

The utilization of common reed (*Phragmites australis*) – a review

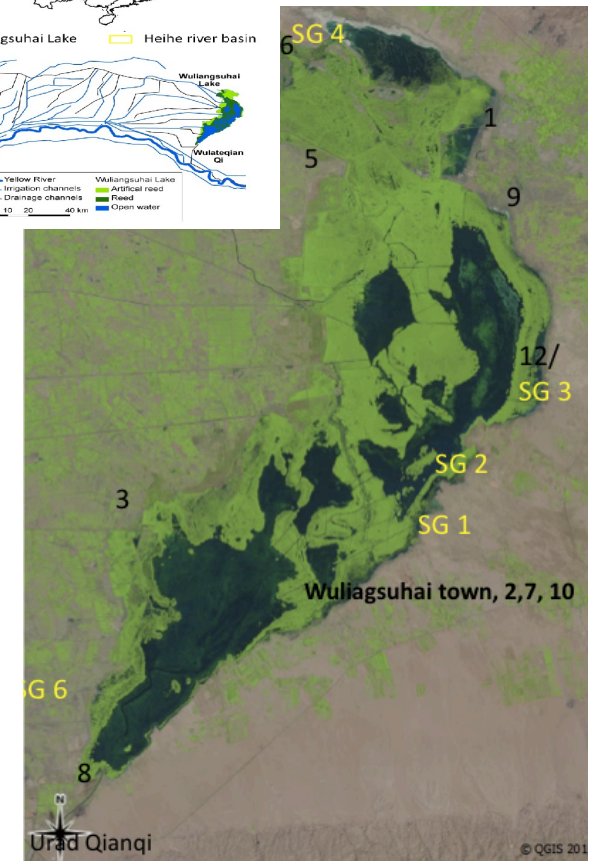
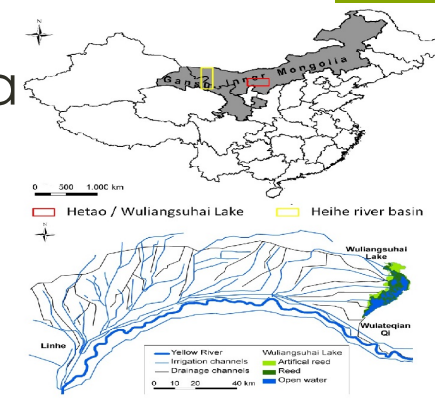
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Own project site

- Research in Inner Mongolia, North-China
- 36.600 ha lake area, half covered with reed (67/ha)
- 110.000 tons annually used for paper production. Purchasing price raw material: 370 CNY/t (44 €/t), at gate 700 CNY (83 €/t)
- Around the lake additional 100.000 tons are harvested
- New utilization possibilities are searched for



Importance of reed

- Their are big areas around the world
- Reed don't need cultivation, fertilization etc.
- In can help to ensure the growing demand for biomass
- Regular harvesting of reed beds maintains it

Potential analysis of reed

- Recorded reed beds worldwide, more than 20 Million hectar



Reed as industrial material

■ Thatching

- The demand in Europe exceeds supply
- Dry, straight winter reed is required
- 20 bundles per m² (40cm thick), 43-80 €/m² in UK

■ Construction and gardening

- Fence, blinds, indoor walls, shadowing, panels
- Panels costs between 6-10 €/m² in Germany
- For 1 m² 0.6-0.8 kg of reed

■ Pulp and paper

- Outdated in Europe, but not in China (2.5 Mil tons)
- One ton of paper pulp ≈ 3.5 of reed

■ Polymerisation (experimental)

- The high cellulose content can produce functional polymers for plastic or viscose



Energy

■ *Combustion*

- Winter reed pressed into bales, pellets or briquettes
- For heat and power generation by burning
- Energy content of pellets 16.2–16.5 MJ/kg
- In Estonia reed energy costs 12–20 € per MWh

■ *Biogas*

- 1 kg of green reed = 0.4-0.5 m³ biogas (CH₄ 55-60%)

■ *Biofuel (experimental)*

- Glucose can be extracted from cellulose

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Agriculture

■ Fodder and Litter

- Grazed by cows, sheep's etc. in spring and summer since centuries
- It also can be harvested for winter fodder or litter
- Nutrition value in 13.31 kg of reed equals to 1 kg of oat

■ Fertilizer/ Compost

- Sludge from biogas production
- Chopping and spreading to the fields
- Mixing with other waste and composting



Water treatment

- By transferring air and uptake of nutrients in the biomass
- Nutrient peak in summer, in average five time more than in winter
- Winter harvest of 5 tons/ha*a extracts 20 kg/ha*a nitrogen, 1 kg/ha phosphate and 8 kg/ha*a potassium in south Sweden
- Summer harvest of 10 t/ha*a removes 92 kg/ha*a nitrogen, 9 kg/ha*a phosphate and 66 kg/h*a potassium

Overview of various reed utilizations (1)

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Utilization	Cutting time	Treatment	Output	Price
Thatching	Winter	Cleaning, packed to bundles	1 m ² needs 1–1.2 ton of reed	2.5 €/ bundle, Thatching 43–73 (UK) to 70-80€/m ² (Finland)
Construction	Winter	Compressed and knitted	1 m ² panel = 20 kg (5 cm thick) of reed	6–9 €/m ² (Germany)
Paper & pulp	Winter	Chopping & pressing	1 ton of paper pulp = 3.3–3.5 tons of reed	
Fodder and litter	Spring & Summer	Directly grazed or cut and stored	nutrition value in 13.31 kg reed = 1 kg of oat	
Fertilizer/ compost	Summer	Digestion in biogas for sludge		

Overview of various reed utilizations (2)

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Utilization	Cutting time	Treatment	Output	Price
Combustion	Winter	Chopping and pressing	Pellets or briquettes 16.2–16.5 MJ/kg	12–20 €/ MWh (Estonia)
Biogas	Summer	Chopping	1 kg reed = 0.4–0.5 m ³ biogas with max. methane content of 55–60%	
Biofuel	Winter	Different treatment to extract cellulose and convert to glucose		Experimental stage
Water treatment	Whole year	Regular harvest	0.4–1.0% N, 0.2–0.9% P and 0.1–0.6% K	Highly variable

Conclusion (1)

- Reed is a valuable resource with multiple applications
- Each product has different requirements which often depend on the harvesting time
- Reed as a renewable energy has low competition to agriculture land and food crops
- With more than 20 Million ha reed beds, there are big potentials world wide. Harvesting of half of it would correspond to minimum 50 Million tons (5t/ha) of reed.

Conclusion (2)

- For Wuliangsu Hai lake there are the following options
 - Building a new, closer paper mill
 - High level of mechanization
- Or
- New, big scale applications e.g. energy
 - But only possible with subsidies
 - Coal price for power plants around 400 CNY/t (48€/t), for consumer 600 CNY/t (71€/t) -> double heating value
 - Straw raw material is available for 200 RMB/t (23 €/t), pellets for 350 RMB/t (41 €/t)





Thank you! Mille grazie!
谢谢! Danke schön!

Also to the funding
organisation and partners