepeque is considered to be one of the cleanest. However, this encouraging category is only an advantage by comparison to other water bodies on the continent.

Between 1996 and 1999, the School of Ocean Diving carried out annual clean-ups of the lake and the surprises hidden in its depths. Javier Mena, instructor at the diving school, recalls that during the first clean up, in a period of two days and with the participation of 300 divers, they brought up three tons of garbage.

At that time, they extracted tires, batteries, plastic bags, cans and even objects of personal use. Throughout the following years, they extracted less garbage. In 1999, only 200 pounds were brought up.

At that point, they abandoned the clean-up effort at Coatepeque and focused their interest on Ilopango, that was getting to a critical state.

## **Clear Accounts for Coatepeque**

( Third submission)

by **Tomás Guevara**

**To establish a hydrological balance of Coatepeque Lake, that has undergone a descent of more than two metres in the last three years, is the first measure to be taken before proposing mitigations to its potential run-offs and to the use of this natural resource.**

When the Mayas directed their gaze to the gray skies, their spirits contemplated the Giver of Rain, Chac, who enriched the flows of the rivers and the lakes with his humid presence.

Now that Coatepeque Lake is in a state of crisis, that prayer which was once offered up by the Mayas from this impressive lake of a volcanic nature, may still take effect.

The estimates of losses in the level of the water body are frightening, considering that in three years, the water level has gone down by approximately two metres. And during the last two winters, the recuperation of some 50 centimetres of average rainfall for the season evaporated within the first months of the dry season. That is to say, that with the arrival of the rain season, the level has not risen to even half of what it had risen to at the end of the previous winter season.

These estimates made a priori by the inhabitants of the basin are indeed a testimony to the fact as such, but there is still a need to conduct tests using scientific methods.

And this is the aim of Hydrological Management Division of the National Service for Territorial Studies (SNET), that hopes to take in the greatest amount of information possible in order to establish a hydrological balance of the waters of the lake in three month's time.

### **Adding and Subtracting**

Celina Mena, Technician with Hydrological Management, comments that the method used to establish this balance is not complicated.

The main point is to measure the quantity of rainwater received in the basin during a minimum period of the last ten years in order to establish an average cycle. On the basis of this amount, water evaporation is subtracted, as well as water used by plants and that which goes out by way of underground fissures and by way of extraction for domestic use.

In the last balance conducted in 1973 by the Hydrological Service of the Ministry of Agriculture and Livestock, it was estimated that underground drainage of the lake is located at the head of El Chorrerón, El Tinteral and La Joya, wells that feed into the Sucio River at a volume of 721 litres per second.

To conduct the balance that SNET has in view, these measurements must be brought up to date, as Celina Mena foresees, because there may have been alterations after the earthquakes with the settlement of the fault lines.

However, while this puzzle is solved, the indicators point in several directions. In the first of this series of articles, water extraction was estimated at 22 thousand barrels daily, according to the numbers provided by the Coatepeque Foundation and facts offered by the heads of water pumping projects for the communities located outside the basin.

### **Climate Change**

Others attribute the reduction in water levels to climate change and the amount of rainfall, which has gone down considerably during the past decade.

According to a detailed register of the amount of rainfall in the basin between 1976 and 2003, Don Antonio Cabrales maintains that the lower level is due to a natural phenomenon.

His data proceeds from a udometer (an instrument used to measure the amount of rainfall) that is installed at the ranch El Porvenir, located within the Coatepeque basin.

His estimates detail that between 1997 and 2003, the basin has only received an average rainfall of 1,536 millimetres annually; a figure considerably less than that of 1,800, that is considered to be the normal average in the territory of El Salvador, according to Tomás Rivas Pacheco, coordinator of the Centre for Climate Prediction of SNET.

With the rain season at the doorstep, the meteorology management team hopes that the rains will reach a higher average this year, with some variations in the microclimates of the eastern and coastal areas of the country.

In response to this reality, Don Antonio Cabrales, who served as an employee of the Ministry of Agriculture and Livestock between 1989 and 1994 during the mandate of Alfredo Cristiani, ensures us that we need to reflect seriously on this natural resource without setting aside the water needs of the area's population.

### **Mother Nature Pays**

The concerns of the inhabitants of Coatepeque, and those surrounding another three water resources in the country undergoing the same situation, has reached the attention of the National Development Foundation (FUNDE), which has already established a multidisciplinary team that searches for the reasons behind the problems and seeks to propose short-term concrete solutions.

Diego Salcedo, Environmental Economist and Consultant to the Foundation, assures us that the project that is already underway not only plans to identify the reasons for the reduction in water resources, but also tries to gain the commitment of users to protect the resource from pollution and ensure that this remains so for the future.

The objective of this plan is that the communities that are supplied with the resources take on the payments and costs of environmental services. This is a modality that interests the World Bank when considering offering loans.

However, in the executive part of the plan, the country's political structures must also be called upon to work on the issues. For the FUNDE team, water is not only a conflictive issue in Coatepeque, but by virtue of the very needs of the population as a whole.

They are sure that once having the final result of their study, anticipated by next July, some of the differences in needs among those affected will be highlighted, for example, whether it is more important to have water for irrigation or for human consumption.

Julio Quiñónez, Hydrologist and also a member of the consultative team of the Foundation, affirms that with the water balance study created, elements of the problem will be identified; however, the facts produced by this will also have to be taken as a reference for seeking solutions to the water problem on a national scale.

While the discussions follow their course and proposals towards solutions begin to emerge, Coatepeque Lake continues in its descent, waiting on Chac, whom the Mayas once implored to bring them rain.

## **A Lifesaver for Coatepeque**

( Last submission)  
by **Tomás Guevara**

**Before the rain arrives to mitigate the crisis of the lake that is shrinking, the storm of proposals begins to fall, but achieving consensus among all the users in the Coatepeque basin could unravel a true tempest.**

Completely still, as rarely occurs but few days ever, the waters of Coatepeque allow one to see peacefully, from deep within, the houses, docks, gardens and even its own basin, denuded of trees, reflected in the mirror of its surface.

This is a day in which the stillness of the water seems to indicate that the anticipated rains will be late in coming. By surprise, only a couple of hours go by before the waves begin to rise before the imminent presence of a gray cloud that appears as if having emerged from the Santa Ana volcano, before pouring in by streams into the lake.

This cycle of rains is the first hope of recuperation for Coatepeque Lake, which in the last three years has experienced a dramatic descent in its water levels, having lost some two metres in this short span of time.

The phenomenon has awakened concern, as much for the inhabitants, as among the state institutions in charge of environment and water.

### **Inputs for a Plan**

The causes of the water level's descent continue on a course for proof, sought out by those in charge of responding to the avalanche of questions generated by this phenomenon.

One thing is certain to Celina Mena, Technician of Hydrological Management of the National Service for Territorial Studies (SNET), who, by way of previous studies on Coatepeque and updated information, seeks responses to the complex crisis surrounding the lake.

Her unit's contribution will be to offer a complete diagnostic study so that from this, guidelines may be established that may help to structure a management plan for the entire basin.

SNET's motives are not gratuitous. Coatepeque as a body of water having a parameter of 35 kilometres and a maximum depth of 115 metres, is without any doubt the most significant water reserve in the western region of the country.

Not only does the Lake provide water to some 20,000 persons who live within and around the basin, the aquiferous body of Coatepeque nourishes the humid agricultural valley of Zapotitán and other water sources near the volcanic complex of Santa Ana.

According to Don Rafael Aguilar, who took up a water supply project some ten years ago for a community close to the Los Pinos Cooperative, the margins for action to protect the resource are limited.

The shortage of resources makes it impossible to establish a project to save the lake.

However, he does what is within his reach. Thanks to him, there is no garbage on his stretch of beach where the pipeline passes through to extract water for some 40 homes. Moreover, he has planted trees along the shore that are full of life.

His criticism is strong of those who, before constructing, hew down as many trees as may be obstructing their view of the lake. "They could build large houses without having to bring down all of the trees," he says.

But deforestation is only one of the factors indicated among the problems, although perhaps its reversal is the most viable palliative to consider that could serve to reverse the reduction in the water level of the lake.

### **Helpful Facts**

Before entering into the guidelines of a management plan for the lake, Federico Castellanos, who carried out a water study for the Coatepeque basin in 1999 under contract with the Coatepeque Foundation, refers to the conclusions proposed in his study to reverse the problem of the low water levels.

Castellanos identified the factors contributing to water loss of the lake. At that time, the majority of its volume was lost by condensation and by way of the natural outflows that fed into the Sucio River, for which he recommended a periodic control.

Another critical point signaled by the specialist was the deforestation of the basin, which needed to be

urgently recovered in order to improve the infiltration of rainwater into this major body of water.

Castellanos' study showed that human consumption, which surpassed one million cubic metres during one year, was merely the smallest source of water loss for the lake.

Already by that time, however, the change in water reserve levels during the rain season was generating numbers in the red.

During each cycle, it lost an average of 5 million cubic metres of water, that is, 4.46% of the total stored.

### **Voices of Commitment**

In 1998, an environmental law was adopted, but the majority of institutions turn a blind eye when it comes to putting it into effect, as a matter of cultural practice, according to the opinion of the Director of National Heritage of the Ministry of Environment and National Resources, Ernesto López.

In the face of this reality, his office takes charge to contribute to proposals to move ahead. And Coatepeque is in its sights, ever since a joint effort with the National Development Foundation (FUNDE), that anticipates generating inputs to establish an action plan for the basin.

The modality is that the users of the basin should pay for the services received from nature. But this proposal is yet to be sold over to the hundreds of families who have their homes along the shores of the lake.

### **Crossroads**

These projects on "payment for environmental services" enjoy the endorsement of the World Bank as a condition to release funds.

Enrique Merlos of FUNDE sees the realistic dimension of the situation in the Coatepeque basin. To him, it is not simply a question of placing prohibitions on farmers who continue to cut down trees to make agricultural use of the land, but rather, proposing alternative, environmentally friendly livelihoods.

And in the Coatepeque basin, given the issues, the owners of homes on the lakeshore could contribute to encouraging those who live on the outskirts to stop their harmful practices and work on reforestation projects throughout the zone.

Don Jesús Méndez is one of the community leaders of Potrerillos de la Laguna, located at the peak of the basin. Water stopped reaching his house when the water pump that supplied the 127 families of his village broke down, and the collective funds amongst the neighbours were not enough to have it replaced.

The suggestion offered during a forum organised by FUNDE a couple of weeks ago, at the office of the Coatepeque Labour Centre, was that reforestation needs to be well-planned.

To him, the solution lies in sowing fruit trees, "...because people practice burning to clear land to sow maize, but if what they would burn bears nourishment, they will be incapable of setting it on fire, and they will protect it," he says.

The solutions jump out everywhere, and those who already have their feet in a solution ask that they be looked to as an example. Isabel Morales, of the Salvadoran Association for Environmental Conservation (ASACMA), who executes a project to protect the Las Lajas Forest, considered to be the area of greatest water absorption for the basin, says that her entire community is involved in the work of protecting the 400 hectares.

The payment made by the neighbours to protect the resource is not monetary, plus they also receive something vital. Within the forest, there are water sources which, were it not for the forest, would have disappeared.

While the rains fall on the Coatepeque basin, the rise and fall of numbers are small. Before going any further, we must see what consolation the rain season may bring and what will be the human will of everyone together to throw a lifesaver to Coatepeque.

## **Teopán, the Green Jewel**

**In the Coatepeque basin, only the island of Teopán relies on a management and urban development plan.**

It looks as though is a big green hat floating along the southern side of Coatepeque Lake. In reality, they are 145 square blocks that comprise the island of Teopán, which in the Nahuatl language means "Home of the Gods."

The vegetation is exuberant and the fauna is so well recovered, that the garrobos (an iguana-like reptile), armadillos and squirrels allow themselves to be seen from just a short distance away.

But the island, that was condemned to depredation some 40 years ago, has recovered thanks to the intervention of the visionary plan of Don Antonio Cabrales, landowner of this portion of land over the last four decades.

When I came from the United States, I found the island and thought of it as heritage that we must leave for future generations," he said.

The advice of Don Francisco De Sola, his father, pushed him to seek out professional help to propose a future for this natural resource.

Don Francisco put him in touch with a prestigious international company in charge of developing management plans for this type of natural sanctuary, and this proposal still remains in force today for the owners of plots on the island.

### **Conservation First**

In 1970, a group of specialists from the "Sea Pines Company" arrived in Teopán from the island of "Hilton Head" in South Carolina.

The consultancy group designed a development plan that contained strict measures for the protection of flora and fauna on the island, and an urbanisation plan in balance with the environment.

The consultancy firm, recalls Cabrales, recommended that the housing in the areas resembling the brim of the hat and the top of the hat should conserve their primary forests.

No sooner said than done, of the 40 houses constructed on the island, the owners have committed themselves to respecting the norms mandated by the construction company.

Among the environmental requirements complied to by the owners is to use only those trees that are necessary to construct housing, which should be situated at a minimum of 50 metres from the edge of the lakeshore.

Another modality is that the houses should have no walls, except for natural barriers. And wastewater should be deposited as far away as possible from the edge of the lake.

There are no regulations on the exploitation of the land, and less so for the use of the lake water. The director of Natural Heritage of the Ministry of Environment, Ernesto López, says that the environmental law approved in 1998 likewise states that any construction should remain at a minimum of 50 metres' distance from any water resource.

However, in practice, the mandate leaves much to be desired. To him, beginning to comply with a law is an important step in resource protection. For now, the island of Teopán is the only sanctuary within the basin that shines like a green jewel.

### **FIGURE 1**

An Analysis on the Behaviour of Water Systems in El Salvador carried out between the years 2001 and 2002 by the National Service of Territorial Studies (SNET) indicates that surface water has diminished by 30 per cent, comparing current data registered on caudals with that registered in the decade of the 1970s.

In order to reverse this process, that can be most seriously observed in the Coatepeque basin, hydrologist Federico Castellanos recommended in 1999 the installation of at least two meteorological stations in the area to measure temperature, solar radiation, atmospheric pressure, wind direction and velocity, and evaporation. Besides this, he recommended the installation of a hydrometric station to conduct evaluations with precision on the variations in the lake's levels.

He also recommended the urgent reforestation of the basin's hillsides to support the replenishment of this water body, towards which the community of users should play an important role and should be informed regarding the balanced use of this natural resource, that is showing clear signs of endangerment.

### **FIGURE 2**

The only regulation on "Water quality, drainage control and areas under protection" was approved under Executive Bill No. 50, dated 16 October 1987.

Article 5 of said regulation calls for the protection and enjoyment of water resources in the country, which should be protected by a State entity created for such ends. However, to date, no such institution exists to take charge of enforcement and of protecting subterranean and surface-level bodies of water.