Water-Energy-Food Nexus research in Aral Sea Basin

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1) Hybrid Wind-Solar Water Desalination in Aral Sea basin (project development stage)

- Continental cold arid desert climate
- Mean annual temperature $13.4^\circ C$
- 320 sunny days per year
- Total mineralization = 1800 mg/liter
- Ground water toughness = 10-25 mg/liter
- Water salinity 10-fold increase (from 10 to >100 g)
- Hydrogen parameter $pH = 8.5$
Local needs:

1) Clean water with low level of salinity

2) Green energy generated from solar – wind power in a decentralized way

3) Socio-economic model – choosing the best matching technology to ecological conditions of Aral Sea basin
Current experiments:

Chemical Technology faculty, Urgench State University
Research specifics

- 3 step desalination process
- 36 litres/hour ground water desalination
- sediments, salts, microbes are removed
- Salinity decreases from 20 to 1 mg-eq/l
- Easy to apply in households
- wind-solar energy should be integrated with ground water pump
Options under revision
Impact

• Clean drinking water for community
• Increased human well-being in rural communities
• Tackles medical diseases resulting from ecologically un-clean water
• better socio-economic life conditions
2) Biogas Production from Agricultural Wastes in the Aral Sea Basin

- Funded by REPIC (Renewable Energy Promotion in International Cooperation)
- Project duration: 2016-2018

Location specifics:

- Continental cold arid desert climate
- Mean annual temperature 13.4°C
- 320 sunny days per year
- Agriculture oriented region
Field-trip to farms

- Situational analysis and data-mining trips to livestock famers
The solution must be:

- **Practical**: manure is mixed with stones and sand in stables
- **Flexible**: organic wastes are heterogeneous (solid, dry, liquid, mixed with inorganic...)
- **Well isolated**: it is a sharp-continental climate zone
- **Simple and cheap**: farmers have limited technical knowledge and finances.
Bottlenecks

- Sedimentation and clogging
- **Temperature fluctuations** due to poor insulation
- Very short retention period
- Extensive water use (CO$_2$ production rather than methane)
- Air-compressed loading of the biomass
- Poor circulation and mixing in the digester
Options under revision

a) enhancement

b) Container solution

c) Plug flow
Water-Energy-Food Nexus impact of biogas & bio-fertilizers:

1) Yield increases by +20%
2) Water consumption decreases by -15%
3) Land is protected from wild plants
4) Chemical fertilizers are not utilised
5) Land mineralization decreases
6) Fossil fuels are not used for cooking
Project partners:

Khorezm Mamun Academy

Thanks for your attention!