IRRIGATED AGRICULTURE : DIRECT AND INDIRECT EFFECTS ON ENERGY COSTS AT A REGIONAL LEVEL

A CASE STUDY IN TADLA (MOROCCO)

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Introduction

Irrigation, especially groundwater use :

- **allows considerable agricultural development** (buffers against drought for crop production, intensification of existing farming systems, diversification, introduction of high-value crops…)
- **leads to an increase in agricultural energy's consumption and energy costs through pumping and intensification which depend on the type of irrigation** (collective system or individual system/ Gravity or localized).

In most countries, irrigation and energy policies are defined independently so there is a limited understanding of how to assess the total energy costs (induced both by pumping and intensification) at a regional or national level (World economic Forum 2011)

Irrigation and energy policies in Morocco

Irrigation has been a major component of agricultural policy pursued by Morocco. Currently, though only 15,8% of country's arable land is irrigated, irrigated agriculture contributes to 45% of agricultural Added Value (a normal year) and 75% of agricultural exports

In the recent years, the consumption of energy in agriculture has increased :

- from 2004 to 2011, the consumption of energy per ha increased by 40 %
- in 2012, the total direct and indirect energy consumption of the irrigated sector are MAD 9 billions (the equivalent of 9.2% of the agricultural added value) and 45% of this energy is subsidized.

The recent agricultural strategies (GMP) based on private investments, intensification and irrigation **and energy policies**, which highly subsidize energy (especially gas), **reinforce intensification and support indirectly private irrigation systems.**

Objectives

To assess indirect and induced effects on energy costs of rainfed and of different type of irrigated sectors (private irrigation, Large scale schemes, collective medium and small scales schemes) **at a regional level, taking into account costs of pumping and costs linked to intensification.**

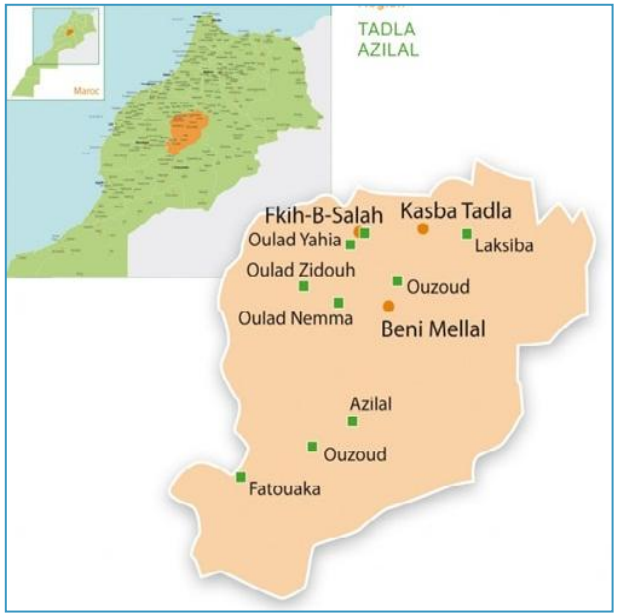
To compare the multiplier's effects of irrigated and rainfed agriculture, on the regional economy

To show how SAM (Social Accounting Matrix) can contribute to assess energy costs at a national or regional level and **to analyze the limits of sectoral policies**

Case study:Tadla azilal region

- Total arable land : 529 640 ha
- Irrigated agricultural surface : 207 142 ha
- Population: 1,49 billions habitants : 61% rural; 39% urban

Irrigation sub sectors	Total (ha)	%
Collective Large Scale schemes (LH)	81 486	15
Collective Small & Medium scale schemes (MSH)	53 466	10
Mixed (Mix)	36 704	7
Private irrigation (PI)	9 826	2
Rainfed	348 158	66



Method : Social Accounting Matrix and multipliers' effect

Classically, SAM is an extension of the national accounting system so it represents the whole economic system

A SAM has been built at Tadla Azilal regional level :

- using 2012 data (Rais, 2014)
- disaggregated by type of irrigation system and by type of energy (diesel, gaz, electricity) (El Ghandour 2015)

Production multipliers allow to assess the impact of agricultural production's increase on the local economy (Miller & Blair, 2009; Yang, Thurlow, & Lahr, 2012).

Results : Energy subsidies

Agricultural added value, energy consumption and subsidies by irrigated subsector

	agricultural added value in billion MAD	energy consumption in billion of MAD	% of energy consumption subsidized	% of subsidies in AAD
LH	1 451,9	64,3	21%	0,9%
MI	630,8	284,5	59%	**26,7%**
SAH	1 157,0	15,1	21%	0,3%
PI	303,6	184,6	62%	**37,9%**
Rainfed	1 513,0	131,9	21%	1,8%
Total	5 056,3	680,4	**48%**	6,5%

- Energy's subsidies cover almost 48% of energy consumption
- **Subsidies for energy in PI and MI represents 37,9 % and 26,7 % of these sectors' added value respectively**

Energy multiplier's effect

	LH	MI	SMH	PI	Rainfed	Livestock
Energy consumption	0,9	1,87	0,95	1,8	0,62	0,39

- If we increase by one unit the production in MI and PI, energy's consumption will increases by 1,87 and 1,8 respectively
- Mixed irrigation and private irrigation have the highest effect on energy consumption and rainfed have the lowest multiplier

Results : Added value per ha of different Irrigated Sytems

	Added Value (billions of MAD)	% of Added Value	Added Value in MAD/ha
LH	1 451,90	29	17818
MI	630,8	12	17186
SAH	1 157,00	23	21640
PI	**303,6**	**6**	**30898**
Rainfed	1 513,00	30	4346
Total	5 056,30	100	9547

PI has the highest productivity per ha …

Results : Multipliers' Effects on added value

	LH	MI	SMH	PI	Rainfed
Added Value	**2,02**	**1,84**	**2,27**	**1,90**	**2,07**

… but PI and MI have the lowest multipliers' effect on added value

- SAM multipliers show that investments in rainfed, LH and SMH agriculture could be more profitable for the economy of the country than in private or mixed irrigation

Multipliers' effects on value added for 6 main crops

	Cereals	Sugar beet	Fodders	Citrus	Oil trees	Vegetables
LH	1,272	1,487	1,359	1,427	1,439	1,549
MI	1,070	1,412	1,271	1,273	1,067	1,470
SAH	1,499	1,510	1,522	1,364	1,614	1,584
PI		1,278		1,073	0,713	1,356
Rainfed	1,360				1,601	

- Rainfed oil trees have the highest multiplier's effect on added value
- Vegetables on PI sectors have the lowest effect on vegetables added value

Conclusion for Morocco

Subsidies for energy in PI and MI represents 36% and 26% of added value respectively

The energy consumption per production unit increases twice as fast in PI and MI than in LH and SMH .

SAM multipliers show that investments in rainfed, LH and SMH agriculture could be more profitable for the economy of the country than in private or mixed irrigation (Risk !).

General conclusion

SAM can support a better design of more consistent irrigation and energy policies.

To be fully efficient, there is a need for reliable and more comprehensive statistical data