Nexus efficiency of centralized and decentralized models for water management and food production in the region of Alentejo, Portugal

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INTRODUCTION

The region of Alentejo is characterized for activities like agriculture, forestry and agro-food industries.

The main regions for agriculture production and animal husbandry are the areas of holm oaks and cork oaks. Rural settlements are usually clustered in the hills and in compact villages.

Due to these factors there is a heterogeneity in the landscape and productive structures in the region, therefore is considered as the food pantry of Portugal.

Food Production

Agriculture products: vines, tomato, olive groves, wheat, sunflower and forage oats.

Hectares used for agricultural production according to land uses (1989-2009)

Average area (Ha.) used for agricultural exploitation (1989-2009)

Water consumption

The Alqueva dam is the main source of water for agriculture (124,585,745 m³/year) in the Alentejo. The system consist of 120,000 ha of irrigated land and is mainly fed by the Tejo and Guadiana rivers.

Water consumption in Alentejo (1989-2009)

Area used for irrigation croplands by the Alqueva Dam (2017)

DESCRIPTION OF THE PROBLEM

The development of decentralized models for sustainable use of water for agriculture has not been seen yet as a feasible solution to be implemented by governmental programs.

The Common Agriculture Policy (CAP) and current techniques of food production, are not fixed to the current situation of agricultural sector in southern Europe, so far the policies have not been able to improve the supply of water and ecosystemic services related.

Centralized System for Water Storage

Source: García-Guarín, 2017

Decentralized System for Water Reservoir

Source: García-Guarín, 2017

OBJECTIVES

General objective

- To stress the importance of sustainable water management through decentralized models such as water retention landscape (WRL) as a feasible alternative for regional self-sufficiency and regenerative basis for autonomous water supply and food production.

Specific objectives

- To assess how the efficiency of centralized and decentralized models of water and food management contributes to the restoration and regeneration of the surface layer of the soil, vegetation cover and other ecosystem services.
- To showcase how ecological design is a sustainable long term solution for settlements, both rural and urban, and the livelihood of the inhabitants by allowing free access to clean water and healthy food.

WATER & FOOD NEXUS DIAGRAM (ALENTEJO REGION)

Source: García-Guarín, 2017

METHODS AND PROCEDURES

MESMIS

Framework for the Evaluation of Natural Resources Management Systems incorporating Sustainability Indicators.

By a percentage approach is able to quantify qualitative data, and to show it through AMOEBA graphics for further assessments.

Masera 1999 & Astier 2007

Selected indicators

ATTRIBUTES	SUSTENTABILITY INDICATORS (%)
Productivity	Cost investments among total population. (1)
	Cereal crops produced in the area. (2)
Equity	Stakeholder's participation. (3)
	Satisfaction in decision making processes between local authorities and stakeholders. (4)
Stability and self-management	Water catchment for irrigation from the region. (5)
	Cultivated land for permanent crops. (6)

How to calculate them?

$$PP = \left[\frac{SS}{TS} \right] OP$$

PP = Performance Percentage
SS = Selected Sample
TS = Total Sample
OP = Optimal Percentage

Source: García-Guarín, 2017

Indicator performance

81-100% : 5
61 - 80% : 4
41 - 60% : 3
21 - 40% : 2
00 - 20% : 1

Indicator values

RESULTS

Centralized System

Centralized system	Performance Percentage	Indicator Value
(1)	98%	5
(2)	3%	1
(3)	28%	2
(4)	35%	2
(5)	32%	2
(6)	57%	3

Even though the performance is low, the system shows the stability required for running itself. The economic element plays an important role for its productivity as well as the populations liability. The efficiency Nexus could be qualified as standard and reliable in the short term.

Decentralized System

Decentralized system	Performance Percentage	Indicator Value
(1)	2%	1
(2)	3%	1
(3)	93%	5
(4)	80%	4
(5)	13%	1
(6)	66%	4

Due to its high performance, the system is able to balance the lack of productivity in terms of investments. Stakeholders are key elements for its stability. The efficiency Nexus is above the standard and reliable in the mid-long term despite its low value in water catchment.

CONCLUSIONS

Considering the targets and aims of the analyzed systems the Nexus model is a reliable tool able to give the foundations to elaborate and evaluate precise indicators between water-food interactions.

The implementation of decentralized system for water reservoir, under the principles of Water Retention Landscapes shows how a sustainable use of water resources and food production can be achieved. On the other hand, how the nexus accelerate the restoration process of the ecosystems, contributing to the prevention of hazards in regions threatened by erosion and droughts.

The systemic approach of MESMIS methodology allows to analyze qualitative and quantitative data to rate the level of sustainability between centralized and decentralized models considering the emerging properties from the interaction between the subunits within the system.

Both approaches are feasible and efficient enough to maintain themselves along different time frames. Therefore, what is suggested is to take the main strengths from each system and to integrate them to enhance each other performances and to improve the level of sustainability within the nexus.

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