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Multifunctional Agriculture, Quality of Life and Policy Decisions: an Empirical Case

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Abstract: **The TOP-MARD research project (Toward a Policy Model of Multifunctional Agriculture and Rural Development), that will be here described in its Italian version, links farmers' behaviour with their economic, social and environmental effects, showing the difference between a behaviour guided by market profitability only and one guided by the interest of a broader social group. It was financed by EU in 11 European countries, and it took place in 2006-2008.**

The TOP-MARD research defined a 10-modules model (POMMARD), that links use of land and production techniques to several dimensions of a context (quantitative and qualitative, from economic to social and environmental) and to the quality of life of its population. STELLA, a Systems Thinking software, has been used in order to develop the POMMARD model.

The POMMARD model is partially supply-driven with demand constraints: land use and its dynamics produce a mix of marketable and non-marketable goods, that impact other sectors and the territory through an I-O or a SAM, and through the consequences of their production on the quality of life. Labour requirements and demography can produce – therefore – immigration, and contribute to job creation and dynamics.

Public intervention influences local resources and human behaviour.

Farmers can choose their style of production and land use, that are the "key drivers" of change: when land is converted from a land use to another or from a conventional to a non-conventional style of production, there occurs a change in the vector of inputs (means of production and workers) and in the vector of outputs, that also comprehends public goods.

Provision of public goods increases the quality of life. Rural areas become therefore more attractive to younger generations, encouraging them to stay rather than migrate, and attracting new-comers. Tourism can also be influenced by the attractiveness of the area, which can contribute further income, within the limits of tourism capacity and seasonality. Starting from the actual systematic links, the model considers the main variables (population, income, …) under different policy scenarios: providing suggestions to policy makers about the possible effects of exogenous shocks, such as policy measures, on rural development and quality of life.

Keywords—**Multifunctional Agriculture, Quality of Life, Policy Decision.**

I. INTRODUCTION

Agriculture, together with its principal task of producing food and other marketable goods, performs several social, environmental and cultural functions: it may for instance help preserve social cohesion and a better relationship with the labour market through the predominance of independent jobs, often perceived as characterized by a peculiar life style; it can have a positive role on soil, water, air, or, on the contrary, it can damage them in a pervasive and widespread way, difficult to trace and prevent; it can protect (or destroy) biodiversity; it can help transmit traditional practices and life styles to younger generations; it can provide therapeutic activities for disabled or disturbed people, thanks to the closeness to nature; it can shape the landscape, contributing to a pleasant visual context that can benefit other economic operators, or increase beauty and wellbeing.

The transition from the idea of agriculture as mainly producing marketable goods to a broader vision of multifunctional agriculture is progressively gaining ground in the agenda of researchers and of policy makers. A number of projects have been recently financed: some, such as MULTAGRI [1],[2],[3], were meant to explore the state of the art; others, such as

SEAMLESS, SENSOR, MEA-SCOPE, EURURALIS, SCENAR, TOP-MARD, sought to produce models[1]

The role of multifunctional agriculture as peculiar to the model of European agriculture has been emphasised starting from the seminal formulation in the 1980s with the EC document "The Future of Rural Areas" (1988), which stressed the need for a new rural development policy that takes into account local diversity. Later the Cork Conference on Rural Development - promoted by the EU Commission in November 1996 – produced a declaration where a bottom-up approach, multidisciplinarity and diversification of activities were listed as new keys of rural development policy [5].

For a number of years the question of multifunctionality has been used to justify aid to agriculture, even when such aid was actually directed to the most intensive and specialized – and hence most environmentally dangerous – sectors. In more recent times researchers have began to stress the need for a better definition of the public goods produced by agriculture, their characteristics and their role in the territory. In other words, while in the past agriculture's contribution to social welfare was taken for granted and its positive (or negative) effects, comprising environmental influences, were neglected, in our days part of the academic and political milieu have started to consider the necessity, in order to promote effective and non-distortive policies, to define and quantify the public goods (and bads) produced. From this new perspective it is held that "Only those policies that promote genuine European public goods, are efficiently targeted at their objectives, and avoid excessive payments, should be retained." [6]. In other words, a simplistic vision of the public benefits deriving from agriculture is being replaced by approaches that envisage interventions primarily based upon the demonstration of the link between agriculture and the social benefit pursued, i.e., whether such benefit would not be obtained by means of other policies.

Also, however difficult that may be, it is hoped that the advantage and the intervention can be measured. In fact, the principle of subsidiarity suggests that where public goods lack European relevance, they must be financed by the national budgets. It goes without saying that a strict supervision by the Union should prevent national and sub-national authorities from introducing distortions in the domestic market.

We can conclude that both the objectives and the instruments of the CAP (Common Agricultural Policy) are under discussion. Given the radical change of context, the CAP must be re-formulated considering its social acceptability [7].

There is, therefore, a strong interest toward a better focused methodological effort that could help the transition to a multidimensional idea of agriculture which could work as a guidance to political decisions.

The TOP-MARD research project (Toward a Policy Model of Multifunctional Agriculture and Rural Development), that will be here described in its Italian version, links farmers' behaviour with their economic, social and environmental effects, contributing to a decision making process shaped not only by market profitability but also by a broader set of goals. It was financed by the EU in 11 European countries, and it took place in 2006-2008[2].

In order to understand how to use this model, we shall describe the core-model POMMARD designed and implemented by the researchers involved in the TOP-MARD project; then we shall illustrate the Italian version with its specificity, and the projections at 2026 resulting from the area chosen by the Italian team under different policy scenarios. The results come from the prototype of a very powerful engine: additional work is actually needed in order to fully implement and exploit this operative tool.

Let us begin with the structure of the model, the data input, and the output for different policy scenarios. Then we shall consider the information problems, and how to improve the model and integrate it with other forecast and research tools.

[1] Juvancic et al. recently compared the features of these model [4].

[2] Research project TOP-MARD (Toward a Policy Model of Multifunctional Agriculture and Rural Development) financed by EU, Specific Targeted Research Project (STREP) – Framework 6, SSP Priority Topic 8.1 - Policy Oriented Research (FPP-2002-SSP-1), contract n. 501749, coordinated by Professor John Bryden, with Prof. Tom Johnson (Modelling Advisor) and Prof. Ken Thomson (Policy Advisor) [8], [9].

II. THE POMMARD MODEL

The TOP-MARD research defined a 10-modules model (POMMARD), that links the use of land and production techniques to several dimensions (quantitative and qualitative, economic, social and environmental) of a general context, and to the quality of life of its population. To develop the POMMARD model a Systems Thinking software, STELLA, has been used [10].

The specific features of this software are: its ability to trace links between variables pertaining to different phenomena; to model non-linearity; to accommodate qualitative and quantitative variables; to identify dynamism; to operate on relatively few data; to be relatively user-friendly and apt to integrate data from different disciplines [11].

The system dynamics approach has been chosen in order to model the linkages between changes in economic activities, social systems and environment, with a procedure similar to that applied in Ecological Economics. Specific features of system dynamics models are the use of stocks and flows, and of feedback loops. "Unlike static models, where equations controlling variables describe their equilibrium levels, system dynamics models describe the processes by which variables change as they strive to achieve an equilibrium.(…) In general, systems never achieve equilibrium because external stimuli continuously change the equilibrium values" (Johnson in [11]).

Stocks of natural, human, built, social and cultural capital produce a flow of goods and services that increases welfare and quality of life. These area-based assets (especially land and natural characteristics) are key to rural region "performance". What is produced and how it is produced are the key elements to connect agriculture to the life of the local area as a whole. They can cause a worsening as well as a bettering of the local quality of life by producing, or alternatively destroying, public goods and positive or negative externalities. In other words, the production decisions (what and how to produce) determine the territorial impact of production. This causes immediate as well as long term effects. In fact, beside the direct consequences on natural resources, the increase or decrease of natural capital can generate additional welfare by means of the multiplying effect of tourism. Agriculture acts upon the attractiveness of an area both directly (through a clean environment, genuine products, social capital) and indirectly, creating the conditions to develop tourism and, as a consequence, to increase employment and income opportunities.

Human behaviour (land use change, migration, education, labour force participation) is the key to change in a region.

Policies influence place-based assets and behaviours. Fifty years of CAP have clearly proved that policy interventions enduringly condition production choices at the firm level, which entails a difficulty to modify established routines once the expectations of operators have been consolidated, even in presence of an awareness of the changes in the policy objectives.

The POMMARD model helps decide which policy tools can influence productive choices in order to produce welfare and improve the quality of life.

A. Structure and Dynamics of the Model

A well known basic principle of modern scientific method - we can call it an Occam razor - suggests that it is methodologically sound to simplify the most complicated hypotheses: «all other factors being equal, the simplest explanation is to be preferred». While in univariate models we apply a "parsimony of the parameters", in multivariate models we focus on the variables. In general, however, we deal with models concerning a specific aspect of a phenomenon whose validation is based on data from the past. If we look instead at various aspects of a context observed not only from an economic but also from demographic, social and environmental perspectives, the alternative to a complex model for the representation of reality is a "system of models".

It follows that if complex processes and temporal dynamics imply analytical methodologies capable of dealing with complexity and dynamism, it does not mean that the model's complexity should be increased in order to reproduce reality (like in Borges maps). We rather need the simplest type of abstraction to summarize complexity. The POMMARD model answers to this double need by focusing attention on the relationships. It consists of a web of inter-related modules with an Input-Output (I-O) Matrix or a Social Account Matrix (SAM) at the core. To the latter a

productive agricultural system is linked that uses land to produce saleable and non-saleable goods, and that interacts with the regional economy module, with the module of demography and that of the labour system, showing the changes in the quality of life by means of the effects that the behaviour of farmers has on public goods that are created jointly with production.

The starting point is a demand and supply equilibrium, a population with a known age and education structure, an initial agricultural production, an initial use of land, and a hotel beds endowment that sets the limit to the touristic valorisation of the public goods produced.

From the starting situation, in our case the 2001-2006 interval, we get the evolutionary trend of the model generated by the dynamics of demand, supply and population. If farmers use their land without changing the destinations and productive techniques, they will require intermediate products defined by the I-O relationships, and will sell their produce in a world of prices defined by the equilibrium relationships. The evolution of the system is the result of the preceding dynamics.

The trend can be modified if changes in the use of land, spontaneous or policy induced, take place. The scenarios then represent the effects of policies on individual behaviours.

Let us go deeper into the model.

B. A System of Models

POMMARD is a system of models partly interconnected within POMMARD itself and partly externally connected. It uses data from secondary data collection after the ETL (Extract, Transformation and Loading) step has been taken. It uses two main data types:

- retrospective data (e.g., initial conditions);
- forecasts.

External estimations are rarely possible using the typical models of modern time series analysis [12]. The ARIMA class of models in fact for a correct specification needs time series with more than a hundred observations. But the main reason to avoid such models concerns the nature of the data. These are often yearly data, whose coherence and homogeneity is unvaried over brief periods of time (e.g., variation of the method to gather information, etc). In such conditions preventive trimestrialization looks useless for the estimations.

Concerning external estimations, the classes of useful models are reduced to:

- Naïve methods (i.e., average, indexes, etc);
- Methods derived from the classical time series analysis such as moving average, State Space Exponential Smoothing [13], [14];
- Other models of reality, such as damped models.

Damped models [14] are deemed very useful in predictions with little information. Damped models estimations are coherent with the past, with a lesser intensity of the signal: if an aggregate is growing, its future growth will be deemed less intense (and the other way around), like in the logistics used in demographic forecasts or in the marketing of new products.

External forecasts are derived from Naïve methods.

Damped methods could be of interest in the future.

In each period t (t = 1, 2, …, T) the projection is given by the values of the endogenous variables obtained by the model in t-1 and form the values of the exogenous variables in t.

C. Interconnections between Modules

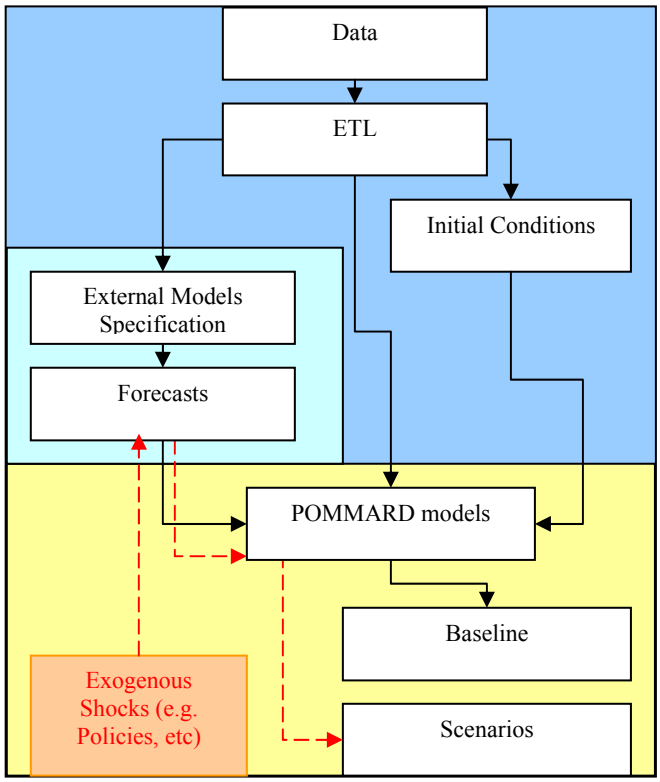
In POMMARD the relationships between the various aggregates, schematized by means of functional links (figure 1), correspond to specific applicative modules (figure 2).

C.1 Land

Land is the primary resource affecting production of agricultural commodities and non-commodities. When farmer chose a production system, he requires land of a certain type, an amount and kind of labour and all the necessary inputs. This choice is the main economic driver in POMMARD. Land is composed of Land Types:

- Annual Crop Land
- Permanent Crop Land
- Grass Land
- Forest Land
- Other Land

Figure 1. A System of Models



Source: POMMARD Model 2009

Within land types, productive systems must be defined in every case study, to adapt them to local specificities.

Land affects the agricultural sector and non-commodities through land cover and its changes.

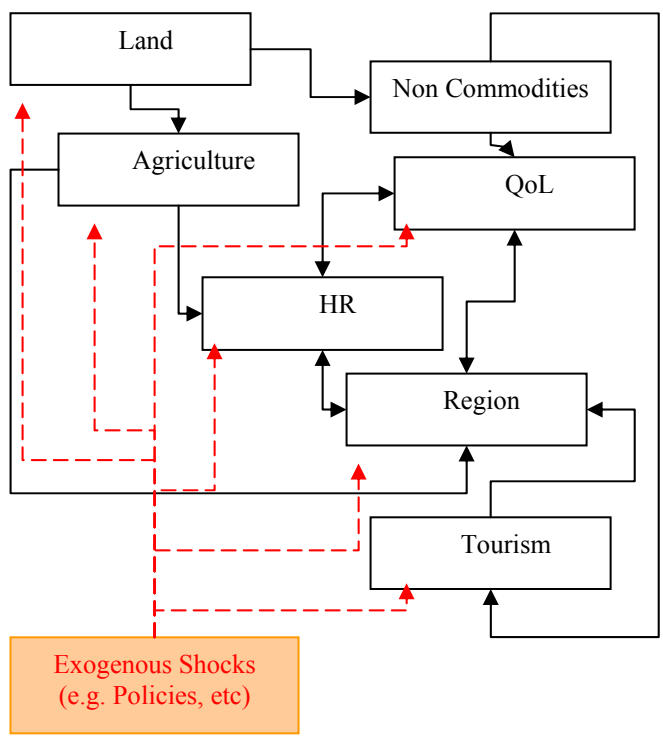
C2. Agriculture

The agriculture module, directly influenced by the land module, affects the regional economy and human resources through production, input requirement and labour demand. Such relationships are described by means of the I-O matrix (or by the SAM).

C3. Non-Commodities

Non-commodities are directly generated by land use and affect the quality of life and tourism through change in natural capital and region attractiveness. There are eleven types of non-commodity outputs included in this model. The first four of these non-commodities are related to land changes: percentage change in forest, arable land, grass land and permanent crops. The fifth is the Shannon Index, measuring diversity in the used type of land. Then there are livestock units per hectare and land cover change. Because cropland is generally a less desirable land use than other farmland uses, increases are recorded as negative changes. Biodiversity is defined as total utilized agricultural land under low-input farming systems. The last three non-commodities measure pollution through total mineral fertilizer applied per year, total surplus of nitrogen applied over that used by plants, and total net emissions of CO2.

Figure 2. The relationships between the different components of the POMMARD model



Source: POMMARD Model 2009

C4. Human Resources

The population is modified according to the natural and immigration dynamics. Immigration dynamics depend on the quality of life and on the regional labour market, with labour demand coming from agriculture and from the other sectors. Population and human resources have impacts on the quality of life

and on the regional economy through population (e.g. change in human capital) and through the labour supply (driven by the natural population change).

C5. Tourism

Tourism is limited by the reception capacity, and conditioned by the availability of public goods, which modifies the area's attractiveness. The tourism sector affects the regional economy through consumption due to tourist expenditure.

C6. Regional Economy

Regional economy is tied to agriculture and human resources through labour supply and labour demand, to tourism through consumption, and to the quality of life through the migration flux. The regional economy affects the quality of life, where income changes cause variations in the regional quality of life, and on human resources through non-agricultural labour demand.

C7. Quality of Life

Quality of life consists of several factors, including income and environmental conditions. It affects population, through in-migrants being attracted to the area by quality of life factors, and the regional economy through the demand created by these in-migrants. Migration coefficients are different according to age.

C8. Policies Control

Besides the natural dynamics of the system, which evolves along the path of the estimated trend, policies can induce behavioural changes. The Policy box allows policy scenarios as exogenous influences on the regional systems. It allows to observe the impact of a range of policies on land use, on other decisions related to multifunctional agricultural activities, on local non-agricultural economic activities, on tourism, on the quality of life (e.g. through capital change) and on human resources.

D. The Input-Output Matrix

POMMARD uses, when available, the Social Accounting Matrix (SAM), or the Input-Output (I-O) tables (fig. 1) proposed by Leontief [15],[16]. For every branch of the I-O we can define a balance equation, that can be expressed in matrix terms with the following equation

$$(I - A)\, X = Z \qquad (1)$$

where I is the identity matrix, A the matrix of expenditure coefficients, a_{ij} (i, j = 1,2, …, n; with $a_{ij} = x_{ij} / X_j$) expresses the direct requirements of intermediate inputs of domestic production, X is the vector of total production and Z the vector of final demand.

Timewise, the terms of (1) are all unknowns. With *n* branches we then have $n^2 + 2n$ unknowns (n^2 expenditure coefficients, *n* levels of production and final demand). To work out the analysis of the economic system in the future we must reduce the number of unknowns to *n* (equal to the number of equations). To do so:

- the first hypothesis introduced in the model is that of considering the n^2 expenditure coefficients as known. Here we have used the classical approach of invariance of expenditure coefficients between the base year and the year in which we want to study the evolution of the system. This is a strong hypothesis that can be replaced, in successive phases, considering a dynamics of the expenditure coefficients (e.g., estimated using variations from retrospective studies). From a statistical-economic perspective the expenditure coefficients change with time in relationship to the variations of the prices system and the variations of the technical coefficients. This last factor is not independent from the level of production (non constant returns to scale) nor from process and product innovations (technical progress) ;
- the second hypothesis introduced is that of considering the final demand *Z* as exogenous. Typically, we can define the vector Z as the result of economic policy interventions (i.e., economic planning), or as the result of a temporal extrapolation (the formulation of projections about the economic system).

Now we can re-write (1) in order to obtain the production vector of a future year

$$X = (I - A)^{-1}\, Z \qquad (2)$$

where $(I - A)^{-1}$, which contains the direct and indirect requirement coefficients of the fluxes of internal production, is the matrix of the activation coefficients.

Once X is determined, it is easy to construct the future I-O. In fact, given that $Y_j = X_j - x_{.j}$, and that the gross product can be decomposed into the contribution of *r* primary costs $Y_j = Y_{W,j} + Y_{S,j} + Y_{K,j} + Y_{D,j} + Y_{T,j}$ (Y is gross production, Y_w wages, Y_S social expenditures, Y_K other incomes, Y_D ammortization, Y_T indirect taxation net of current production subsidies), we can build the matrix of the coefficient of primary costs $c_{rj} = Y_{rj} / X_j$. Also in this case, we can see that the c_{rj} must be thought of as constant (or must be extrapolated in terms of dynamics).

Figure 3. Simplified schema of the I-O

$$\mathbf{I - O} = \left[\begin{array}{c|c} \mathbf{x} & \mathbf{Z} \\ \hline \mathbf{Y} & \mathbf{O} \end{array}\right]$$

Source: [17].
Notes: x intermediate fluxes Matrix; Z final fluxes Matrix; Y primary costs Matrix; O Null Matrix.

Starting from the future I-O we can build other equations to define interesting aggregates, such as labour, immigration, etc. For instance, if we consider among the primary factors labour, we can define he apparent productivity of labour of the jth branch by means of the following expression

$$\rho_j = Y_j / l_j \qquad (3)$$

where ρ is productivity, Y gross production and *l* is labour. Hypothesizing ρ_j (j = 1,2, …, n) constant over time (or to be estimated), and Y_j being known once built the future I-O, the amount of necessary labour can be immediately determined by means of the following expression

$$l_j = \rho_j / Y_j \qquad (4)$$

III THE IMPLEMENTATION OF THE MODEL FOR THE ITALIAN CASE STUDY

The implementation of the model for each of the 11 territories pertaining to TOP-MARD teams starts from the choice of the area. Most of the teams chose a NUTS3 area for the availability of data at the territorial level. This happened also for Italian team, that chose the Latina Province as its case study area.

The availability of data also influenced other choices: from the segmentation of the territory into land types and production systems, to technical coefficients, to the range of public goods considered in the model. Most of the data come from existing sources, supplemented by a direct collection of data concerning specific categories: farmers, non-farming entrepreneurs, and a third group composed of residents in the area, a combination of young people, young mothers and elderly persons. This direct collection of data focused on specific questions: we wanted to know the farmers' attitude towards multifunctionality, the relationship of non-agricultural entrepreneurs with the agricultural sector, and the last group had been devised in order to gather information on the availability of public goods and the quality of life, with the aim to estimate the connection between such availability and the propensity to stay put or to migrate from the area.

The questionnaires have allowed us to gather interesting qualitative information used as primary source for the analysis and not easily found in statistics.

Within the project we have also identified another reference subject: the National User Group (NUG), made of institutional and non institutional subjects interested in the agricultural sector and in local development. The NUG was supposed to represent both a source of information and a subject interested in the results of our research, that could be used for planning and policy purposes, filling the gap between research, practice and policy, and linking local expertise with scientific competence.

A. The Italian Area, Latina Province

The Province of Latina lies in the south of Latium, between the provinces of Rome and Frosinone, covering 13% of the Region's area. The territory is heterogeneous, with alternating costal or internal plains, hilly areas and mountains. Close to the coast we find the Agro Pontino, the fertile agricultural area reclaimed in the 1930s. These characteristics, whose particulars we shall spell out in what follows, make it a perfect candidate for research on multifunctionality, pluriactivity and on the relationship between

agricultural practices, old customs and new ideas, and local development.

The hills present a marked heterogeneity, from olives to livestock (buffalos, sheep and goats). The plains (Agro Pontino) host an intensive agriculture: vegetables (greenhouses as well as field production), fruits and dairy farming (water buffalo is very important and characteristic). Agricultural revenue in this part of the province is two and a half the Italian average.

Industry is located on the coast, which also hosts tourism.

The province registers the simultaneous presence, and links, between rurality and modernity. This gives it a high potential in terms of the development of the multiple functions agriculture can take. Historically the area has undergone a profound evolution, from the land reclamation and colonization of the Agro Pontino that took place during fascism[3], to the industrialization induced by the "Cassa per il Mezzogiorno" after World War II. Its strategic position, just to the South of Rome, and its agricultural productions, have been crucial during WWII as well as in the post-war period. Another important resource that has gained importance with the post-war development of the city of Rome is the labour force from the internal, mountainous areas of the province, mainly employed in the constructions industry.

During the economic boom of the 1960s, and more so in the recent years, the area developed pluriactivity: the agricultural family, to survive modernization and industrialization, specializes the functions of its components, distributing them in the farm as well as in the labour market. This has permitted the survival of small farms whose economic dimension would otherwise be inadequate to withstand competition. Pluriactivity also allows relief from the periodical crises that sweep the labour market [20].

The resident population in 2005 registered an increase of over 40 thousand units with respect to 1992, due to the migratory movement. Population increased in the plains, while the hills have shown a decline or a less steady growth. The age structure is similar to the Italian average.

The average income of the region is € 22,332 (Italy's is €19,726). The active population is 42% (Italy's is 41.7%). 36.1% of the people hold a high school or university diploma, as compared to Italy's 28.2%.

Less then a fifth of the employed population of the region works in industry.

In the Agro Pontino operate 36,000 agricultural firms, with 93 thousand hectares of actually utilized agricultural land (AUA). Most (92.2%) are family farms employing mainly or exclusively family labour.

Not only the number, but also the dimension of the farms have been decreasing, contrariwise to the tendency in the rest of Latium. Large holdings are above 13%, while the rest of the Latium region never goes beyond 7 (the Italian average being 8.7). The average farm area is 3.63 (-0.6%), while the region average is 4.99% (-0.25%).

Microscopic firms (less than 1 hectare) seem to be growing in number. This is due to a peculiarity of the Italian census, that registers them as firms because no income threshold is considered. Such small firms in fact are often family vegetable gardens (63% of the total, and 27% of the SAU). Some of the smallest productive farms concentrate on highly intensive, high income productions, such as green houses and flowers. 7% of the agricultural farms are highly professional and of excellent quality. They take 44% of the SAU, contributing to the great economic dynamism of the province. 20% tend to lose the firm character with the death of the person who actually manages its agricultural production.

Animal breeding has declined; animal heads, apart from buffaloes, have gone down. The province of Latina holds 20 thousand buffaloes, used to produce the famous mozzarella. The water buffalo dairy sector is not subjected to the EC quota system.

The Aprilia and Circeo wines were awarded the Protected Designation of Origin (PDO), while artichokes and kiwis have the IPG label.

The quality of water, soil and atmosphere is bad. There is a big load of N and P in water: 50 % of nitrogen pollution and 80% of phosphorous can be attributed to agriculture, above all to livestock

[3] A technically competent analysis of the land reclamation and colonization is in Voechting, [18] especially in the rich introduction by A. Parisella. Franzina and Parisella [19] collect several interesting papers on this subject; among them, the most relevant for our theme are those written by Parisella and by Gaspari.

breeding. This last is also chiefly responsible for the emission of greenhouse gases.

23 municipalities are at landslide risk, 20 at flood risk. The plain areas are totally dependent on de-watering pumps: if these should suddenly stop, 10 days of hard rain could convert the area in the swamp it used to be before the reclamation of the 1930s.

Finally, it is worth noticing the presence of a widespread black and informal economy, especially in agriculture [21]. Latium and Campania show a 10% of added value from such activities (6.5% of GDP) [21] p.29. To Rey, ¾ of the official added value of the economy of Latium is subjected to IRAP fiscal evasion, heavily related to informal and black economy activities, with an IRAP evasion in agriculture reaching at the national average level 60%. Given the difficulty in estimating these data, the importance of this phenomenon can be thought to be much bigger than what Rey supposes.

Survey based on interviews, and estimations based on official data, should therefore be carefully devised on a regional basis, and by sector.

B. Policy Scenarios

Policy scenarios have been defined according to the actual debate and to the explicit suggestions we received from the Commission.

First of all, two base scenarios were defined: the initial baseline and the Main Baseline which represents the comparator scenario. The aim of the Initial Baseline was to establish a reliable data set as a starting point for the simulation. It was agreed to choose 2001 because it was a major census year for most of the countries involved and data were already published. The Main Baseline updates the Initial Baseline from 2007 with policy changes due to Mid Term Review.

Eight alternative scenarios were defined to take into account changes in policy after 2007.

In the definition of the alternative scenarios drastic hypotheses - such as abolition of CAP - were not considered, nor any combination of hypotheses. That is, each scenario takes into account one policy change at a time.

We thus introduced the following hypotheses [22]:

- A drastic reduction of direct payments,
- Modulation, that is a transfer of resources from Pillar I to Pillar II
- Three different articulations of resources along the intervention axes of the rural development policy – competitiveness, environment, quality of life and diversification.

Also, we hypothesized three scenarios external to the tools of the Common Agricultural Policy: an increase of resources for regional policies, the effects of a 100% increase of the cost of energy, and, last, a 100% increase of hotel capacity.

The aim of the exercise was not prediction of future income, or of future population, or the effects on the labour force coming from external shocks (among them policy changes), but to identify and analyse how these shocks affects the whole economic, social, environmental system in its linkages. Each scenario has to be read as a "moving picture" [22], and the relevance of the results is, rather than in the projection's figures, in the interrelations among phenomena suggested by the model. Obviously, lack of data and lack of linkages are weakness of the model to be solved in the future.

The eight different scenarios are then:

A: Direct Payments (SFP) cut: reduction of 50% in all direct payments, without any reallocation of funds. Direct Payment has been considered as a transfer of income to population aged 40-64, reduced under this scenario.

A2: Direct Payments (SFP) cut with modulation, that is the SFP cut switches to rural development according to the actual distribution of the resources across the axes[4].

B: Agri-Environment (Axis 2): All Pillar 2 expenditure is allocated to Axis 2. Since this expenditure may be able to improve the beauty of the area, it could result in an increase of tourism as well as of exogenous expenditure in the sectors affected by tourism. This scenario has been modelled, therefore, as an increasing re-allocation of all spending on rural development (Pillar 2) in exogenous expenditures in retail trade, recreational activities, hotel and catering.

[4] This scenario and the Competitiveness scenario have been suggested at the final TOP-MARD conference in Bruxelles. Also the Energy scenario has been added at a later stage of the project as an external suggestion.

C: Rural Development (Axis 3): since expenditure in Axis 3 is mainly aimed at improving local infrastructures, this scenario has been modelled as an increasing re-allocation of all spending on rural development (Pillar 2) in exogenous expenditures in the sectors affected by public investments (constructions, transport, etc.).

D: More Regional Funds: modelled as a 50% increase in all regional policy spending.

E: Doubled Energy Prices: modelled as a general inflation of 6% in the agricultural products prices and an additional 4% increase in the cereals and forages prices to conform to the renewable energy productions prices.

F: More Tourism: modelled as a gradual increase in potential annual tourist and daily arrival capacity up to 100% between 2006 and 2013[5].

Z: Competitiveness (Axis 1, farm development investments): modelled as an increasing re-allocation of all spending on rural development (Pillar 2) in the exogenous expenditures in Household, Business activity and Other.

In defining scenarios, besides demand, the other fundamental exogenous variable is "change in land use", i.e., the redistribution of land among the various productive systems following policy interventions. We must in fact emphasize that most of the dynamics are linked to the hypotheses of changes in land use (see table 1). Starting from the past trend described in column MB, we hypothesized that each scenario directly related to Common Agricultural Policy (that is all but D and F) affected differently production systems. In fact, the additional demand coming from policy is transformed in land requirement that change land use in proportion to the change in final demand. For instance, looking at the Z scenario, we moved on axis 1 about 10 million euro (corresponding to about 3% of the sector's production); the same percentage is applied as a change in land use that affects "sensible" sectors (in this case orto-floriculture affected positively, and permanent cultures affected negatively.

Data construction for tendency variations is based on a linear temporal perspective and the average yearly growth rate (CAGR), calculated between two available periods; a linear variation has been applied to the aggregates considered (e.g. demand). Thus we used the I-O tables 1995, 2000 and the 1990, 2000 agricultural censuses.

Monetary aggregates have been deflated applying the average inflation 2001-2007 for the following years.

Most of the data come from official sources (ISTAT, FADN), or are estimated from them. Other information comes from the field surveys. Structural information comes from the Census (Census of Population and Census of Agriculture). Information about tourism comes from ISTAT - Statistics on Tourism.

Table 1. Changes in land uses in the different policy scenarios

Productive Systems	Tendential Variations Ha/year	Scenarios							
	MB	A	A2	B	C	D	E	F	Z
Cereals	-674.92		+		-		+		
Ortofloriculture	665.15	-	+	-			-		+
Permanent	-2,834.56	-		+	+				-
Erbivores	-5,380.81	-					-		
Mixed: animal and crop farming	-3,646.79	-	-		+		-		
Forests and other non agricultural systems	11,871.93	+					-		

C. *Main Results*

Table 2 shows some of the indicators outputs from the different scenarios at 2026 (2001=100) in comparison with the Main Baseline. The first column shows a selection of indicators coming from the projection of MB to 2026. These results are used as a base of comparison to gauge the other scenarios.

In the Main Baseline Scenario the contribution of agriculture diminishes in terms of added value and employment: if we take the initial 2001 value to be 100, value added and employment come to be, in 2026, respectively 94 and 67, while population, total income and non-agricultural income grow by 20-30%

[5] In this scenario we do not consider public expenditure (neither agricultural subsidies nor regional funds).

(according to Engel's Law). The policies included in the MB also reduce all the negative environmental effects (Mineral Fertilizer, Excess Nitrogen and Livestock Unit), while worsening the Shannon Index and Biodiversity. But the model also seems to shows that decrease in agriculture could be mainly attributed to reduction of marginal farms, as witnessed by the different dynamics of income and employment.

Scenario A, Direct Payment (SFP) cut, shows a further heavy downsizing of agriculture, in which incomes go down faster than employment. That means that even the most productive farms depend on public support. Because of the high productive intensity of the area, the environment benefits from this downsizing: negative externalities linked to pollution and livestock pressure diminish. But at the same time biodiversity gets worse, because the Shannon Index and the low-input firms go down. There is no doubt that with richer data that can better render reality the effects on the environment would be more clearly outlined. The indicators too can be improved in a future.

Scenario A2 (modulation) considerably reduces, indeed almost neutralizes, the negative effect on income and employment that is entailed by cuts in Single Farm Payment. It also improves environmental features.

If we transfer funds to the agro-environment, as in scenario B, the downsizing of agriculture does not take place. On the contrary, agricultural employment grows and biodiversity improves.

With rural development (scenario C) agricultural indicators grow. Agricultural employment grows more rapidly than income, but the livestock intensity per hectare increases too.

Scenario D fundamentally operates on the regional economy, improving labour demand in sectors other than agriculture.

Scenario E shows the effect of an increase in agricultural prices. As demand is rigid, this produces an increase in agricultural incomes because the increase in price is higher than the reduction in the quantities sold.

Scenario F (tourism), like scenario D, influences the welfare of the region increasing non-agricultural labour demand, with noteworthy effects on population too.

Scenario Z (competitiveness) has small effects, but in the predictable direction: in fact it shows a small increase in added value and a reduction of agricultural employment.

Table 2. Indicators outputs at 2026- Policy scenarios compared with the Main Baseline

	MB (2001=100)	MB - IB	A - MB	B – MB	C - MB	D - MD	E - MB	F - MB	A2 - MB	Z - MB
Gross Value of Agriculture	94	0.000	-5.170	-0.830	1.040	0.000	5.303	0.000	-0.074	0.830
Ag Employment	67	0.000	-4.391	0.394	1.150	0.000	1.043	0.000	-0.397	-0.394
Total Population	123	0.149	0.032	0.034	0.011	0.083	0.027	4.973	0.008	-0.029
Per Capita Income	128	0.330	-0.389	-0.075	-0.014	0.002	0.194	0.064	-0.141	0.073
Non Ag Labour Demand	136	0.200	0.426	0.010	-0.098	0.114	-0.050	8.145	0.046	-0.002
Shannon Index	88	0.000	-1.973	0.039	0.114	0.000	0.487	0.000	-0.046	-0.040
Mineral fertilizer	65	0.000	-4.240	0.009	0.149	0.000	0.919	0.000	-0.127	-0.009
Excess Nitrogen	71	0.000	-3.815	0.000	0.000	0.000	1.985	0.000	0.000	0.000
Biodiversity	73	0.000	-2.653	0.040	-0.372	0.000	0.101	0.000	0.222	-0.040
Livestock units per hectare	48	0.000	-5.061	-0.004	0.317	0.000	-1.253	0.000	-0.744	0.004

The above results, despite their being very coherent and interesting, are, however, hard to interpret due to the marked heterogeneity of the province of Latina. In particular, it would be interesting to be able to distinguish productive systems in relationship to their being in the plains, with their intensive crops, or in the hills. Such a study has not been possible due to a lack of appropriate data at the local level. Improvements in the quality of information would certainly help a full exploitation of the interpretative potentialities of the POMMARD model.

IV CONCLUSIONS AND FUTURE PERSPECTIVE

This research suggests that in order to face and meet the new challenges that social and environmental problems present to all of us, and to increase wellbeing, we should view differently what links producers, consumers, politicians and administrators. In fact local areas, with their treasures of knowledge, customs and institutions, work to integrate changes, that spread to all sectors [23]. The success of rural regions is frequently linked to the effective transformation of a range of public goods, some of which are associated with farming, into new kinds of commercial activity based around nature and culture [24].

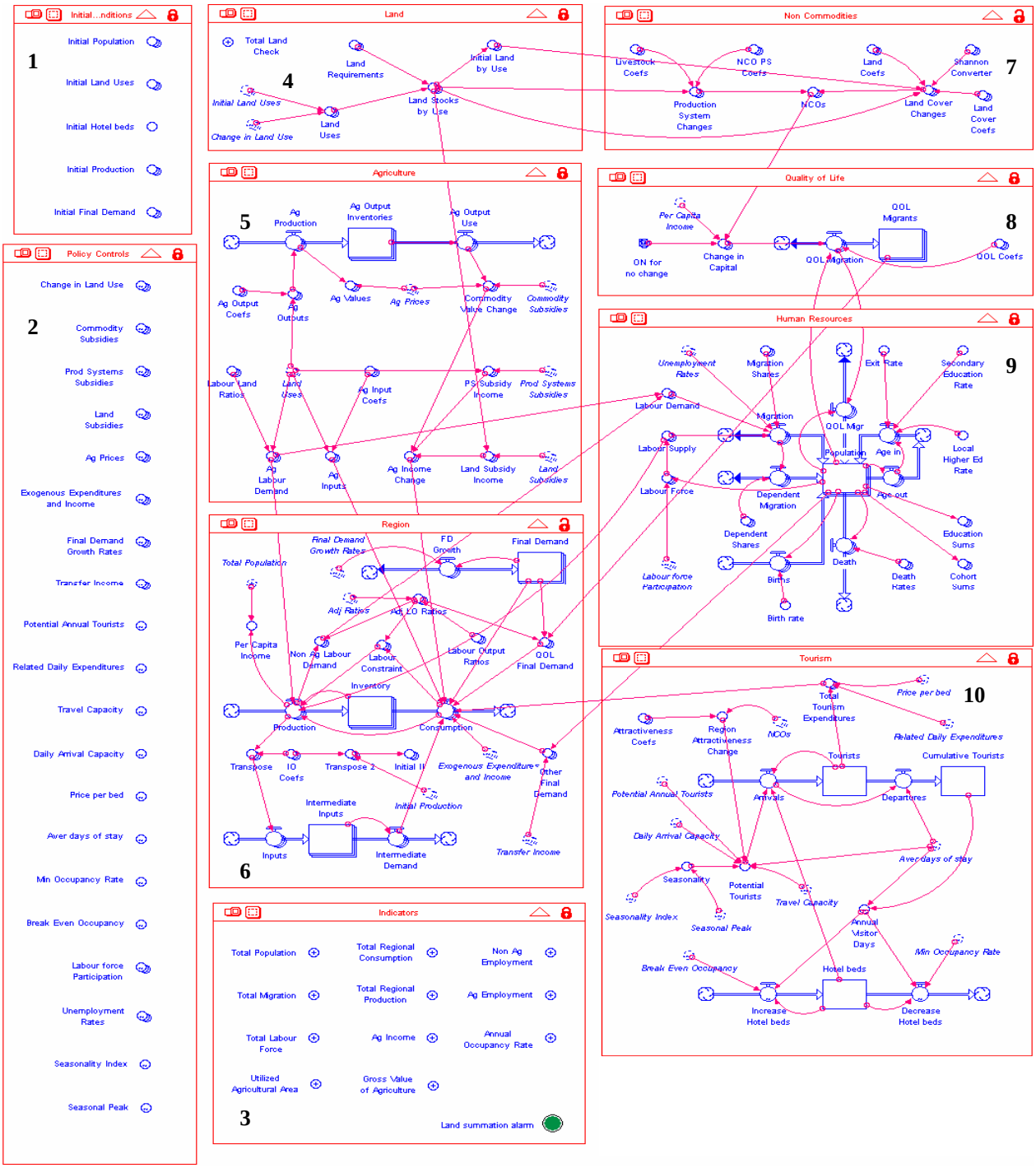
Coming from theoretical reflection to the practical application of evaluating the impact of policies, it is necessary to improve the availability of information in order to capture the complexity of reality. Therefore, we should add other factors to the data that are traditionally used to describe the social and economic characteristics of an area. Recent research pays great attention to the need to widen the analyses. For aspects such as landscape, possible solutions have been found. For other aspects, despite their acknowledged importance, it is more difficult to identify measurable parameters. In any case, even when such parameters theoretically exist, it is very unlikely that they may be found in official statistics at the appropriate territorial level. If appropriate data are available, POMMARD, the model developed within the TOP-MARD project, has the potentiality to develop analyses of the impact of policies that take into account not only sector effects, but the more general effects on the area associated to the production of public goods.

We have worked at a macroeconomic territorial level, but different segmentations of the territory in differentiated and non conventional land use might better show the consequences of productive styles more attentive to collective welfare. In fact, farmers can choose to follow a conventional style of production, mainly driven by intensification and technological improvement. Or they can choose to reduce costs through a better use of resources, among them better care of soil; or choose a style of production that also benefits environment, landscape and consumers, through better quality, shorter chain, provision of additional services [25].

Policy makers can have an influence on dynamism, by providing incentives toward different types of land use. Through this change, as already said, farmers will provide a different set of marketable and non-marketable goods that will be transformed - through the links between agriculture and the other economic sectors - in rural development and quality of life. It is therefore very important to understand all the interrelation inside a territorial system, in order to provide policy makers with the right knowledge that will help their decision-making process.

Lastly, the connection or integration of POMMARD with other models, such as Linear Mathematical Programming or CAPRI, would certainly improve the quality of the results. In fact the accuracy of the forecasts about firm behaviours is fundamental in the evaluation of the overall effects of policies on the development and the quality of life of an area. An integration of POMMARD with an I-O matrix in which agriculture is more dis-aggregated , or with a SAM [26], would also be extremely interesting. Both possible development would produce more realistic and valid results for policy makers.

Figure 4. The POMMARD Modules



Notes: 1. Initial Conditions; 2. Policy Controls; 3. Output Indicators; 4. Land; 5. Agriculture; 6. Region; 7. Non-Commodities; 8. Quality of Life; 9. Human Resources; 10. Tourism.

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