Large-scale management of common reed, *Phragmites australis*, for paper production:

a case study from the Liaohe River Delta, China

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Qingdao, China

Qingdao Institute of Marine Geology, CGS (QIMG)

An exceedingly well equipped research facility

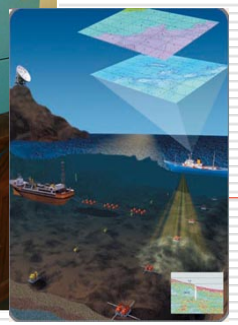
– QIMG, CGS, MLR

Drilling facility

Scientists: 280 persons
Technicians: 250 persons
Research budget: $30 million USD per year

Magnetic meter

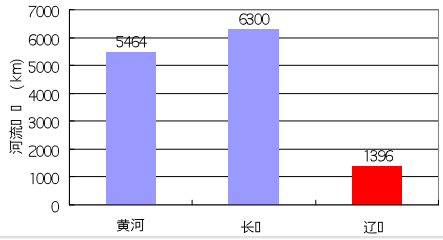
Gravity Meter

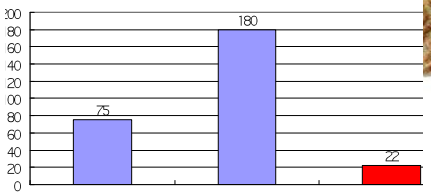


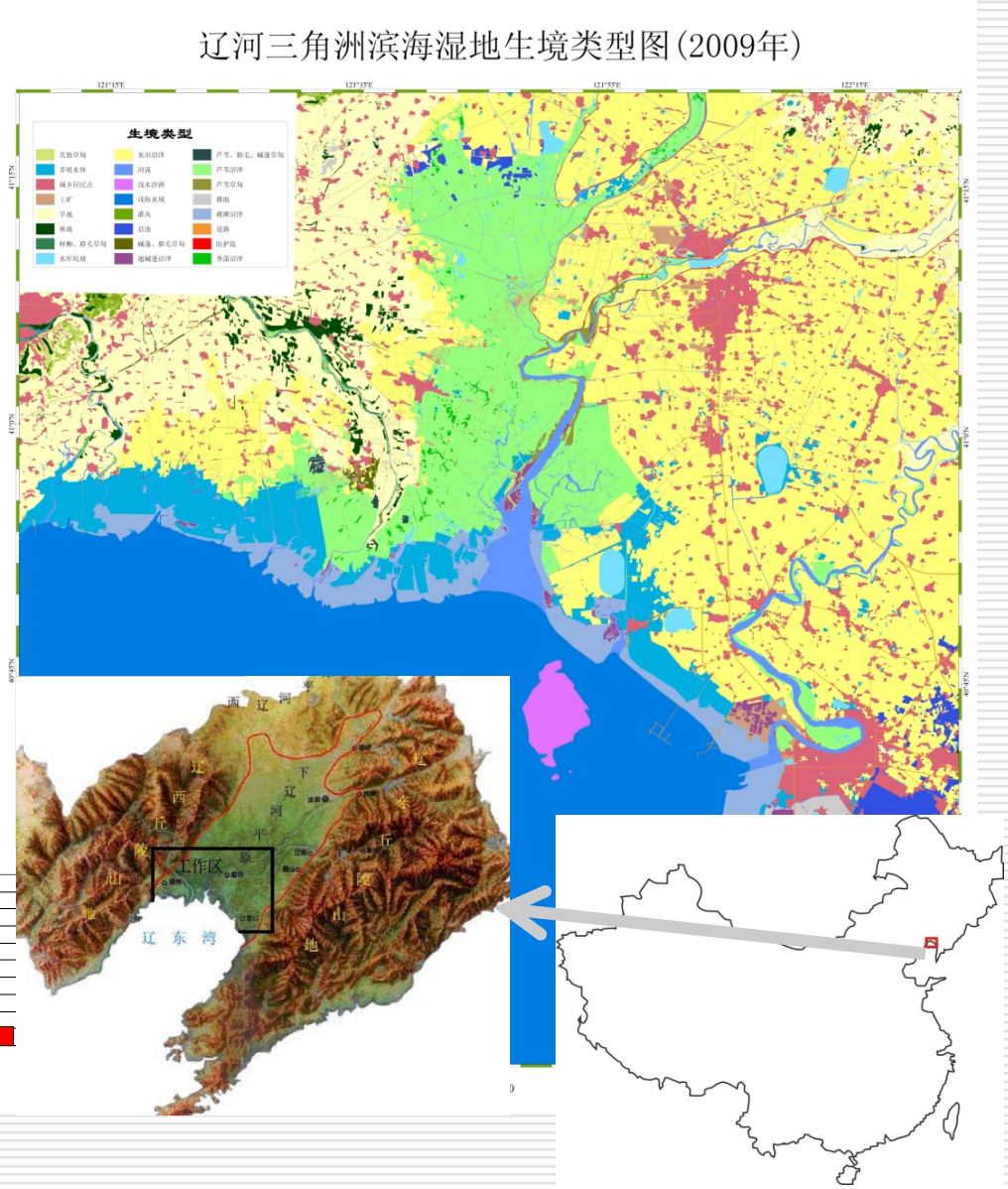
Multibeam swath bathymetry EM950

The study area is in the Liaohe Delta, China, to the north of Liaodong Bay, within the range of 121◦35–122◦55E and 40◦40–41◦25N.

- The Delta was formed from the transgressive deposits after sea level rised to the maximum 7000 years ago
- The mean T is 9◦C, (July 27.4◦C, January −10.4◦C). Growth : April - October.
- 5 rivers run through
- Long evolution history
- Stable river course
- Delta area 5000 km²
- Reed wetland area 1000 km²







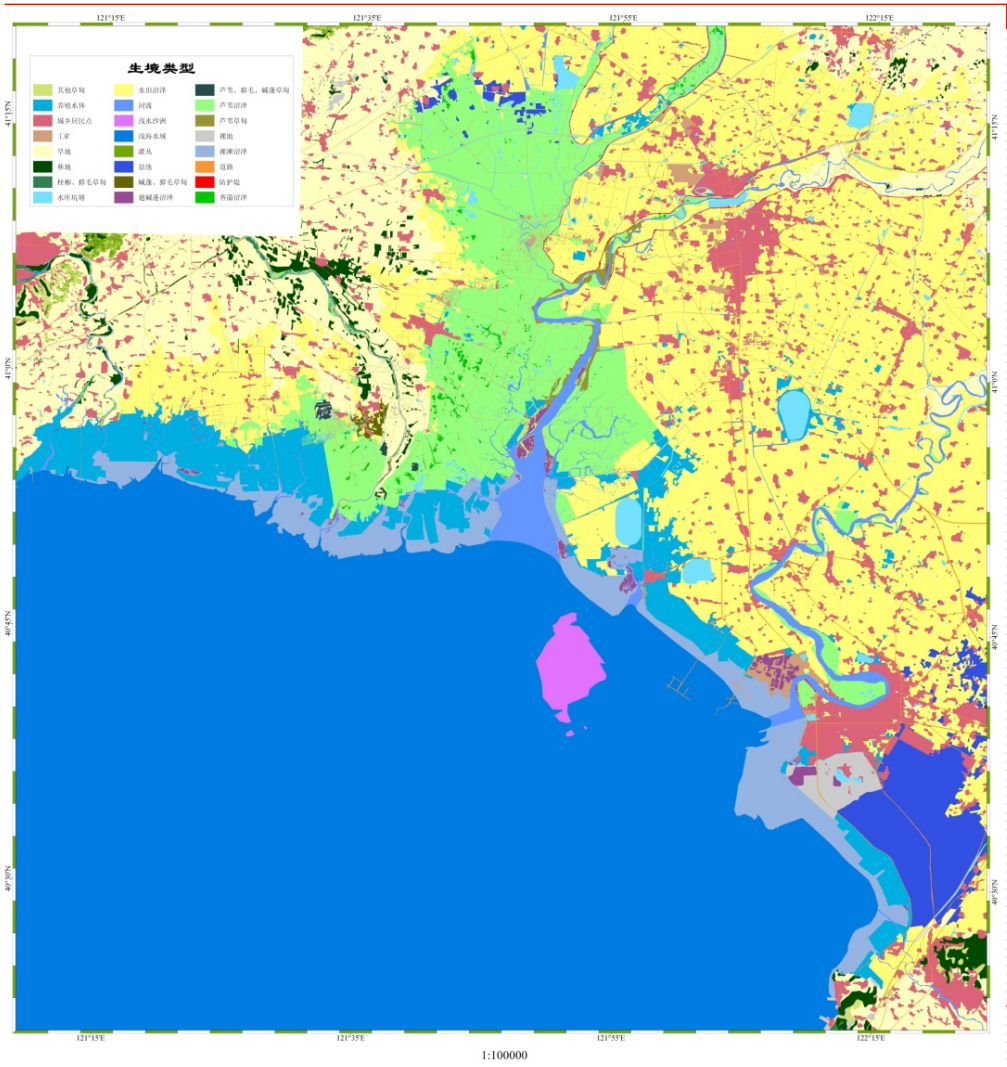
The best way to protect wetlands is to seek economy from this habitat

China Facts:

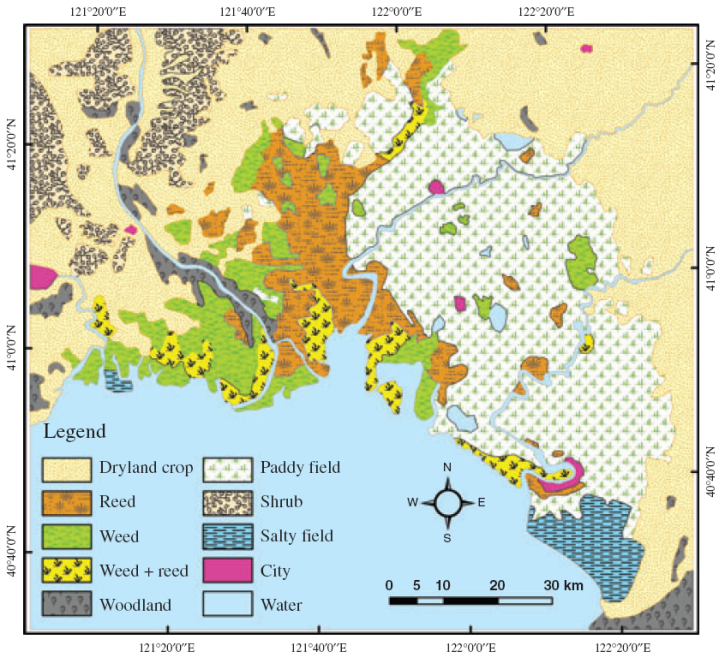
Of the world's population of 6.7 billion, China currently accounts for 20%. Almost 60% of Chinese citizens live in 12 coastal provinces

Although China has the third largest landmass of any nation, only about 15% of land is farmable. So, there is a high pressure on the land to feed so many people!

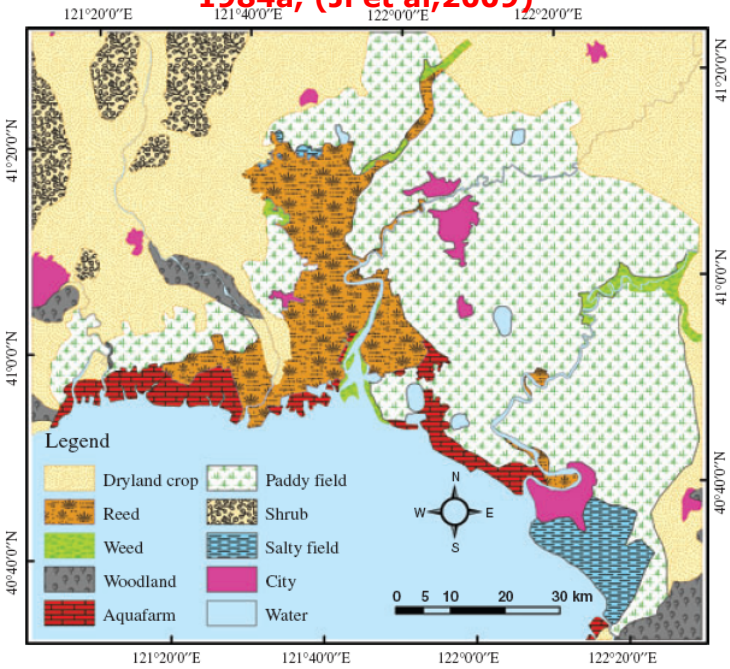
The reed marsh in the Liaohe delta is the largest in the world, with an area of about 100,000 ha



2009a, (This study)



1984a, (Ji et al,2009)



2006a(Ji et al,2009)

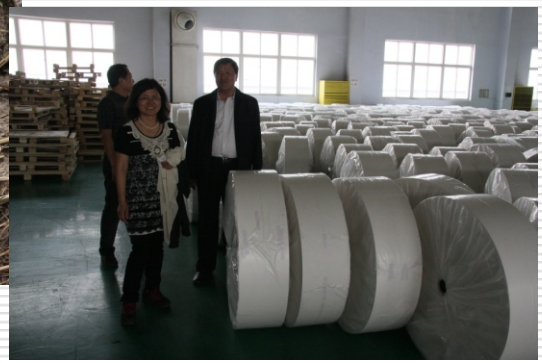
Annual reed yield and pulp

Annual reed yield: 450,000 tons
Annual paper pulp: 204,000 tons
(Liaoning Ecologic Papermaking Group at Panjin lacked 140,000 tons of reed materials in 2011).

The driving force for large-scale distribution of reed in the delta is the paper industry and other uses

- Most reed fields are managed by the local people with irrigation in spring, natural flooding inundation in summer, and harvesting in winter. Tidal water is prevented from entering the fields by dikes along the coast.
- The tall reed stems (>2 m) and deep water (often>30 cm) has brought much difficult for the monitoring.

use reed leaves to make Zhongzi, which is the special food for Drogon Boat Festival



Managements used in Reed bed

How can water level management and other managements make reeds grow most flourishingly to provide materials for paper making?

- Climate
- Hydrological conditons
- Soil and

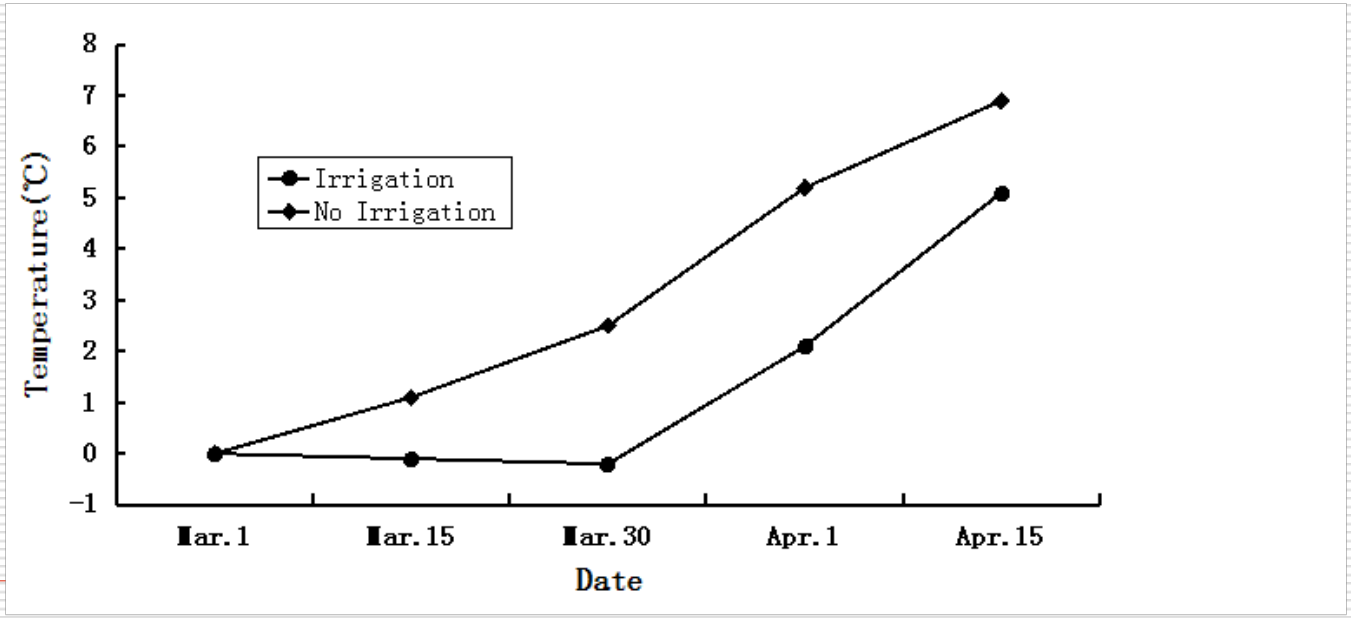
Water levels

(1) Shallow Irrigation in Early Spring (SIES)

In late March every year before **the** reeds **are sprouting** and **the** soil thaws, "peach water" (i.e. rising river water during the season when peach trees are in full bloom) is used to irrigate the reed wetland to reach a water level of 5-10 cm, which favors early development and early growth of reeds.

The function of SIES

- To make soil thaw earlier by 10-15 days
- To prevent the upper 10 cm soil from melting **during the** day and freezing **during the** night
- To remove salt & alkali (as it can decrease salinity in the upper 30 cm soil layer by 0.08%-0.1%)



After SIES

Drainage begins in early April to **reach a** water level below surface by 10 cm within one week

-- **being ready** for breeding crabs and fishes.

Frequent Irrigations in Summer (FIS)

Period: Mid May to early August

Water demanded: during FIS account for about 80% of the total water requirement for the reed growth

water depth: 20-30 cm

periodic drainage: to have good ventilation **of the soil** to satisfy physiological needs of reeds and to promote development of the root systems.

Drainage in Autumn Beginning Day (DABA)

DABA should be done within one week to keep the water level 20 cm below the surface

- To pro**vent** the stalks **from** turn**ing** green and grow**ing** tiny **'water** roo**t**s'
- To **prevent** nutrients transport to the reed **sideshoots** and keep it in the r**hizome** system for next year**s** growth
- To promote the maturity of stalks and increase reed yield

Other Managements

- Harvest
- Storage
- Transportation
- Pest control in the reed field

Harvest

4GL-185 type prefixal harvester

Rearmounted harvester (horse harvester)

Manual strapping

Transportation

Transportation by motor vehicles

Transportation by mini trains

Reed storage field with ditches around it

Storage

Reed storage field with lightning conductors

Pests

aphids

Asian migratory locust

Powdery mildew

Pest control

Spread pesticides

--pollution

--poisoning of humans & livestock

--damaging fishery

Pest control

Ecological control

- Shaotang (Burning reed stem)

--can burn eggs and grass seeds

--lose N, get to much K

- Flooding control

--In early spring maintain flooding for 7d, 56% of locust died, and 14d, 100% died

Liaoning Zhenxing Ecological Papermaking Limited company

Papermaking

- reeds are cut into small pieces

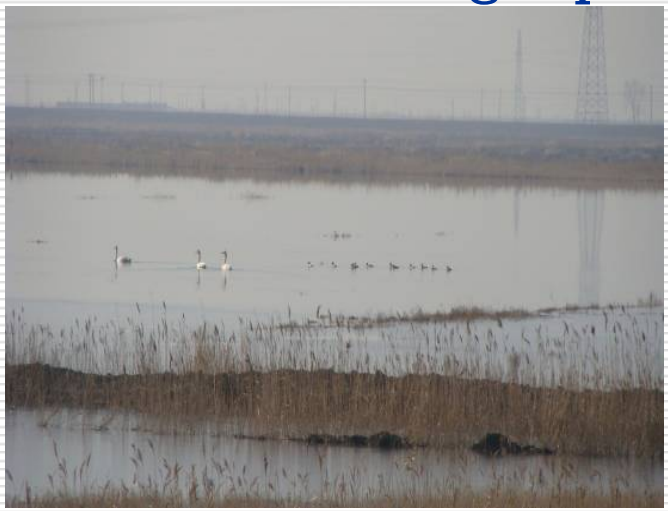
- Stewing

——small pieces are digested in a rotary spherical digester until they pulp

Screening and Decoloration

Waste water treatment facility

Sewage purified Pond



Oxidation Pond

Summary

In addition to the importance for biodiversity, and rehabilitation and stabilization projects, wetlands in the Liaohe Delta can function as:

- Carbon sequestration

Annual biomass 450,000 tons (dw)*45%=202,500tons C

(eq 742,500 CO2 was fixed from atmosphere)

- Fortune made from reed

204,000,000kg(pulp)*4 yuan/kg=208million Chinese yuan

(27 million Euro)

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Thank you for your attention