

Performance and Competitiveness of the Moroccan Tomato

Fouad Elame^{1,*}, Hayat Lionboui²

¹National Institute of Agronomic Research, Agadir Regional Center, Agadir, Morocco

²National Institute of Agronomic Research, Tadla Regional Center, Beni Mellal, Morocco

Email address

fouad.elame@yahoo.fr (F. Elame)

*Corresponding author

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Abstract: The agricultural sector accounts for almost 16% of the country's GDP and plays a fundamental role in employment, particularly, in rural areas. Despite rainfall variability, the agricultural sector achieves performance in certain value chain, including tomato. The aim of this paper is to evaluate the government's intervention policies for greenhouse tomato production based on data collected from a sample of farmers in the Souss-Massa area. The choice of this area was made for several reasons, including the potential of tomato crop production, the share of the greenhouse tomato production in relation to domestic production and the existence of the different segments and operators involved in the fresh tomato industry. For this study, we used the Policy Analysis Matrix (PAM) method to assess the profitability of tomato exports; surveys were conducted among producers, processors, and exporters. The Financial and Economic Benefit ratios, nominal and effective protection coefficients and comparative advantage ratio were used in this study. Data analysis showed that tomato production at the farm level is profitable. It has a comparative advantage and can generate foreign currency. This is due to the lower social costs of tradable inputs and to the fact that actors use many domestic resources in their production systems. Thus, with a Domestic Resources Cost ratio (DRC) below one, the activity is competitive and will be more competitive in case of social costs decrease of domestic resources.

Keywords: Value Chain, Tomato, Policy Analysis Matrix, Comparative Advantage

1. Introduction

Irrigated agriculture is an important strategic sector for Morocco, contributing to food security and employment. It occupies 15% (about 1.5 million hectares) of the total Moroccan cultivated area and contributes around 45% on average to the agricultural value added of the country [1]. This importance given to the agricultural sector has been boosted recently with the Green Morocco Plan (PMV). This ambitious program aims, among other things, to adapt the Moroccan agricultural sector to the requirements of globalization, food security, climate change, sustainable development and reducing poverty. The focus will now be not only on increasing production, but also on economically efficient production that optimize the productive resources use.

The tomato sector in Morocco has an important socio-

economic impact. Indeed, tomato exports play an important role as they generate nearly 1.1 billion dirham in foreign currency. At the social level, the sector creates an average of 9 million working days per year on production, packaging and processing. Moreover, it plays a role of new technologies development driving for agricultural and agro-industrial sector. Tomato (*Solanum lycopersicum*) is one of the most important vegetable plants among early crops in the Souss-massa region. It represents nearly 27% of the area and provides 63% of the total production and 70% of early crops exports. Indeed, with an average area of 5000 ha for tomato under greenhouses, the tomato sector provides a total production of 565.000 tons of which 420 300 tons are exported [2][3].

The main tomato varieties used in Morocco is "Calvi" which is originated from "Daniella pristyla". Many cherry and grapes tomatoes cultivars are used in different areas depending on high yielding and diseases resistance. The

planting season is July and August for the late season crops. The density is around 18000 to 20000 plants per hectare for crops under greenhouse and 23000 to 25000 plants per hectare for open-field crops. Generally, tomato can be harvested over six months, from October to June. The average yield varies from 120 to 220 Tonnes per Hectar (t/ha) under greenhouse and 40-60 t / ha for open-field depending on the crop monitoring.

Regarding exports, 90% of Moroccan tomato was exported to the European Union (EU), 8% to Russia and 2% to the rest of the world. Round tomatoes represent 68% of exports, grapes 6% and cherry tomatoes 26% [4]. However, the competition in the EU market is very high. Spanish producers and suppliers bother Moroccan exports by market occupancy of various distribution channels and a highly competitive selling price, boosted by the grants and subsidies from the EU [5]. This competition is difficult to bear for Moroccan producers of tomato since Spain has a free access to the EU market and get an important EU aid, which induces an accentuated competition against Moroccan exports. In addition, The EU applies a complex system of preferences for tomato imports from Morocco. Quantities are fixed and serve as entry price quotas and tariff rate quotas at the same time [6]. These market forces encourage the adoption of best agricultural practices conducted by the government.

The main objective of this study is to establish an economic analysis of the tomato sector. In this context, we carried out a S.W.O.T analysis (Strengths, weaknesses, opportunities, threats) [7], as well as the comparative advantages of this sector through data of the main actors involved in fresh tomato production (Exporters, farms, professional associations and agriculture departments).

2. Methods

The assessment of the comparative advantages of a market chain commodity includes a wide range of conceptual works derived from cost-benefit analysis and international trade theory. The basic concept is that an economic activity in a given country has a comparative advantage as far as it can compete with alternative source of supply through import without benefiting from any specific support from the rest of the economy under the form of resources transfer. The comparative advantage of a given productive system is measured through the computation of several accounting entities and ratios that have been gradually developed and consolidated into one method named the Policy Analysis Matrix [8].

The PAM analysis is based on the fact that the observed prices of goods and services at the market level do not reflect their real economic value. This is due to the existence of distortions created by the failure of the market itself (existence of monopoly or oligopoly), government intervention through taxes, subsidies and exchange rate policy. The aim of this method is to correct these distortions by using the economic prices applied in a theoretical calculation and to show divergences between the

reconstituted accounts and the agents' financial accounts (individual accounts or consolidated accounts). The implementation of the method requires that domestic prices for different goods have to be compared to their equivalents on the international market, assuming that international prices are considered as opportunity costs.

This method is based on economic profitability indicators and comparative advantage, calculated using the PAM [9], which will allow evaluating water valuation by tomato crop and to analyze the link between taxes and competitiveness.

2.1. Definition and Role of the PAM

The Policy Analysis Matrix is a tool that "provides an organizational framework for presenting the effects of policies on incentives for production and marketing. It distinguishes the individual effects of macro and micro policies, as well as dysfunctions and other market distortions [10]. The PAM presents a powerful tool for policymakers because it uses simple budgetary data from producers and companies and is a tool that the analyst can use to answer several questions about the value chain of a given sector.

According to Fredrik [11], the PAM provides a structured accounting framework to identify the intervention effects at different stages of the value chain. The PAM data can be easily used to provide adequate measures of policies impact on economic efficiency of different value chains.

The matrix is used to measure the divergence between real prices and efficiency prices. It can also be used to calculate a number of indicators measuring the extent of distortion, to assess the effects on the economic efficiency of the government's intervention to achieve a given objective and compares the efficiency and comparative advantage of several sectors or producers on different regions.

2.2. Structure of the PAM

The matrix is built on the same principle as the budget formation [12]. It is based on the concept of economic profit defined as the difference between income and costs. These costs are decomposed into tradable inputs costs and domestic factors costs.

The difference between tradable goods and domestic factors is fundamental for the conceptual framework. Tradable is a good or a service that can be internationally traded and includes both intermediate inputs required during the production process, and the final output of the production process. The second category of costs is the domestic factors, which include basically labor and the capital required to produce the final output (Table 1). Income, costs and profit are measured at current market prices and social prices. As a result, the PAM consists of one line at market prices, another at social prices and a third line of existing divergence between the two lines [13].

In addition, several useful coefficients can be calculated from the PAM components to measure the impact of policies on prices, on resources use efficiency and compare the impact of these policies on different value chains. Among

these indicators, the Nominal Protection Coefficient of Outputs (CPNO), the Protection Coefficient of tradable Inputs (CPNI), the Effective Protection Coefficient (CPE),

and the Domestic Resource Cost Coefficient (CRD). The formulas, the description and their interpretations are illustrated in Table 2.

Table 1. The Policy Analysis Matrix.

	Revenue	Tradable Input	Domestic factors	Profit
Private prices	A	B	C	D
Social prices (shadow prices)	E	F	G	H
Divergence = transfers	I	J	K	L

A: income at private prices

B: Cost of tradable inputs at private prices

C: Cost of non-tradable inputs at private prices

E: income at social prices

F: Cost of tradable inputs at economic and social prices

G: Cost of non-tradable inputs at social prices

D = A-B-C: the private profit

H = E-F-G: Income

L = D-H: net transfers

I = A-E: Goods transfers

J = B-F: Input transfers

K = C-G: transfers on domestic factors of production

The PAM provides a range of indicators for assessing the efficiency and the comparative advantages of a given system. If D is positive the system generates profit under the current policy and market conditions and is competitive. Similarly, if H is positive the system would be able to make profit even without benefiting from subsidy or conversely being

constrained by taxes, and the system is supposed to have a comparative advantage. If a system is benefiting from subsidy for input use, or has to pay a higher price for labor than it would if the labor market was performing well, the system can be competitive (i.e. $D > 0$), while having no comparative advantages (i.e. $H < 0$) [14].

Table 2. The protection coefficients and the comparative advantage calculation.

Coefficient	Formula	Description	Interpretation
The Nominal Protection Coefficient	$NPCO = A/E$	Reflects distortions and the gap between market prices and social prices for a commodity;	1. $NPCO > 1$: There is a positive protection of the product due to production subsidies 2. $NPCO < 1$: the main output is undervalued at private price resulting in a transfer of wealth from the productive system to the economy 3. $NPCO = 1$: No government protection;
Protection coefficient of tradable inputs	$NPCI = B/F$	Measures the distortions between local prices of tradable inputs and their international prices;	1. $NPCI > 1$: Means the existence of producer taxes 2. $NPCI < 1$: There is encouragement of tradable inputs. 3. $NPCI = 1$: No intervention in tradable inputs market;
Effective Protection Coefficient	$EPC = (A-B)/(E-F)$	Compares the added values with social prices and market prices. And Measures the total effect of policies on products and inputs;	1. $EPC > 1$, means that the selected systems is protected, increasing Market profit; 2. $EPC < 1$; the system generates less added value at market price than he would at social prices;
Domestic Cost Resources ratio	$DRC = G/(EF)$	measure of the level of comparative advantages achieved by the selected systems;	1. $DRC < 1$: the system has a comparative advantage. 2. $DRC > 1$: the system has no comparative advantage

2.3. Tomato Water Valuation

The water valuation indicator used for this study is the added value per cubic meter of water. While gross margin appears to be the measure of individual actor's wealth (producers), the added value measures the wealth created for the community as a whole (including labor income). It represents the sum of labor remuneration, financial expenses and taxes or subsidies, in addition to the gross income of the producer. The added value is not only a wealth creating process but also a structure of representation of the income distribution to the basic agents of the national economy: households (to whom labor compensation is paid), financial institutions (Taxes and subsidies) and non-financial companies (gross income). The added value will be

computed at financial and economic prices in order to take into account market distortions [15]. In addition, direct agents located upstream (nursery) and downstream (packing station) of the Market chain will be also considered.

2.4. Data Collection and Economic Evaluation of Inputs and Outputs

Using our surveys, we identified the budget at the farm level for tomato greenhouses production in the Souss-Massa area. This budget includes costs and revenues based on market prices for a sample of 20 farms; taking into account the social price, we have also computed the social value of inputs and outputs for the whole budget. As regards the social assessment of tradable goods, it is necessary to value imported goods at CIF price (Cost, Insurance and Freight)

and goods to be exported at FOB price (Free On Board) [12].

3. Results and Discussions

3.1. SWOT Analysis

The surveys of the tomato sector have allowed establishing a SWOT analysis. The following section summarizes the results of a diagnosis of the fresh tomato industry in the study area. Despite the various constraints it faces, the tomato sector presents forces and opportunities that can be grasped. Indeed, there is a shortfall in the profitability of the sector which could be managed by reducing inputs cost. Similarly, the sector competitiveness might be increased by opening up to other international markets.

3.1.1. Strengths

1. High technology: technological development has modernized the equipment used (greenhouse, drip irrigation...) and improved yields.
2. A long production cycle: the production cycle can last up to 7 months.
3. Resistant varieties: genetic improvement allows developing highly resistant varieties.
4. Availability of labor: labor is available with low remuneration (compensation)
5. Qualified and skilled workforce (labor): Morocco has several institutions that provide trainings at different levels in the agriculture sector.
6. Proximity to European Union markets and introduction of modern packaging facilities
7. Favorable climate for early production and during winter season (no supplement energy cost for cooling and heating)

3.1.2. Weaknesses

1. Lack of a national seed development program
2. Complex regulation of the European Union market.
3. Existence of small-unorganized producers;
4. Problems related to high temperatures (heat waves)
5. Excessive use of chemicals: these products have a negative impact on the customer health and the environment.
6. Resistance development to specific treatment: some chemical treatments are no longer effective
7. Inputs import: most of inputs used in tomato production are imported and their prices are increasing (taxes, high customs costs...)

3.1.3. Opportunities

1. Climatic conditions: favorable climatic conditions for tomato cultivation.
2. Markets diversification: an appropriate strategy for opening up to other markets which increases the competitiveness and reduces risks
3. Tomato industry processing: the added value of the processed tomato is high
4. The government encouragement: via subsidies and the

exemption of the agricultural sector from taxes.

3.1.4. Threats

1. Climate change: the region is threatened by drought influencing yields.
2. The increasingly aggressive competition from emerging countries (Spain, Turkey, Egypt).
3. Pests and Diseases: the emergence of new pests and diseases (*Tuta absoluta* in 2008)
4. Risks related to natural resources: water scarcity, groundwater depletion and soil degradation.
5. Highly concentrated market: more than 90% of the total production is exported to the EU market; market diversification is needed to reduce the risk of falling commodity prices and reducing exports.
6. Fluctuations of prices due to the nature of the product (perishable)
7. Risks related to non-compliance with the maximum residue levels (MRL) required by the European Union;

3.2. Competitiveness and Water Valuation

In the area of Souss-Massa where the limiting factor is not land, the analysis per hectare is not relevant. It is rather interesting to focus on the limited resource like water in this case. Similarly, water valuation should not be limited to the farm level since a given crop can have effects on the upstream and downstream of the Market chain.

As regards to water use assessment, it is difficult to estimate the water quantity used in packing station, which is even insignificant compared to the volume of water used at the farm level. In this context, only the quantities used at the nursery and / or farm level were considered. An average water consumption of tomato at the farm level was set at 8000 cubic meter per hectare. Regarding the water consumption for the whole market chain, an average of 8050 cubic meter per hectare was chosen.

As a result, the average water valuation is about 49.19 MAD (1 US\$=9.63 MAD) per cubic meter. Compared to an average of 10.00 MAD per cubic meter for other early crops such as potatoes, the production activity (farming) values water at 42.29 MAD per cubic meter. This ratio shows that tomato values water resources better and that a large amount of the water resource is valued at the farm level (86%) (Table 3).

Table 3. Decomposition of the water valuation by tomato production.

	Tomato	
	Water valuation (MAD/m ³)	Ratio (%)
Production	42.29	86
Packing Station	6.90	14
Total added value	49.19	100

3.3. Result of the PAM: Coefficient of Protection and Valuation of the Water

Using the indicators of the Policy Analysis Matrix, several important coefficients have been computed to assess the impact of policies on prices efficiency of resources use, and

also to compare the impact of policies on different sectors.

The protection coefficients allow comparing the domestic prices of inputs and outputs of a sector with their equivalent at the borders. These indicators are useful to determine the

implicit structure of taxation or subsidy in the formation of prices at national level and the divergence between domestic and international prices (Table 4).

Table 4. Economic indicators of the PAM.

Nominal Protection Coefficient of outputs	Protection Coefficient of tradable inputs	Effective Protection Coefficient	Domestic Resource Coefficient
0.969512195	1.077847456	0.945101915	0.32522727

1. Nominal protection coefficient (NPC)

The nominal protection coefficient of outputs (NPCO = 0.97): The NPC is the domestic price ratio of a commodity to its equivalent border price. Since the good is tradable, its price is equal to the FOB price. This latter price represents an economic value that reflects the efficient use of production factors. It reflects also the Market distortions and the gap between market prices and social or economic prices. The NPCO is below 1, which means that the domestic price is free and is not encouraged by government intervention.

The nominal protection coefficient of inputs (NPCI = 1.077): Measures the real gap or distortions between local prices of tradable inputs and their international prices. The NPCI is above one which means that there is a slight tax on producers. In other words, the producers bear the costs of purchasing tradable inputs at prices that exceed international prices.

2. Effective protection coefficient (EPC)

The effective protection coefficient (EPC = 0.94): this coefficient assesses the implicit taxes and subsidies, taking also into account the distortions of input prices. It compares the added value of tradable inputs at social prices and market prices;

This coefficient is below 1: the combined effect of transfers on revenues (income) and tradable inputs reduces market profits. This indicates the absence or lack of a positive protection for tomato production. It means that the combined effect of transfers on revenues and on the cost of tradable inputs would reduce the market profit below the social level. Most of these distortions come from the taxation system applied to inputs (fertilizers, chemical products, seeds, Gasoline...) and the overvaluation of the exchange rate.

3. Domestic resource cost ratio (DRC)

This comparative advantage coefficient compares the costs of domestic resources with the prices prevailing in the international market and provides a measure of the comparative advantage level achieved by the studied system.

4. Domestic resource cost ratio (DRC = 0.325)

Compares the social cost of the domestic resources used with the net value of the obtained foreign currencies. It measures whether a sector can generate more foreign currencies. According to our calculations, this cost is below 1. This confirms that tomato production has a comparative advantage. As a result, we can conclude that tomato production in the study area is very profitable.

4. Conclusion

Tomato ranks first in Moroccan early crops exports, accounting for more than half of exports. Despite the improved tomato competitiveness, exports remain relatively low compared to the national production, barely 50% of production. This is mainly due to the European Union market dependence and some constraints related to the complex binding regulation of this market (quotas, entry price). Therefore, Moroccan exporters should take advantage of free trade agreements to diversify markets and thus get advantage from the commodity competitiveness.

At the farm level, tomato production in the Souss-Massa region is very profitable and valued water better than other crops. At the international market level, it has a comparative advantage at social prices and can generate more foreign currency. This is due to the lower social costs of tradable inputs and to the fact that actors of the market chain use many domestic resources in their production systems. As a result, with a CRD below one, the tomato production system is competitive and will be more competitive if the social (economic) costs of domestic resources are reduced.

This analysis shows that competitiveness, financial profitability and water valuation are indicators of performance that have been achieved by the tomato value chain. It is also necessary to give importance to the organization of the local market as a complementary part of the export sector and to avoid overproduction in a segment to the detriment of others.

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