AgroHyd
World food consumption and water resources: an agro-hydrological perspective

- Introduction to ATB
- Overview of AgroHyd Project
- Business Plan

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Goal: Improve resource efficiency in agriculture

- 280 employees
- 3 ha of raw material/energy plantation
- 40 ha of experimental lots
- 4 research programs:
4: Technology Assessment in Agriculture
Focus - Modeling of agrosystems

- Modeling energy, water, carbon and nutrient fluxes
- Method development (LCA, economy, logistics)
- Decision support (e.g. policy making)

Current Project: AgroHyd
World food supply and water resources – an agricultural hydrological perspective
Challenge: increase in water requirements to meet future food demands

Determine options to reduce water demand

Green water and blue water in farm management

- 80% of agricultural land worldwide relies on rainfed production systems, providing 62% of the world’s food.

- 80% of agro-evapotranspiration comes directly from rain (when crops turn water into vapor)

Comprehensive Assessment of Water Management in Agriculture. (2007)

Strategy: influence partitioning of rainfall (or irrigation) between evaporation ☐ transpiration and infiltration ☐ runoff

Green Water

Rain and soil water

Blue Water

Ground and surface water

Hoff et al. (2010)
Water use for food production in Germany

Schematic representation of water use in the food supply industries for Germany (proportions not correct)
Data source: *ET – calculated from long-term water budget (BGR 2008); SBA (2012) Umweltnutzung und Wirtschaft,#Nahrungsmittel und Getränkeindustrie
Objectives in „AgroHyd“
Evaluate hydrological processes and agricultural management options to increase farm water productivity

Improve water use in farm management
- calculate the water demand at farm scale
- recommend most suitable options for individual farms worldwide

Target groups – farmers and regional policy makers

Calculate water use in crop and livestock production
Develop database of farm water indicators

- Indicator – water productivity: mass of output per m³ water input
  - depends on many factors
  - can vary between regions
  - and within one region

Analysis of water productivity requires consistent data at the farm scale

System boundaries and water flows

**Inflow**
- precipitation
- irrigation
- water in input
- indirect water
- drinking water
- process water

**Farm**
- plant production
- feed production
- livestock production

**Soil**

**Outflow**
- transpiration
- interception
- water in output
- evaporation
- percolation
- waste water
Water productivity in dairy production
Management options

- Feeding strategies with varied diet components
  - silages, pasture, concentrate

- Intensity of production
  - milk yield, replacement, life span

- Breeds

- Barn specific strategies
  - milking systems
  - cleaning processes
  - cooling processes
AgroHyd Farm Model: water demand on farms

Goal
- consistent and accessible farm data base
- reference sustainability indicators on farm water use

Info: Drastig et al., (2013)
Water Productivity of Farm Products

Forage crop
- winter rye
- winter wheat
- corn silage

Milk
- 4,000 kg
- 8,000 kg
- 12,000 kg

1 balanced diet with half day grazing in summer
2 8000 kg milk with half day grazing in summer
Application of the AgroHyd Farm Model:

- Build database of indicators
- Calculate scenarios for improved water efficiency – farm management options, effect of diet, aggregation to regional level

=> What can farmers do to meet the water demand for food production in the future?

Outlook

- More regions (Brazil, Vietnam,...)
- More farm management options
Choice of indicators and their range of values

- Farm Water Productivity (FWP) [output per m_{\text{Winput}}^{-3}: on mass, energy or monetary basis]
- Degree of water utilization (DWU) [-]
- Specific technical water inflow (STWI) [m^3/ha]
- Future model development – GHG emissions
Determination of indicators of water consumption at farm scale - Farm water productivity

\[
\begin{align*}
\text{FWP}_{\text{mass}} &= \frac{\text{Mass}_{\text{output}}}{W_{\text{input}}} \\
\text{FWP}_{\text{energy}} &= \frac{\text{Energy}_{\text{output}}}{W_{\text{input}}} \\
\text{FWP}_{\text{mon}} &= \frac{\text{Revenues}}{W_{\text{input}}} 
\end{align*}
\]

Indicator values depend on:
- regional variations
- farm size
- management options
- annual deviations

Goal: reference sustainability guideline values for indicators

Water productivity improvement in farm systems

**FA1 - pilot project**

What problems / opportunities does the component solve / respond to?
- Changes in water availability for food production in farm systems (climate change)
- Increase water productivity in crop and livestock production

What are the components proposed solutions to the problems / opportunities?
- Quantify current water use on farms
- Estimate potential for increasing water productivity

Who are the component’s clients, and how will the component market / ‘sell’ its services/products to them?
- Farmers interested in improving their water efficiency
- Governments and regional planning agencies: develop overview of current practices, estimate potential

What is the component’s added-value?
- Proof of concept: provide basis for comparison of water productivity within and between regions
- Support to farmers with planning improvements
- Link with stakeholders in other regions

What are the component’s key activities?
- Project preparation: methodology and software development, baseline assessment of various regions and management options for farm systems
- Project implementation: contact with farmers, gathering basis regional data, estimating farm water options for plant and livestock production

What are the component’s estimated capital and resource requirements?
- ?USD for the finalization of project preparation
- ?USD during implementation: gathering data and evaluation

*Full concept note available from the support group*
Thank you for your attention!

AgroHyd Project

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1. **Short description of the project**, where target groups, objectives, actions, activities and expected results can be visualized.

2. **A clear explanation of how this project is related to improving efficiency** (Closing the efficiency gap) and its implications on natural resource use.

3. Finally a **short description of a business plan associated to this project** in terms of target groups, problems to solve, solutions to these problems, added value, key activities, resources requirements. For this element, please find enclosed a P. Point presentation of an example using two projects (presented in the last Guiding Group meeting).
AgroHyd Farm Model

Climate

Crop

Model ET₀

Model Growing Plant Tc

Soil data

Soil map

Model T_Cadj

Sowing

Fertilization

Plant protection

Harvest

Transport/Conservation
Management strategies

**Plant production**

Soil tillage and humus conservation
- application of organic matter
- mulching
- turning under of crop residues

Cultivation under different regional characteristics
- `usual` plant varieties
- drought-tolerant plant varieties
- plant varieties with low transpiration coefficient

Seeding
- high crop density

Fertilization
- sufficient potassium supply
- support of root formation

Optimizing of crop rotation and use of intermediate crop

**Livestock production**

Feeding strategies with varied diet ingredients

Dairy and Beef/Meat production
- intensity of production (e.g. yield, replacement, life span)
- breeds (cattle and pig)
- site specific characteristics

Barn specific strategies
- milking systems
- cleaning processes
- cooling processes

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Range of indicators

- Indicator values depend on:
  - regional variations
  - farm size
  - management options
  - annual deviations

→ to be considered when sustainability guideline values for indicators are defined