Soil Moisture Conservation and Management in Spate Irrigated Agriculture

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Spate irrigation – some facts at a glance

- Perhaps the oldest, existed for 50 centuries?
- Source of livelihood in some 20 countries
- Least studied and understood?
- Notable investments in past two to three decades
- Flood diversion efficiency
- Limited attention to soil moisture conservation and management

Why soil moisture conservation and management?

- Unpredictable, destructive floods
- Flood season precedes crop production period
- Crops grow under extended dry spells
- Large reliance on resdiual soil moisture
- Evapotraspiration > 2000 mm, rainfall 50 - 300 m
- Large irrigation gifts (200 to 1000 mm)

Factors affecting soil moisture conservation and management

- Irrigation turns and gifts
- Water rights and rules
- Field water application and distribution systems
- Field bund design and maintenance
- Soil water holding capacity
- Infitration rate of the soil

Irrigation turns and gifts

- Single gift ranges from 200 to 1000 mm
- Turns are unpredictable
- No well defined and orderly irrigation turn/schedule
- *There is flexible irrigation turn/schedule*
  - *Rule on irrigation turns*
  - *Rule on size of fields*

Irrigation turns and gifts

- “Critital mass” for timely maintenance
- Modernization
- Securing 3 turns or more
- Field to field water distribution

Irrigation turns and gifts

Does 3 turn result in more net soil moisture than 2 turn

- ***Highly likely scenario***: two irrigation turns in July and a third in either June or August, a bi-weekly interval between any two turns
- ***Less likely scenario***: two irrigation in either June or August and one in July, a two week interval;
- ***Unlikely****, yet possible scenario*: two or three turns in June or August at a weekly interval

Irrigation gift and turns

Does 3 turn result in more soil moisture than 2 turn?

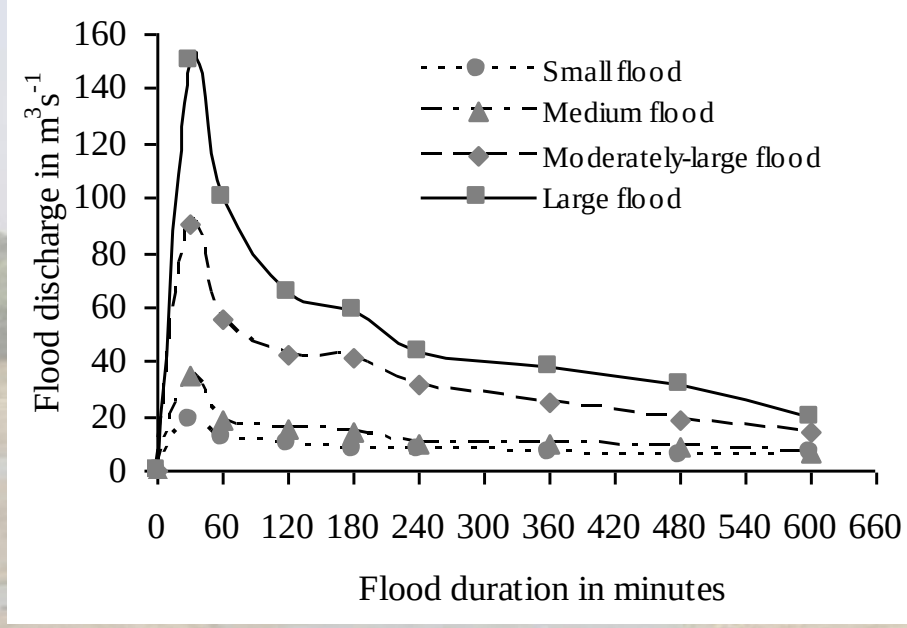
- Two and three turns of 500 mm gift each and one turn of 1000 mm conserves same amount of net soil moisture as long as the timing of the last irrigation turn is the same
  - *Ist July = 660 mm*
  - *15 July = 690 mm*
  - *30 July = 730 mm*
  - *15 August = 770 mm*

Key message is: two irrigation turns or a gift of 1000 mm may be sufficient for optimum yield

Modification and enforcement of water rights

- Rule on flood sizes: *Regardless of the size of the flood, if a field gets 2 turns (1000 mm), the subsequent floods should be supplied to downstream*
- Small and medium floods are more frequent – 50% of the total number of floods that occur annually
- Small and medum floods are non-saline, while large floods were found to be moderately saline
  - *20 to 50% yield reduction in sorghum and maize production*

Field water application and distribution



Shift to individual field distribution system?

Large spate flows in short period

Sediment control and management

Field-to-field: reduce command area

Field-to-field distribution: possible damages

Almost no difference between field levels

Big differece between field levels

40 to 50 cm

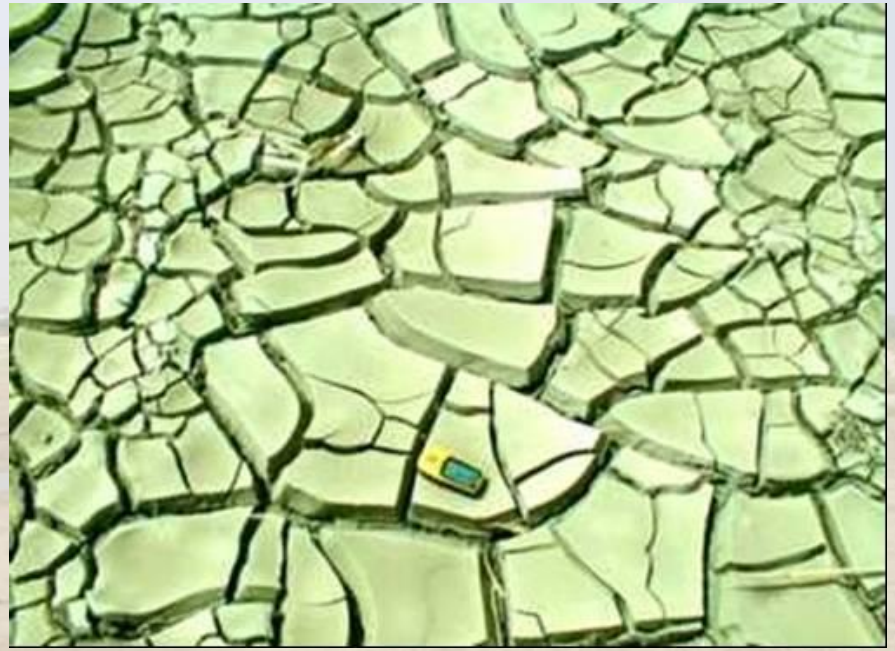
Field-to-field distribution: Overflow control

Field-to-field distribution: maintenance

- Individual as well as collective responsibility,
- Collective impact – single fabric that suffers when damaged

- Explicit penalities:
  - Compensation for crop lost
- *Lethband*: hereditary tenant – one who mainatians the field bund

Water holding capacity and infiltration rate



Water holding capacity and infiltration rate

- Bulk density: 1000 to 1300 kg/m^3
- Bulk density : 1600 kg/m^3
- Bulk density: 1800 kg/m^3

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Discussion statements/recomendations

- Soil moisture conservation and management (SMCM) has so far received the least attention in spate irrigation improvement projects/initiatives/activities
- Spate irrigation improvement can hardly be successful with out an effective SMCM
- SMCM is a package with interrelated elements
  - *Irrigation turns and gifts, water rights, water distribution system, field bund maintenance, tillage practices*

Discussion statements/recomendations

- Field-to-field water distribution system is preferred to individual distribution system, but single inlet fed command area may need to be reduced
- Unassuming as they may seem field bunds are major determining factor regulating soil moisture in spate irrigated fields
  - *Over flow control structures*
  - *Maintining small level difference among fields*
  - *Avoiding bund heights of above 1 m*
  - *Strict water rules*
- Water rights and rules are at the core of SMCM, they need to have a water quality dimension

Discussion statements/recomendations

- Limiting irrigation turns to two or a gift of 1000 mm
- Simple oxen driven conservation tillage and soil mulching practices can conserve as much as 100 mm of soil
  - *Tractors and tractor driven implements*
- Maintaing the water holding capacity and infiltration rate is fundamental, improving it imperavtive
  - *Avoid redundant tillage practices*
  - *Avoid tillage when the soil is very wet*
  - *Adopt agroforestry – multipurpose trees*


Thank you
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