

Analysing Farmponds

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Jalyukta Shivar Abhiyan Follow-up Workshop

Aurangabad

Agenda

- Farmponds and the emerging situation
- Characterizing different types of farm ponds
- Analysis of farmponds: capacity, catchment area and command area
- Economics of farm ponds
- The FP debate and the way out

The emerging situation

- Changing cropping patterns: Rise in horticulture
 - Need for frequent and assured water; very sensitive to water stress
 - High returns and high investment
 - Long term commitment
- Rising uncertainty in water availability
 - Frequent droughts and erratic rainfall
 - Kharif stress
 - Ground water not reliable as buffer
 - Soil moisture stress in rainfed farming
- Rising popularity of farm ponds across varying farm practices and soil types

Farm ponds: boon or curse?

Some news excerpts...

- *Farmpond as **response to climate change** – Tribune*
- ***Drought proofing**: Farm ponds turn out to be game changer – Indian express*
- *Farm ponds play a big role in tiding over **droughts** – The Hindu*
- *Why and how farm ponds can **save Indian farmers**-yourstory.com*
- *Maharashtra Farm Ponds: accelerating **groundwater exploitation** rather than harvesting rain? – SANDRP*
- *The great **farm pond chase** (center expects to see two million FPs in the year): Down to earth*
- *Ponds **need pondering** – India water portal*
- *Adaptation or maladaptation: case of farm ponds converted into **storage ponds** - WOTR*

Farm ponds : different types, uses



Naigaon, Sinnar



Ghusar, Akola



Wadgaon, Sinnar



Jamdaya, Hingoli



Nandur Shingote, Sinnar

Characterization of FPs

- Lined/unlined
- How the FPs are filled
- Farm soil type and other bio-physical factors: the impact of FP on water budget
- Use of farm pond water

1. Inlet/outlet type FP in small streams



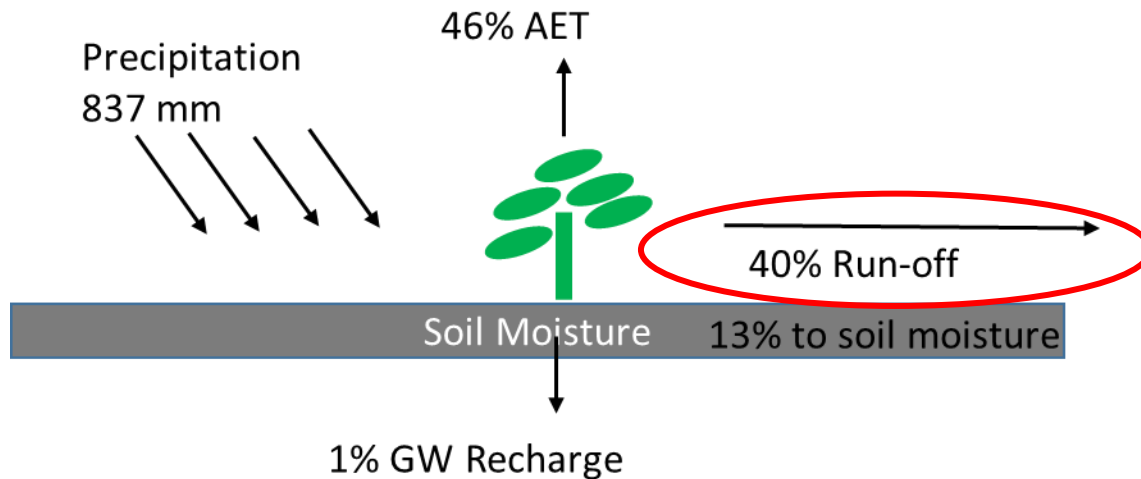
Location: Ghusarwadi, Akola

Inlet/outlet type FP

- Cascading ponds filled by diverting water from small order streams
- Water availability
 - No plastic lining; compacted clayey soil layering lowers seepage loss
 - Water may stay in the pond for 2-4 months beyond rainfall
- Typical uses:
 - 1-2 post monsoon irrigation
 - Well recharge
 - Protective irrigation during late monsoon dry spell
 - Channeling farm runoff prevents water logging in deep clayey soils
- Limitations:
 - silting, plant growth, erosion of pond walls at inlet and outlet, seepage loss can be significant depending on soil type

Runoff filled FPs: implication for water budget

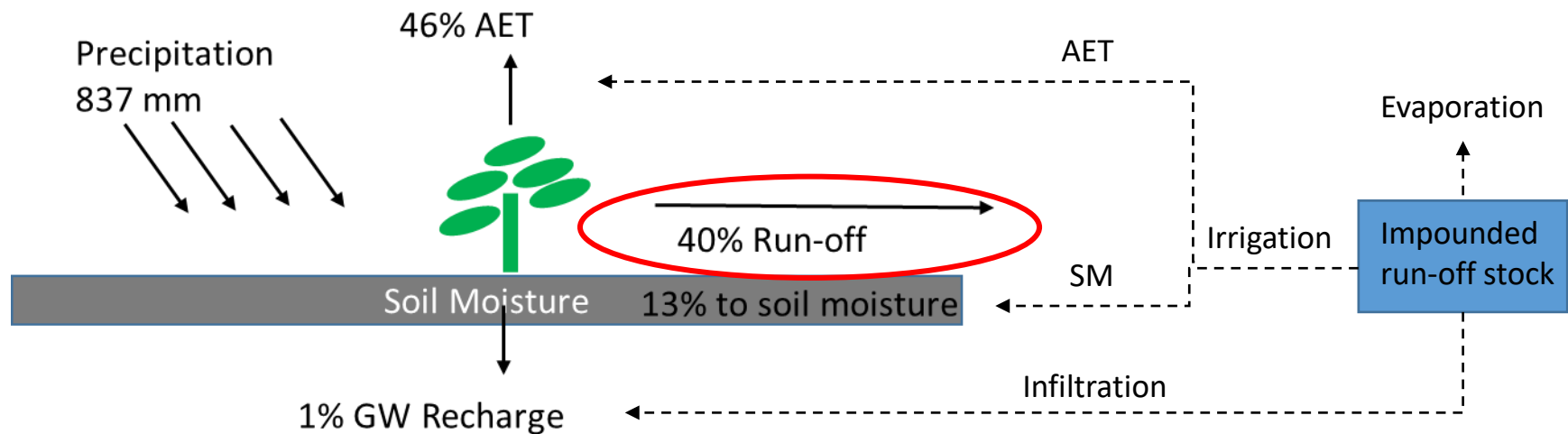
Gondala Deep Clayey soil Farm water balance 2016



- Typically used in deep clayey soils: high runoff and slow percolation to GW
- FP feasibility depends upon available run-off

Runoff filled FPs: implication for water budget

Gondala Deep Clayey soil Farm water balance 2016



- Typically used in deep clayey soils: high runoff and slow percolation to GW
- Feasibility depends upon available run-off
- *Exercise: How is it different from percolation tanks?*

2. Off-stream FPs capturing farm run-off



Location: Ghusar, Akola

Catchment area and number of fillings



Location: Ghusar, Akola

Will the farm pond fill up?

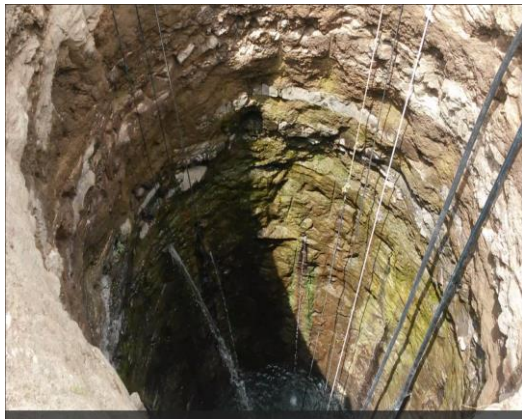
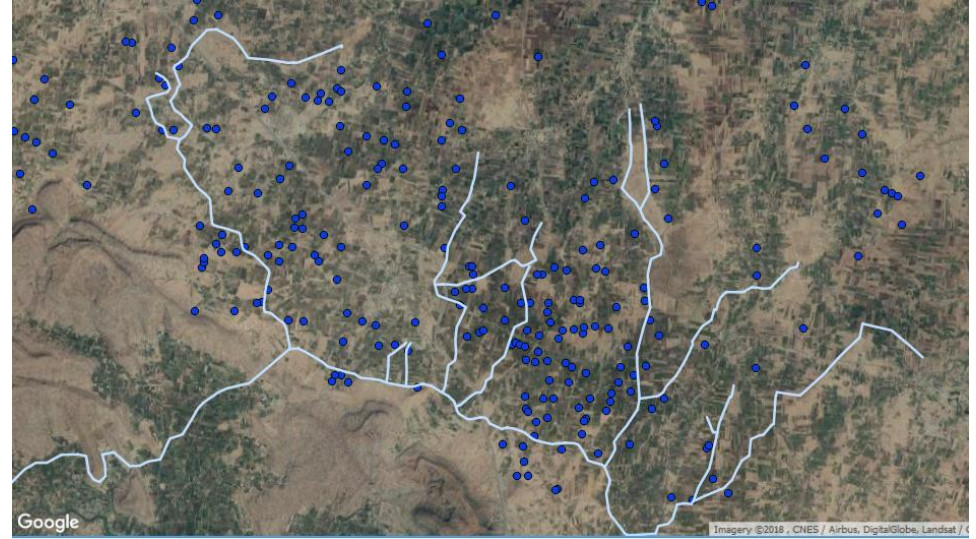
Ghusar	2017	2016
Rainfall (mm)	550 mm	920 mm
Calculated run-off for cotton crop	77 mm	410 mm
Catchment area required to fill a 2TCM farm pond	?	?

Will the farm pond fill up?

Ghusar	2017	2016
Rainfall (mm)	550 mm	920 mm
Calculated run-off for cotton crop	77 mm	410 mm
Catchment area required to fill a 2TCM farm pond	$=2000/0.077$ sq. m = 2.6 ha	$=2000/0.410$ sq. m = 0.48 ha

- FP filling depends upon runoff generated and upstream structures within the FP catchment area
- Ghusar case: upstream FP filled both years, downstream FP only in 2016
- New demand for FPs must consider rainfall patterns and existing structures to determine feasibility

3. FPs near canal systems



Location: Near Bhojapur canal in Dodhi, Sinnar

Canal water filled FP

- Filled through direct lift or wells next to canals
 - In non-command areas or when rotations are uncertain
- Water availability
 - FPs are lined with plastic to minimize seepage
 - Water can be available for summer/annual crops
- Typical uses:
 - horticulture cultivation depending on assurance of rotation
- Implications for water budget:
 - External water being imported
- Problems:
 - Causes losses in canal operation; water for protective irrigation diverted for productive irrigation; also illegal

4. GW filled FPs

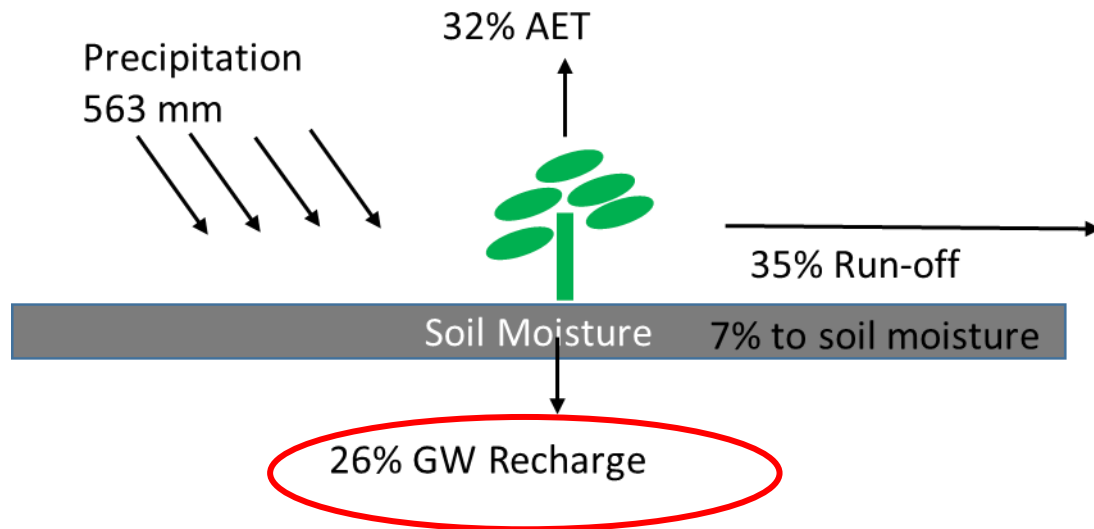


GW filled FP

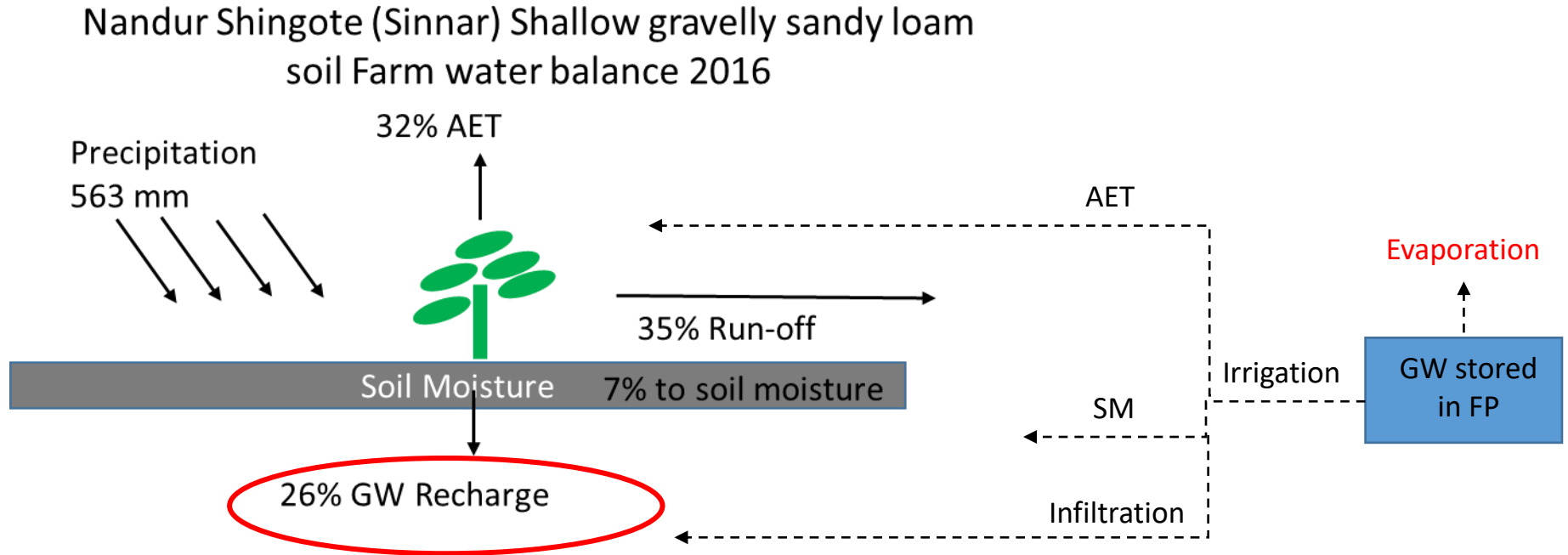
- Filled by pumping water from wells mainly during monsoon season
- Number of fillings
 - Usually once during monsoons and regularly topped off until well has sufficient water
- Water availability
 - FPs are lined with plastic to minimize seepage
 - Water can be available for summer/annual crops
- Typical uses:
 - where wells available but GW is uncertain in later months
 - Drop in ground water levels due to subsurface flows, or
 - Increased GW competition causes uncertainty
 - Assured water for horticulture crops
- Problems:
 - GW competition vs. co-operation; often coexists with drinking water scarcity; losses to evaporation which can be prevented if water remains as GW

GW filled FPs: implications for water budget

Nandur Shingote (Sinnar) Shallow gravelly sandy loam
soil Farm water balance 2016



GW filled FPs: implications for water budget



- Typically used where wells available but GW is uncertain
- May impact drinking water and shallow irrigation wells

Typical FP size and capacity

इनलेट आऊटलेटसह व इनलेट आऊटलेट विरहीत शेततळे -

अ.क्र.	शेततळयाचे आकारमान	पृष्ठभागावरील क्षेत्रफळ (चौ.मी.)	होणारे खोदकाम (घ.मी.)
अ. इनलेट आऊटलेटसह शेततळे			
१.	१५x१५x३ मीटर	२२५	४४१
२	२०x१५x३ मीटर	३००	६२१
३	२०x२०x३ मीटर	४००	८७६
४	२५x२०x३ मीटर	५००	११३१
५	२५x२५x३ मीटर	६२५	१४६१
६	३०x२५x३ मीटर	७५०	१७९१
७	३०x३०x३ मीटर	९००	२१९६
ब. इनलेट आऊटलेट विरहीत शेततळे			
१	२०x१५x३ मीटर	३००	६२१
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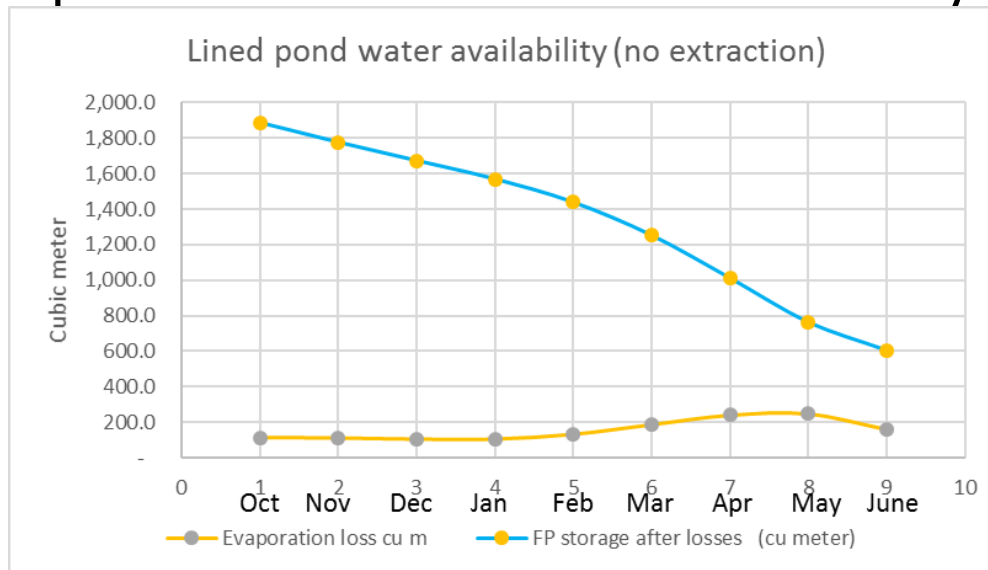
.09 ha or
<0.25
acres

2.2 TCM * no.
of fillings =
water
harvested

GR dated 17/2/2016 for Magel Tyala Shettale

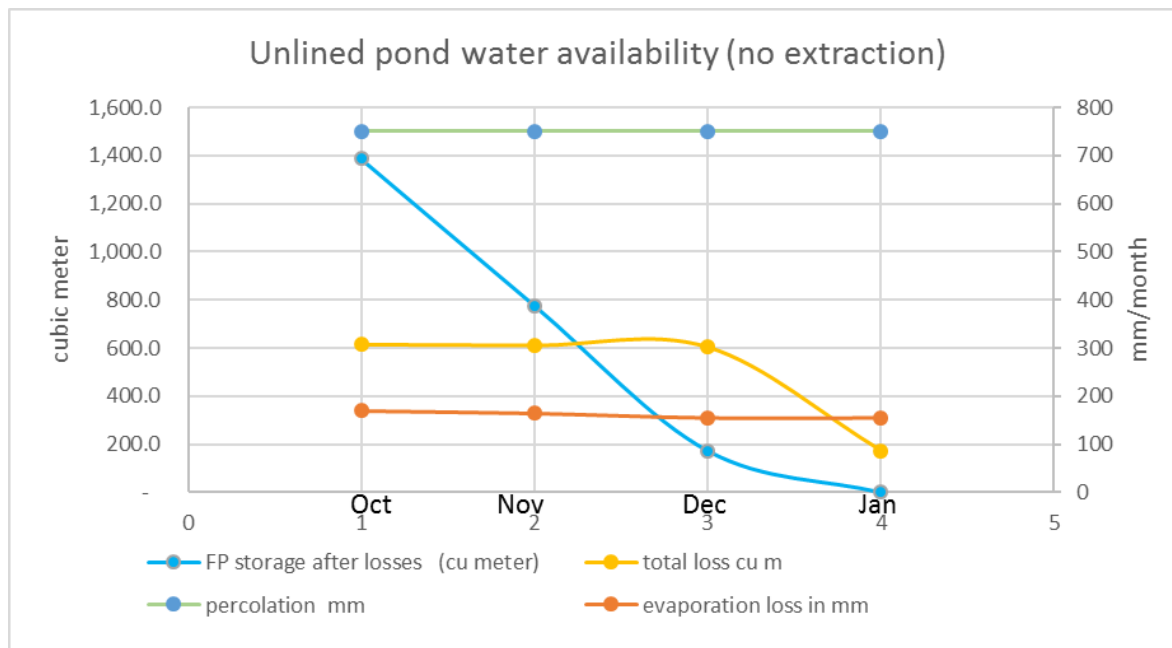
Losses from farm ponds

- Evaporation, percolation, leakages and other application losses
- Lined FP losses
 - Evaporation loss: depends on climatic conditions ~5 to 12 mm/day
 - 50% evaporation loss by April for summer protective irrigation
 - Evaporation is the true loss from the system



Losses from unlined ponds

- Unlined farm ponds
 - Seepage loss depends upon soil type and head of water
 - Rahuri thumb-rule: 24mm/day
(Ref: CRIDA publication)
 - Seeped water remains in system but evaporated water is true loss



Ref: Quoted for US soils in IITD and CRIDA paper

Table 1. Seepage rate with different soil types	
Soil Types	Seepage
Clayey	7 cm/day
Silty	23 cm/day
Loamy	29 cm/day
Sandy	48 cm/day

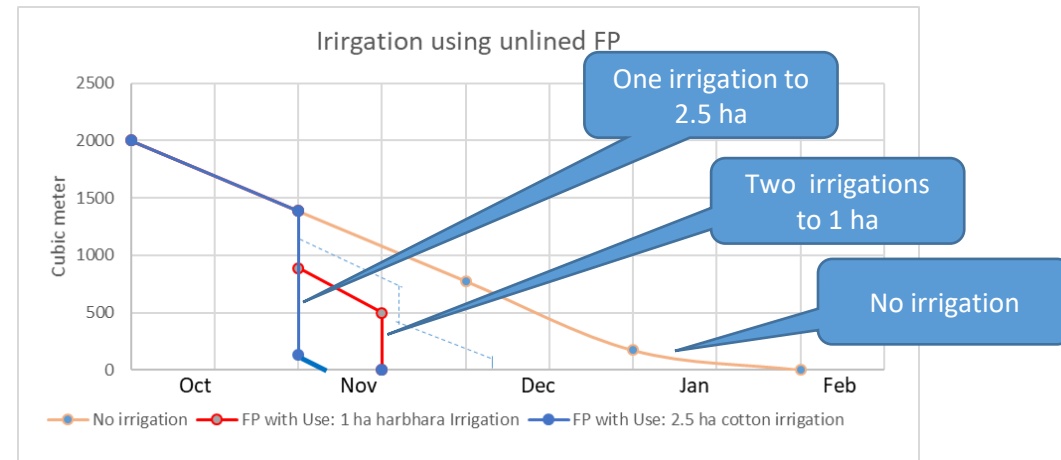
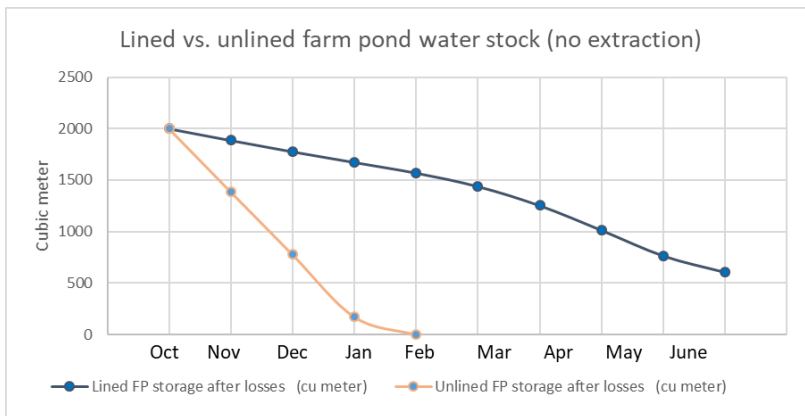
How much can a FP irrigate?

- Crop Irrigation requirement Example:

- One 50mm irrigation to 1 ha cotton = $0.05 \times 10^4 \text{ cu.m.} = 500 \text{ cu.m.}$
- Two irrigations to 1 ha harbhara

Month	irrigations	TCM
Oct	1x50mm	0.5 TCM
Nov	1x50mm	0.5 TCM

- Losses from FP (evaporation and/or seepage)



Exercise: What % of water is used productively in the different irrigation scenarios?

Impact on yield: Ghusar Farmer surveys

Crop	Farmer No	Unirrigated	Irrigated
Cotton (Ajit 155)	1. w/FP	7Q/acre (in 2017)	8Q/acre (one irr in 2016)
	2. w/bore	3-5Q	8Q (July 2017 protective irr)
	3.		12Q (1 kharif protective + 1 in Nov 2017)
Harbhara (Vijaya)	1. w/ FP	5Q (2016)	6Q (one irrigation)
	2.	2-3Q	6-7Q (post mung; one irr Oct 2017)
	3. (w/ bore)	5-6Q (after mung, no irrigation)	(after soya) Pre-water before sowing + 2 more in Nov and Dec: 6-7Q/acre
(Jackie)	4.	6-7Q (post mung)	10Q (twice irrigated post mung)
Soyabean	1.	Crop failed (2017)	
	2. (w/bore)		5Q (1 in Oct 2017) full yield ~12Q w/2 more water
	3.	1.5Q (2017)	
Tur	1.	1.5Q/acre	5Q

Farm Pond Economics

- Government schemes
 - JYS, Magel Tyala Shettale : subsidy of Rs 50,000
 - NHM: community tank subsidy upto 100%
- FP cost depends upon soil profile and size:
 - 30x30x3 cu.m. : Rs 75k to 1.5 lakh; additional 1.5 to 2 lakh for plastic lining
 - Annual maintenance cost, pumping cost etc
- 2 TCM Unlined pond: Calculate ROI (i.e. in how many years will the farmer recoup investment)
 - Case 1: farmer uses 2TCM FP to cultivate 1 ha harbhara
 - Assume market rate: Rs 4000/Q
 - Case 2: 2TCM FP for 2.5 ha of cotton
 - Assume market rate: Rs 4000/Q

Farm Pond Economics

- Government schemes
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 - 30x30x3 cu.m. : Rs 75k to 1.5 lakh; additional 1.5 to 2 lakh for plastic lining
 - Annual maintenance cost, pumping cost etc
- 2 TCM Unlined pond ROI: 2-4 years with subsidy
 - 2Q/acre yield increase in 1ha of harbhara (at Rs 4000/Q) results in additional profit of Rs20,000 per season
 - 1Q/acre yield increase in 2.5 ha of cotton (at Rs 4k/Q) increases profit by Rs 25,000
- 2 TCM lined FP ROI: increased yield alone not sufficiently profitable shift to high value crop

Post FP crop viability: 2016-17 example

		Post FP crop								
		Irr Tur	Irr Cotton	Kharif crop + Irr Rabi Jowar	Kh crop + Irr Rabi Harbhara	Kh crop + Assured Rabi Wheat	Kh crop + Assured Rabi onion	Kh crop + Rabi Tomato	Kharif + Rabi + summer vegetable	Annual Pomegranate orchard
Pre - farm pond crop	Rabi fallow or unirrigated tur/cotton/jowar/harbha ra	+22,000 to +65,000	+12,000 to +55,000	0 to + 43,000	0 to + 48,000	+ 6,000 to + 49,000	+ 18,000 to + 61,000	+ 35,000 to + 78,000	NA	Insufficient water
	Irr Tur (1000 cu.m by well)	NA	NA	NA	NA	-30,000	-2000	+11,000	+20,000	Insufficient water
	Irr Cotton (1000 cu.m by well)	NA	NA	NA	NA	-18,000	+11,000	+24,000	NA after cotton crop	Insufficient water
	Irr Jowar (1000 cu.m by well)	NA	NA	NA	NA	+11,000	+40,000	+53,000	+20,000	Insufficient water
	Irr Harbhara(1000 cu.m by well)	NA	NA	NA	NA	+2000	+28,000	+61,000	+20,000	+87,000
	Unassured Wheat (3000 cu m)	NA	NA	NA	NA	+23,000	+69,000	+107,000	Insufficient water after full wheat	+93,000
	Wheat (4500 cu m)	NA	NA	NA	NA	NA	+81,000	+124,000	+20,000	+215,000
	Onion	NA	NA	NA	NA	NA	NA	NA	+20,000	+134,000

Amortizes FP cost to 30k per year (lined) or 10k (unlined)

- Horticulture a natural partner of lined farm ponds

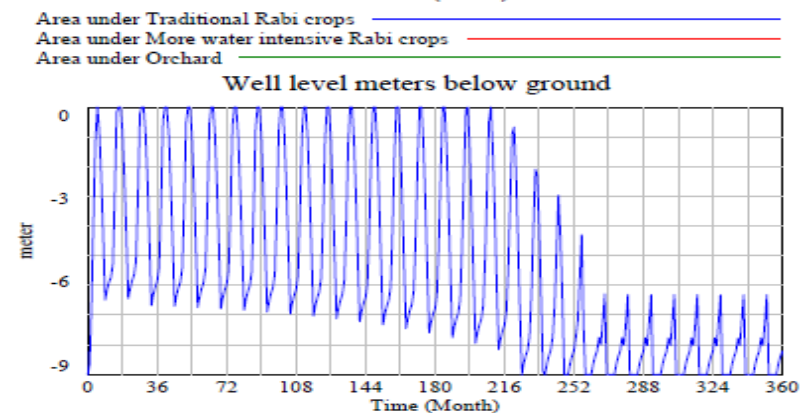
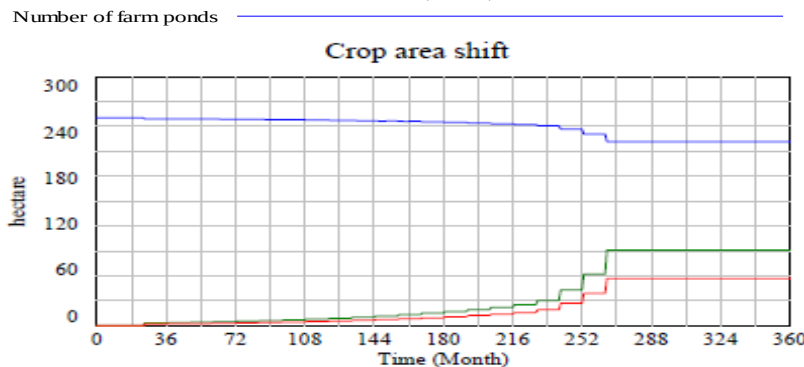
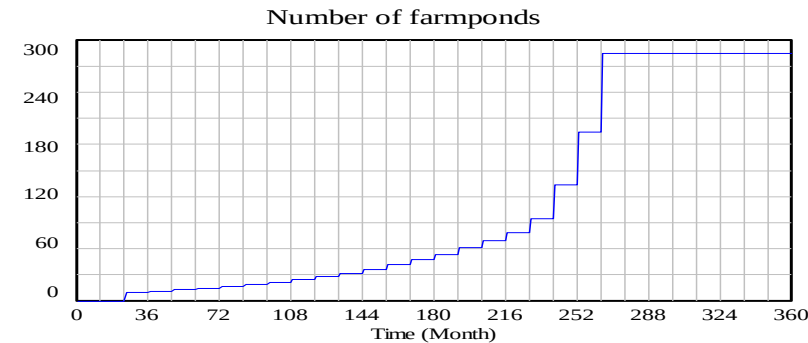
The FP debate : how to resolve?

- Not all FPs are the same
 - Ask which type of FP? How will it be filled?
 - FPs harvesting run-off no more downside than other line treatment
 - Enable shift to high value crops => on average yield higher returns
 - Very useful in **salinity effected areas** or areas with deep clayey soil
 - FPs filled using GW (or canal systems without formal accounting)
can be problematic
 - Equity concerns *community farm ponds?*
 - GW sustainability concern *How many are sustainable?*
 - GW lost to evaporation *can we afford this?*
- Water budget crucial to determine the optimal number of farm ponds
 - Possible to get an optimal range of GW filled FPs for a watershed
 - Need to regulate this range

Thank you



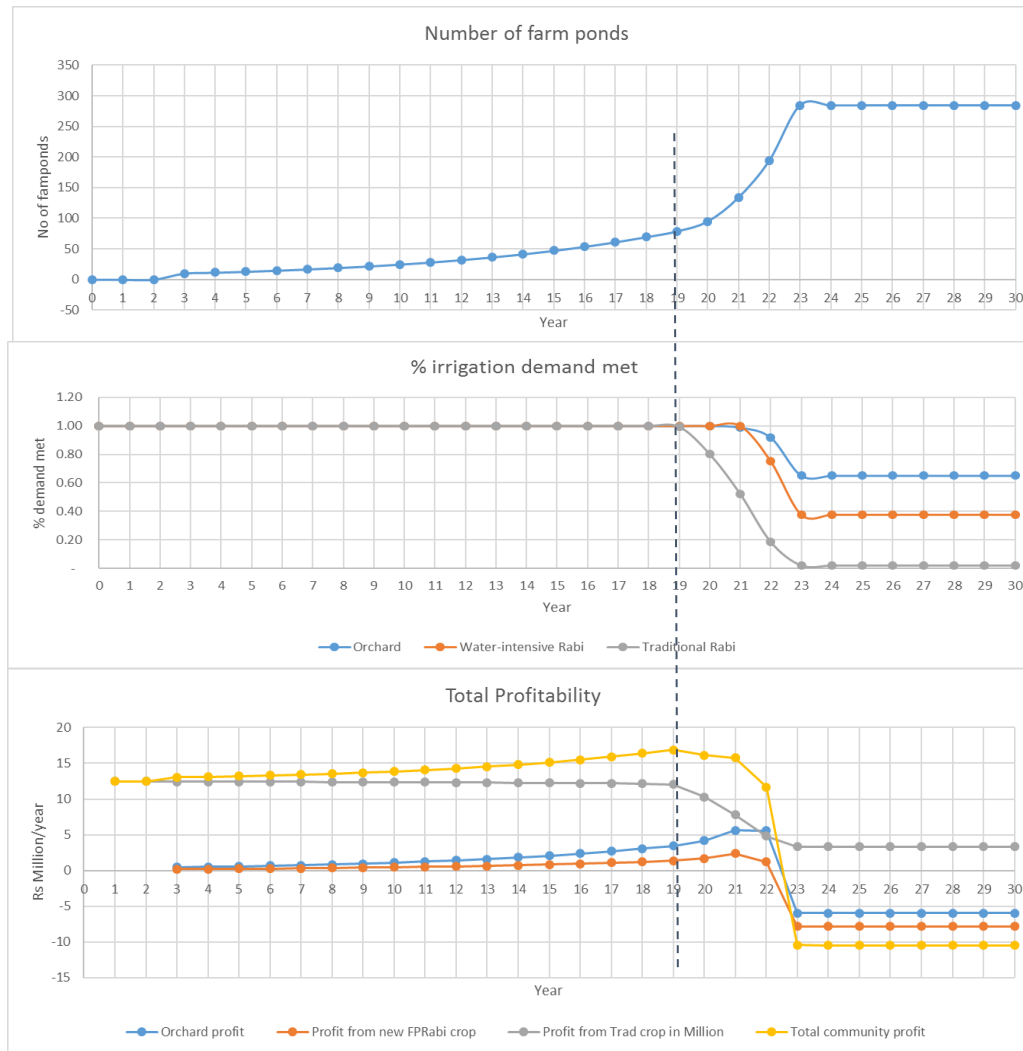
E.g. Modeling GW based farm ponds: shift in cropping pattern and impact on GW



GW level meter below ground

- Model: Every new FP triggers a shift in cropping pattern. This impacts GW demand
- Beyond certain count of FPs, GW levels drastically fall
- Can this “optimal” point be a point of equilibrium without regulation?

Modeling profitability from FPs



- More FPs => shift towards horticulture crops=> increasing total profitability
- GW starts to become scarce => unmet demand => lower crop yields and profitability for non-FP farmers first.
- FP owning farmers continue to be profitable due to high returns on orchards incentivizing more investments in FPs
- By the time FP farmers are hit, GW crisis is in place and everyone is worse off

- Possible to get an optimal range of GW filled FPs for a watershed
- Need to regulate this range