



Groundwater Management: Ecological Security Oriented Demand

CHEN Ying

Ministry of Water Resources, China
Water Resources Management Center



Content

- **Role of Ecological Services of Groundwater**
- **Probelms and Main Goals**
- **GW and Ecological Security Oriented Demand**

Background

Groundwater is an alternative source to surface water in most places available from a well.

The role of groundwater is often adopted as providing a vast resource being increasingly tapped for people' s vital uses, e.g. irrigation, domestic uses, and industry.

However, The role of its ecological services is not recognized clearly until it becomes ever scarce.

The ignored services of groundwater are invisible and hard to quantify with which often maintains the stream flow, the wetland, the vegetation, especially when it is not raining, and maybe the only water source for many people, animals, and organisms in various locations.

Background

If properly managed, groundwater can provide an important contribution in guarantying long-term water supply and meeting the needs of socio-economic growth, also mitigating climate change and solving regional water crises on earth.

The depletion of groundwater is caused primarily by mismanagement. e.g., overpumping, but also by reduced natural recharge due to climate change and urbanization.

Climate change- change in precipitation patterns

temperature change and increased evapotranspiration

Managing " Hidden" resource or invisible resource make it more tough than surface water

Despite its manifest importance for water security, groundwater is often overused and poorly managed ,leading to aquifer depletion and contamination that is now visible. As A " hidden" resource, groundwater is not easy to manage.

Groundwater is by far the largest store of liquid freshwater, making it a key component of a secure water supply.However, over the past few decades the amount of usable groundwater available around China has rapidly decreased.

The role of GW 如何认识地下水?

Vertical Order of Groundwater and Ecological Security

地表 Surface Water

Groundwater
Depth
埋深

地表生态保护 (潜水蒸发作用)
surface ecology protection (pneumatic water evaporation)

eco-security control water level
生态安全控制水位

地下水源保护 (水源涵养作用)
groundwater source protection (water conservation)

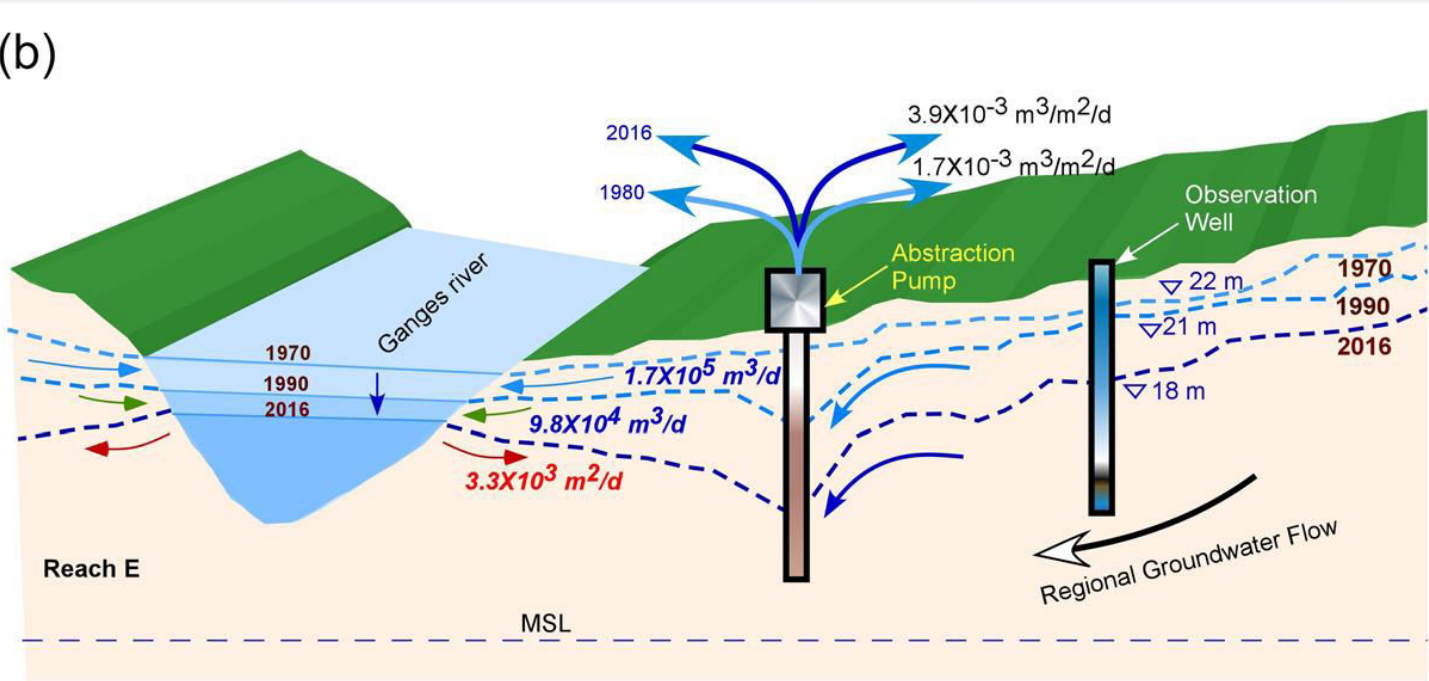
**balanced groundwater
level of water discharge
and recharging**
采补平衡水位

地下水超采: *overdraft of groundwater*
(no connection between surface water and groundwater,
rainfall does not produce runoff. Water is suspended in the soil
严重者地表地下完全失去联系, 降雨不产流、悬浮于土壤中)

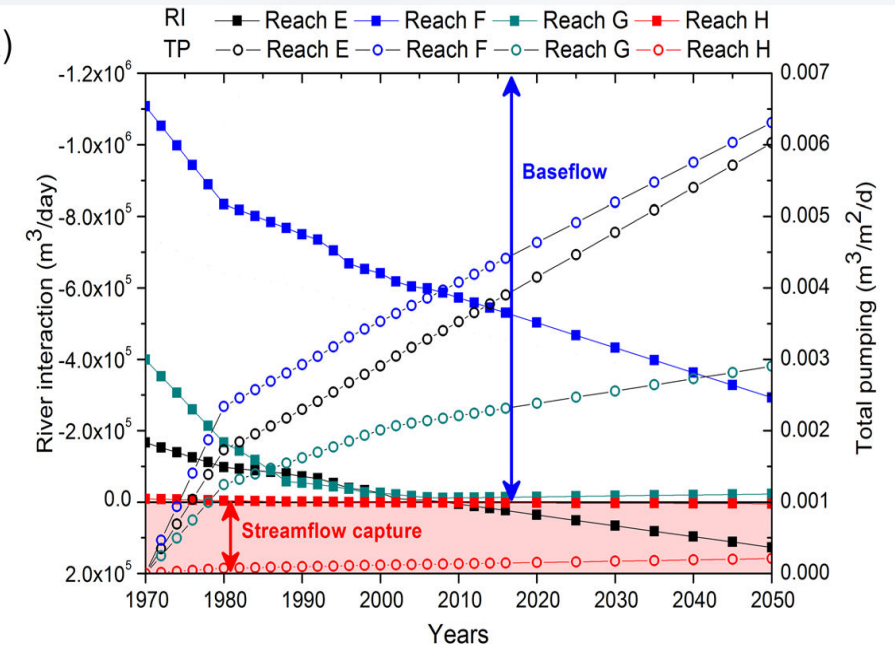
- 分布广泛
- 长年累月蓄集
- 含水层多
- 年调节能力强
- 水量稳定
- 取水设施不易受到外力破坏

Groundwater depletion causing reduction of baseflow

(b)

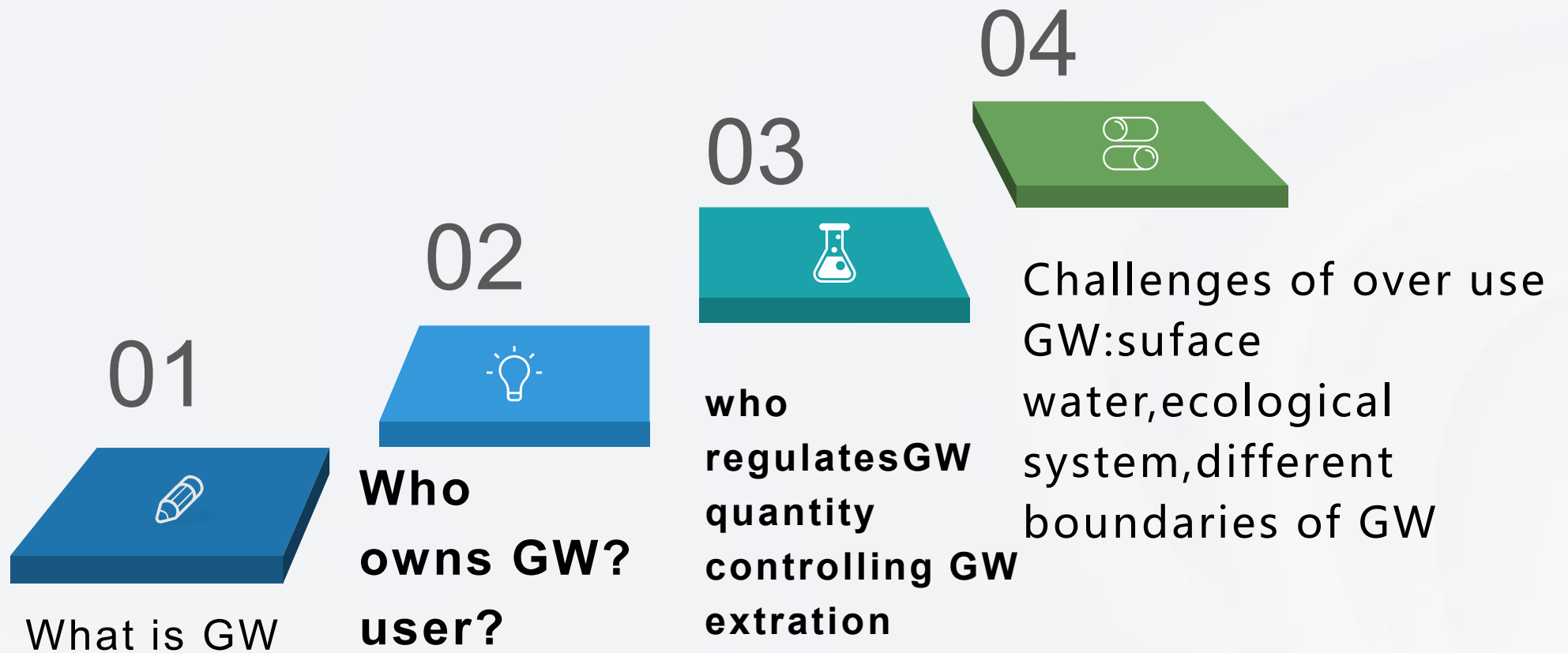


(a)



Abhijit M , Nath B S , Yoshihide W . Groundwater depletion causing reduction of baseflow triggering Ganges river summer drying[J].scientific Reports, 2018, 8(1):12049-.

Ecological Security and sustainability oriented: Groundwater Management



从资源开发到资源的管理模式我们需要什么

From Resource Development to Management Mode

what we need?

地下水资源量

**How much
groundwater
occurs ?**

information



谁取用

取用多少水量

在哪里取

**信息和监测数据长
期需求**

Who withdraws?

where?what

quantity?

Who regulate GW?

宏观层面：划定地下水利用管理控制的限制额度和标准（地下水取用水量、地下水水位）

Macro level: control extration limits

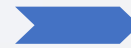
微观层面：取水许可，每一眼井登记造册

Micro level: control rights, entitlement and licences

from macro to micro, GWM aims to hold reasonable exploitation to be in the context of ecoenviorment.

关注

- 地下水资源量
- 地下水水位变化



管住

- 取水、用水

who- the targets to govern

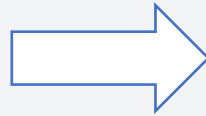
All environments have been modified by human activity and those interactions produce “winners” and “losers” .

Improvements require changes in **human behaviour**, especially when these activities deny opportunities for future generations. However, **changing human behaviour can be difficult to accomplish.**



Groundwater Management + Ecology threshold values

- **A clearly stated objective is vital**



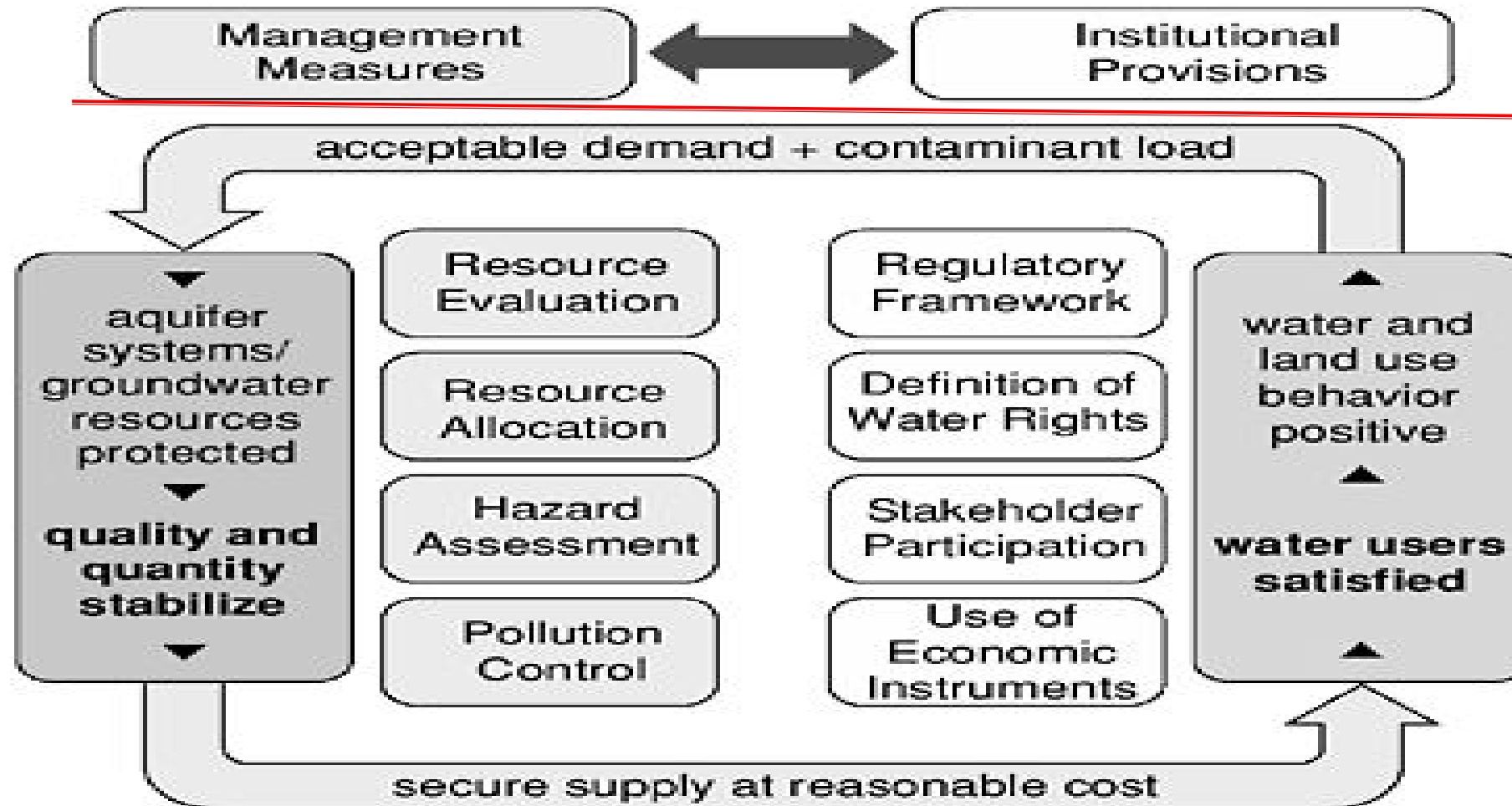
- **Groundwater depth**
- groundwater quality
- land surface subsidence
- changes in streamflow
- surface water quality where they impact or are impacted by groundwater pumping

The establishment of threshold values for readily measured quantities

Detailed Groundwater Management objective Concerning Ecology Function is important

- When a threshold level is reached, the rules and regulations require that groundwater extraction be adjusted or stopped to prevent exceeding that threshold.
- Management objectives may range from entirely qualitative to strictly quantified. At a local level, each management objective would have a locally determined threshold value that can vary greatly.

Managing groundwater is as much about managing people (water and land users) as it is about managing water (aquifer resources)



Case study 1-Arid area

- **Vegetation cover is an indicator to eco-environment.especially in arid area.**
- **The natural vegetation mainly depends on the surface river water,of which the groundwater works.**
- **The soil moisture and salinity conditions are closely related to the groundwater depth.**
- **Groundwater depth is a key factor affecting vegetation ecology and an important eco-environmental index that causes the natural plants to wither and die.**

- **the relationship between the groundwater depth and the actual growth of plants**
- most natural plants can not survive when the groundwater depth is more than **7m**, few extremely drought-tolerant plants can survive.

When the depth of groundwater is more than **9-10m**, all plants will die. The ecological water level should be controlled at **2.5-4m** in the marginal zone of oasis



CASE STUDY 2

Relationship between groundwater depth and safe ecology in Shannxi province

陕西地下水埋深与生态安全的关系

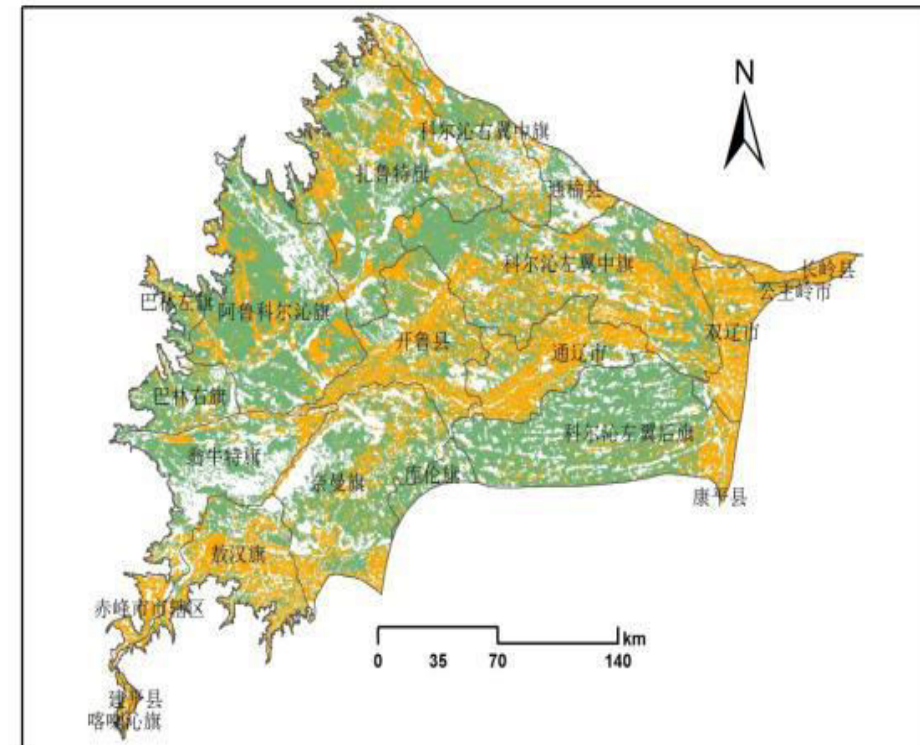
地下水埋深(m) groundwater depth	geomorphic type	ecology safety goals
1.67-7.62	terrace area	<p>The min depth metric in the case study area is set to avoid soil salinization.</p> <p>The maximum depth in alluvial fan is to ensure the continuous flow of the river.</p>
47.23	loess tableland area	

Defining hydro-ecological relationships as thresholds can support management decisions. This method takes a precautionary approach by setting the threshold higher than the maximum groundwater depth.

case study 3-Indicators of groundwater depth control in the West Liaohe Plain: differential management in pastoral areas, irrigation districts and urban areas

地下水位控制性指标与安全管理

- 牧区地下水埋深不超过2~2.5m
- The groundwater depth in pastoral area should be kept during 2~2.5m
- 农灌区地下水埋深不超过7~8m
- The groundwater depth of agricultural irrigation area should be kept during 7~8m
- 城区以10m为控制指标
- The groundwater depth in urban area should be kept at 10m as a control index.



Three categories of groundwater depth management 不同地区、不同问题与水位关系的三类情况

1. The first category aims to secure the surface ecological systems, especially those ecological sensitive zones, where lower water tables would result in land salinization, continued withdrawal of water from groundwater would lose the vegetation and surface waters.

第一类针对地表生态安全问题，主要是西北生态脆弱区，表现在如果地下水埋深过浅造成地表盐渍化，水位过深会导致地表植被和地表水体的消失。

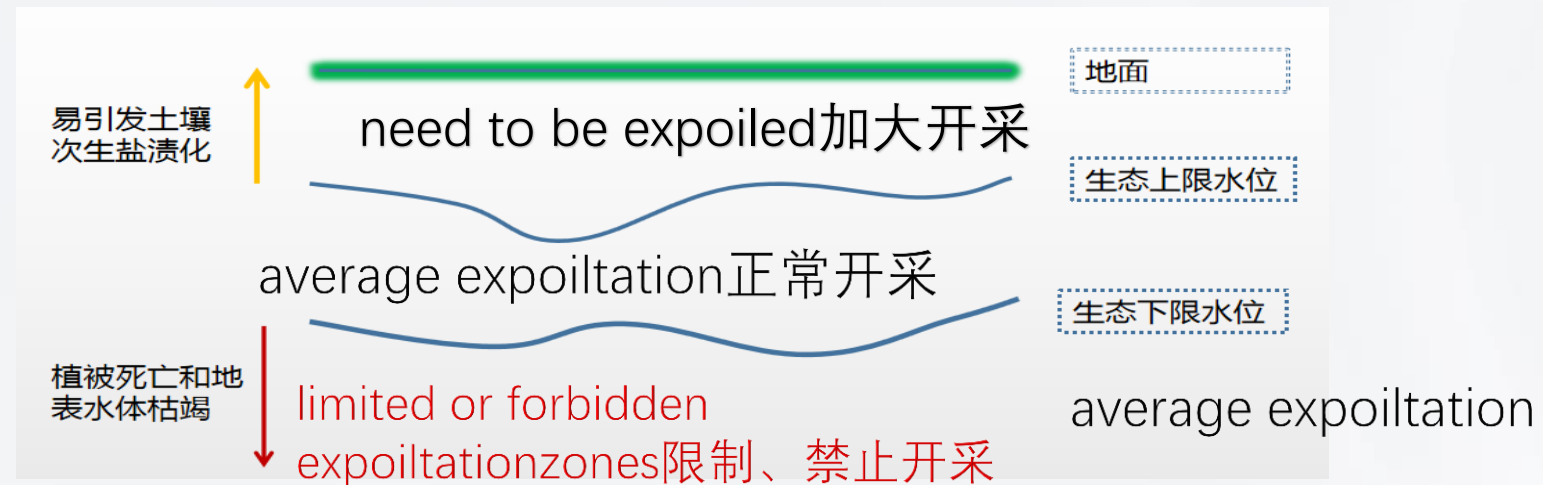


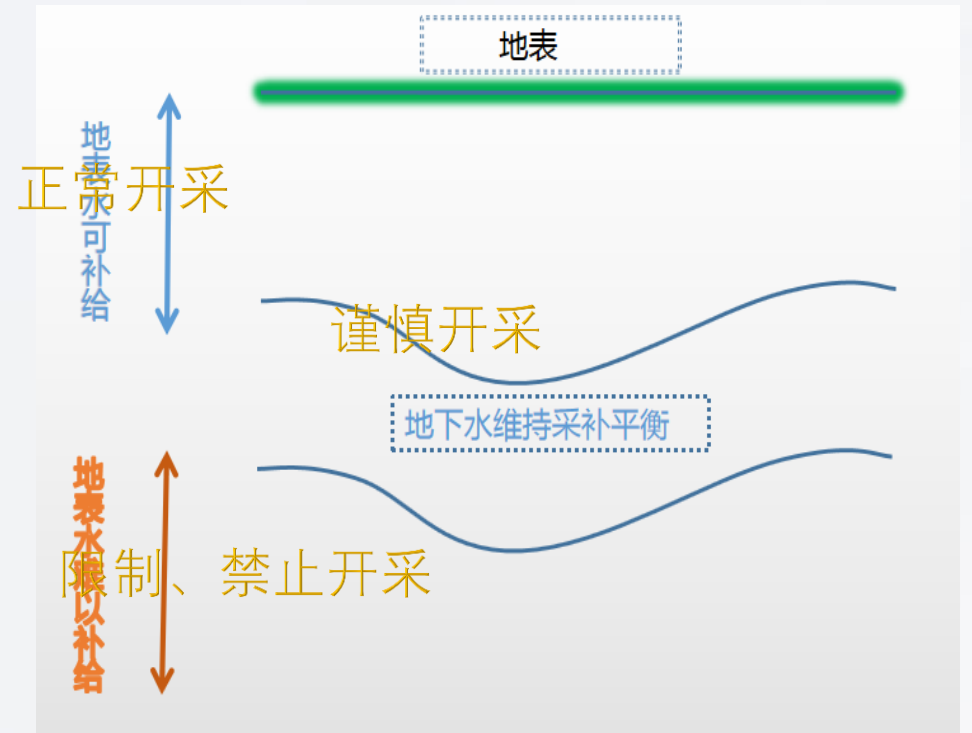
Figure 1 impacts of different groundwater levels on surface ecosystems
生态安全水位示意图

The second category aims to conserve groundwater to reach the balance between discharge and recharge.

第二类针对水源涵养

If the water table is kept in a reasonable level, groundwater can be recharged by infiltration via surface water bodies, or diffused by percolation of precipitation through the unsaturated soil zone to sustain baseflow and groundwater.

即维持地下水的采补平衡，在一定水位范围，地下水可以得到降雨入渗补给、河流湖泊等地表水体入渗补给。

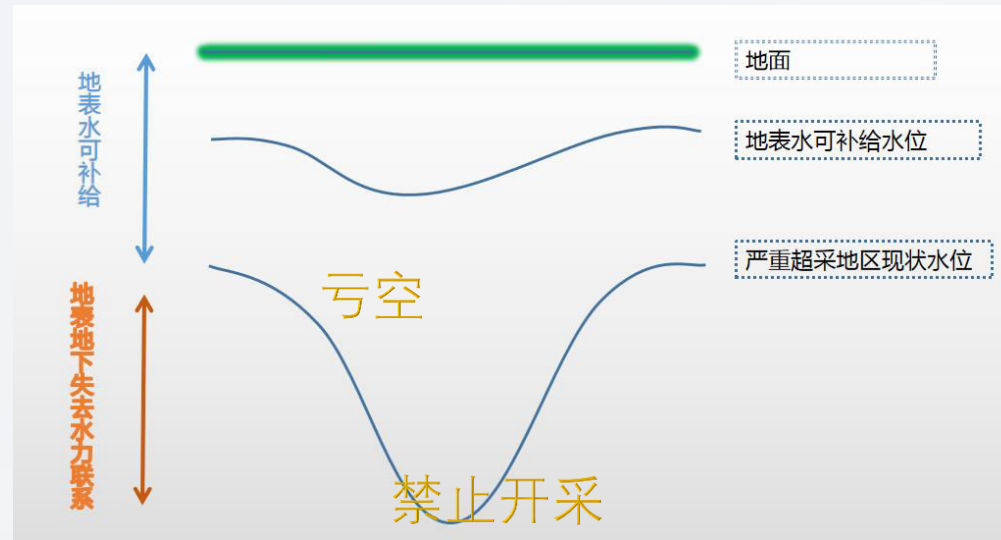


地下水水源涵养示意图

The third category is groundwater overexploitation prevention and governance.

第三类针对地下水超采问题，即采补平衡遭到破坏，突破地下水采补平衡之后持续开采，水位不断下降，水源涵养补给能力不断减弱，直至完全丧失地下水和地表水的水力联系，甚至引发地面沉降等地质环境问题。

地下水超采: overdraft of groundwater (no connection between surface water and groundwater, rainfall does not produce runoff. Water is suspended in the soil 严重者地表地下完全失去联系, 降雨不产流, 悬浮于土壤中)



地下水超采地区水位示意图

A decorative border featuring pink and white flowers, green leaves, and four butterflies: a black and yellow butterfly, a monarch butterfly, a blue butterfly, and another monarch butterfly.

CHEN Ying

Mobil:86 18611368827

Email:chenying@mwr.gov.cn