

Ministry of Agriculture and Agrarian Reform

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The Development of an Economic Model for the Study of Syrian Agricultural Production

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1. Introduction

In the Syrian Arab Republic, the agricultural sector still plays a dominant role for national income, employment generation, and in the modernisation of society. In order to ensure the positive contribution of agriculture to the national objectives, the agricultural sector has received considerable attention by policy makers in recent decades. Major policies were formulated to establish direct support through price mechanisms for strategic crops and to promote infrastructure investment in rural areas (primarily roads and irrigation as well as land reclamation). Significant emphasis was also placed on the laws of agrarian relations and agrarian reform as tools for obtaining a structure of production according to the policy preferences. At the same time, the agricultural sector and the farming community has faced a series of developments, which include, among others, increasing exposure to international markets.

Over the last several decades, the orientation on food self-sufficiency was remarkably successful and food production kept pace with the rapidly growing population, leading to a low dependency on imports for basic food items. Food production needs in combination with the state-stimulated orientation on raw material production for the agro-industrial sector (mainly cotton, tobacco and sugarbeet) have shaped the production structure of the agricultural sector.

The agricultural policies in Syria simultaneously pursue several objectives. In the case of food crops, they included a focus on stimulating food production in support of increased national food self-sufficiency, which changed in the 1990s to focus more on achieving food security. At the same time, the policies aim to support the farming community by offering floor prices and fixed prices. In the case of industrial crops (tobacco, sugarbeet and cotton), there are also the objectives to ensure an adequate supply to the processing plants and to enhance the trade balance by increasing exports (cotton) and reducing imports (sugar).

The traditional objectives of agricultural policies were directed at optimum utilisation of natural and human resources and securing adequate supplies for food security, processing industries and exports. They evolved over the last 15 years from strict self-sufficiency policy to broader self-reliance, based on the recognition of the critical role of competitiveness to marketing raw and processed output internationally. The declared policies reflect at the same time an increasing concern for environmental constraints of production, especially the necessity for efficient use of scarce natural resources including land and water. In addition, inherent trends towards decreasing farm sizes, the limits of natural resources (particularly water to expand irrigation), and the cost of support to agriculture led to increasing difficulties to pursue earlier policies over the long-term (Fiorillo & Vercueil 2003).

The difficulties that obstruct the achievement of the national goals have generated a debate on the sustainability of the set of the previously prevalent agricultural policies and have led to some changes in the recent past, while more reform is expected in the future. In this respect, the Syrian government has recently been carrying out gradual reforms in economic and agricultural policies, giving up the centrally planned economic system and moving towards a more liberalised one that depends on the intersections of market forces. The analysis of such a system requires reliable tools to predict the potential market responses to policy changes.

In order to support informed policy decision-making at this crossroads of Syria's agriculture history, the Ministry of Agriculture and Agrarian Reform (MAAR) has commissioned, from the National Agricultural Policy Center (NAPC) and other MAAR departments, a number of policy studies documenting policy changes, and sub-sectoral trends and responses to such policy changes. These studies cover the analysis of risks, opportunities and policies in meeting these challenges while preserving the social achievements inherited from the past. They are summarized in an impressive volume, "Syrian Agriculture at the Crossroads" (Fiorillo & Vercueil 2003). One series of studies looks at various sub-sectors, for example the olive sub-sector including olive oil and table oil developments (Malevolti 1999), the citrus sub-sector, which so

strongly influences the economy in the coastal farming system (Westlake, 2000), the livestock sub-sector (Cummins 2000), and the agricultural industry (Rama 2000). A different series of studies focuses on policies, including agricultural and food policies (Wehrheim 2001), policies affecting the environment (Edwards-Jones 2001), irrigation water (Varela-Ortega & Sagardoy, 2001), input marketing as well as agricultural credit (Parthasarathy 2000 and 2001), and the so-called strategic crops (Westlake 2001).

Recently, the NAPC has conducted a series of working papers – the findings of Syria’s Farming Systems Study (FSS) – to provide a framework of analysis based on a consideration of both the geographical differentiation as well as the socio-economic stratification of the agricultural sector in Syria. In addition, the working papers of the Comparative Advantages Study (CAS) are expected to be finalised in the near future. These papers describe and analyse in detail the commodity chains of seven agricultural commodities (see below). They also try to explore the situation of comparative advantages of these commodities by using the Policy Analysis Matrix (PAM).

Based on the above and to extend the analysis and improve its outcome, this paper has been prepared to set up a model that represents Syrian agricultural production. The model is expected to describe the structure of the agricultural producing sector in a way that allows us to make simulations and scenarios to predict the impacts of any policy change on the sector. In this context, the paper will try to explore the results of the FSS and the CAS in order to distinguish which of them are useful in setting up a model that represents the agricultural production in Syria and which data needs to be collected to complete setting up the model.

2. The basic elements of the model

The production function of a farm can be given by:

$$h(\underline{q}, \underline{x}, \underline{z}) = 0 \quad (1)$$

where \underline{q} is the vector of output quantities, \underline{x} is the vector of variable input quantities, and \underline{z} is the vector of fixed factor quantities. Variable inputs are usually hired labour, fertilisers and other chemicals, seeds, hired machinery, and all other inputs that can be purchased in desired quantities. Fixed factors are private factors that cannot be acquired in the time span analysed such as land and equipment, and public factors such as roads and extension services and other exogenous features such as weather and distance from markets.

Assuming that p and w are the prices of outputs and inputs respectively, the producer’s gross margin is given by $p \cdot \underline{q} - w \cdot \underline{x}$. Assuming that the producer is a profit-maximiser subject to technology constraint:

$$\text{Max } pq - wx \quad \text{s.t. } h(q, x, z) = 0 \quad (2)$$

The solution to this problem provides a set of output’s supply and input’s demand functions at the individual farm level, which heavily depend on the technology described in the production function (1).

One widely used method of representing the farm profit-maximising problem (2) is to use *linear programming*, which requires some simplifying assumptions:

1. variable inputs’ use can be described by their per-unit cost, so that the objective function described in equation (2) simplifies to

$$\max \sum_{i=1}^n \tilde{p}_i q_i$$

where:

$$\tilde{p}_i = (p_i - c_i)$$

where:

c_i is the per-unit cost of variable inputs

2. the technology is described by

$$Aq \leq z$$

where:

A is a matrix of technical coefficients expressing the unit requirements of fixed resources.

The typical elements of this matrix, a_{ij} , would indicate the amount of the i -th fixed factor required to produce one unit of j -th output. Typical relevant fixed resources include land (possibly distinct between rain-fed and irrigated), family labour, hired labour (possibly by season or month), liquidity, water, etc.

Additional rows to the matrix A can be included to describe the relevant technological constraints, such as cropping rotation requirements, licensing systems, etc.

Based on the observed data on actual farms, theoretical models such as (2) can be *calibrated* in order to define reasonable sets of technical coefficients compatible with the prevailing technology in each farming system. Therefore, the model can be modified according to the farming type and the purpose of the analysis. Consequently, very accurate, deliberate and disaggregated data are needed in order to quantify p , c , A and z and to present the farm types of Syria and explain them.

3. Available sources of data

3.1. The Farming Systems Study (FSS)

The specific contribution of the national Farming Systems Study to the tasks undertaken by the NAPC lies in providing a framework of analysis based on a consideration of both the geographical differentiation as well as the socio-economic stratification of the agricultural sector of Syria.

A main objective of the FSS was to allow policy-makers to base their decisions on a better knowledge of the agro-ecologic and socio-economic conditions of the households and of the potential impacts of agricultural policy changes (e.g. prices, market openness). Therefore, Syria has been divided into six main geographical farming systems. Each farming system is characterized by its natural conditions, market integration and historical influences leading to differentiation and specialization of production within it. Within each farming system, typical households represent the socio-economic variation which exists naturally in any rural society. These household types are developed in light of typical resources endowment, their mix of livelihood assets and main changes of the last decade. The share of each household type in a farming system in combination with its production orientation allows analyzing the ability to adjust to, opportunities deriving from, and vulnerabilities to changing production conditions.

The research findings show how policy change and technological innovation will affect each household type, depending on the relative importance of its different income sources and livelihood strategies. The key finding is the characterization of each farming system in the national context. This allows reviewing the possible effects of policy and technological adjustments for representative households, individual farming systems, as well as at the aggregate level, providing valuable information for agricultural policy-making.

However, despite the use of quantitative measures in the FSS, the latter also relies heavily on qualitative analysis. The results from the analysis of typical households defined in the FSS do not represent a statistically significant simple mathematical average of statistical information

commonly generated in national agricultural censuses or household surveys. They are abstractions or notional models describing typical farms within the farming systems they represent, with the intention to indicate the impact of policy decisions on one family with their income sources. The typical households developed in the study provide nevertheless a very useful basis for applying complementary analytical tools, such as the development of simple household models to study the impact of improved farm management and the application of new technologies or price changes.

These typical households were based on the main findings of the FSS survey. These are the calculated cropping patterns (CPs) of different households of different areas, the cropping calendars that were calculated for the most important crops in each farming system zone, and the gross margin calculations (GMs) that were performed for the most important crops in the areas where the survey was conducted. These main three findings are all useful for the supply analysis of agricultural production.

The GMs were mainly collected for serving the CAS, which studied the possible comparative advantages for seven products and crops (cow milk, cow meat, cotton, wheat, tomato, olive oil and orange). Therefore, the collection of the GMs was focused on these products and crops, while relatively fewer GMs were collected for other crops according to the importance of each in different farming systems zones. In addition, many GMs were calculated for ewes since they form the main income source of the Syrian steppe (Al-Badia), which is considered a separate farming system in the FSS.

The gross margin calculations (GMs) that were collected through the FSS can provide us with valuable information to define the parameters \underline{p} (prices of inputs and outputs), \underline{c} (per-unit cost of variable inputs), $a_{i,j}$ (fixed factors required for one unit of output) and \underline{z} (fixed resources). Every GM sheet includes information about: total variable cost, physical input cost, hired labour cost, family labour, total revenue, yields, sale prices of main products and by-products (when they exist), machinery use, water consumption and cost, irrigation source and scheme, GM per unit of family labour and GM per unit of water used. All of these data were calculated per unit of land area (ha). The total variable costs and the yields can be used to estimate the per-unit production cost \underline{c} . Moreover, the GMs include information about the fixed resource requirements such as water use, labour use (divided into hired and family). This information helps defining the constraints these fixed resources might form on the production when the availability of these resources, \underline{z} , is defined.

The estimation of prices will be different according to whether the crop price is regulated by the government or left to be determined by the market forces. In Al-Ghab farming system, for example, where most agricultural land is cultivated with state-controlled crops (wheat, cotton and sugarbeet), prices of such crops as used in the GMs are valid since the government fixes them. However, prices of other crops (such as peanut and beans) as recorded in the GM surveys need to be corrected by averaging across different farms or different time periods, since they fluctuate from year to year or even from month to month.

In addition, the data collected can only be thought of as representative of the areas covered by the survey of the FSS, while big areas were left without coverage due to resource constraints and therefore still need to be covered. Therefore, the FSS focused the survey in the mantikas that are considered best representative of the relevant farming system. In most zones, especially in the central, northern, and north-eastern plains, production systems are diversified between different mantikas within each broad farming system in such a way that were difficult to be captured by the FSS survey. Another limitation of the FSS data is that they are focused on the main present crops, without considering crops that occupy now minor areas but have potential to develop in the future. Such crops are crucial and should be considered in the supply analysis approach. Therefore, further data need to be collected on these crops.

3.2. Comparative Advantage Study (CAS)

As mentioned above, the GMs were mainly collected for serving the CAS. Therefore, the collection of the GMs was focused on the products and crops of the CAS. Through constructing the Policy Analysis Matrices (PAMs), the fixed costs of the relevant crops and products were estimated. These fixed costs can be used as a basis for setting up the different farm types that will represent the farming systems of Syrian agricultural production. These costs include water fees (when water source is mainly the public canals) and land costs (whether rented or privately-owned).

3.3. The Syrian Agriculture Database and Syrian agricultural statistics

The Syrian agricultural statistics, which are partly available in the NAPC Syrian Agriculture Database, has valuable information useful for the supply analysis of Syrian agricultural production. Most important are those related to the areas and the yields of different crops on the mantika level. This information can be useful in setting up and calibrating the model in order to make the results of our model as close as possible to the observed ones.

3.4. Other studies conducted by NAPC

These studies provide an adequate and useful package of information and recommendations in many fields such as land tenure, investments, credits, water policies, food security, and others, which should be further studied. Thus, the proposed model enables the follow-up of the results of these studies in a more precise way for the purpose of decision-making.

4. Conclusions and proposals for further action

The data available now are confined to some mantikas and do not cover all the country. Despite this limitation, they can be used as a basis to estimate the data that can be considered representative for other areas after some adjustments taking into account the local circumstances of each mantika with respect to the production structure, technology and agrarian rotations in each mantika. However, trying to use this representative estimation method might bring up other difficulties because of the significant differences between the various mantikas of Syria. More surveys need to be conducted to augment the available information and to fill in the large gaps that currently exist.

The available information about the cropping calendar is expected to be sufficient to set up the model since all important crops are included. More information about the cropping patterns is needed especially since the calculated cropping patterns of the FSS were too approximate to apply on a wide range of farms, and they are not particularly representative. In this context, the NAPC database and the statistical abstract of the Ministry of Agriculture and Agrarian Reform (MAAR) can be used to complement the information. One advantage of the FSS cropping patterns is that they consider the differences in the cropping patterns between poor, medium and better-off farmers in each farming system, which mostly reflect differences between small, medium and large farms.

The gross margin calculations performed by the FSS are the most important element for setting up the model of supply estimation. However, the ones available now are insufficient for two reasons: they do not cover all mantikas in Syria, and they do not consider all crops. Nevertheless, they are sufficient to set up the model and start the analysis. Based on those initial models and analysis, we can better determine what data are missing, and which need to be gathered later on.

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