

A METHODOLOGICAL APPROACH TO TOURIST MANAGEMENT THROUGH A STELLA ® MODELLING APPLICATION

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***Abstract:** the study uses a Stella modelling application to illustrate the type of action necessary to guarantee an environmentally sustainable tourist flow. It focuses in particular on the variables that can be controlled by an Environmental Management System. The effectiveness of adopting a systems approach to tourist management in environmental terms is demonstrated, with specific reference to mountain retreats.*

INTRODUCTION

Positive trends in tourism and the extension of this phenomenon to areas with highly vulnerable environments are the underlying basis for actions aimed at controlling tourist flows and the adoption of tools to reduce the impact of the same the long term [1]. The description and the comprehension of complex systems such as those used in Environmental Sciences is facilitated by the use of modelling tools, written in the appropriate languages. STELLA is an example of a tool of this nature that has been used extensively [2-4]. The use of a simulation model in a Stella environment enables the overall performance of the system to be visualised as the intensity of the variables/factors that condition its behaviour are modified. In this study, STELLA is used to illustrate the environmental impact of management choices that focus on reducing the impact of the flow of tourists on the environment in order to guarantee high environmental quality in the long term.

DESCRIPTION OF THE MODEL

Firstly the elements that make up Stella language will be described, namely stocks, flows, converters and connectors (figure 1).

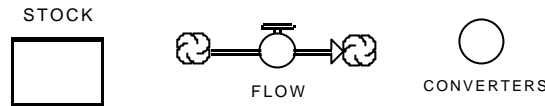


Figure 1. The elements of STELLA language

The **stocks** from an operational point of view they are the accumulators and indicate the total amounts that they are accumulating in the time. The **flows** are used to describe activities or changes causing modification the stocks. The **converters** modify the activities (or verbs) within the system bud, unlike stocks, they do not represent an accumulation of anything, nor do they have any memory. The final element of the language are the **connectors** used to connect the stocks to the converters, the stocks to flows, flows to each other, converters to flows and converters to other converters.

The model shown in figure 2 is made up of two sectors that regard tourism and the environmental quality of the area respectively. The stocks, tourists and reserves, express the number of tourists that arrive in a certain area, obtained from the balance between the inflow and the outflow, expressed by the “arrivals” and “departures” flows, and the quantity of resources available which are generated by the environment and consumed by tourist activities. The consumption of resources is directly proportional to the number of tourists in accordance with a factor called “consumption per unit of tourists”. The consumption per unit of tourists is assumed to be *non linear* and a function of the relation between the resources available at a given time and those available initially. Environmental quality is inversely proportional to the tourist outflow, according to a “loss rate”. The trend of the tourist flow over time is therefore linked to the level of environmental quality. The aim of the study is to illustrate the influence that the intensity of the variables, represented by converters, have on the stocks and, in more general terms, on the behaviour of the model. Controlling the intensity of the converters can have many practical implications such as for example:

☞☞ **Number of tourists in a unit of time**

?? Control of the tourist flow through a system of permits and/or with the application of economic tools (access tariffs).

☞☞ **Regeneration rate of resources**

?? Introduction of equipment or management systems to reduce pollutants.

?? Introduction of training courses to increase environmental awareness of staff.

☞☞ **Consumption per unit of tourists**

?? Improve the efficiency in the use of resources.

?? Action aimed at seeking the cooperation of tourists in managing environmental problems.

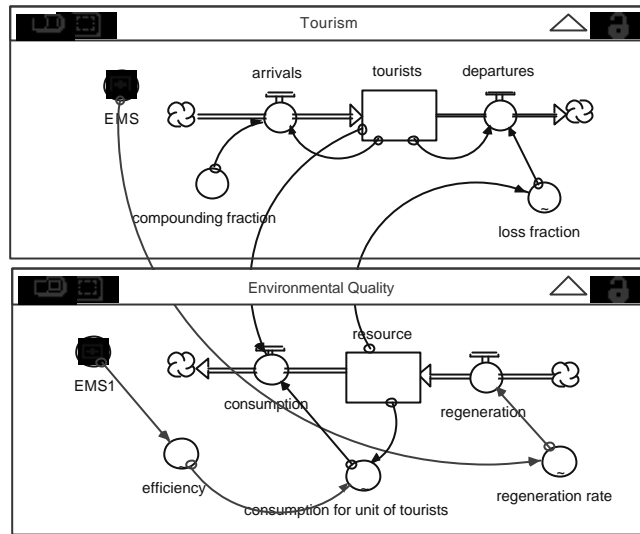


Figure 2. STELLA Model

Simulations carried out in the STELLA environment illustrated in this document take points 2 and 3 above into consideration, as the same are directly related to the choice of systems and management tools by tourism operators, while the options highlighted in point 1 above, that involve economy policy measures, are largely ignored. The graphical interface of the model is shown in figure 3. By acting on the “indicative tools” shown in the control panel it is possible to see the evolution of the model on the graph shown in the centre of the box. With reference to figure 2, the actions taken are aimed at increasing the regeneration rate of resources (EMS-Environmental Management System) and improving the efficiency in the use of the same (EMS1-Environmental Management System) aimed at reducing the consumption of resources per unit of tourists. By acting on the sliders, namely the elements shown by no. 1 in figure 3 that vary from 0 to 1 depending on the presence or absence of a Environmental Management System, it is possible to verify the behaviour of the variables “tourists” and “resources” over time. In table 1 it’s possible to see the different scenarios.

Table 1: Different Scenarios

	<i>EMS (Environmental Management System)</i>	<i>EMS1 (Environmental Management System)</i>
<i>Hp 1</i>	NO	NO
<i>Hp 2</i>	YES	NO
<i>Hp 3</i>	NO	YES
<i>Hp 4</i>	YES	YES

The **first hypothesis** (figure 3) shows how an increase in the inflow tourists provokes a drop in the environmental quality of an area and consequently a fall in the demand for tourist services. Following this decrease in quality, the environment manages to regenerate but to a level that is inferior with respect to the original one, taking into account the degradation factor. The sinusoidal trend is counter phase to environmental quality and the inflow of tourists, and will continue until a point of stability between the two factors is reached that corresponds to reaching load capacity, that can be defined as the maximum number of people that can use a certain area without provoking an unacceptable alteration in the physical, cultural or socio-economic environment.

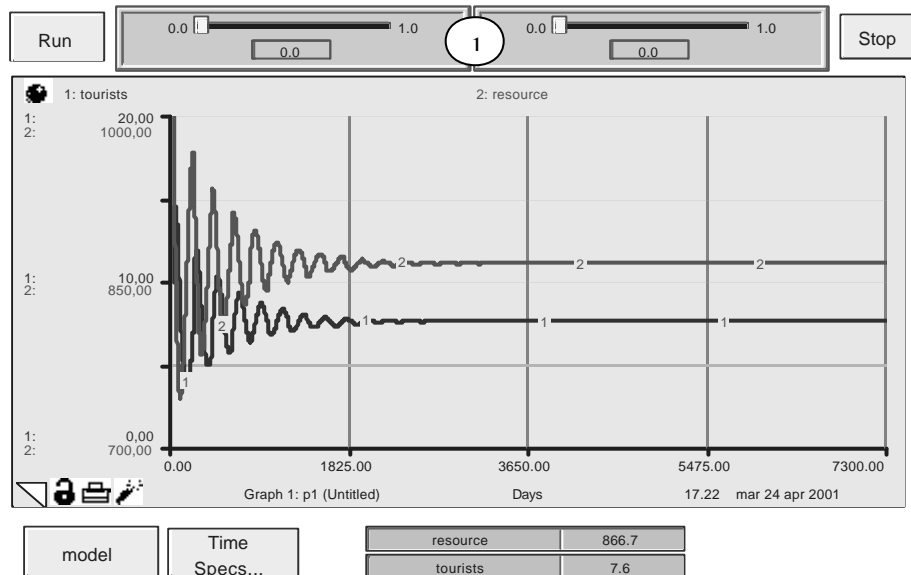


Figure 3. Grafical Interface Model and first hipotesis

By introducing EMS that acts on the regeneration rate of resources, **hypothesis 2**, the same level of environmental quality is achieved with a higher number of tourists. Simultaneously, the time horizon needed to reach stability is shortened. In this way, operators in the sector achieve their objectives, or in other words, the maximisation of the flow of guests and the maintenance of this level to guarantee a constant and optimal flow of income (figure 4).

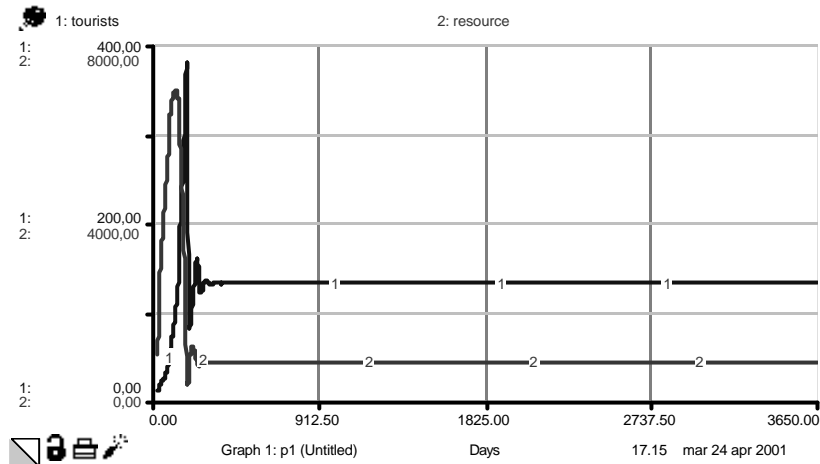


Figure 4. Hypothesis 2

The improving the efficiency aimed at reducing the consumption of resources per unit of tourists, cause the deferment in the time of the equilibrium between resources and tourists (figure 5).

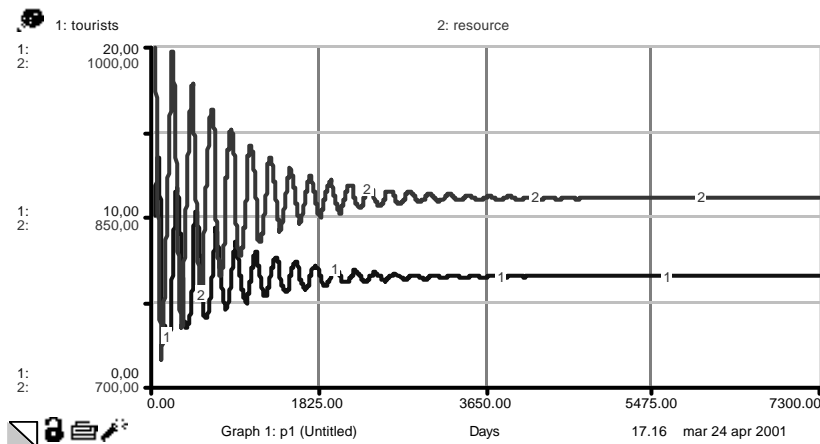


Figure 5. Hypothesis 3

Finally, the combination of the two operations (hypothesis 4) defers the balance point, compared with hypothesis 2 and coincides with a higher number of tourists, compared with hypothesis 3 (figure 6). It's necessary to specify that these operations, ex-post and ex-ante, are comparable if they concern a local impact dismissable from local processes. For example, it's possible to operate

on the regeneration rate improving the water treatment system and at the same time on consumption for unit of tourists reducing the water consumption.

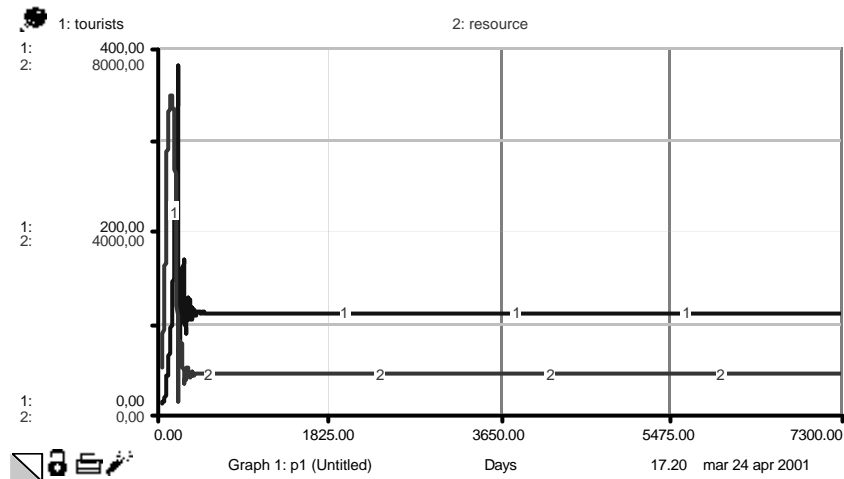


Figure 6. Hypothesis 4

CONCLUSIONS

The control of the use of resources and of polluting discharges in the environment, results in an increase in the maximum number of tourists sustainable in a certain area and in the improvement in environmental conditions. The use of environmental management tools appears to be effective in guaranteeing a stable level of environmental quality, which gives rise to a similarly stable demand for tourist services. The sustainability of the tourist supply and environmental sustainability must go hand in hand. The application of STELLA language illustrates how action taken on the “regeneration rate of resources” and on “consumption per unit of tourists” gives rise to an increase in the number of tourists over a certain period of time at a level that does not compromise the quality of the environment and the maintenance of this level to ensure a constant and optimal flow of income.

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