INTRODUCING RECIRCULATING AQUACULTURE SYSTEMS IN ARMENIA: IS THE CHANGE WORTH IT?

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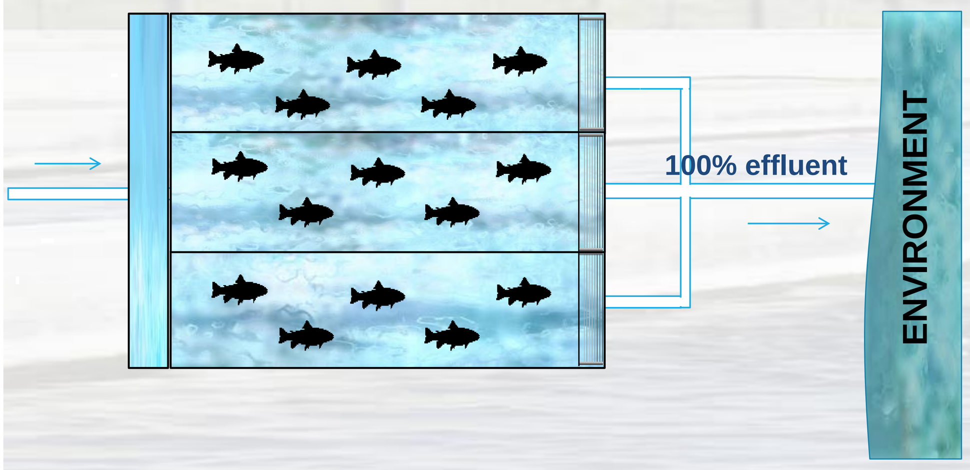
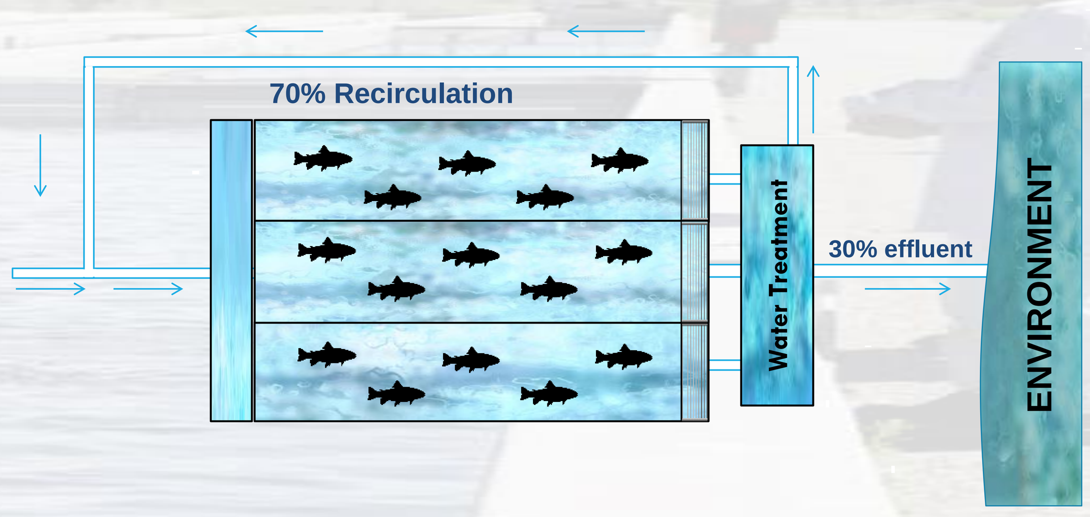
Introduction

Pic 1. Current System



Increased groundwater abstraction for fish farming (mostly Rainbow trout (*Oncorhynchus mykiss*)) in Ararat Valley, Armenia, challenges the long-term viability of groundwater aquifers [1]. Upgrade from common raceway configurations (Pic.1) to recirculating aquaculture systems (RASs) (Pic.2) was suggested to improve environmental footprint and water resource efficiency in fish farms [1].

Pic 2. Recirculating Aquaculture System



The aim of the current research is to analyse economic feasiblity of RAS in small-, medium- and large-scale trout farms and to determine potential water footprint of RAS installation.

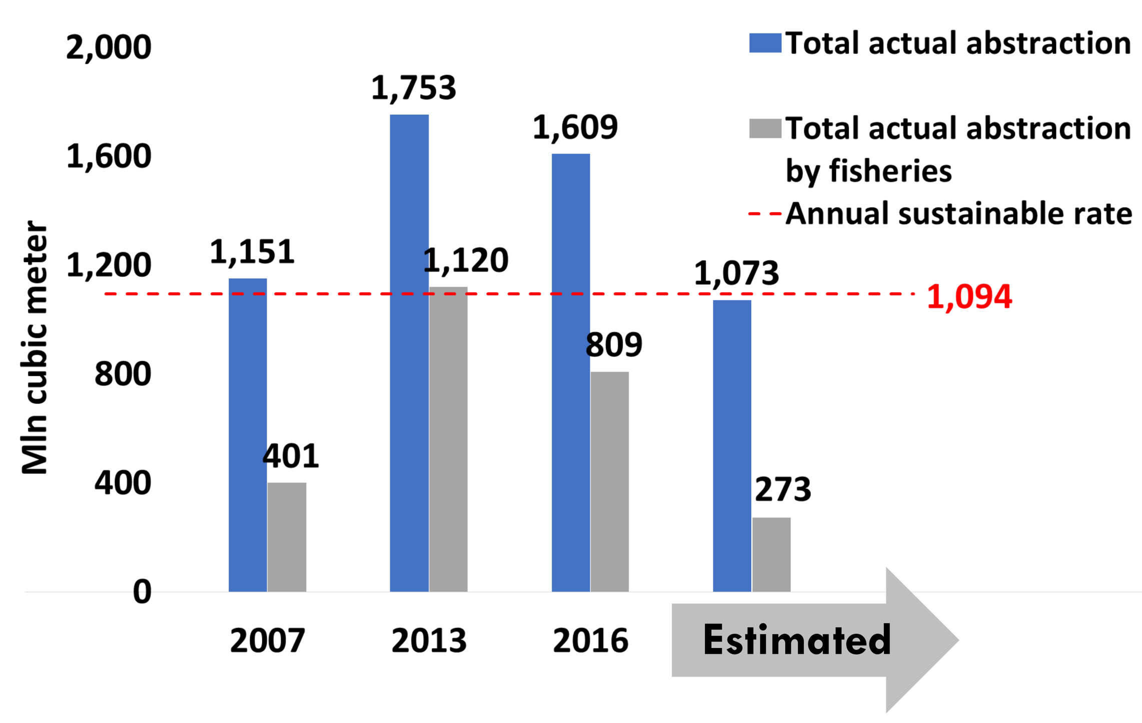
Results and Discussions

Economic performance of RAS

	Small-scale farm	Medium-scale farm	Large-scale farm
Average volume of ponds, m^3	1,300	3,920	10,150
Average annual production volume with RAS, kg	26,000	78,400	203,000
Annual average net farm income, USD	4,660	20,937	69,240
Average increase in profitability, times	7.8	3.5	4.9
Average capital investment, USD	15,789	41,411	126,963
NPV, USD	-2,653	12,100	80,114
Probability of getting negative NPV, %	74	20	2
MIRR, %	31.3	43.4	50.2
Discounted payback period, years	5.7	4.0	2.59
Conclusion	Not feasible	Feasible	Feasible

- RAS installation and farm intensification will increase total annual fish production in Ararat Valley by 2.6 times.
- RAS application will lead to higher water efficiency and savings.
- RAS will use $17m^3$ groundwater for a kg of fish production instead of the current $128m^3$.

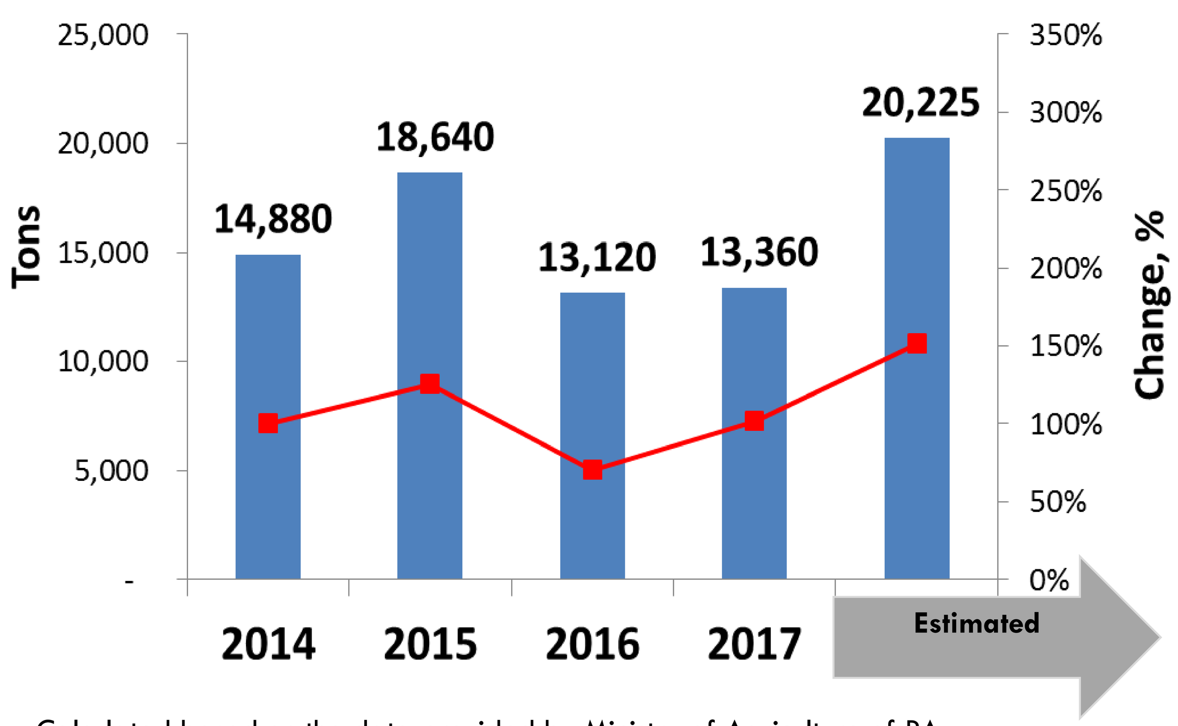
Groundwater use in Ararat Valley



Calculated based on the data provided by ASPIRED

- Installation of RASs results in higher fish production volumes, but requires large capital investments (16,000-130,000USD, depending on farm size).
- Implementation of RAS configuration results in positive NPVs for medium- and large-scale fish farms, and negative NPV for small-scale farms.
- RAS implementation in Ararat Valley is feasible only for medium- and large-scale farms.

Fish production in Ararat Valley



Calculated based on the data provided by Ministry of Agriculture of RA

- Large scale fish farms (18% of total farms) account for 63% of aquaculture groundwater abstraction.
- About 60% water saving can be achieved by implementation of Danish Model Type 1 RAS [2] in medium- and large- farms (abstraction rate >50 L/s).
- RAS can provide better environmental pollution control due to treatment and separation of dissolved and solid wastes.

Methods

Study area and data collection:

- Ararat Valley, Armenia.
- In-depth interview.

Economic analysis method:

- Capital budgeting.
- Monte Carlo simulation.

Water footprint:

- Water mass balance for current and modelled Danish Model Type 1 RAS (70 % recirculation).

Conclusions

While implementation of RASs is environmentally beneficial, it is economically feasible only in medium- and large-scale aquaculture farms in Ararat Valley, Armenia.

Implementation of RASs in medium- and large-scale farms can significantly (by 60%) reduce water abstraction and result in notable country-wise economic benefits due to increased fish production volumes.

1. Mirzoyan N *et al*. (2018). Groundwater for Sustainable Development, 6, pp. 1-5.
2. Jokumsen, A. and Svendsen, L. M. (2010). Farming of freshwater of rainbow trout in Denmark. DTU Aqua. Institut for Akvatiske Ressourcer.

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