Advies- en ingenieursbureau

Natural treatment systems for waste water

Soil Aquifer Treatment (SAT) to optimize water use and to accommodate irrigation

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Water to accommodate development of sub regions of Rajasthan

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Why think about recharge and recover (of treated waste water)?

- Region faces water scarcity (low rainfall, high evaporation)
- Overexploitation and decline of water table is reported
- Groundwater situation is very precarious
- Wadis actually did not carry water for decades, not even in short monsoon periods
- Local surface water as well as import from other areas, is not an option
- Project area is a large basin consisting of coarse and permeable sands and gravel above underlying rock

For sustainability it is essential to:

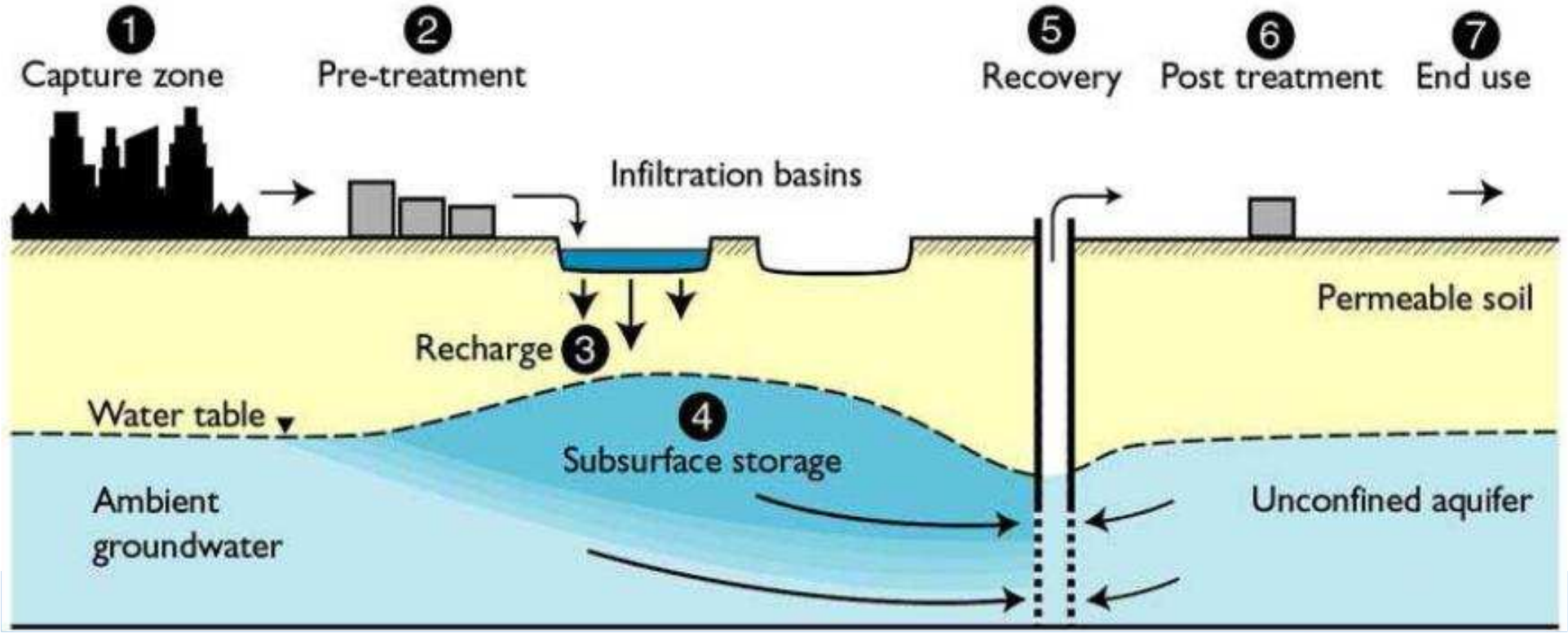
- Impose stringent restrictions regarding water use to cut down on demands and limit consumption
- Harvest and capture rainfall and prevent it from evaporating
- Attract industries with low water consumption and large degrees of recycling and water reuse
- Minimize evaporation losses due to irrigation
- Assist farmers to shift to more efficient irrigation
- Promote drip irrigation, stimulate transition to less water demanding crops
- Think about SAT

SAT, what is it?

- Managed aquifer recharge … as well as
- Additional waste water treatment (beyond primary or secondary)
- It produces water for indirect potable use
- SAT breaks the pipe to pipe connection
- A natural psychological barrier
- It removes the social issue and brings public acceptance of (indirect) water use

SAT mechanisms responsible for improvement of water quality

- Waste water is subjected to a natural combination of physical, chemical and biological processes
- Filtration, precipitation, ion exchange, adsorption and desorption, complexation, redox reactions, microbial degradation, dilution …..



Comparison of natural and conventional treatment

	Natural treatment (SAT)	**Conventional treatment**
Ammonia	Nitrification (oxic)	Oxidation, stripping
Nitrate	Denitrification (anoxic)	Ion exchange, RO
Particles, suspended solids	Filtration	Coagulation, flocculation, (membrane) filtration
Microorganisms	Filtration, inactivation, natural die-off	Filtration, disinfection
Micropollutants	Adsorption, precipitation, biodegradation	Coagulation, ion exchange, RO, oxidation, adsorption
Phosphorus	Adsorption, precipitation	Chemical precipitation

Business case for Recycle, Reuse or Recharge of normal effluent: comparison of three options

1. Recycle: Distribution of B-grade water produced by additional treatment of normal effluent

2. Direct Reuse of effluent as irrigation water in agriculture

3. SAT (or Aquifer Recharge and recovery) for agricultural, industrial or domestic use

Three options: pro's and con's

	B-grade water Recycle
Pro's	- Savings on demand and plant size for drinking water
Con's	- Only part can be reused for toilet flushing - Serious health risk due to cross connections - Costly separate system for distribution - Additional treatment of effluent

Three options: pro's and con's

	B-grade water Recycle	Direct Reuse in agriculture
Pro's	- Savings on demand and plant size for drinking water	- all of the effluent can be reused - Farmers are willing to pay ('rich water, containing nutrients') - no additional treatment (in case of flooding - the part of the water that percolates is treated 'naturally'
Con's	- Only part can be reused for toilet flushing - Serious health risk due to cross connections - Costly separate system for distribution - Additional treatment of effluent	- difficult to collect fees - extra treatment is required in case of sprinkling of drip - regulation needed because only part of farmers benefit - limited crops can be grown with this water (not raw eaten vegetables) - requires a channel distribution system

Three options: pro's and con's

	B-grade water Recycle	Direct Reuse in agriculture	Indirect use via artificial Recharge
Pro's	- Savings on demand and plant size for drinking water	- all of the effluent can be reused - Farmers are willing to pay ('rich water, containing nutrients') - no additional treatment (in case of flooding - the part of the water that percolates is treated 'naturally'	- aquifer is natural filter for pathogens - all crops can be grown - no need for extra distribution system irrigation water - in case of ponding combinations of functions is an option (recreation, theme park, cycling) - recovered water has constant quality
Con's	- Only part can be reused for toilet flushing - Serious health risk due to cross connections - Costly separate system for distribution - Additional treatment of effluent	- difficult to collect fees - extra treatment is required in case of sprinkling or drip - regulation needed because only part of farmers benefit - limited crops can be grown with this water (not raw eaten vegetables) - requires a channel distribution system	- discussion to what level the water should be treated - area/land needed in case of ponding

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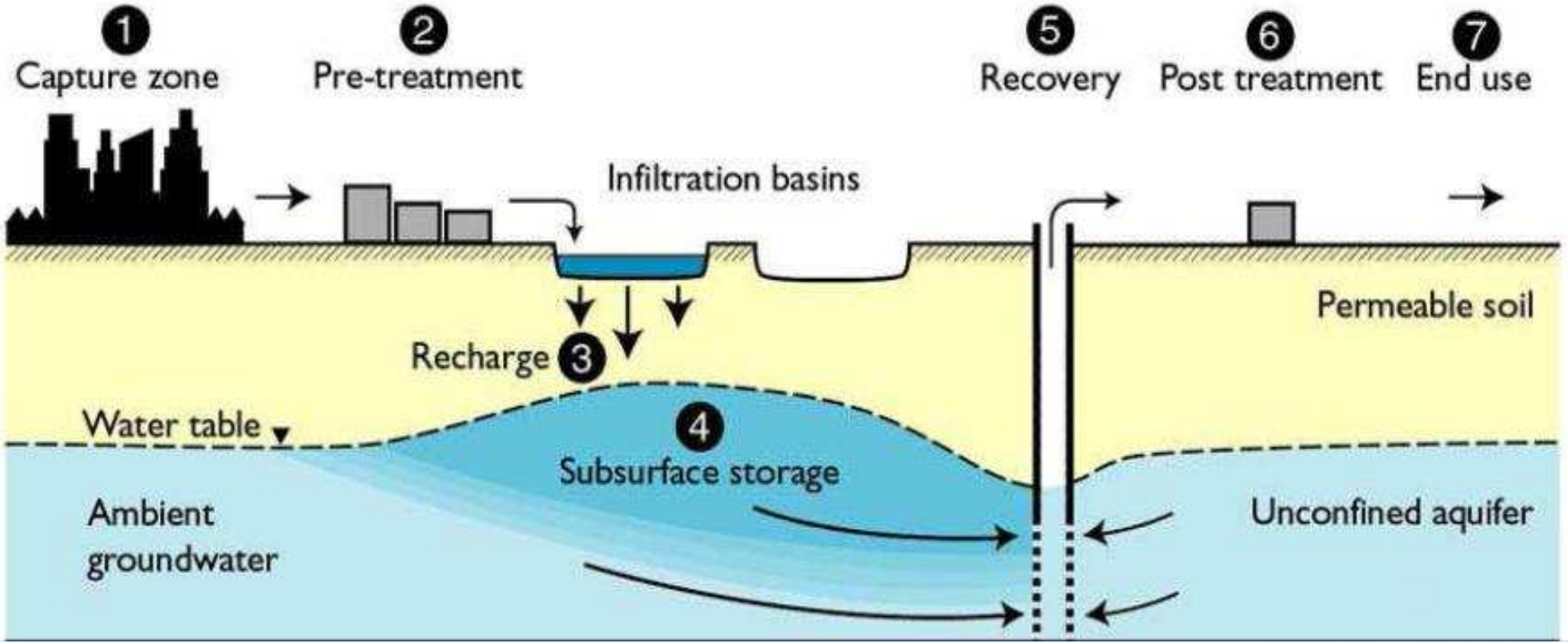
What about capital costs of the three options

B-grade water Recycle	Direct Reuse in agriculture	Indirect use via artificial Recharge
- Extra costs for additional treatment of part of the effluent - Reduced costs of smaller drinking water treatment and less abstraction wells - Costs of extra distribution system	- In case of sprinkling or drip irrigation extra treatment is required - Costs of a channel distribution system	- Costs of land may be high. But in case of an in- or near stream AR-site, it is not needed to acquire land

Conclusions

SAT is very promising and helps accommodating development based on local water resources and helps restoring water deficit

In particular if geo-physical and local conditions are favourable: relatively flat area, non consolidated soils, high permeability, land available



Further reading and acknowledgement

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