2020 International Conference on the Nile and GERD

LAND AND WATER DEGRADATION AND WATERSHED MANAGEMENT

PRESENTATION 3

TENA ALAMIREW

Addis Ababa University, Ethiopia

PRESENTATION TITLE:

Hydro-Sedimentation Burden Shift in the Blue Nile (Abbay) Basin

AAiT ADDIS ABABA INSTITUTE OF TECHNOLOGY
ADDIS ABABA UNIVERSITY

FIU Institute of Environment

Hydro-sedimentation Burden Shifting in the Abbay (Blue Nile) Basin

2020 International Conference on the Nile and GERD

AAiT

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FIU Institute of Environment

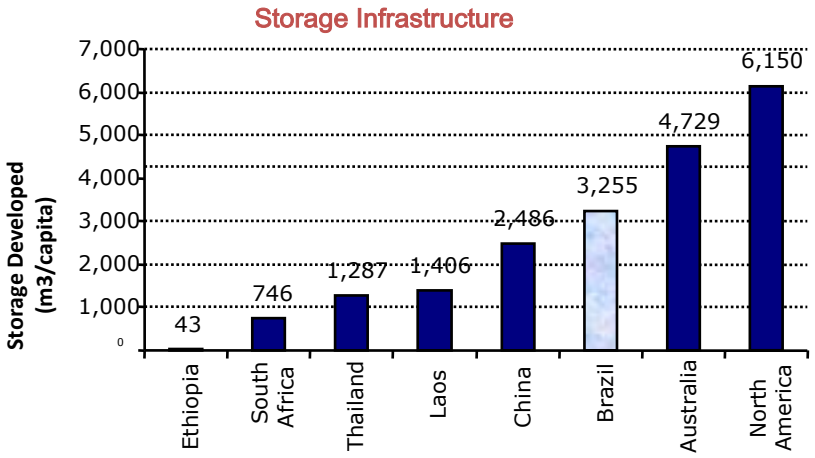
Tena Alamirew, Amare Bantered, Get Zeleke
Water and Land Resource Centre
Addis Ababa University

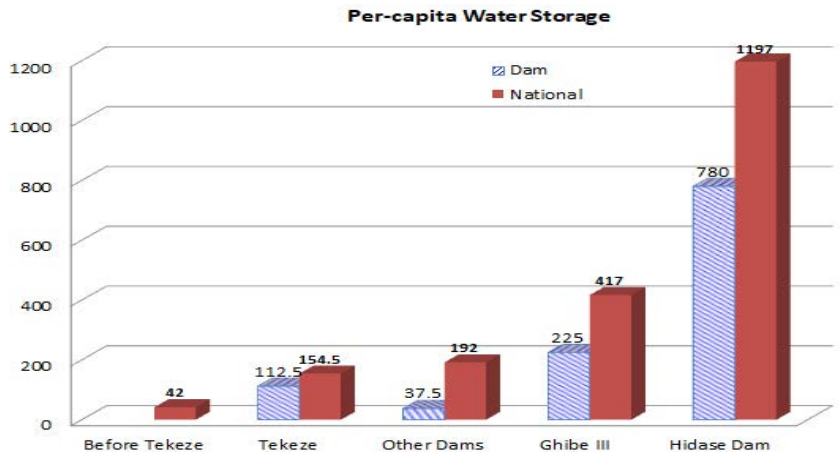
Agenda

1. Water Storage Status and Issues
2. Reservoir Sedimentation Impact
3. Sediment Estimates for the Abbay Basin
4. The Option for Sediment Management
5. Conclusion

1. Water Storage (status and issues)

An aggressive enhancement of water storage to the massively energy starved economy and public has now become **necessary** condition for country to sustain.





That is why Ethiopia is investing hefty amount of investment on hydro-infrastructures - storages.

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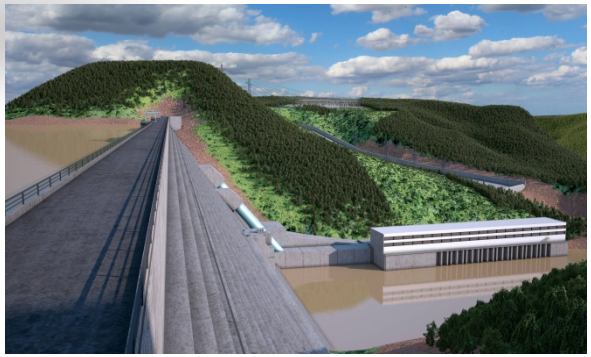
Tekeze

Gibe III

Genale Dawa

GERD



Koysha (Model)

- But benefits of water resource projects oftentimes fall short of original expectations owing to sedimentation of reservoirs.
- Globally 1 – 2 percent of the storage volume is lost annually
- In Ethiopia, 2% reservoir siltation will be a conservative estimate?
- Why

Massive sediment concentration of rivers

This is where it is coming from

GERD Before a Year

2. Reservoir Sedimentation Impact

- Reduces:

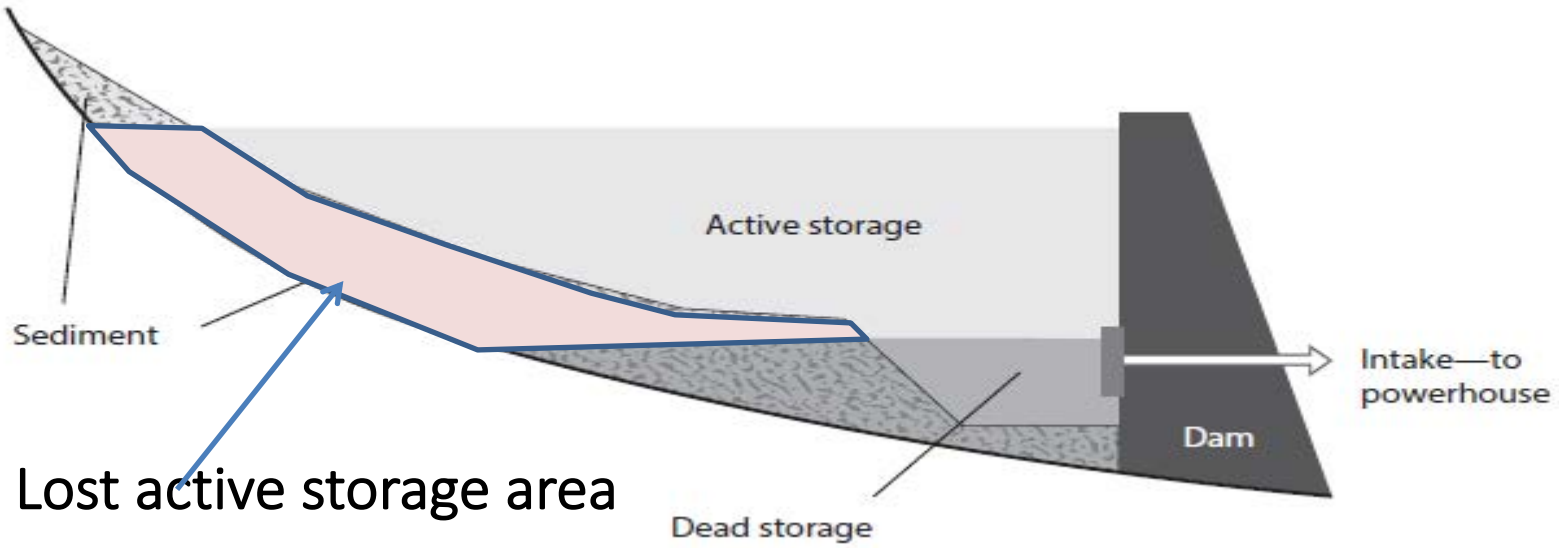
  storage and energy production, discharge capacity and flood attenuation capabilities.
- Safety of dams - increases loads on the dam and gates,
- Damages mechanical equipment (moving parts),
- Creates a wide range of environmental impacts.

Impact of sedimentation

Dams have traditionally been designed under the design life paradigm which entail estimating of the sedimentation rate and trap efficiency and provision of sediment storage volume equivalent to the design life (typically 50 to 100 years)

The old and common – but incorrect assumption is that dead storage space is reserved for deposited sediment. (WB P20)

But note - sediment deposition in the active storage space is as prevalent and common as the dead storage space, particular in large reservoirs.



Hence it is necessary to account for the loss in active reservoir storage space early on the life of a project and to recognise its impact on the reliability of water and on flood control.

An example: Rosier Dam/Reservoir

- Has been the sediment sink of Abbay
- Over 122 MCM/yr. reach at the border
- It decreased from 3.3 BCM to 1.9 BCM/yr

  (Lost 1.44 BCM or 40% of the storage in in 41 years)
- The total amount of sediment delivered in 41 years was

  5 billion ton or 3 BCM.
- Large economic loss to Sudan, in addition to the high maintenance costs of sediment clearance in front of the turbines to facilitate hydropower production

Omer, et al 2013

- Roseires is e first trap to the sediments coming from the upper catchment in Ethiopia
- Roseires reservoir has already lost more than one-third of its storage capacity due to sedimentation in the last four decades.

This is a large economic loss to Sudan, in addition to the high maintenance costs of sediment clearance in front of the turbines to facilitate hydropower production.

David T. Williams, WEST Consultants Inc, Carlsbad, United States wrote

During the flood season, the dam's turbine intakes become blocked with debris and sediment.

After a severe blockage in 1981, which prevented hydropower generation for several days, consultants from USAID were asked to make recommendations on reducing the sediment and debris impacts on reservoir operations.

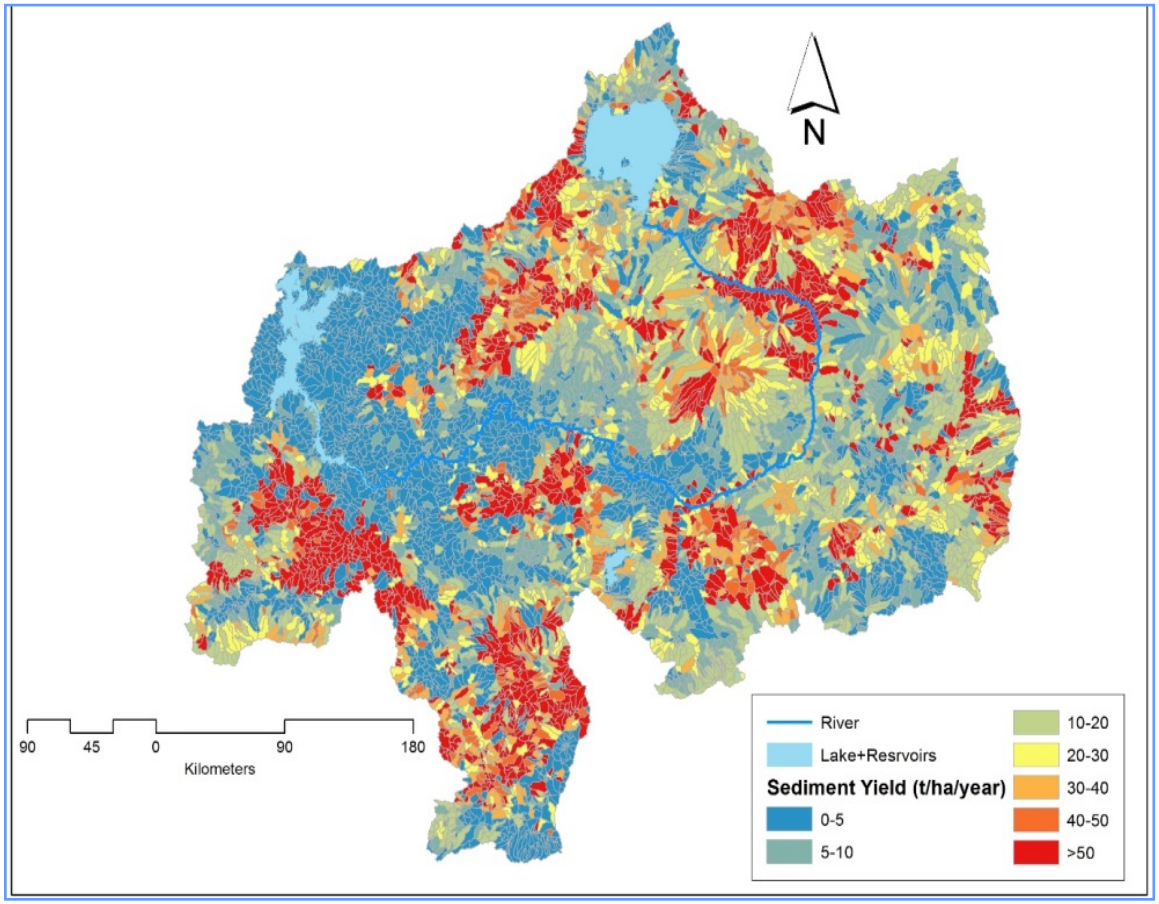
This led to debris clearing and dredging equipment acquisitions in 1982.

In 1988, blockage occurred again during the flood season.

So with the construction of GERD, the burden the sedimentation problem is in the Ethiopia court.

3 Sediment Estimates for the Abbay Basin

Soil Erosion vulnerability Map



Average 30.5 ton/ha/year based on small watersheds.

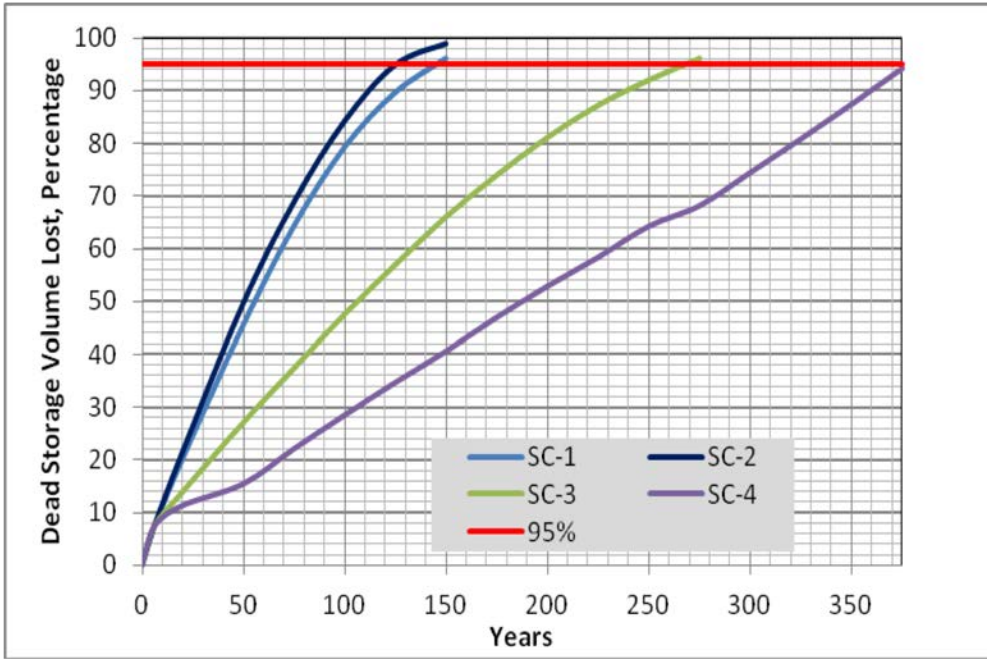
But for a basin as big as Abbay this is too high 7- 10 ton/ha/yr may be fair estimate (Tammo et al)

Catchment area = 20 Mha

From WLRC Payment for the Ecosystems study

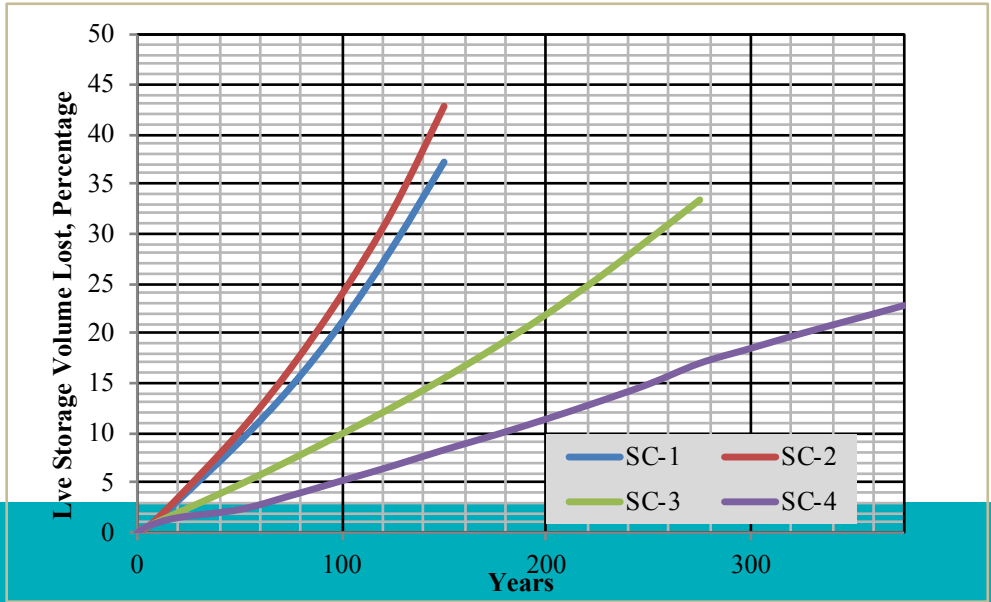
- Scenarios & results: time to fill dead storage:
  - S1: Current: 140 years
  - S2 (10% increase): 125Ys
  - S3 (50% reduction): 275Ys
  - S4 (70% reduction): 375Ys

➔So the life time of the dam can be extended to 375+ years with the best IWM scenario



➔Live storage reduction is visible as of the 1st 20 years on S1 and S2 - ~10% finished in 50 years,

25% in 100 Years



Haregewein, et al also esteemed that

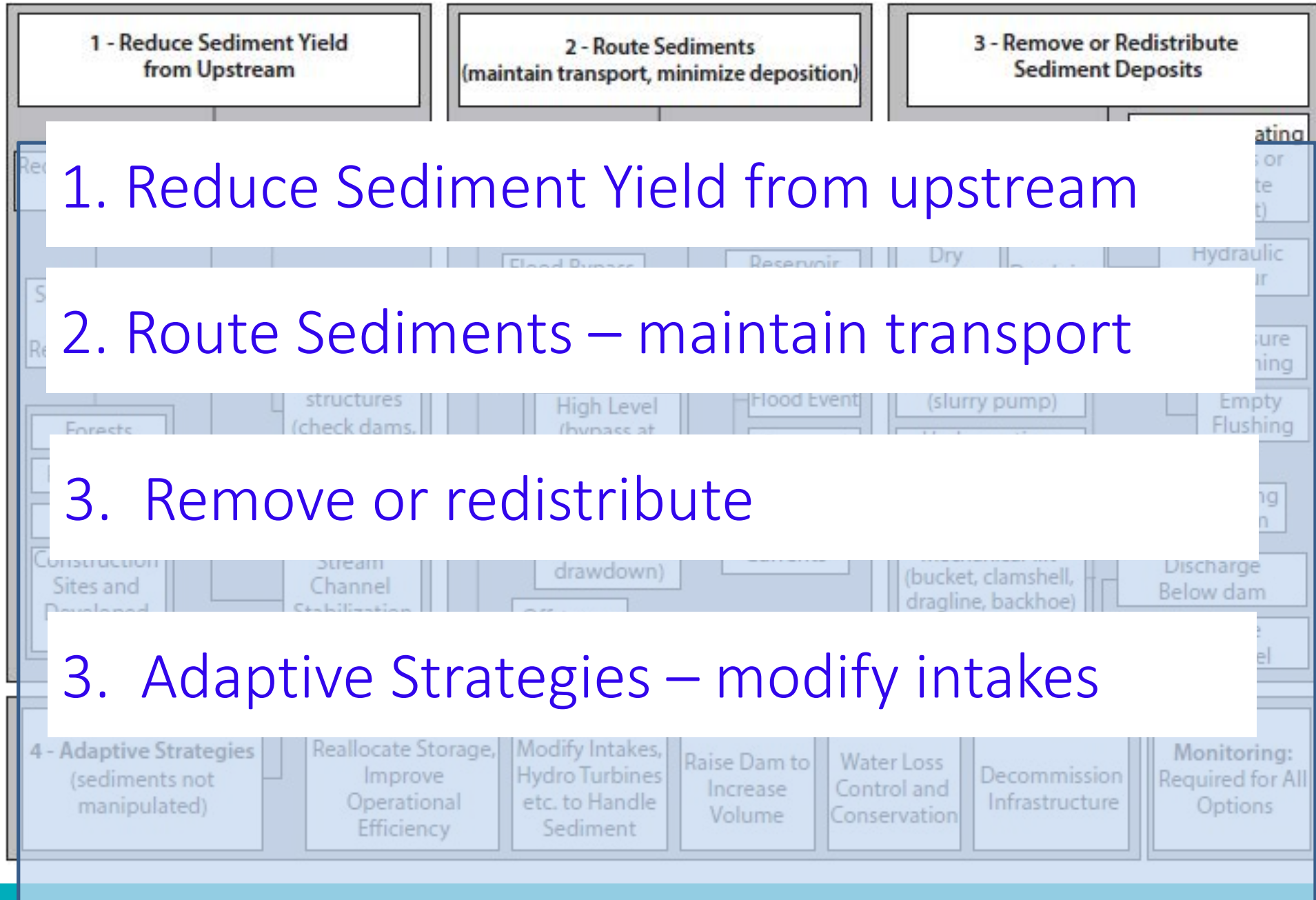
- Basin generates an average soil loss rate of 27.5 t/ha/yr and a gross soil loss of ca. 473 Mt/yr, of which, at least 10% comes from gully erosion and 26.7% leaves Ethiopia.

  = (147 MCM/yr)

- If appropriate soil and water conservation practices targeted ca. 77.3% of the area with moderate to severe erosion (>15 t/ha/yr , the total soil loss from the basin could be reduced by ca. 52%.

  =(76.4 MCM)

4. Sediment Management Options



1. Reduce Sediment Yield from upstream

2. Route Sediments – maintain transport

3. Remove or redistribute

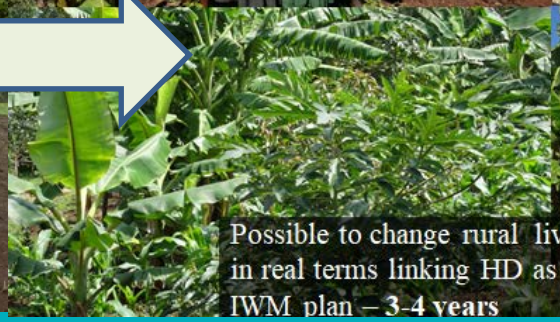
3. Adaptive Strategies – modify intakes

Options 1 (for Ethiopia)

- Prevention - retain the soil where it comes from (the field) – SLM
- This also improves the lives of farmers

The land can be transformed

Fruit trees on farm terraces – Debre Yakob LW



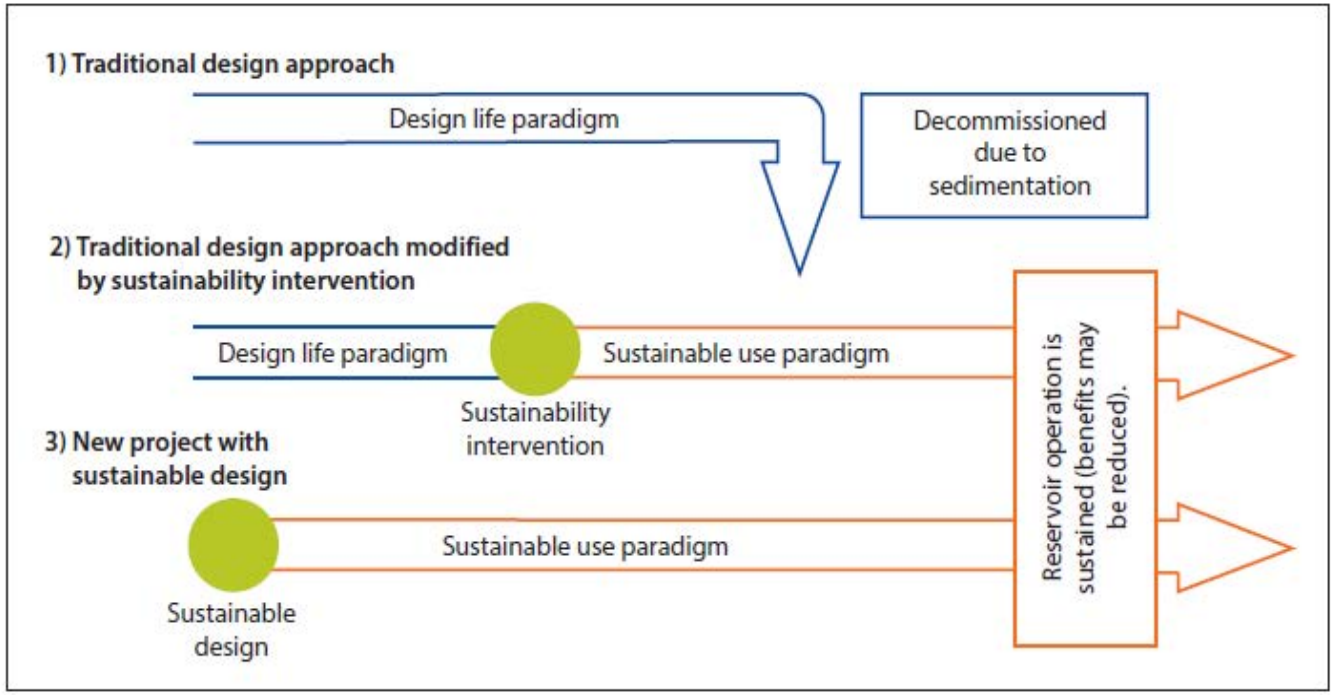
Possible to change rural livelihoods in real terms linking HD as part of IWM plan – **3-4 years**

Option 2 – Cascading dams

- ENTRO (2007) projected that that Mandaya reservoir would lose some 40% of its gross storage capacity through sediment deposition within 50 years if not reduced by watershed management or if Karadobi dam is not constructed (upstream) and traps a considerable amount of sediment.

- To save GERD – upstream cascading dams should be constructed at the earliest possible

Operate 3. The advantages of the latecomers (Contrasting design life and sustainable design life)



Economic analysis is not sufficient to develop and manage dam reservoirs.
We have to think generational and intergenerational equity

5. Conclusion

1. PBC - Sustainable Land Management

   Transform land husbandry – WLRC has plenty of best management practice

   From campaign to culture - Institutionalise the current campaign - both community mobilisation and green legacy though informed land use policy, regulatory and enforcement.

   Ensure the proposed Payment for Eco-systems Service.

2. Monitoring starting from day 1 and in all places.

   (monitor deltas at the river mouths – Beles and Dabus may not be too far from the dam)

3. Engage and learn from Sudan (Roseires dam)

I thank you !