

Harnessing Nature

by Camilla Calamandrei

PROJECT 3D-VIEW

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www.trc.org.ls/water.html

Please note that quotations of children and adults in Lesotho used in this book are based on real comments made by residents in Lesotho communities relocated because of the construction of the Katse Dam.

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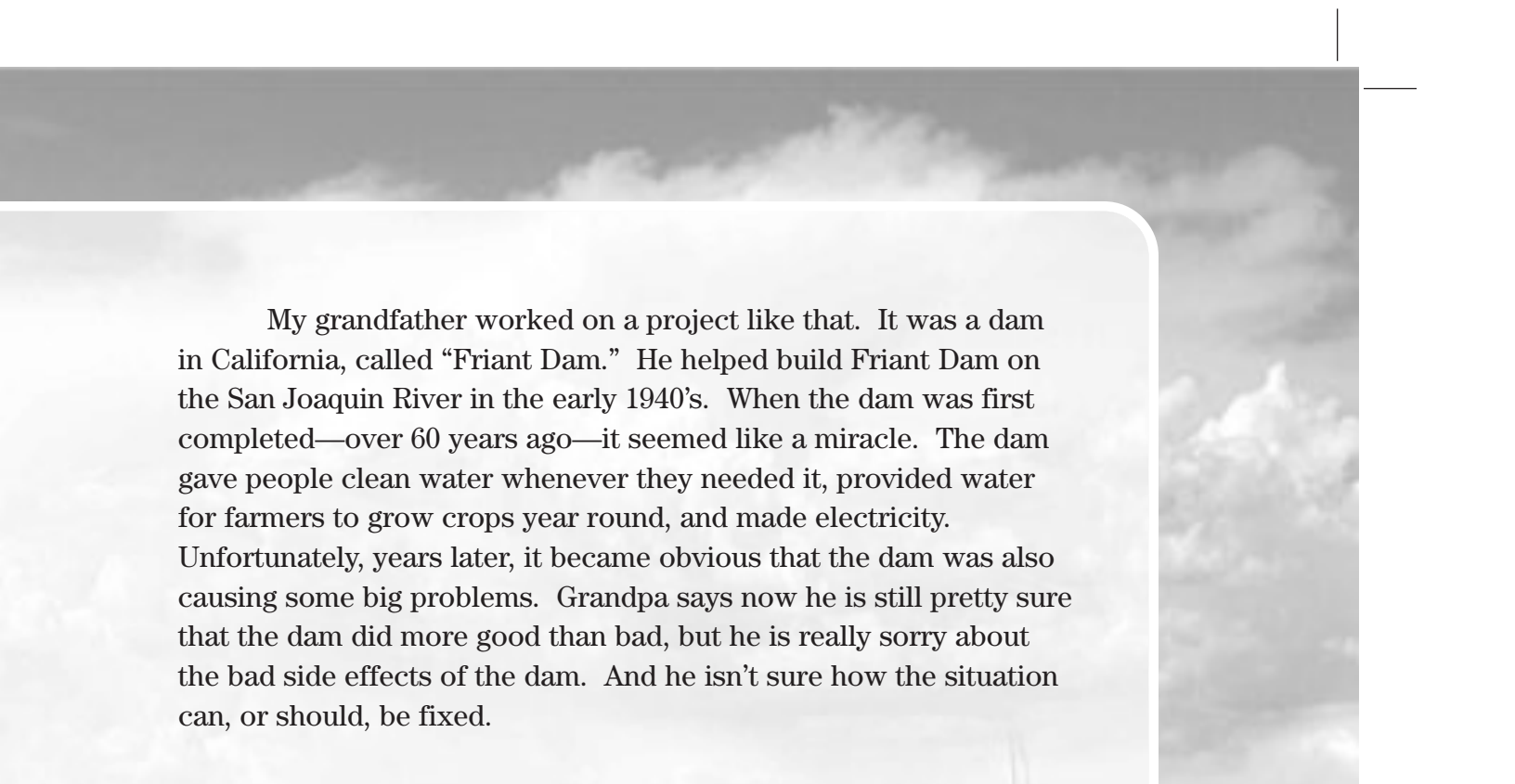
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Introduction

People make mistakes. We make them all the time. Little mistakes, big mistakes—it is only human. The strange thing is that sometimes we know right away that we have made a mistake. Other times it's not so obvious. And, it's only after time has gone by that we can see that, while we were trying to make something good happen, we also made something bad happen. I think that's the toughest kind of mistake to make; one where you think that you are doing the right thing, but in the end bad things happen too.



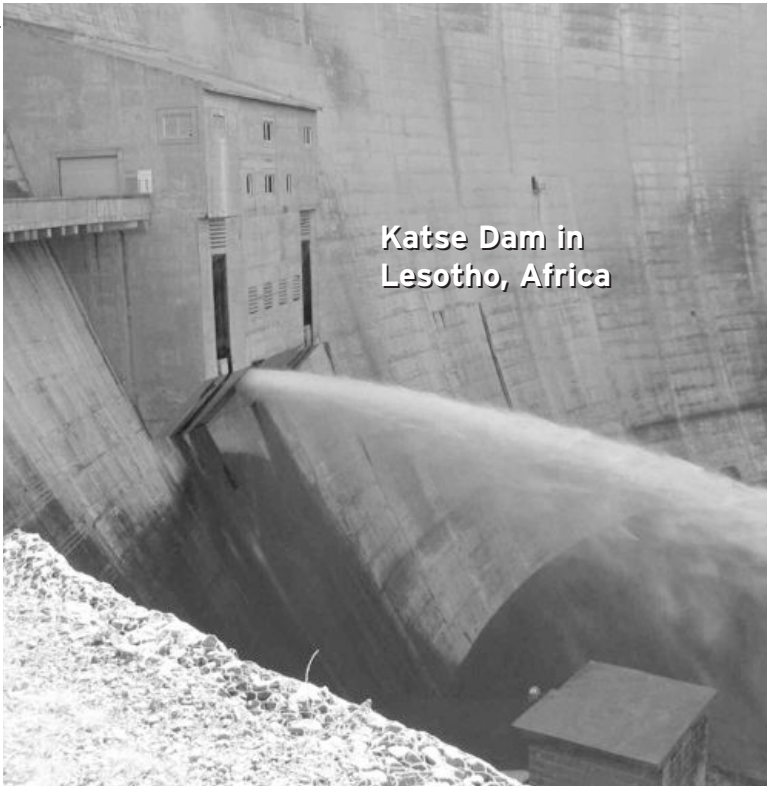


My grandfather worked on a project like that. It was a dam in California, called “Friant Dam.” He helped build Friant Dam on the San Joaquin River in the early 1940’s. When the dam was first completed—over 60 years ago—it seemed like a miracle. The dam gave people clean water whenever they needed it, provided water for farmers to grow crops year round, and made electricity. Unfortunately, years later, it became obvious that the dam was also causing some big problems. Grandpa says now he is still pretty sure that the dam did more good than bad, but he is really sorry about the bad side effects of the dam. And he isn’t sure how the situation can, or should, be fixed.



SIDE EFFECTS

A side effect can be good or bad. But, it is always something unintended; not the main thing that was meant to happen. For example, you could give your little brother a bath--which is a good thing. But your brother could get a lot of water on the floor of the bathroom as he gets out of the tub. And then later, he could slip on that water--which would be a bad thing. You never meant to let him get hurt. It was a side effect of giving him a bath and the fact that he splashed water on the floor.



Katse Dam in
Lesotho, Africa

This book is about Friant Dam. The problems it solved and the problems it created. And, it is also about a much more recent dam in Africa called “Katse Dam”—and the story of how that dam changed the lives of two girls living near the dam.

Today there are over 45,000 large dams all over the world. Each one of them has changed how a river flows.

And because of those changes in how the rivers flow, a lot of other things have changed. Read about Friant Dam and Katse Dam, to get an idea about how changing one thing in a system can change a whole lot of other things in that system at the same time.



Chapter 1

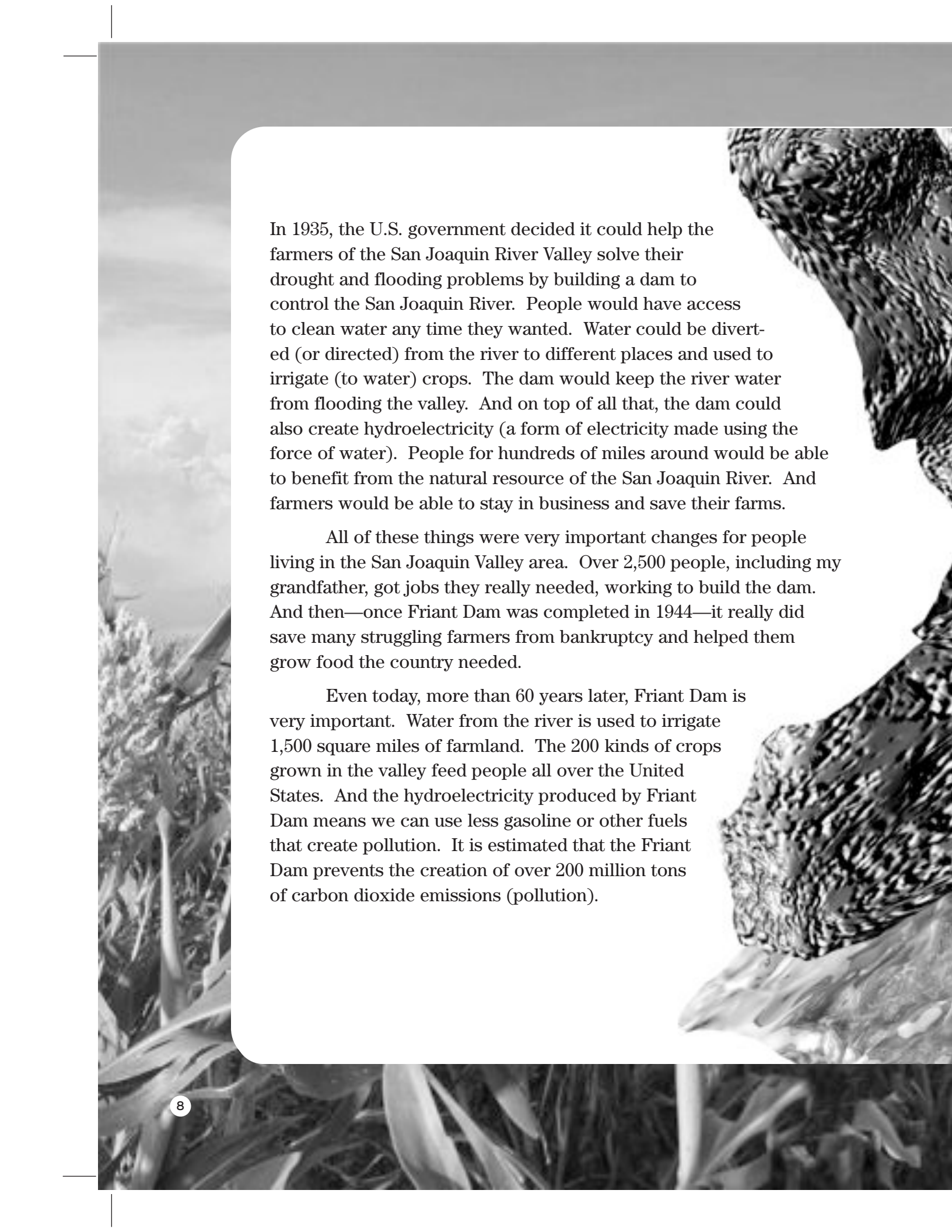
Friant Dam

In the 1800's (and long before) the San Joaquin River was a huge river. It started in the Sierra Mountains and ran for approximately 350 miles before it eventually ran into the Sacramento-San Joaquin Delta and the San Francisco Bay. The area it ran through was almost a desert. During the summer, when there was little rain the San Joaquin Valley was parched and the river was low. But in the spring—when there was more rain, and snowmelt from the mountains—the river overflowed and flooded the land around it. Farmers in the area realized they couldn't count on the river to be consistent. There were months when they didn't have enough water for their fields, and other months when floods would ruin the crops.

In the early 1900's, farmers solved the problem of too little water, by drilling wells to get water from deep under ground. (This didn't solve the problem of the river overflowing sometimes. But, at least with the wells, the farmers could get water when they needed it.) Unfortunately, after a few years, the ground water started to dry up. To make things worse, in the early 1930's there were several years of drought (almost no rain) in the area. The farmers couldn't grow anything. They were going to go bankrupt and lose their farms. And there wasn't enough food for the people or the animals.

The Three Gorges Dam in Hubei Province, China.

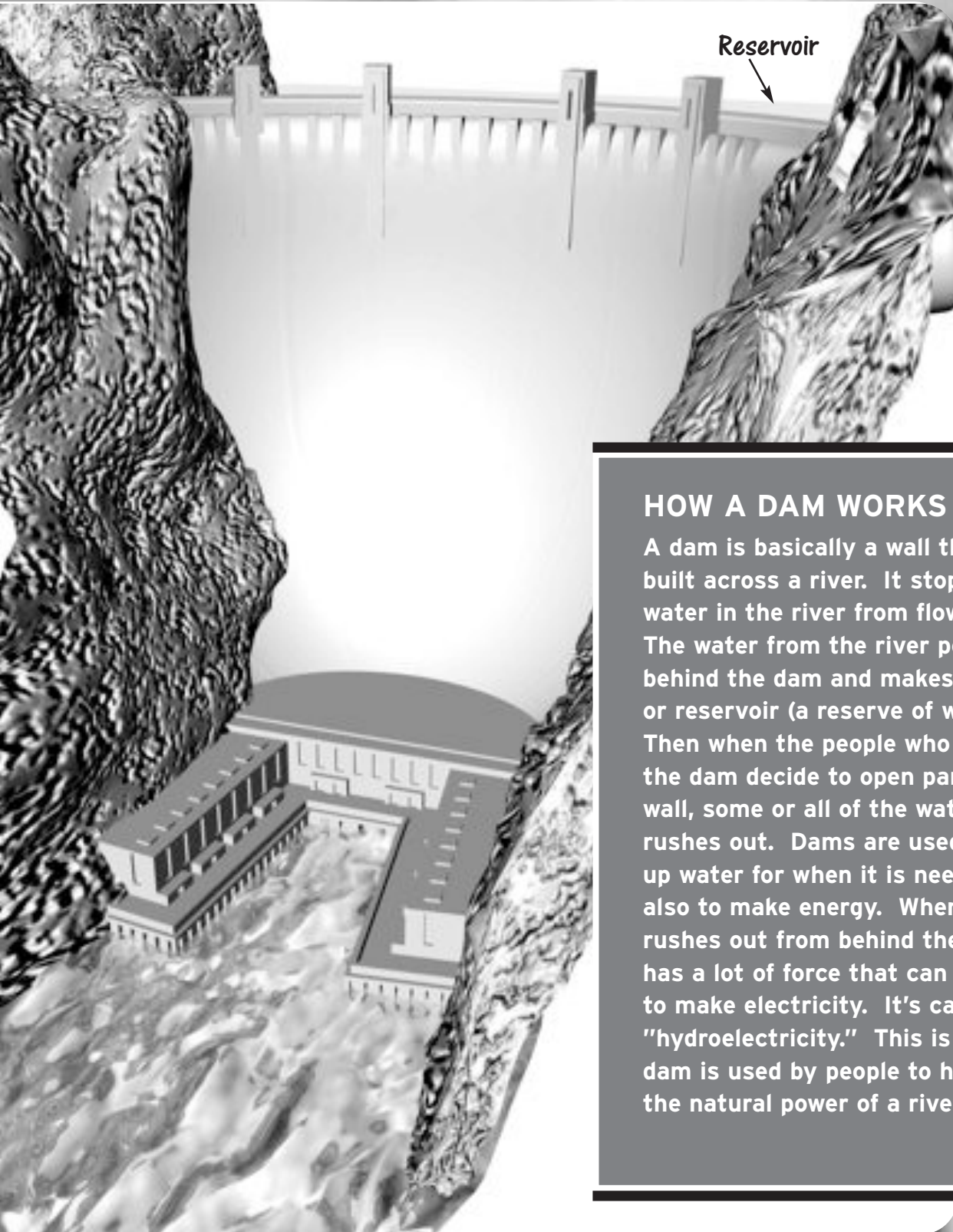




In 1935, the U.S. government decided it could help the farmers of the San Joaquin River Valley solve their drought and flooding problems by building a dam to control the San Joaquin River. People would have access to clean water any time they wanted. Water could be diverted (or directed) from the river to different places and used to irrigate (to water) crops. The dam would keep the river water from flooding the valley. And on top of all that, the dam could also create hydroelectricity (a form of electricity made using the force of water). People for hundreds of miles around would be able to benefit from the natural resource of the San Joaquin River. And farmers would be able to stay in business and save their farms.

All of these things were very important changes for people living in the San Joaquin Valley area. Over 2,500 people, including my grandfather, got jobs they really needed, working to build the dam. And then—once Friant Dam was completed in 1944—it really did save many struggling farmers from bankruptcy and helped them grow food the country needed.


Even today, more than 60 years later, Friant Dam is very important. Water from the river is used to irrigate 1,500 square miles of farmland. The 200 kinds of crops grown in the valley feed people all over the United States. And the hydroelectricity produced by Friant Dam means we can use less gasoline or other fuels that create pollution. It is estimated that the Friant Dam prevents the creation of over 200 million tons of carbon dioxide emissions (pollution).



Reservoir

HOW A DAM WORKS

A dam is basically a wall that is built across a river. It stops the water in the river from flowing. The water from the river pools up behind the dam and makes a lake or reservoir (a reserve of water). Then when the people who control the dam decide to open part of the wall, some or all of the water rushes out. Dams are used to save up water for when it is needed and also to make energy. When water rushes out from behind the dam, it has a lot of force that can be used to make electricity. It's called "hydroelectricity." This is how a dam is used by people to harness the natural power of a river.



Unfortunately there have also been some negative side effects from the building of the dam as well. Only 5% of the original river water is allowed to flow downstream past the dam. Farms and people consume the other 95% of the river water. This means the river below the dam is very different than it would be naturally. Today the river often runs dry just 37 miles below Friant Dam.

Habitat for different animals, plants and insects is affected by the reduced water downstream of the dam. One of the most dramatic examples is the Chinook salmon that once thrived in the river. Before the Friant Dam was built, it was estimated that over 15,000 Chinook salmon lived in the San Joaquin River. Every spring they would swim up river to return to their spawning (or breeding) grounds. This is where they would lay and fertilize eggs that would become baby salmon. Because the Friant Dam blocks the river, the salmon can't make it back to their spawning grounds to the north. (On other rivers

FISH LADDERS

Since fish don't have feet it is funny to think of them going up a ladder. But they do. A fish ladder gives fish a way to go around and past the wall of a dam. A fish ladder has a long string of interconnected pools arranged as "steps." The fish follow this path of pools from the pond below the dam to the pond or lake above the dam. At one dam in Canada, they report seeing over 450,00 fish go up their fish ladders in May, 2003. That's a lot of fish!



in California something called a "fish ladder" has been built so the salmon can get around a dam. But Friant Dam doesn't have a fish ladder.) And, because of the lack of water downstream from Friant Dam, salmon are having a hard time surviving there as well. This has meant that for over 60 years, there have been few salmon for fishermen to catch and for other animals to eat.



Another problem that has shown up downstream of Friant Dam is toxic, or poison, water. Because so little clean river water passes through Friant Dam, any chemicals or pollutants that enter the river below the dam are not diluted (or watered down). For example, some of the clean river water that is used to irrigate crops does eventually dribble back to the San Joaquin riverbed through the soil. By the time this water gets back to the riverbed, it is carrying pesticides (chemicals to kill bugs) that are used on crops. Cities along the river, and the canals that lead to the river, also dump dirty water that flows back to the riverbed. The pesticides and city run-off make the lower miles of the river especially toxic during the hot summers when there is also little rain.

Because of the intensity of the toxins in the lower part of the river, some scientists now say the river is dying. They say the only way to save the San Joaquin River is to take Friant Dam down—so that all the river water can run naturally. But can they do that? It turns out there is no easy answer to this question.




My grandfather and lots of other people say farmers still depend on the dam. And that taking down the dam would ruin the multi-billion dollar farming economy of San Joaquin River Valley.

On the other hand, ecologists and fishermen think the river needs to be restored. In 1986 a group of ecologists and fishermen started a lawsuit to get more clean water running downstream of Friant Dam, so the river and its salmon population could recover and thrive again. Farmers in the area were upset that water they needed for crops would be sent down river instead of to their farmland. (They said they would be forced to use more ground water, which environmentalists say is already over-used.) It took 17 years for a federal court to finally decide that more water should run down river to help maintain the historic salmon population. That decision was made in 2004, so we do not know yet if enough water has been released for the river to recover. And we do not know yet what the side effects of this compromise will be; especially if farmers use more ground water to make up for the river water they are losing in this deal.

DO RIVERS DIE?

Some environmentalists say that a river is dying, or dead, when it can no longer support fish life. This can happen for a number of reasons. But, one example would be a river where a lot of water has been diverted to farms by a dam. Not only would there be less water in the river below the dam, but eventually fertilizer from the farms would seep into the ground water and back into the river. That fertilizer would then cause algae, a kind of plant, to bloom in the river. After a while, there would be so much algae in the river, that it would use all the oxygen in the water, and no fish would be able to live in the river anymore.



And, as you can imagine, the water issues related to Friant Dam don't end there. In 2006 a developer announced plans to build a large group of new homes on Lake Millerton (which is the lake/reservoir that was created when Friant Dam was built). He wanted a guarantee that there would always be enough water in that lake, and filed a lawsuit to get an agreement from the government never to empty the lake. Of course, if they ever took Friant Dam down, the lake/reservoir would empty as all the river water returned to its natural flow.

Another recent twist regarding Friant Dam was that there was a record amount of rainfall in 2006. The dam had to release more water than planned, and it had to do it in large bursts. This meant that the people who live downstream had to worry about flooding again. These kinds of floods are good for renewing the land and the river, but they are bad for businesses along the river, like fish hatcheries.

As my grandfather says, when we are dealing with nature, we never control all the factors—even if we would like to think we do.



Engineers have learned a lot since 1944 about dams and their effects on nature and people. Today some things are done to build dams that are less damaging in some ways than Friant Dam. But at the same time, enormous dams continue to be built around the world as the demand for water and energy only increases.

In each situation when a dam is going to be built, the people in power need to decide if the benefits of having a dam will outweigh the negative side effects. Dams can make life better for some people, but now we know they also cause health problems for people and the environment. Should we keep building them? The next story is about two girls in Africa who live near a dam that was built just a few years ago. Some good things and some bad things have happened because of the dam. See what you think about their story.

DO DAMS DIE?

Dams need to be maintained, or they become unusable, or even worse, they can collapse. This happens because of the buildup of silt behind the wall of a dam. A river always carries very small rocks and pieces of soil as it flows downstream; we call that material "silt." When the river gets to a place where the flow stops, or slows down a lot, the silt is deposited. Because a dam blocks the flow of a river, all the silt being carried down the river gets deposited, and starts to build up in the reservoir right behind the dam. Over time, there gets to be so much silt in the reservoir that it creates pressure on the dam wall, and also fills up the reservoir so it can hold less water. At that point, engineers have to clean out the silt from the reservoir, or take down the dam. Of course, if they take down the dam, they still have to think about what is going to happen when all that deposited silt comes down out of the reservoir.

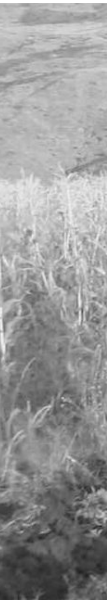
Chapter 2

Life in Lesotho, Before the Dams

Imagine that it is 1995 and you are visiting two nine year-old girls who live in the mountains of a country called “Lesotho, Africa.” We’ll call the girls “Femi” and “Rada.”

Femi and Rada are best friends. They live in a small village and they do everything together. That is pretty easy, because they live next door to each other, in the same village. Everyone in Femi and Rada’s village live in small stone huts with grass roofs. They sleep on mud floors. You are surprised to see that no one has a TV or radio or running water in their house.

Femi and Rada’s families are poor. So are all the other families living in the Highlands. (*Highlands* is what the local people call the mountains). Very few people in the Highlands of Lesotho have paid jobs. So people have to work hard to: grow their own food, build their own houses, and gather wood to make fires for cooking and staying warm. Women and girls are in charge of getting water from the well, preparing meals, doing work in the garden, and collecting wood and dung (dry animal manure) for cooking and heating. Girls are also responsible for plastering the walls of huts to make sure they are solid, cutting grass for roofing, and weaving items from grass.





Men and boys are in charge of milking cows, plowing fields, cutting grass, and looking after the animals (mostly sheep and goats). Some of the animals are kept in fenced in areas near the huts. But most sheep and goats have to be taken out to graze (or eat) high on the slopes of the mountains. The boys who are shepherders can't go to school because they have to be out all day with the animals. You even see old women washing blankets in the river. There is a lot of work for everyone to do.

Fortunately Femi and Rada are cheerful. They don't mind doing the chores as long as they can do them together. Femi likes the songs that Rada makes up. And Rada thinks Femi is very funny. She laughs at Femi's jokes all the time.

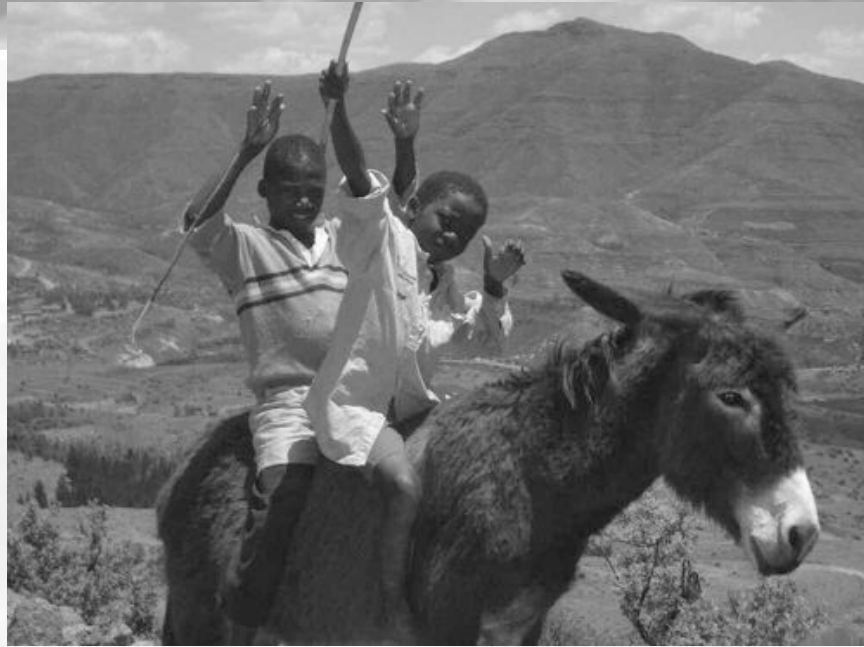


You find out that Femi learned to tell jokes from her dad. They say he is really funny. Unfortunately, he isn't around much because he has a job far away. Femi's dad works in the coalmines in South Africa (the country next door). He only gets to come home every few months. Femi misses her father. But everyone in the family knows that he has to keep the mining job as long as he can. Their family needs the money. Even though they can do a lot for themselves, they need money to pay school fees, and to pay for medical services and clothes and any food they can't grow themselves.

Femi's mother tells you that she makes a little extra money by farming some land that they own. She doesn't make a lot of money. Still, the family can feed themselves all year round from the crops they grow. And they also grow enough corn to make homemade corn beer that they can sell.

Rada's situation is a little different. Rada's father was once a miner, like Femi's dad. But, he got sick and lost his job. He is home now and can't work. He has a lung disease that he got from working





in the coalmines. Fortunately, Rada's father bought sheep, horses, goats and cattle with the money he made in the coalmines. So even though they don't own much land, they have a large herd of animals. Rada's two brothers are in charge of the animals. Once in a while the family sells a goat for money or kills one to eat.

Rada's mother and grandmother also do some things to make money. Rada's grandmother gathers special plants from the fields and uses them to help cure people who are ill. And Rada's mother grows a few crops on a small piece of land that belonged to someone else. (That is called "sharecropping," and basically it means they have to pay the landowner to let them use the land.)

You can see that life in the Highlands is definitely hard, especially in the winter. The houses are cold, and they smell of smoke from all the wood they have to burn to stay warm at night. Femi and Rada offer to share their lunch with you. You eat it without complaining but it isn't what you are used to. These families have to live off food they grow themselves. And what they mainly grow is cabbage, onion, potatoes and corn. So they are eating cabbage soup and cornmeal mush. The girls tell you that they eat this for lunch pretty often.

Chapter 3

A Plan for Five Dams

While you are visiting Femi and Rada's village, you learn that the Lesotho Government has started building a large dam just a mile away. They have been working on it for four years and it should be completed by 1998. Eventually the government is going to build three or four more dams on other rivers in the Highlands as well. The first dam—that is already being built— will be the largest dam of the group. It will be called "Katse Dam." The government's plan is that both water and hydroelectricity produced by the dams will be sold to the rich, neighboring country of South Africa.

When Katse Dam is completed, it will block the water flow of the Malibamatso River. The canyons and valleys behind the wall of the dam will fill with river and rainwater. Miles and miles of farmland and grazing area for animals will become one huge lake.

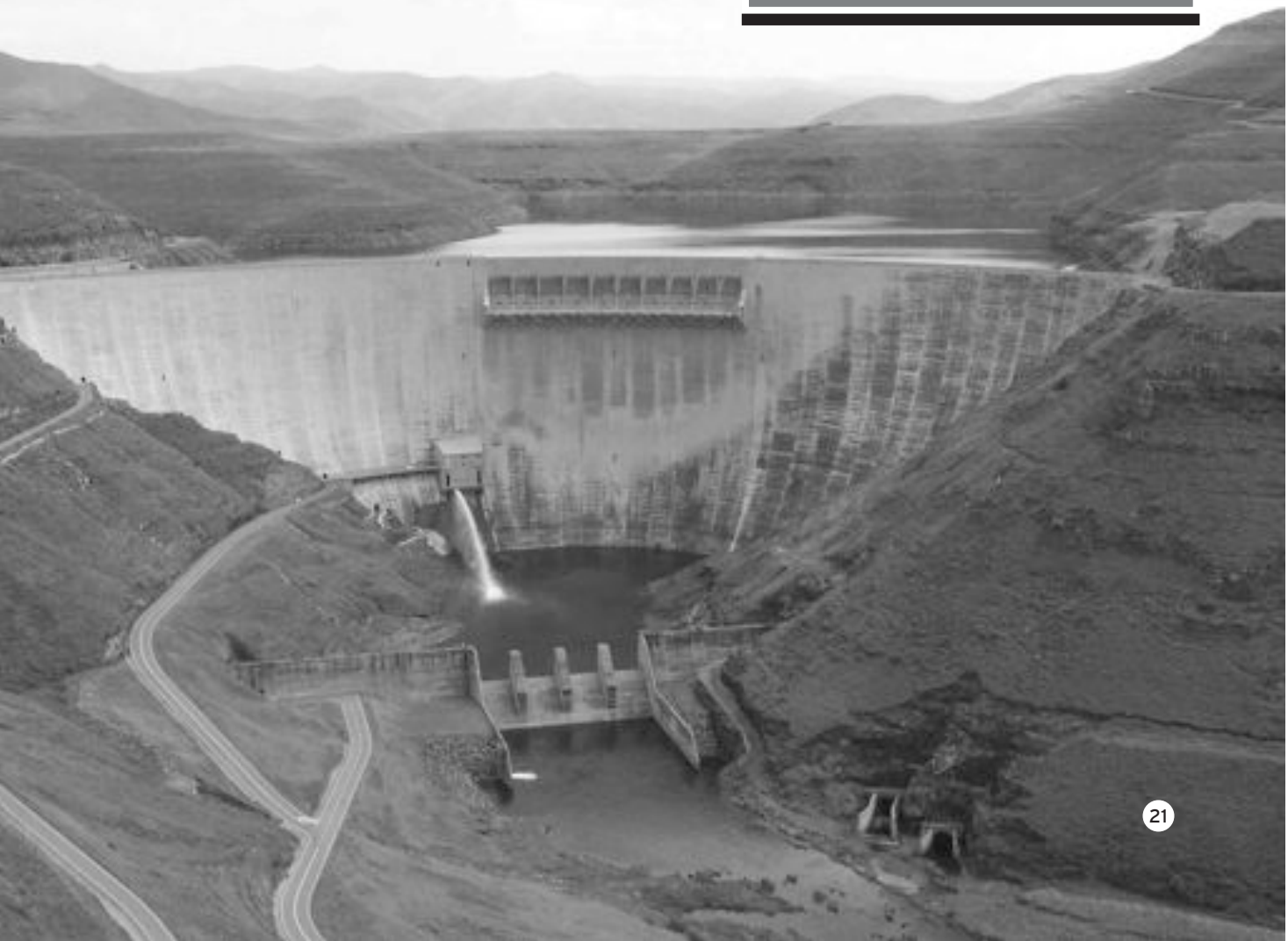
Because so much land will be flooded and made into a lake, many villages (including the one where Femi and Rada live) will need to be moved. People for miles and miles around the dam will have to give up their houses, as well as their farmland, and grazing areas for their animals. Some will need to move because their village will be under water. Others, whose villages won't be under water, may choose to move because the chance of earthquakes is greatly increased whenever a really big dam, like Katse Dam, is built.

The government's plan is that people who live in the Highlands near the dam site will give up their land and go live somewhere else. The government will give them a new house and a piece of land, or money, in exchange for what they give up. People are split in their reactions to the news.



EARTHQUAKES AND DAMS

Dams are usually built in valleys and a lot of valleys have an earthquake fault under them. When a dam stops the river flow and water builds up in the reservoir, there is a lot more water weight in that area. That can make the area vulnerable to earthquakes as the ground under the reservoir settles under the extra weight.





Femi's mother tells you she is happy to have a chance to move to a new place. She is tired of life in the Highlands. Plus she has heard that she will be given a new house for her family and some money as compensation, or payment, for the land she is giving up. "They have promised to build us houses," she says. "Besides that, there is money which will be given to us for the upset of leaving our village, fields, trees and other things."

Femi says the government told her family that they can choose to live in another village in the Highlands or in the lowlands which is what they call the areas that are not in the mountains. She thinks her mother will want to live near a city.

Unlike Femi's mother, Rada's mother and father aren't so happy about the changes that will come with the Katse Dam. They are sad to think of leaving the place where they have lived all of their lives. They don't want to see their huts disappear under water. They don't want to give up their land and they are worried about all

of their relatives that have been buried near their village. The people of Lesotho believe that relatives must be visited and cared for even after they are dead. They are worried that their relatives will be unhappy being moved, or worse, will be buried under water.

“My life is very good. I do not have any problems and I do not see why I should move,” grumbles Rada’s father. Her oldest brother feels the same.

“A lot of things about living here make me happy—especially when the family has plenty to eat and the animals are doing well.” he says. Rada’s father and brother tell you their concerns about moving their herd of animals to a new place. “The grazing is good where we are. Maybe in a new place it won’t be as good,” says Rada’s brother. “What if there are people there who might steal animals?”



Of course, Femi and Rada are sad at the idea that they might not live near each other after their families relocate. The decision of exactly where to move will be an important one for each family. Another village will have its own people who have lived there for a long time. The resettled people will be newcomers. Also, families that have lived near each other for their whole lives will not necessarily choose to move to the same place. Even within families, older people might make a different choice than younger people. Families might split up.

Femi tells you that it would be nice to live nearer to a road. But her brother pipes in that it would be bad to end up in a new location that is farther from a water source than where they live now. Femi and Rada's village actually has four springs—one that gives water even when there is drought. It would be very strange,





and a bad thing, if they moved some-place where they needed to walk far to get water. Imagine moving so other people could have more water, and ending up with less water yourself! That would be really unfair.

The good news is that the Lesotho Highland Development Authority promises money and food as compensation every year for 50 years to families that must relocate. And officials say that if there is no spring water near new homes, a pump will be built for the resettled people and they won't have to get water from a well far away.

The bad news is that a total of 20,000 people will have to be relocated because of the dams. It is hard to understand why the government of Lesotho is making the decision to build the dams when so many people will have to move.

Rada's father explains that Lesotho is a poor country with very few resources—except for water and mountains. The people in power want money and there are few ways to make money. The deal to sell this water and power to South Africa will double the amount of money the entire country makes in a given year. So, the government has gone ahead and agreed to sell water and hydroelectricity to South Africa.

The water and electricity is specifically for a fast-growing area called “Gauteng Province South Africa.” Gauteng Province has water but the number of businesses and factories keep growing—so demand for water and energy keeps increasing.





The government of Lesotho promised its own people that it would use some of the money it makes to bring development—or improvements—to Lesotho. “They say they are going to build schools and make the roads better,” Femi tells you. “They even say that the dams will provide electricity to some places in Lesotho.”

On that cheerful note, everyone is quiet now. No one wants to talk about the changes to come anymore.

NATURAL RESOURCES

Many countries are rich or poor, depending on their natural resources. Some countries have oil, gold and other minerals, excellent fishing, or good farmland. Lesotho only has two things in great quantity—mountains and water. By having water so high up in the mountains, they didn’t have to use any energy to get it to run downhill.

Chapter 4

Return to Africa

Now imagine that eight years have gone by, and you have a chance to go back to Africa to see how Femi and Rada and their families are doing. It is 2003. Katse Dam has been up and working for almost five years. This time you fly into Johannesburg, the capitol of South Africa, because it has a much bigger airport than the one in Lesotho. You will drive from South Africa into Lesotho.

When you arrive in Johannesburg, you are surprised to find that it is a big, modern city with skyscrapers, lots of traffic, big hotels, and suburbs for miles and miles around it. The city sits in the middle of the area called “Gauteng Province.” This is the fastest growing area in South Africa. It is the area that is buying water and power from the Lesotho dams. You notice that even though Johannesburg is built on desert land, there seems to be water spilling out everywhere. Houses all have green lawns. Poor neighborhoods have pipes leaking water all over the place.

On the drive from Johannesburg to Lesotho you pass miles and miles of farms along the way. There are sprinkler systems shooting glistening water onto the crops. You can’t help but wonder if this might be water that started in the Highlands of Lesotho.

JOHANNESBURG, SOUTH AFRICA

Joburg (as locals call Johannesburg) was a poor city once but you wouldn't know that now. In 1886 a miner found gold and the area became a financial center with its own mining industry, bank and stock market. Over time, all that gold provided money for business and industry to develop. And now the entire Gauteng Province is the main industrial center of South Africa. That means there are a large number of businesses: mining for gold and other minerals, growing vegetables and fruit, and making things like chemical products, machinery, electric appliances and vehicles. South Africa exports, or sells, things such as gold, machinery, appliances, etc. to other countries including Japan, Italy, the United States, and Germany. South Africa also imports, or buys, a lot from these countries, including textiles, clothes, and mining equipment. All this making and selling is why the government of South Africa wants the extra water and electricity from the dams in Lesotho. The more the country can make and export, the richer it becomes.



As you are driving, you think to yourself about all the ways that your family uses water at home—brushing teeth, taking a bath, making coffee and tea, washing dishes, washing clothes, watering the lawn, washing the car, washing the dog, filling the swimming pool, and filling your super-soaker guns. Your family uses as much water as the people of Johannesburg but it's confusing to see the water being used so freely in Gauteng Provinces since you know it is coming from a country that needs it as much as South Africa does.

As you think about it, you realize that the twist in this story is that the water could be more efficiently used in the Lesotho precisely because it's naturally wetter there. In other words, Gauteng Province needs this water because it doesn't have much. To make a green lawn there you have to use twice as much water as you would need to in Lesotho where the ground is already a little wetter. Taking water from Lesotho to use in Johannesburg is basically like taking rain from a normal place to try and water the desert. You



deprive the first place of what it has naturally, and you use at least twice as much to get some result in the new place.

It would be better just to let the rain do what it does naturally in the place it is. But, because the gold was found in Johannesburg, that's where the people and business developed. So that is where the money is now. Almost by default, the needs of those businesses made the decision for Lesotho to give up their water. It's almost like the money and the demand made the choice to move the river water, more than any real people did.

E DAM seen from the back

Chapter 5

Life with Katse Dam

When you get to Lesotho, you are eager to see how Femi and Rada are doing. You go directly to find Femi's family. They have moved from the Highlands to a village outside the capital city, Maseru.

When you arrive at their house, Femi is still at school. It turns out that now all the kids in the family go to school. Femi's mother pays the school fees with the money she receives as compensation for the land she gave up. Life is very different here. Femi's family must buy food rather than grow it themselves. They also must buy fuel for heat rather than collect wood and dung. The good news is that they have a heater inside their house, so they don't get so cold in the winter.

Femi's mother is happy to see you and she says life is good near the city. She is proud to be able to send all of her kids to school, and happy that roads make it easy to get to the doctor or to a store. But she admits that there is a problem with the fact that the government payments come at the end of the year. She needs to pay the school taxes during the year, so she has to borrow money to do that while she waits for the government money. As a result, she is often nervous that the money won't come and they will be ruined by their debts (money they owe). Also her husband, Femi's father, has been laid off from the gold mine in South Africa because he had become ill. So now he is home, but not able to get a new job. The family seems to worry more about money now than they did before. Mostly because they don't have any land on which they can grow food themselves.



When Femi shows up from school, she looks all grown up. Now she is 17 years-old. She shows you around the neighborhood. In this village there are lots of families living in modern houses. The houses are very close to each other. There are paved roads nearby, and each family has a small yard for a little garden, but no animal pens.

She says “Katse Dam is good and bad. The dam project brought some paved roads and schools to the people in the Highlands. Now people can get places without arriving all dusty and dirty from walking. Also, there are some clinics now.” She tells you that several thousand people had construction jobs working on the Dam. But now that the Dam is finished they are out of work again. Also, for the people—like her family—who gave up their fields, homes, grazing land, and other property, it had been a huge change of lifestyle.




Femi says her dad has taken it the hardest of everyone in the family. He misses making his own living and wishes he could at least grow his own food. But he must live off of the money given to them by the government, because they have no land. Even her brothers who enjoy school said they missed being with the other shepherders. One of her brothers said that the lowland kids were as smart as the Highland kids but they didn't know all the songs and games the kids in the mountains knew. Still he appreciates getting an education. "I am getting through school very fast. Before I would have to do many grades over again because I had to work in the fields. Now that is not a problem."





You ask Femi about Rada. She says she has heard a little from Rada but doesn't get to see her very often. Rada's family still lives in the Highlands but they have moved twice since the dam was built. The first place they moved was still too close to the dam, and had an earthquake. As the wall of the dam was being built, water was filling up behind it in the reservoir. As more water filled the reservoir, there was pressure on the ground below. The earth





under the reservoir had to adjust to the pressure. Finally, there was a pretty big earthquake that made a big crack in the ground. Rada's family decided they didn't want to stay so close to the dam. So they moved to another village, but stayed in the Highlands.

A couple of year later, Rada's father died from the lung cancer he had gotten while working in the coalmines. He was only 52. They were all sad about that, of course.

Also Rada's grandmother isn't very happy these days because two of the plants she used to heal people were wiped out when the land behind Katse Dam was flooded. And the plants don't exist anywhere else, so she cannot help people or make extra money that way anylonger.

You tell Femi that you would like to see Rada again, and also the completed dam. She says the dam is both very impressive and scary. She asks you to say hello to her dear friend Rada for her.

As you leave to make your way up into the Highlands, you think about all the changes you have seen just in Femi's family alone. It's confusing. It seems good that Femi and her brothers get to go to school, that it's easier to get to the doctor and that they have a heater for winter. But it is sad that they feel poor and still don't have jobs, and that they can't be together with their friends in their old village.

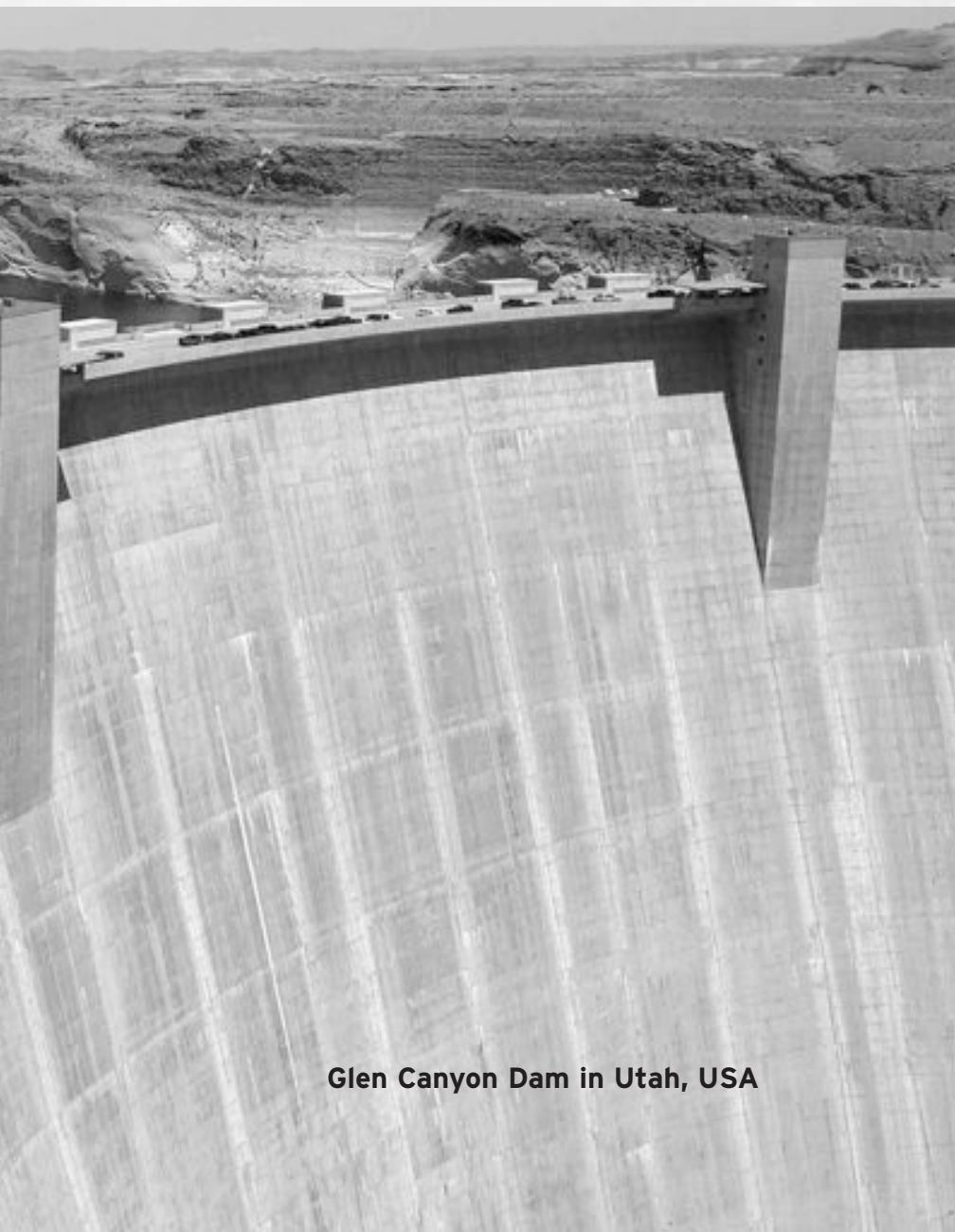
How could you decide what is better? To go without money for roads, and clinics and schools? Or to give up the traditional way of living, the home you grew up in, the land that your animals live on? It seems like an impossible choice. Kind of like having to choose between supporting farmers (and their families) or fishermen (and their families) in California.



When dams were first built in the 1930's and 1940's the builders didn't know as much about the possible problems dams could cause. But now we know a lot. When we build a dam today, the side effects are not as much mistakes, or surprises, but accepted trade-offs that we are choosing to make. Since our need for water and power is not decreasing, we keep building dams to harness the power of nature. And the same questions about the trade-offs—of good and bad effects—keep coming up every time a new dam is built.



Humans have been building dams all over the earth at a fast pace for seventy years. Today, one-fifth of all the electricity that people use comes from dams. And the water that dams supply contributes to one-sixth of all the food produced for human consumption. But more than half the major rivers on the planet already have dams built on them. And the dams themselves won't last forever. So before it is time to start replacing them it is probably time to look for some alternative solutions for getting people clean water and power.



Glen Canyon Dam in Utah, USA



Series After Word

In the two stories you just read, people in the United States and in Africa each changed just one thing in their natural environment—the course of a river. And in each situation, the change in the flow of the river ended up changing the lives of thousands of people, animals, insects, and plants even when no one wanted or intended that to happen. This isn't an unusual thing. Every time we change something about how nature works, we are having an impact on a complex web of systems. No system stands alone and every system is always being affected by other systems.



Each of the Earth systems—Lithosphere (Earth), Hydrosphere (water), Biosphere (life), and Atmosphere (air)—has its own characteristics and patterns. But the characteristics and patterns of each system are constantly affected by events/behaviors,

and changes in other systems. People—who we could say are part of the biosphere—are particularly powerful agents when it comes to effecting change in the earth systems. But nature itself causes changes and those changes then have ripple effects through many systems.

For example, the creation of a tidal wave or tsunami is the result of activity in the lithosphere that affects the hydrosphere. When pressure is released from the molten core of the Earth, tectonic plates that make up the earth's crust are pushed into new positions. In some cases, tectonic plates on the floor of the ocean may move and, in turn, displace large amounts of water, thereby creating a tidal wave or tsunami.

Another example would be the alteration of farmland into desert. If wind patterns shift, desert sands may be moved, making land that was once usable for growing crops into desert. Then the people and animals who live on the farmland would face starvation and need to move. Because no earth system stands alone, we have to be careful about every choice we make that changes how something on the face of the Earth functions.

