



From Africa to asia and back again: testing adaptations in FBFS

Improvements of Flood Water Diversion and Distribution Efficiency of FBFS

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Outline

- Brief Introduction
- Key findings
 - Do we have Potential FBFS?
 - Hybrid design
 - Flood spreading weirs
 - Distribution Efficiency

1. Flood-Based Farming SYSTEMS(FBFS)

FBFS includes

- Spate irrigation: direct diversion of flashy floods to irrigated fields
- Flood inundation and recession: rivers overflow their embankment and flood adjacent areas
- Flood spreading weirs: runoff harvesting
- Road water harvesting: Diversion of floods from roads & culverts



A. Spate Irrigation: is the diversion of **flashy floods** running off from mountainous catchment, using simple deflectors or robust structures for agricultural development.



Flood known for its destruction being used for irrigation in Raya valley, Tigray

B. Flood recession or inundation agriculture



Irrigation area served by a combination of Flood Recession and Hand
Dug wells
D/s of Koka dam, Oromia Region

C. FLOOD SPREADING WEIRS



Flood spreading weirs in Afar (Modern ^(a)) and Tigray (Traditional)

Source: ^(a) GIZ

D. Runoff/Flood harvesting from roads



Road ^(a) and Culvert side Water Harvesting in Tigray Region

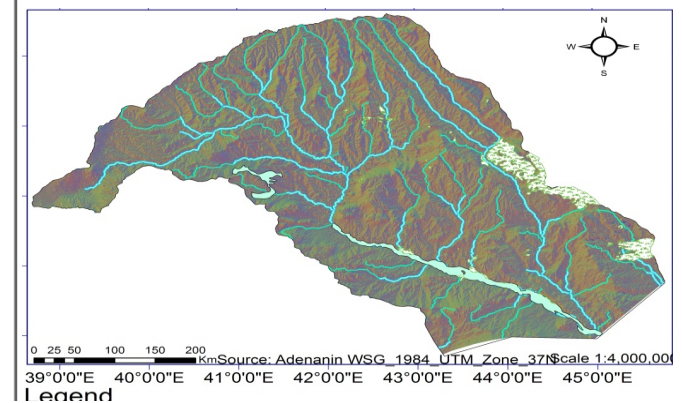
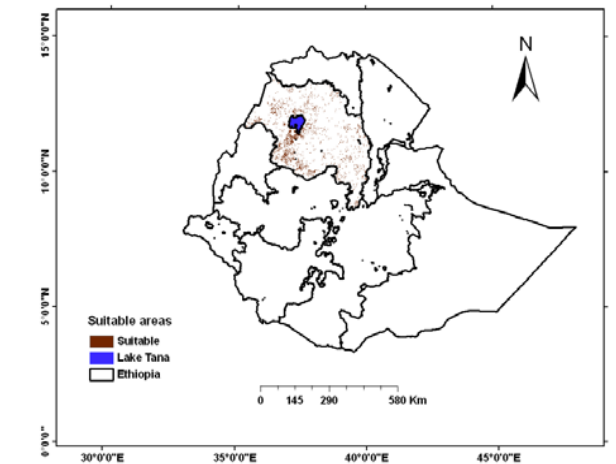
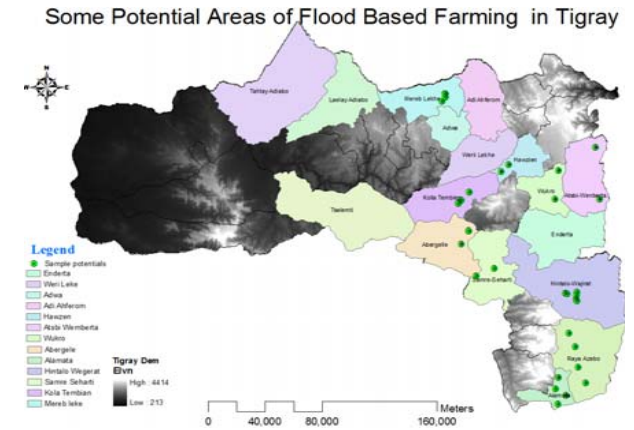
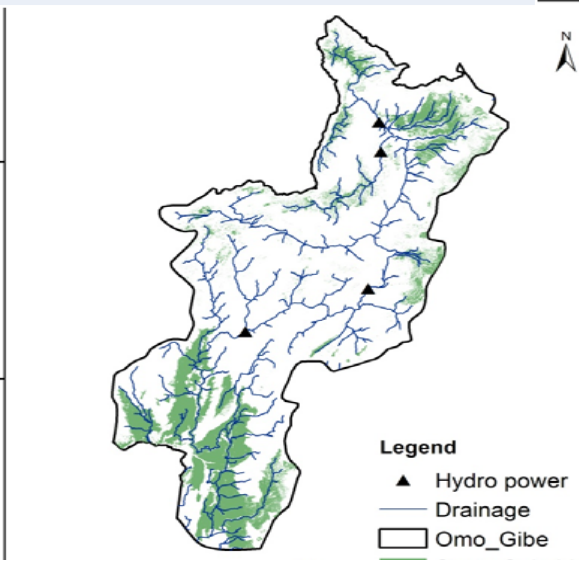
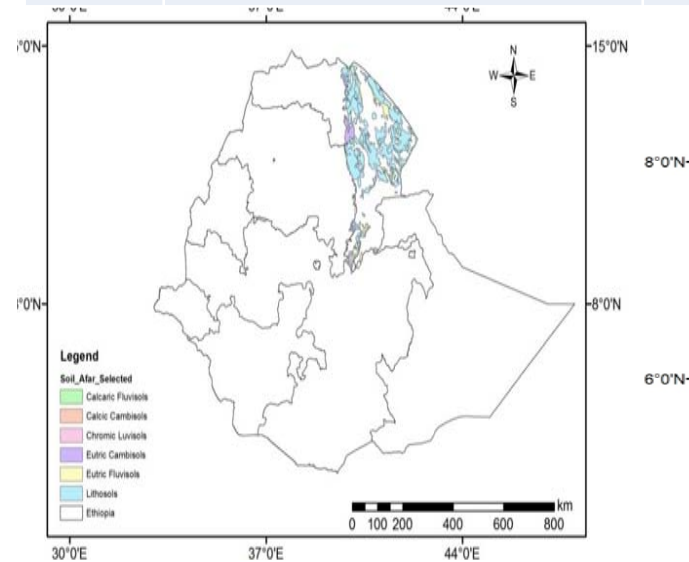
Source: ^(a) Dr. Kifle Weldearegay

2. Key Findings

- Potential FBFS of the country identified
- Flood water diversion - the hybrid design – an innovative design is implemented
- The Flood Spreading Weirs tested
- Distribution Efficiency

2.1. DO WE HAVE POTENTIAL FBFS?

S. no	Region	Potential for FBF/ Spate Irrigation (ha)
1.	Tigray	600,000
2.	Afar	1.3 Million
3.	Amhara	1.08 Million
4.	Oromia	2.5 Million
5.	Benshangul Gumuz	772,000
6.	SNNP	750,000
7.	Somali/ Wabi Shebelle	1.7 Million
8.	Total	8.7 Million



2.2. Hybrid design

- Out of the **17 modern structures built in Tigray**, **13 have totally failed** while the **remaining 4 are serving smaller area** than they were designed for.
- The most important factors that contributed to the failure of the modern systems were
 - **Adopting conventional design approach**
 - Not considering the hydrology, sedimentation and river morphology of seasonal streams.
 - **Lack of community participation**



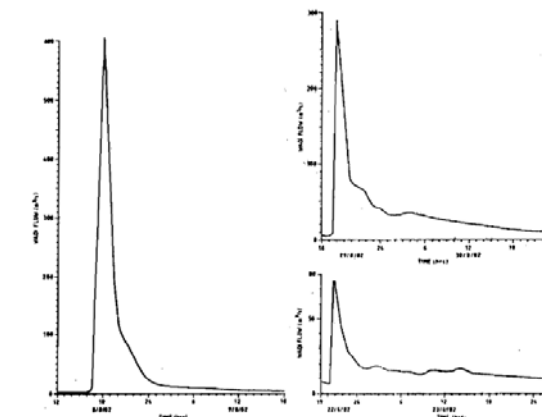
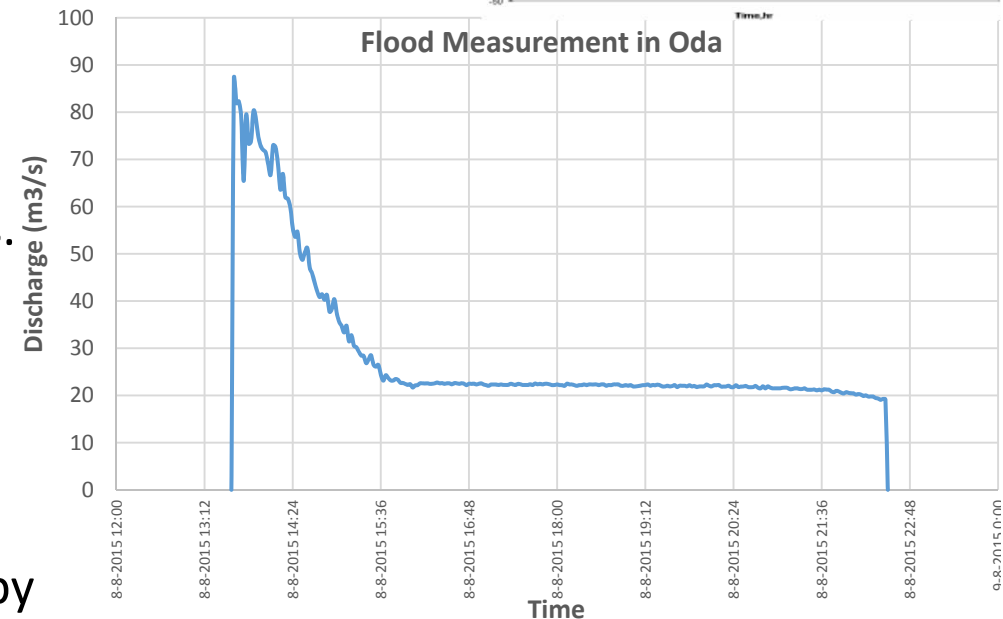
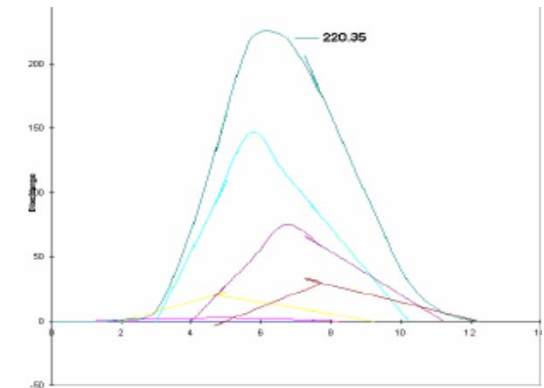
• **Hydrology** of spate irrigation is entirely different from that of perennial flows

- Floods are unpredictable in timing, frequency and volume;
- The floods rise very quickly and then recede over a period of hours or days.

• **Sedimentation & Morphology:**

Ephemeral rivers are marked by:

- High sediment concentrations (10% by weight)
- Strong scour, active erosion and transport
- Frequent change of river course and bed
- Fertile soils

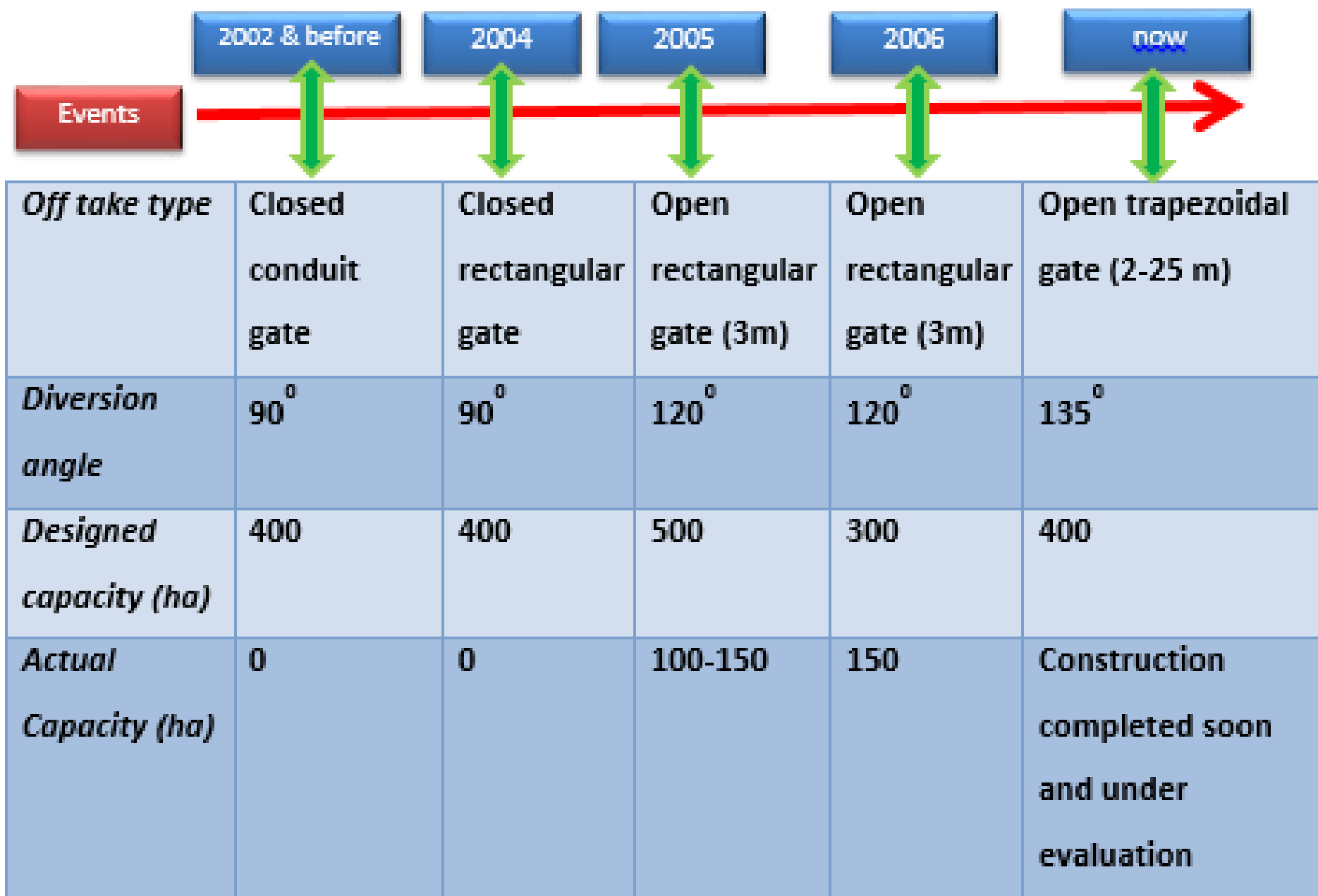




Box culvert off-take and siphon crossing at Hara spate irrigation scheme

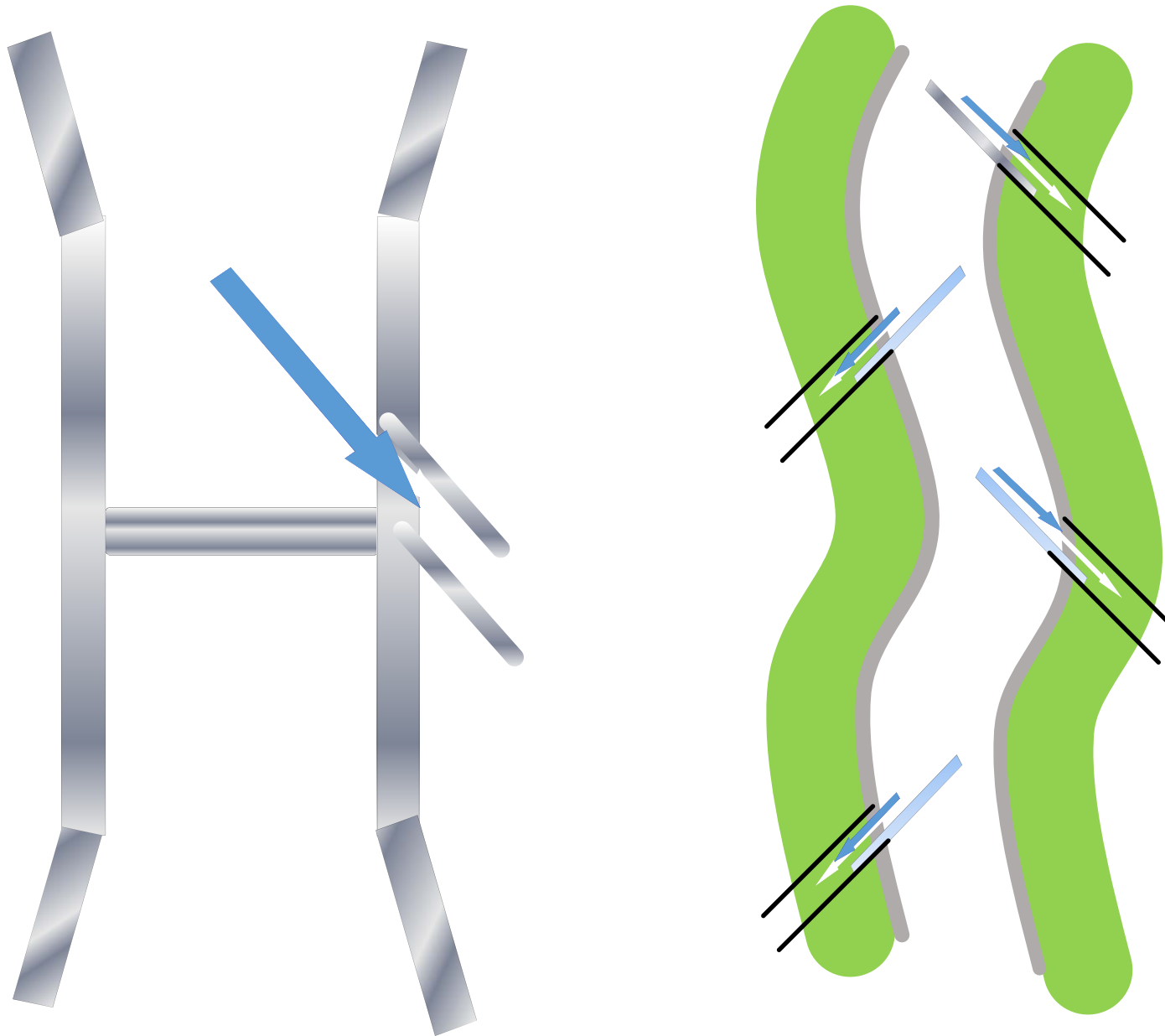


Pipe off-take at Tirke spate irrigation scheme before and after it was filled with sediment

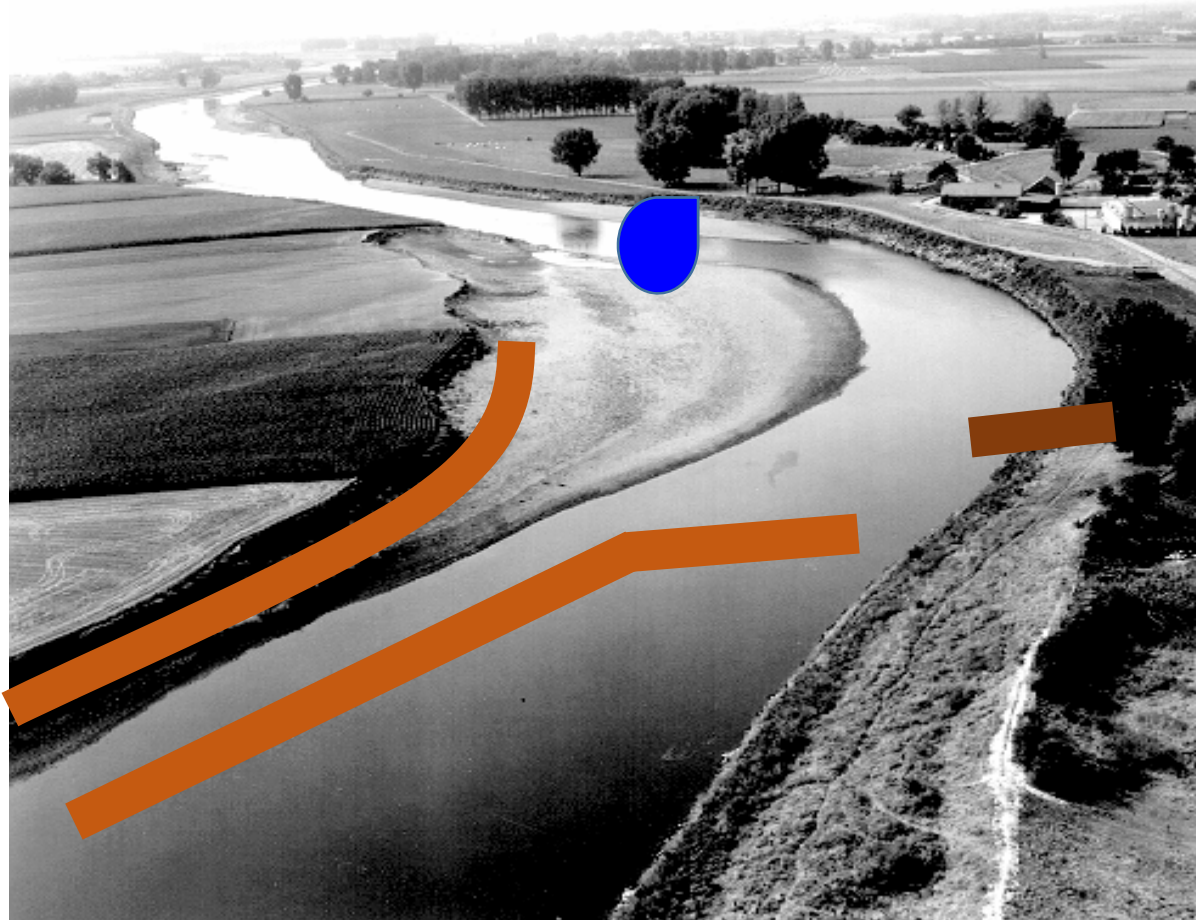


Evolution of Spate Design Approach in Tigray, Ethiopia

Schematics of Hybrid design



Schematics of Hybrid design



Hybrid spate irrigation design in Raya, Ethiopia: A mix of traditional and modern practice

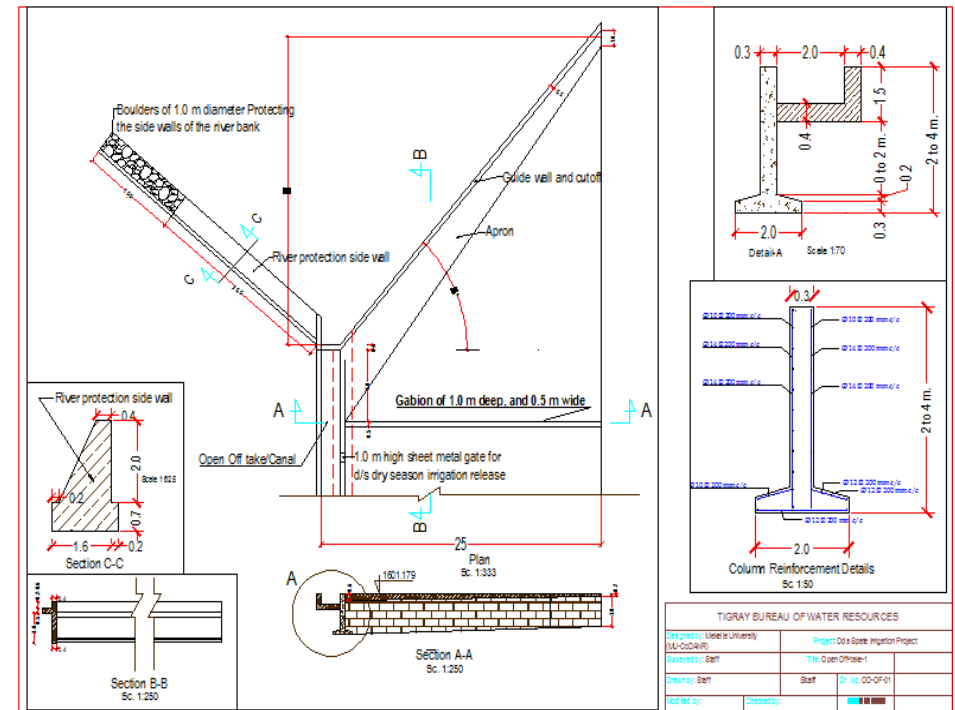
Traditional nature

- Open and wide intake (2-25 m)
- 0.2-0.6 m high & wide diversion angle (135°)
- Causing small disturbance to natural flow conditions



Modern nature

- Diverts large floods
- Diversion ratio – based on demand
- Robust structure - cutoff and apron, river protection structures





Hybrid Design implemented in Oda, Mersa and Tsige'a Spate Systems in Tigray Region



Comparisons with other technologies

	Flood based farming	River diversion	Dam
Average Investment cost per ha	26,285 Birr/ 1,300 USD	95,360 Birr/ 4,750 USD	338,300 Birr/ 17000 USD
Number of cultivation per year	once	Two-three	Two-three
Reliability	Less	High	High
Potential sites availability	Exists (very high)	Almost explored (finished)	Exists (high)

2.3. FLOOD SPREADING WEIRS

- Flood spreading weirs have been tested in Afar region through GIZ Ethiopia, KFW and Chifra district pastoral and agricultural development office.
- Five water spreading weirs were constructed in Chifra woreda in 2014.
- The structures were constructed to spread the water causing the land area above and below the structure to be flooded resulting in:
 - Infiltration of water,
 - River bed rise and restoring gullies and
 - Groundwater table rise.



2.4. DISTRIBUTION EFFICIENCY

- **Work in progress**
 - Diversion and Distribution efficiency – HEC RAS
 - Sediment control and management efficiency- DOSBASS model
 - Water management – Measurements + farmer's interview
- **Division structures:** a combination of the rotational and proportional distribution have to be used in the design and implementation of modern spate systems.
 - Rotational distribution system (lottery, sequence or flexible turns based) is used to distribute the flood among the off-takes within the wadi
 - Proportional distribution can be used to distribute the flood within the off-takes and even at lower scale such as secondary and tertiary canals.
- **Crossing Structures:** flume aqueduct, culvert, super passage and road crossings.
 - Crossings that use pipes cannot be used considering the complexities in managing high sediment loads and concentrations resulting in excessive sedimentation of the route.

A photograph showing a concrete drainage channel or culvert in a rural, hilly landscape. The channel is made of concrete and runs through the center of the frame. To the left of the channel is a dirt area with some sparse vegetation. To the right is a concrete-lined area with some dry brush and green plants. In the background, there are hills covered in green vegetation under a clear sky. The text "Thank you" is overlaid in large, bold, yellow letters across the middle of the image.

Thank you