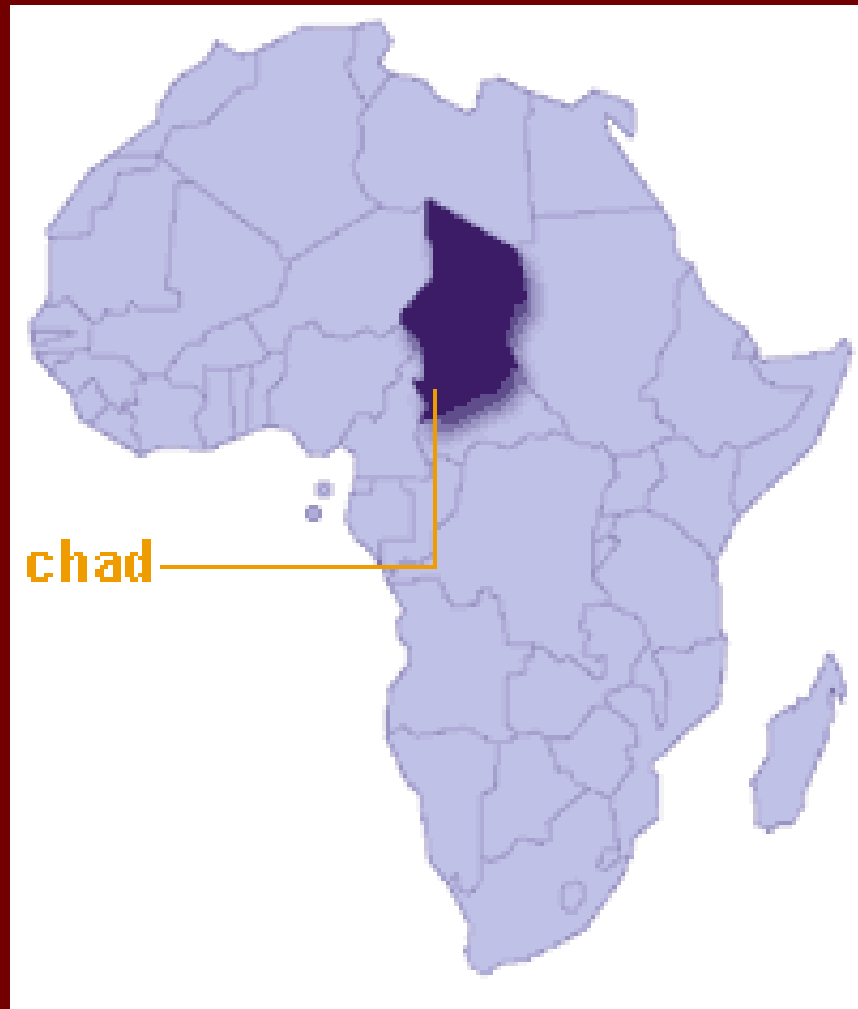


Adventures in Irrigation Engineering: *Lessons from Texas and Around the World*

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Guy Fipps, PhD, P.E.
Professor and Extension Agricultural Engineer
– Irrigation, Water Management

First Job as an Irrigation Engineer 1985 for CARE-International in Chad





ALGERIA

LIBYA

EGYPT

NIGER

S

A

H

A

R

A

BODÉLÉ
DEPRESSION

ENNEDI
PLATEAU

CHAD

Lake
Chad

Mao

Koro Toro

Abéché

QUADDAÏ
PLATEAU

SUDAN

N'DJAMENA
Mongo

Am Timan

Chari

Bahr Aouk

Bongor

S

A

H

E

L

Logone

Lai

Sarh

Moundou

CENTRAL
AFRICAN
REPUBLIC

CAMEROON

NIGERIA





Assignment – find a low cost method of improving the traditional Shaduf irrigation system in Chad's wadi's







*Why didn't
someone else think
of this?*

Is this what they
mean by thinking
out of the box?

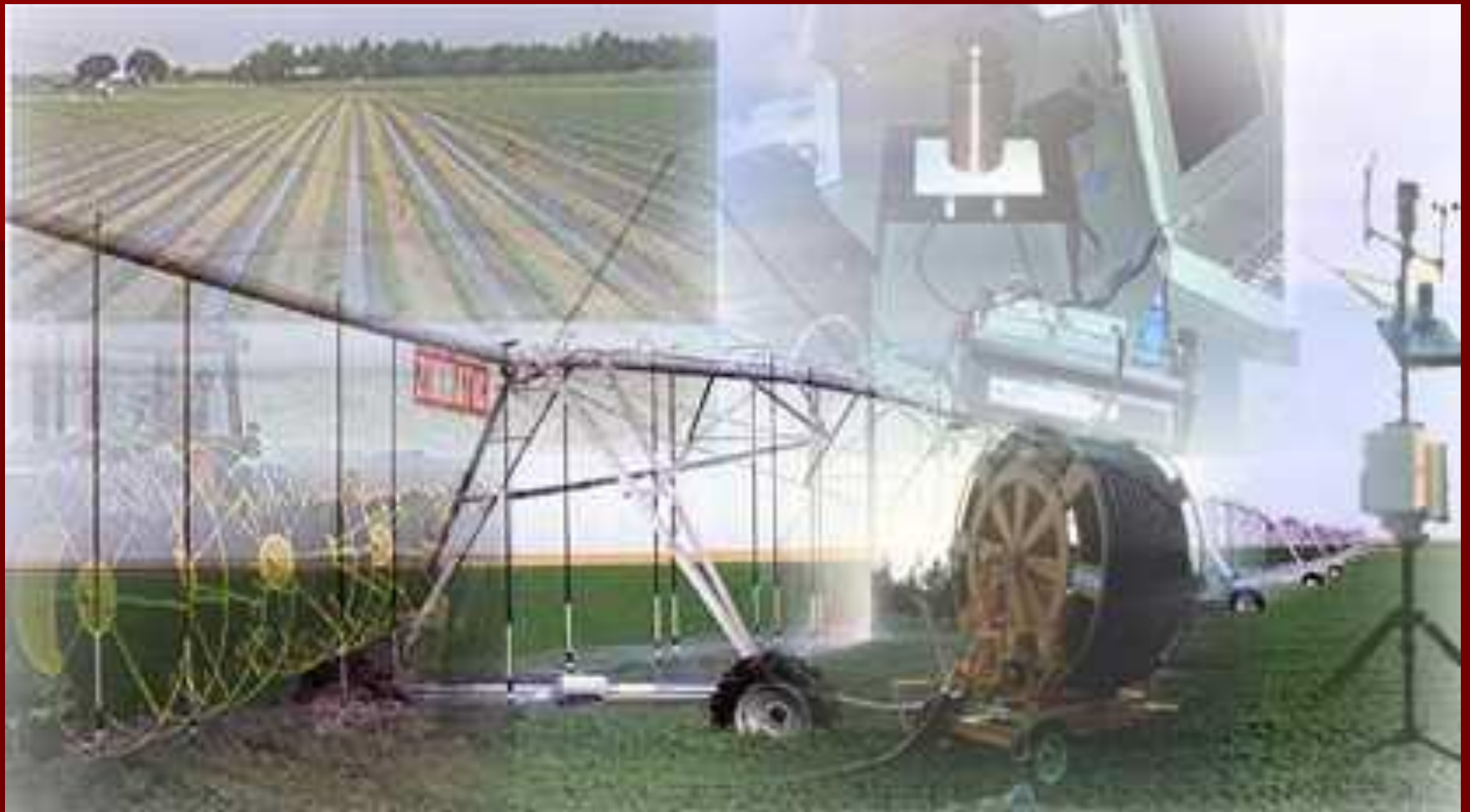


The other lesson I learned in Chad....



*..is don't locate a rice irrigation scheme
in sandy soil!!*





The 1980's saw a revolution in irrigation technology, including the introduction of LEPA, drip tape and surge flow valves....

1988 – Employed as an Extension Irrigation Engineer



- LEPA was just beginning widespread use on the Texas High Plains
- Developed by TAMU Irrigation Engineers
- Works *"like a charm"*

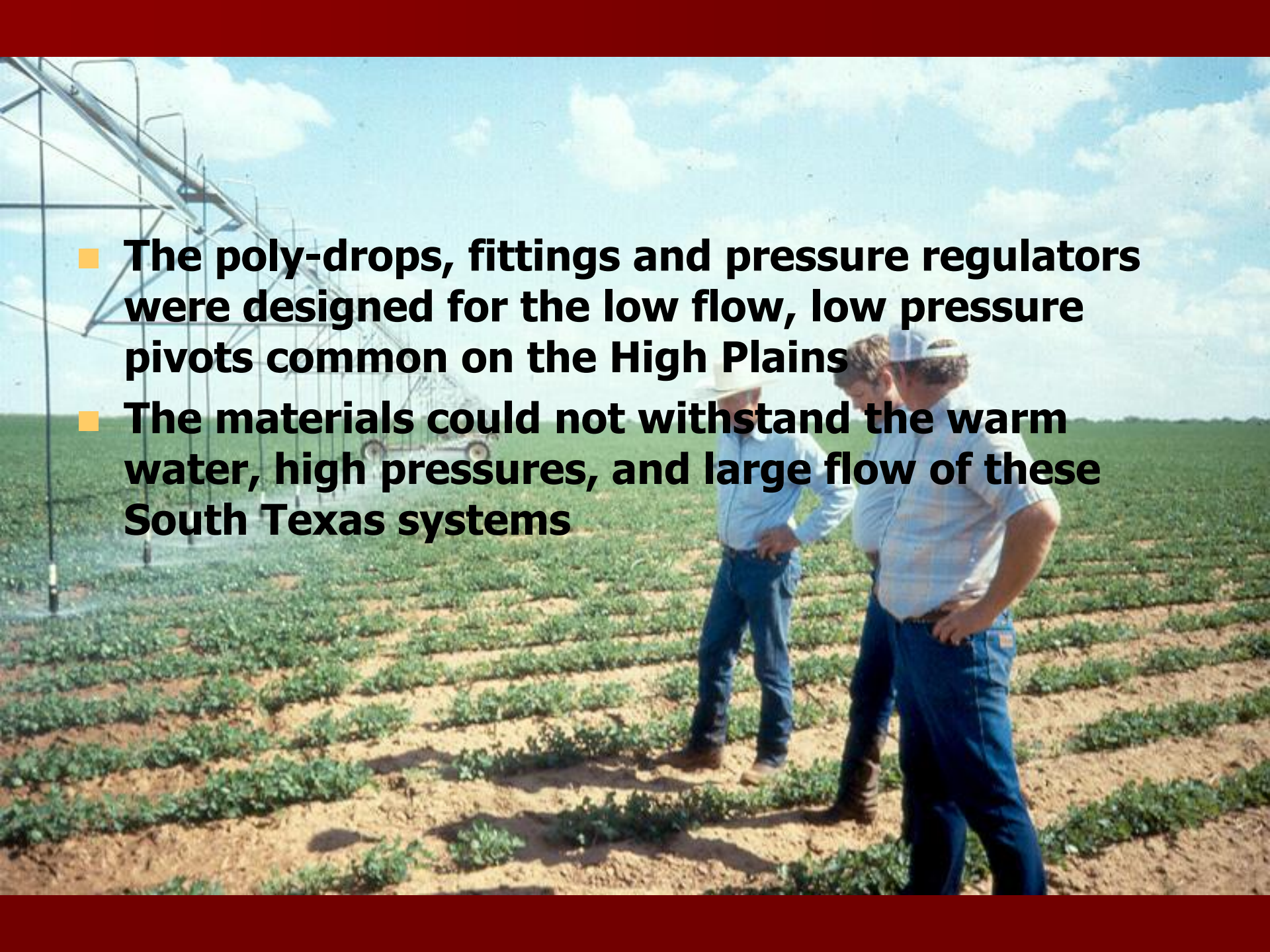
1989 – the first LEPA in South Texas

- 
- A photograph showing a man in a blue shirt and jeans standing on a long, horizontal metal pipe. The pipe is part of a larger structure supported by several vertical poles. The structure is situated in a large, open field with a line of trees in the background under a cloudy sky. The man appears to be working on or inspecting the pipe. The overall scene suggests a construction or maintenance site for a water management system.
- **Material costs by a local groundwater district Evergreen GWD**
 - **I was responsible for design and technical Support**

11 - 44

- 
- **The following Saturday, County Extension Agent calls:**

***..the drops are flying off the pivot –
what do we do??***

- 
- A photograph showing two men standing in a field with a pivot irrigation system. The man on the left is wearing a white shirt, blue jeans, and a white cowboy hat. The man on the right is wearing a white shirt, blue jeans, and a white baseball cap. They are looking at the ground. In the background, there are rows of young green plants in a field, and a large metal structure of the pivot irrigation system is visible on the left side. The sky is blue with white clouds.
- **The poly-drops, fittings and pressure regulators were designed for the low flow, low pressure pivots common on the High Plains**
 - **The materials could not withstand the warm water, high pressures, and large flow of these South Texas systems**



***..moral – don't assume too much when
adapting new technologies into different
environments***

...



In the late 1980's

- drip tape and plastic mulch introduced into Texas
- Very high efficiencies





Management is just as important as having efficient technology



Management is just as important as having efficient technology



Moral.....people save water



- water-move center pivot
- South Russia, 1994
- Comment – *it's hard to imagine a place now where energy and water don't matter I....*



Illustrates the need for

- Education
- Keeping up with technological innovations

Central Asia (former Soviet Union)

- Trip to Uzbekistan in 1992 to look at potential cooperative programs
- Central Asia is (unfortunately) known for the Aral Sea Disaster

Central Asia (former Soviet Union)

- Classified as the largest man-made environmental disasters in the world
- The Aral Sea was once the largest in-land sea in the world,
- *Now....*

Aral Sea – Central Asia

The largest ecological disaster on our planet

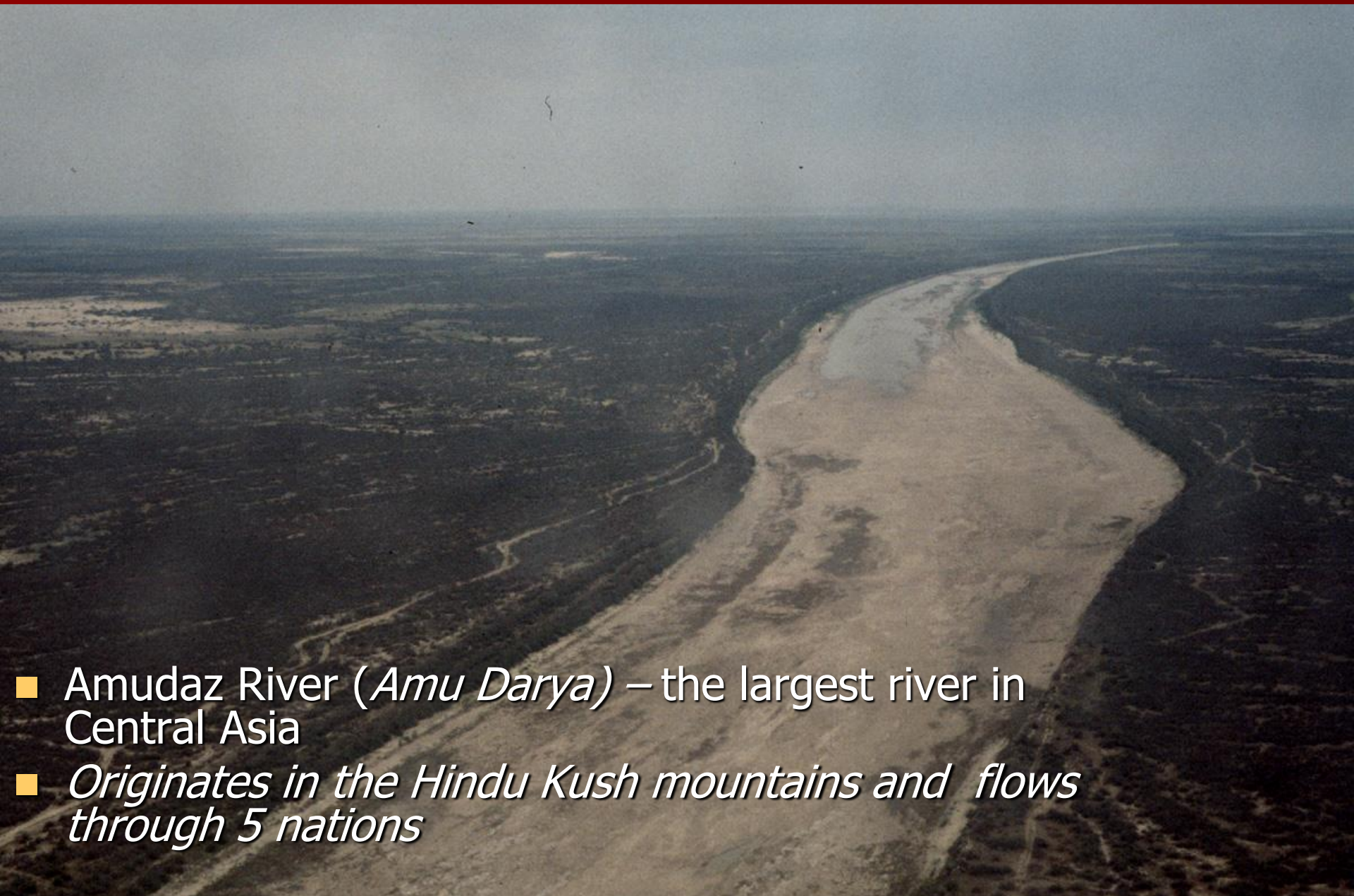
- NASA photograph from 1998
- Extent of the Aral Sea in 1957



Lake has lost
60% of its
area,
40% of its
volume



Photo of the Amudaz River, 100 miles from the Aral Sea



- Amudaz River (*Amu Darya*) – the largest river in Central Asia
- *Originates in the Hindu Kush mountains and flows through 5 nations*

Photo of the Amudaz River, 100 miles from the Aral Sea



- 1960's, Soviet Union expanded irrigated cotton production for hard currency – "*white gold*"
- Diverted so much water for irrigation that inflows into the Aral Sea ceased



- **Over 100 extinct species animals/fish**
- **Large areas of exposed sea bed contaminated with chemicals**
- **Storms pick up dust and contaminants, and deposit over populated areas**
- **Increased illness, particularly in women and children**

..the fishing industry dating back thousands of year now dead



Political Will??

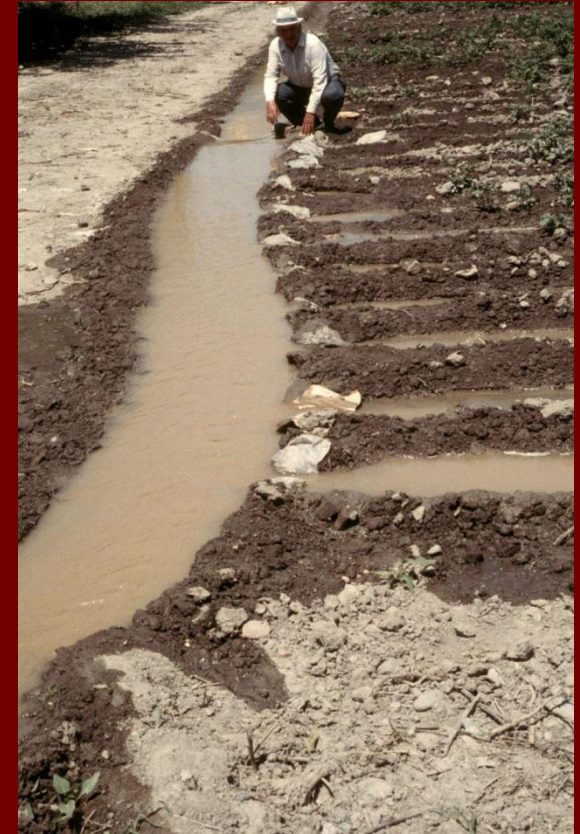


But they still
grow rice in
the Aral Sea
region



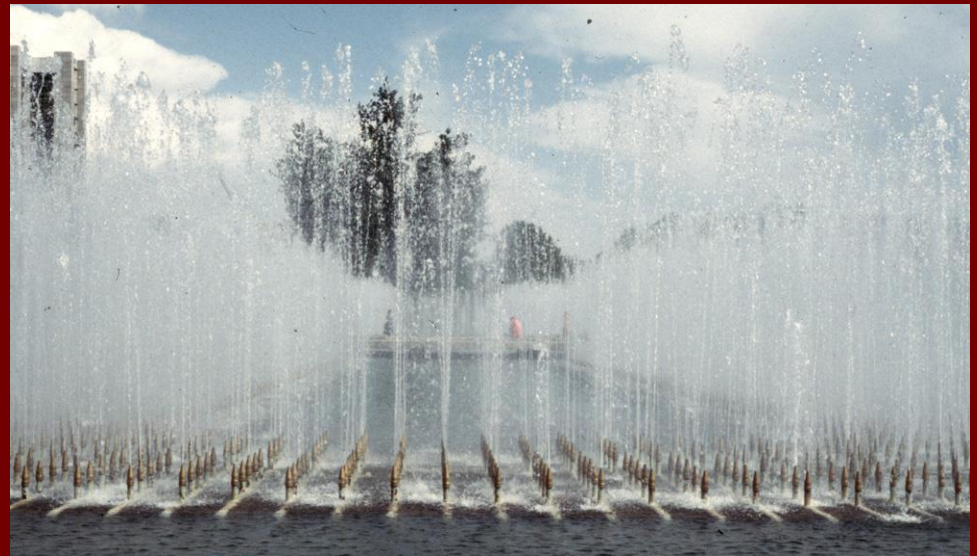
Political Will??

Everywhere you go in Uzbekistan you see inefficient surface irrigation



Political Will??

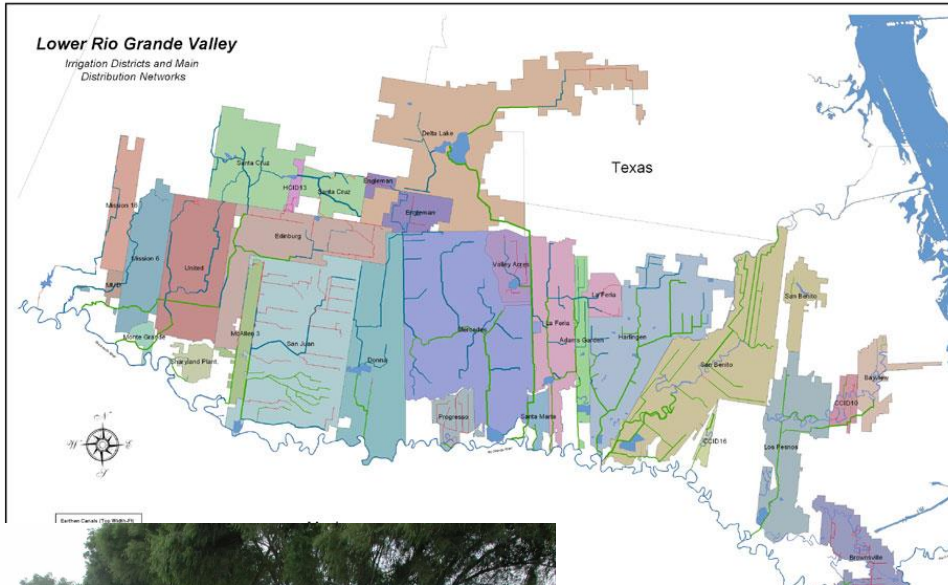
Everywhere you go in Uzbekistan you see water running down the road and spectacular fountains.....



Irrigation District Engineering

- Began a program looking at modernization of irrigation districts in 1998
- Focused on the Texas border region where most of Texas' districts are located
- An adventure that only an engineer would enjoy
- Provided an opportunity to "*play with a lot of toys*"!

Irrigation Districts



Programs for Irrigation Districts



- Determining regional potential water savings
- District modernization
- Information systems
- SCADA
- Training and technical support
- Project evaluation and water savings documentation

- *Should canals be replaced with pipeline??*
- *Can contractors be trusted in absence of standards for irrigation pipeline construction and performance*

One Example – United Irrigation District

District



- This canal was replace with a pipeline
- District noticed a decrease in flow and water volume
- Solution - a pipeline leak loss test



- Contractor reluctantly agreed to do repairs
- Leakage before repairs:
43 ac-ft/yr
- Leakage after repairs
1.2 ac-ft/year

Lots of other projects and issues –
see: <http://idea.tamu.edu>



- One day in early September 2005, I was sitting in my office
- and the phone rang
- which lead to an amazing adventure, perhaps the adventure of a lifetime
- Definitely, the learning experience of a life time....

- The phone call lead to a trip to Washington DC, and meetings at the Pentagon
- I was being recruited to be the Senior Advisor for Water at the US Embassy in Kabul, Afghanistan

- The position was with the Department of State for one year – living and working at the US Embassy in Kabul
- The position would require a Top Secret Security clearance and a diplomatic passport
- Duties were to advise the US Ambassador, USAID, and the Afghan government

So, why was an irrigation engineer being recruited to be the Senior Advisor for Water...

Afghan Proverbs

Water is good, more water is better

*Better to be a servant upstream
than a king downstream*





Afghanistan Suffers from "Feast or Famine"

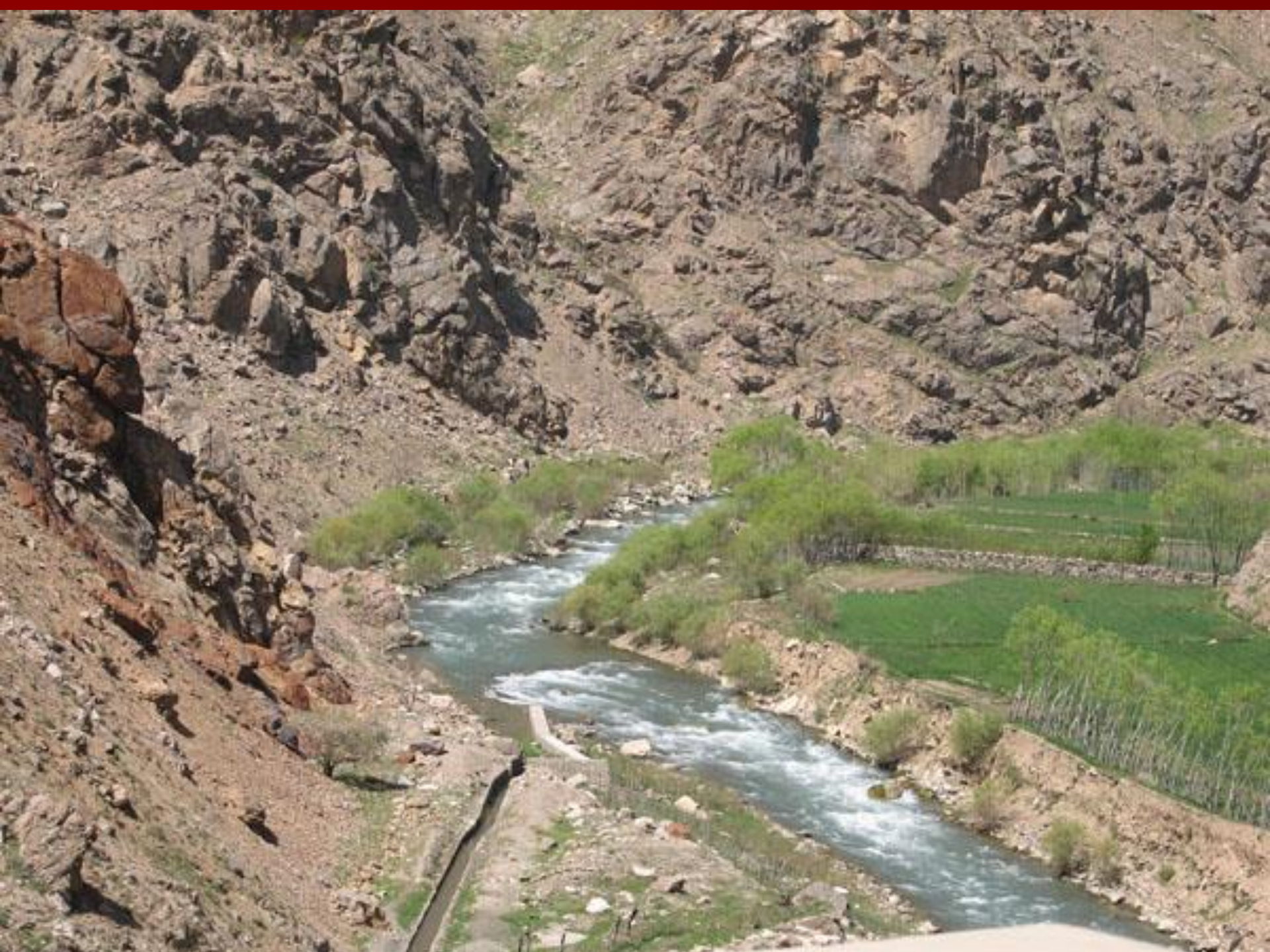
- Water supplies depend primarily on snow melt
- Snow fall varies from year to year, resulting in reoccurring droughts and floods

Afghanistan Suffers from "Feast or Famine"

- The population lives primarily in river valleys and flood plains
- Water is diverted from the rivers into canals
- Canals often run for many miles and carry irrigation water as well as drinking water to most of the population









- 98% of all water diverted from the rivers is used in agriculture
- 60% or more is lost in the canal systems to seepage and poor on-farm efficiency
- These canal systems supply drinking water to the majority of the population

- Agriculture employs ~80% of the population
- Except for winter wheat and minor crops that mature in early spring, all crops must be irrigated
- Less than 30% of existing farmland receives adequate water

Afghanistan Suffers from "Feast or Famine"

- As the snow melts, rivers/stream swell dramatically in spring and early summer
- Few dams and similar structures exist, resulting in uncontrolled flow in rivers and streams
- Erosion and flooding are serious problems
- Melting snow combined with occasional spring rains cause flash floods



Photos of diversion construction in Kunduz





Problems with hand constructed diversions

- Take lots of labor
- Frequently wash out as the rivers continue to rise in the spring
- If repairs and new diversions are not quickly done, whole villages lose their crops

*Saving the city of
Kunduz from flooding
due to misguided good
intentions*

Misguided Assistance

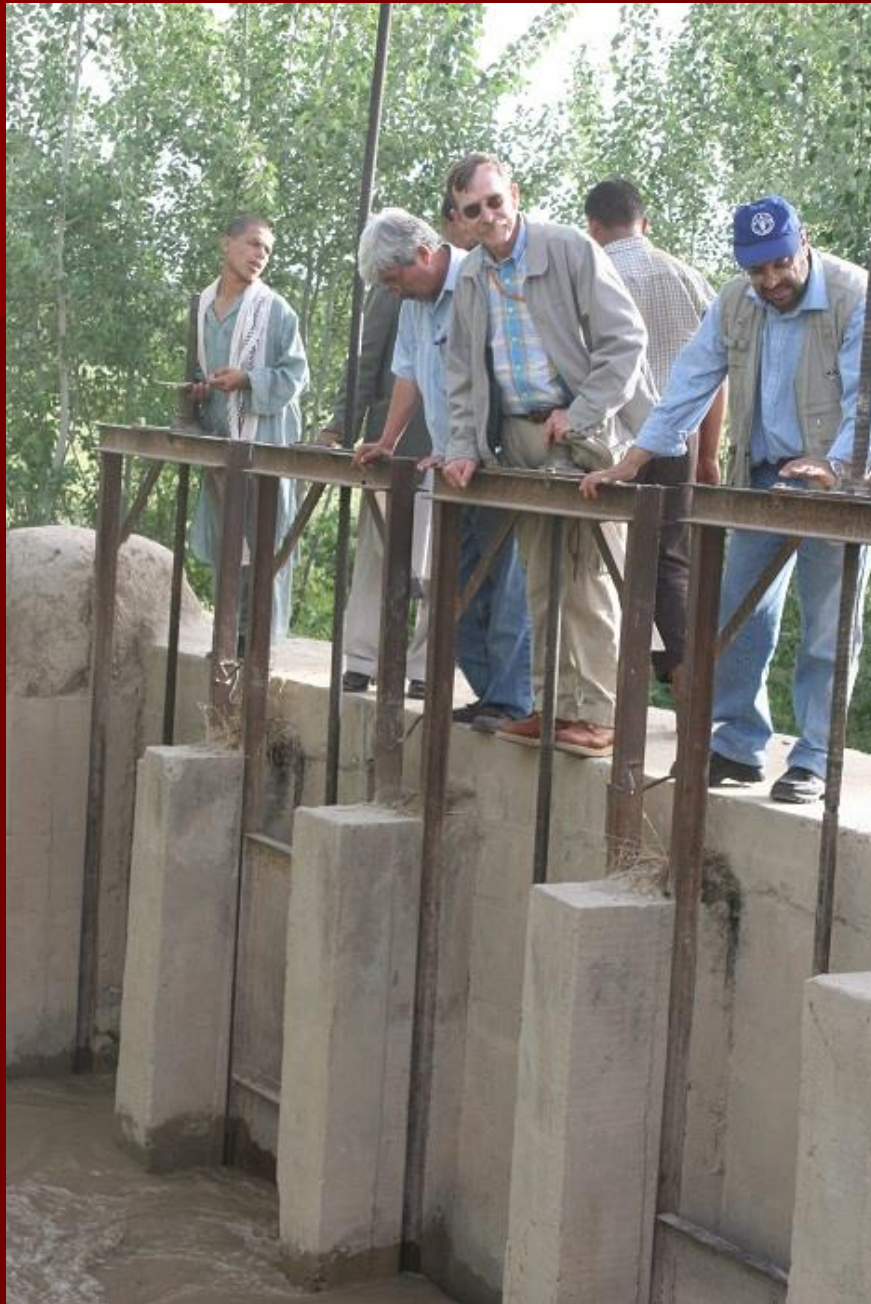
- With USAID funding, a NGO constructed a permanent diversion
- No irrigation engineers were employed for design
- The resulting structure diverted too much water
- Washing out downstream water control structures
- Causing flooding in the city of Kundz

- The resulting structure diverted too much water
- Washing out downstream water control structures
- Causing flooding in the city of Kunduz











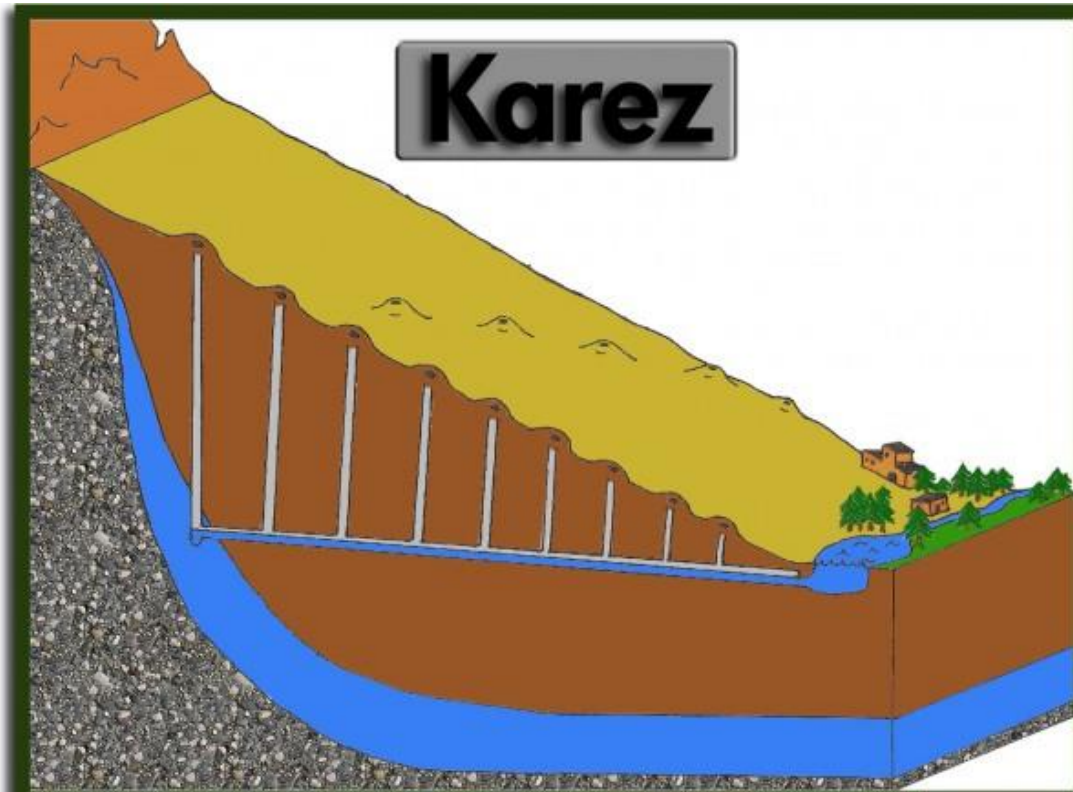
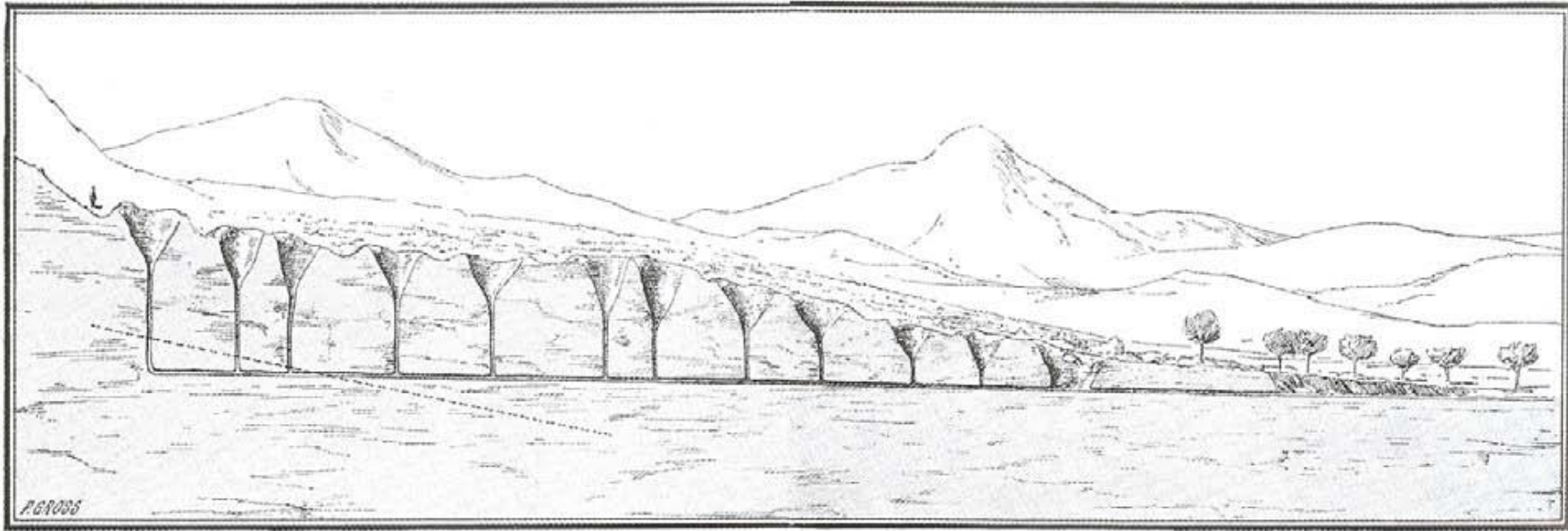


Most of the wells put in by NGOs since 2001 are now dry



While the wells have a good design, there was no study of the sustainability of the groundwater





- Karezes are widespread and an important source of irrigation and drinking water
- Sections frequently collapse and have to be re-dug
- The US Military built the Gardez Forward Operating base on top of a Karez



- a year later, a portion of the karez collapsed
- But the base commander would not let the villages enter the karez to dig it out
- Villages eventually filed a human rights complaint with the UN
- I was asked to come up with a solution...

The Dam that the US built

- 1950's – the US built Kakaji Dam and the down stream irrigation scheme in Helmand Province
- Ushered in the “golden age” in Afghanistan



US Water Programs

- 1950s – 1960s: Kajaki dam and irrigation scheme is reported to have been a success and created a economic boom in Helmand Province
- The irrigation scheme has fallen into a serious state of disrepair

US Water Programs

- Since 2001, Water has not been a major focus of USAID programs
- The Water programs funded before 2006 were poorly planned and executed, wasting \$millions

Best Development Program I've Ever Seen

- EIRP (Emergency Irrigation Rehabilitation Project)
 - Best Water Project in Afghanistan
 - Funding by the World bank, implemented by the UNFAO through Ministry of Energy and Water
 - Repairs irrigation schemes and constructs water control structures to get agriculture functioning again
 - Has construction standards and strick quality control
 - No corruption in awarding projects



One person (particularly an irrigation engineer) can make a difference





One day...

- I was setting office at the US Embassy
- And I got an email from a military unit
- Seeking assistance on a project that they were funding

- US military units received funding from the Department of Defense to fund local projects
- To win the “hearts and minds”
- Being Afghanistan, most were irrigation and water related
- At that time, I was the only irrigation engineer in the US mission



















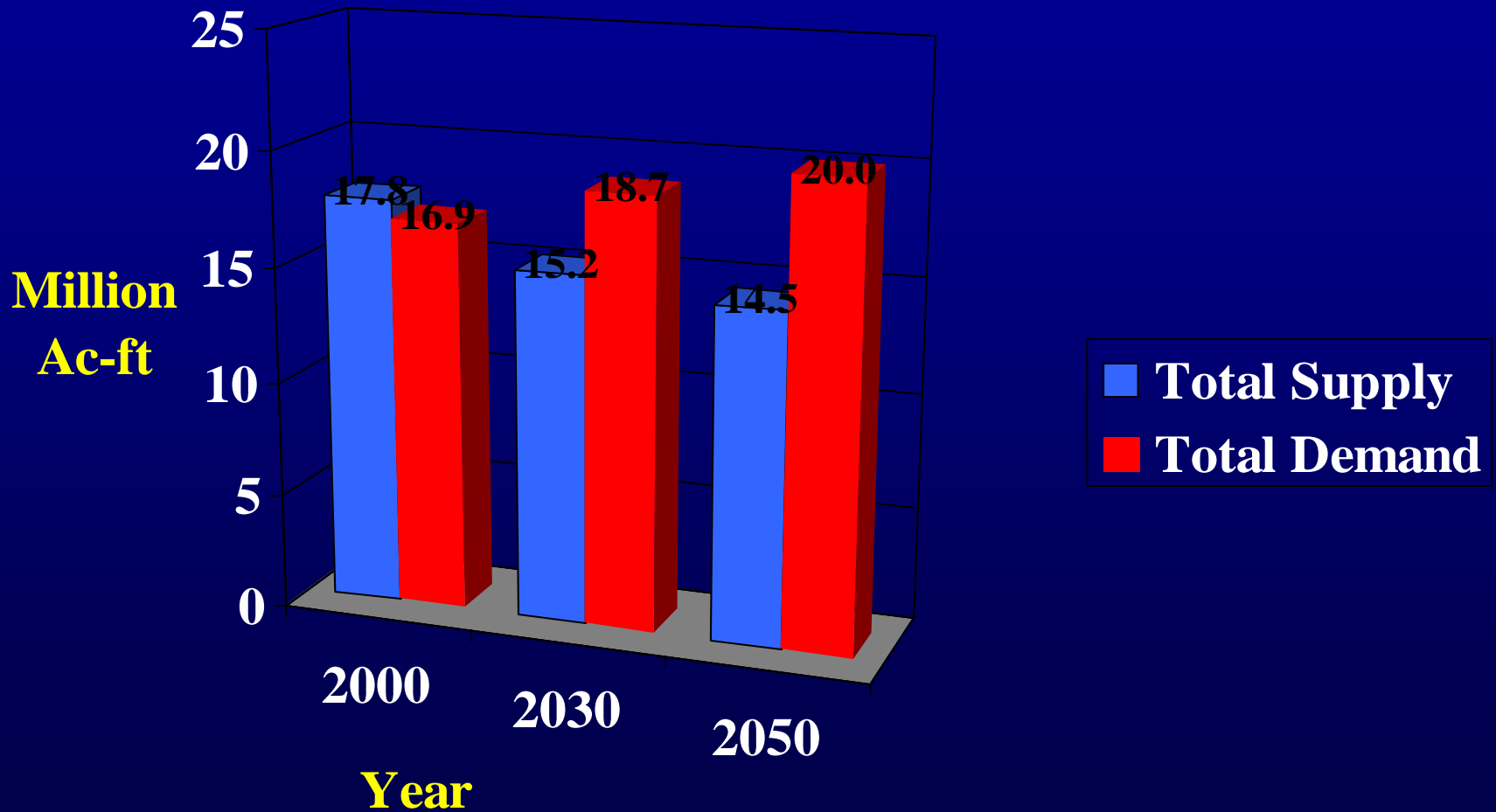
What I've learned...

- Its easy to make mistakes
- Good intentions are not enough
- Much of the world has the same water problems as Texas

What I've learned...

- Limited water supply
- Growing population and industry
- Need to maintain agriculture while freeing up water supply for other uses

Total Water Supply and Demand



Population

**Water
Resources**

Solutions are not easy

*How do we achieve real
water savings in irrigation?*

***...intelligent and
enlightened approaches to
address the complex
issues of
agricultural irrigation ...***

***...and, of course,
Irrigation engineers!!***