Impact of Farmers Practices on Groundwater in South Al Batinah Region, Sultanate of Oman

Dr. Ayisha Mohammed Al Khatri

Head of Water Studies Section

Ministry of Agricultural, Fisheries Wealth and Water Resources
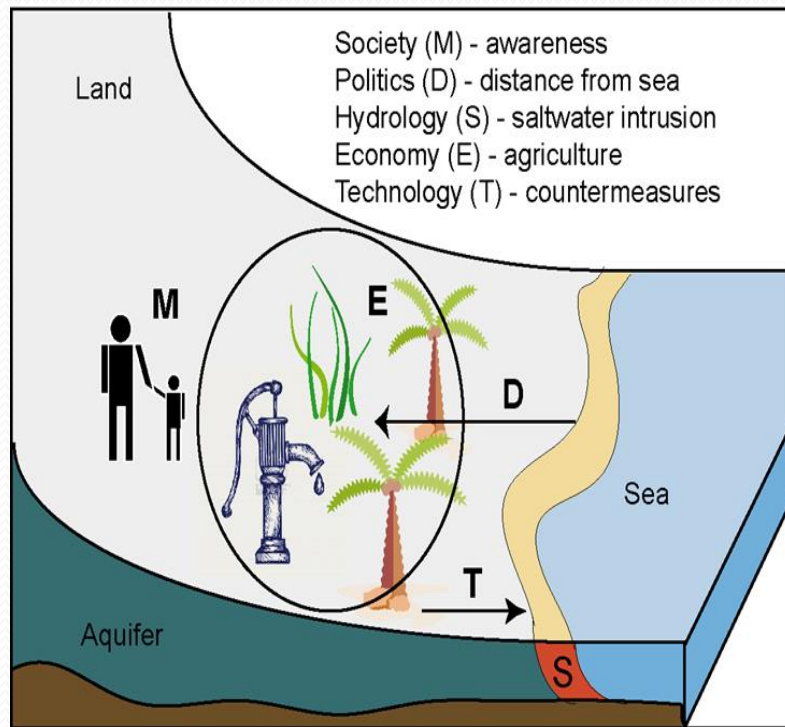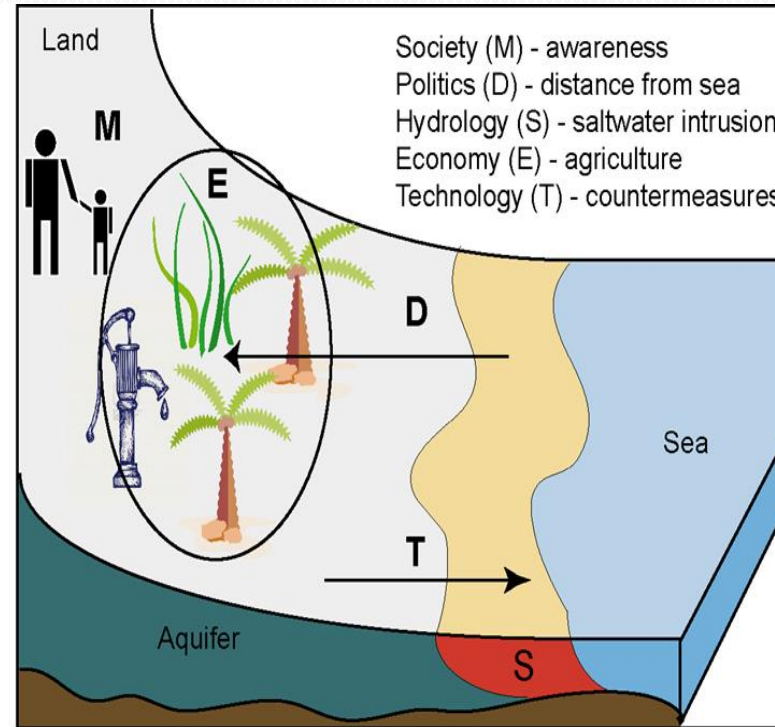
E-mail: Ayisha.Khatri@Hotmail.com

Overview

- Introduction (problem, objectives)
- Methods used
- Results & Discussion
- Conclusions
- Recommendations

Introduction

This work is focusing on analyzing the practices followed by farmers and their role in threatening the groundwater aquifer in South Al Batinah region in Oman.

Source: Subagadis 2015

Introduction

General information about South Al Batinah

- Many of the population in Al Batinah region rely on agriculture.

- farms are located near the coast line

- The aquifer : shallow alluvial unconfined aquifers

- The source of irrigation water for almost all of the farms is the groundwater abstracted from the aquifer by private wells

Motivation and problem

- problem of over abstraction of fresh groundwater for irrigation along the coast

- aquifer is affected by the salinity intrusion

- Several agricultural lands of the coastal areas have become unsuitable for cultivation

- Some farms have become abandoned

What can be done

A global solution is needed;

•**The system need to be managed for the mean term and the long term**

•**Communications in both directions need to be improved:**

- – **Between relevant Decision makers**
- – **Between Decision makers and farmers**

Research objectives

- Explain the dilemma (common-pool resources dilemma) with respect to the behaviors of the stakeholders, & identify if the participatory approach is accepted or rejected.

    – analyzing the practices followed by farmers and their role in threatening the groundwater aquifer in South Al Batinah region.

    – Identify if there is enough knowledge and if the farmers have enough knowledge about how natural systems are working, the water problems in the region and suitable management interventions for the water resources.

- Introduce → a participatory process within the frame of IWRM (to support DMs in taking more informed decisions).

- Identify ways to improve the probability of a specific intervention to be implemented, & with what factor this intervention is more likely to be implemented.

Methodology

- Through a social survey, a combination of environmental, social and economical data were collected.

- Differences were examined between opinions of farmers and decision makers (DMs) regarding potential interventions (18 items).

- Discriminant Analysis (DA) was performed to identify the drivers influencing farmers' opinions regarding the intervention measures.

- Bayesian Networks (BNs) approach was used for mapping stakeholders' behaviors and to show the strength of a relationship between dependent and predictor variables.

Methodology

Data analysis: Statistically

Cross tabulation tables → helpful in understanding whether or not some variables have an effect on others.

The data were analyzed statistically by using SPSS software package.

Discriminant Analysis (DA)

Canonical correlation used → If the canonical correlation approaching 1, it means that the suggested discriminator explains most of the variation between the groups.

Used to identify the drivers influencing farmers' opinions regarding different intervention measures.
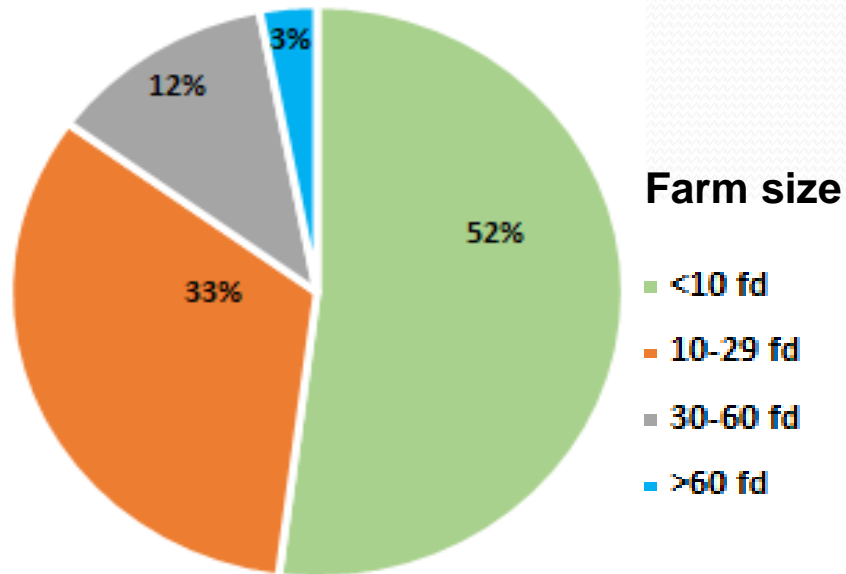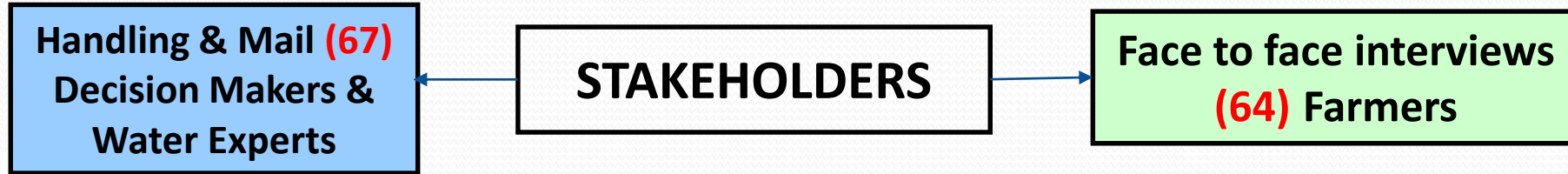
The behaviors of farmers in the area ;

- Over pumping of the groundwater for irrigation, the abstraction rates exceeded the recharge rates.

- Consume a lot of water for crop irrigation without taking into account crop water requirements.

- Not all of the farmers are taking into account the suitable irrigation hours.

- The cultivated crop types are not selected to be salt tolerant or of a good economic return.

- Most of the farmers are farming partially because either they are retired from jobs or still in government or private job employments.

- Some of the farm owners are renting their farms to foreigners for a low amount of money which is less than the value of the groundwater used. (Water conservation is not on the renters' priority agenda. Their concern is oriented more towards getting a high yield)

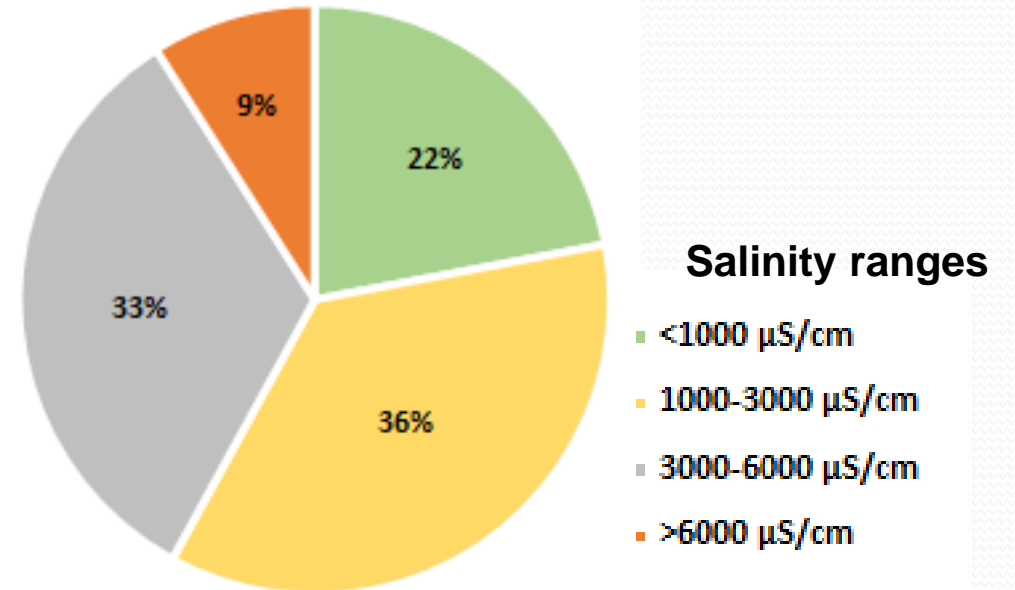# The behaviors of farmers in the area (Cont..) ;

- Many of the farm owners employ foreign labourers to take care of the farm irrigation and productivity. *(Those labourers come from countries which are not really suffering from water shortages. Therefore, they are not aware of water problems and water deficit in the region).*

- In many cases, farmers refuse to implement water meters to the wells of their farms even with the support of the government concerning purchase and implementation. The private wells are registered with the government, but not the amount of abstraction (abstraction rates are not limited) for each well. *(Therefore, it is very difficult to control or observe the exact amount of water abstracted from the aquifer).*

- Recently, farmers have been interested to change their land use from agriculture to urban uses instead for crop production

Results and Discussion

Overview of the Survey

Handling & Mail (67) Decision Makers & Water Experts	← STAKEHOLDERS →	Face to face interviews (64) Farmers

Farm size

- <10 fd
- 10-29 fd
- 30-60 fd
- >60 fd

52%, 33%, 12%, 3%

Salinity ranges

- <1000 µS/cm
- 1000-3000 µS/cm
- 3000-6000 µS/cm
- >6000 µS/cm

22%, 36%, 33%, 9%

1 feddan = 0.405 Hectares

Results and Discussion

Irrigation Methods-Study Area

Farmers' knowledge regarding the existing irrigation water , (n=64)

Statements	No. of agree farmers (%)	No. of disagreeing farmers (%)
The water is used efficiently without wastage	58%	42%
The water is limited	64%	36%
The water is over pumped	63%	37%
The salinity is increasing	88%	12%

Irrigation sources in the study area, (n=64)

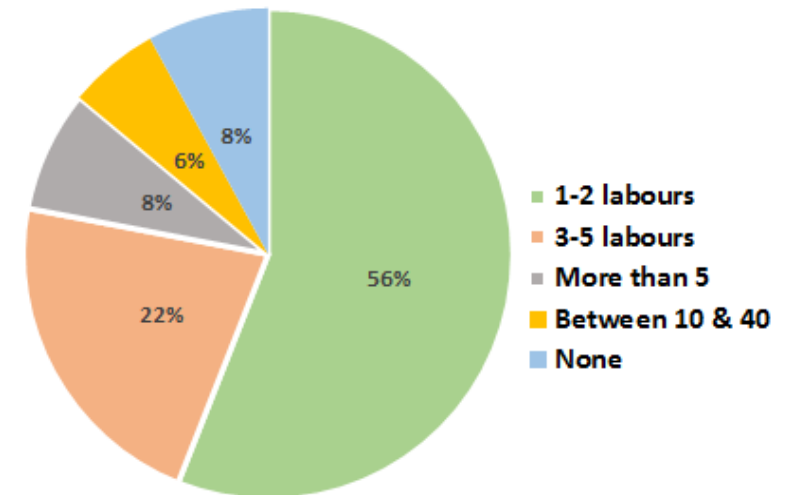| Irrigation source	Number of farms (%)
Wells	64 (100 %)
Falaj	0 (0 %)
tanker	1 (1.5 %)
Others	0 (0 %)

Results and Discussion

Irrigation Methods-Study Area

Irrigation methods

Irrigation method	Number of farms in Percentage (%)
Flood	66 %
Bubbler	0 %
Sprinkler	31 %
Drip	56%
Others	3%

Classification, the area irrigated by flood method, N=69

Percentage irrigated by flood	No. of Farms	Farm classification	Percentage (%)
< 10 %	27	Modern	39 %
11-70 %	21	Mixed	31 %
71-100 %	21	Traditional	30 %

Percentage of foreign labourers in the farms

- 1-2 labours
- 3-5 labours
- More than 5
- Between 10 & 40
- None

Results and Discussion

Farmers were asked to determine the approximate distance form their farms to the sea:

- 96% of the farmers are fully aware about the distance of their farms from the sea and if the saline water affects the agriculture management or not.

- most of these farms (54%) are located between 1 and 5 km only from the sea.

- 4% of them are 15 km or above far from the sea, which means that, the farms are highly subjected to be affected by salinity problems.

Distance from Sea

- Unknown
- 1-5 km
- 6-9 km
- 10-15 km
- >15 km

4% 4%
13%
25%
54%
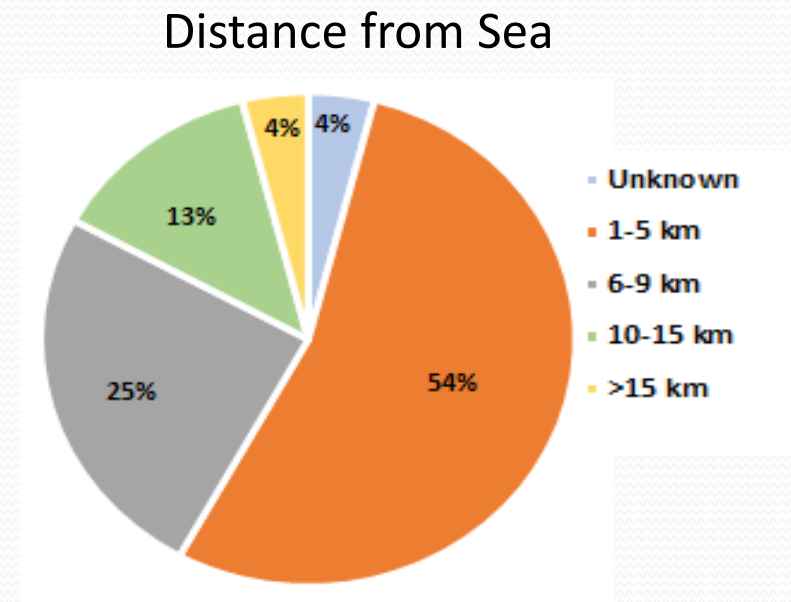
Results and Discussion

Drivers behind Opinions -Frequency Curves (Farmers)

A list of the interventions was provided earlier to the farmers

frequency curves of farmers' (64 farmers) opinions regarding suggested interventions that could be implemented
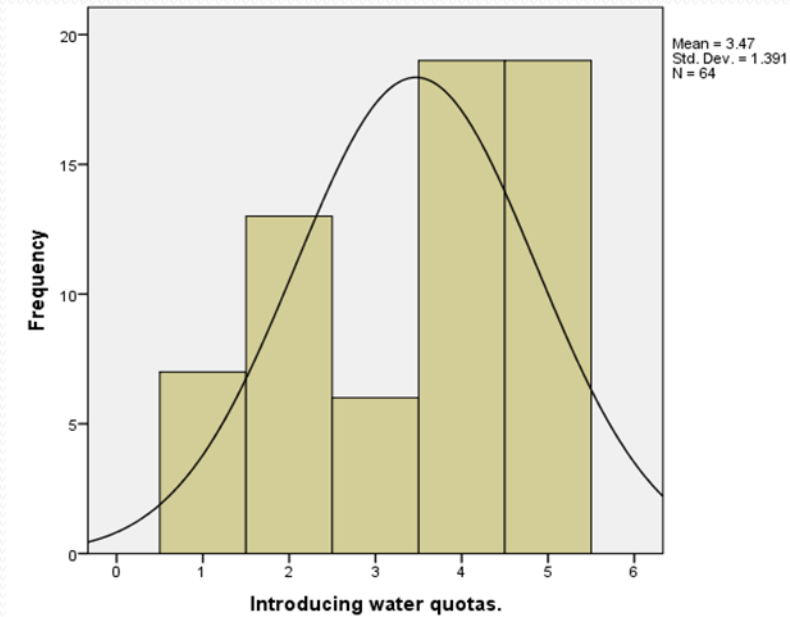
For this analysis, the three types of groundwater quota (WQ) interventions, were used:

1. Water quota
2. Water quotas with subsidies in form of equipment and,
3. Water quotas with subsides in form of guidance and training.

Results and Discussion

Drivers behind Opinions -Frequency Curves (Farmers)
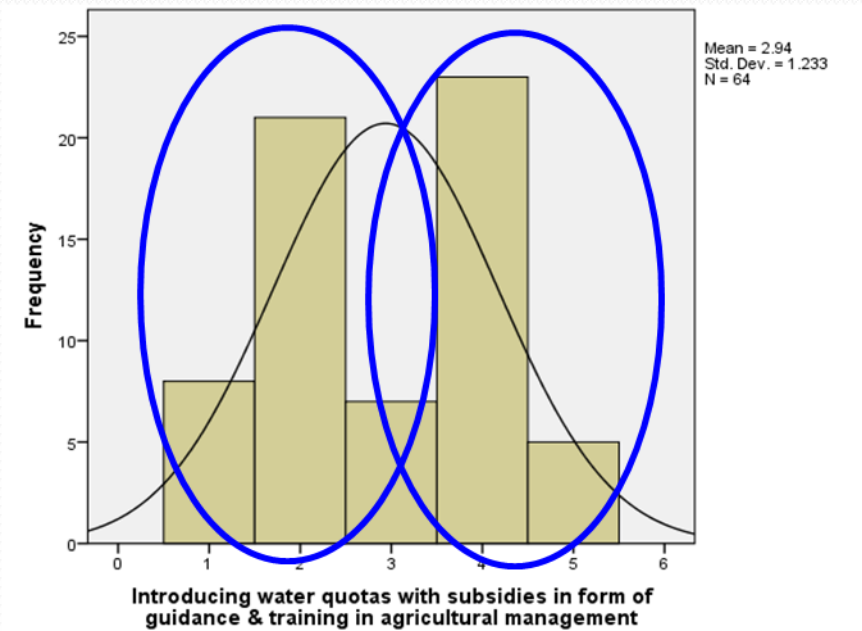
Score ranges between 1 for strongly agree and 5 for strongly disagree

% of farmers agreed & % of farmers rejected the idea of water quota with subsidies, is similar.

Cross-tabulation + DA are performed to identify the parameters which might be the reason behind.

Results and Discussion

Cross Tabulation Analysis
The Influence of Salinity Levels on Farmers' Opinions

Salinity range	No. of Farmers	Implementation of water quotas	Options		
			Agree (%)	I can't decide (%)	Disagree (%)
<1000 µS/cm	12	water quotas	9	25	67
		water quotas + equipment	42	16	42
		water quotas + guidance & training in agricultural management	42	25	33
1000-3000 µS/cm	23	water quotas	26	9	65
		water quotas + equipment	48	9	43
		water quotas + guidance & training in agricultural management	48	4	48
3000-6000 µS/cm	20	water quotas	45	5	50
		water quotas + equipment	50	10	40
		water quotas + guidance & training in agricultural management	35	15	50
>6000 µS/cm	5	water quotas	60	0	40
		water quotas + equipment	100	0	0
		water quotas + guidance & training in agricultural management	80	0	20

Results and Discussion

Discriminant Analysis (DA)

List of Indicators

No.	Indicator	Type
1	Age (A)	A
2	Farm size (fd)	A
3	Area used for agriculture (fd)	A
4	Area used for commercial (fd)	A
5	Salinity range (µs/cm)	A
6	Educational level	C
7	Level of cooperation with Ministries	C
8	Farm classification	C
9	Percentage of products sold	C

(A) continuous data and (C) categorical data, (fd) feddan

Used with mixed list of categorical and continuous data

Results and Discussion

Discriminant Analysis (DA)

The suggested discriminators by Discriminant Analysis

Analysing options	No. of samples	Suggested discriminators	Canonical correlation
Water quota			
Stepwise method	40	1. Salinity range	0.352
Independents together method	40	1. Level of cooperation with Ministries 2. Salinity range	0.516
Water quota with equipment			
Stepwise method	40	No variables are qualified for the analysis	--
Independents together method	40	1. Level of cooperation with Ministries 2. Area used for commercial 3. Farm size	0.448
Water quota with guidance & training			
Stepwise method	40	No variables are qualified for the analysis	--
Independents together method	40	1. Level of cooperation with Ministries	0.469

Results and Dicussion

Involvement of stakeholders in the decision making process

Organization	n	Yes%	No%	No Idea%	No Answer%
Farmers	64	95.3%	1.6%	0%	3.1%
Ministries and Water issue Organizations	54	88.9%	5.6%	10.8%	1.9%
Research Organizations	12	83.3%	16.7%	0%	0%
Total	**130**	**91.5%**	**4.6%**	**1.5%**	**2.3%**

Findings

• Most of the DM's groups indicated that they agree with the idea, by at least 80% of the total respondents.

• Researchers were more cautious about the idea, at least 16% of them thought that it is not a good idea.

Farmers were asked to identify if they are ready to be members in these meetings or associations

• More than half (78%) - interested in taking place in meetings and negotiations, while

• (22%) were not interested to be involved.

Summary of Results

- Need of improvement and implementing new management strategies.

- Obtaining different professional judgments through decision makers and water experts opinions

- The idea of the participatory approach is not rejected by the different groups of stakeholders.

- Farmers are not fully aware about the limitation of the natural system, especially in form of quantity. Many expressed the situation by; ' *the water is available, but salty*'

- Level of trust between users and decision makers has an impact on the level of acceptance of farmers regarding implementing a particular intervention

Recommendations

For the case of South Al Batinah

- Continuing to introduce modern irrigation systems.

- Find new alternatives to minimize dependence on foreign labourers.

- Address training programs for Farmers.

- Continuing to monitor salinity of groundwater.

- Assess the impacts of the implemented measures. This should be done with the help of models.

- Persuading farmers by incentives and subsidies.

- Continued stakeholder feedback.

- Increase awareness and knowledge (especially with farmers)

Conclusions

- The study underlines the importance of a participatory approach with contributions from all relevant stakeholders in order to achieve a real IWRM implementation process.

- Water management strategies should not only focus on the technical means, but should also be directed to improve management practices and social behavior changes.

- DMs & other stakeholders should play a role in implementing appropriate changes.

- A coordinated response is needed between relevant organization, farmers as well as the media to help this message become part of local understanding.

Thank you