Characterizing of the Agroecosystem as a Component of a Traditional Product Quality by Using Emergy Synthesis. A Bi-national Geographic Indication for Argentine Central Mesopotamia Region and Brazilian Alto Camaquã Region Sheep Meat Production

Susana Alderete Salas, Marcos Borba, Gloria Rótolo, Marcelo Champredonde

ABSTRACT

In order to establish a link between local products and territory, researchers from EMBRAPA Brazil and INTA Argentina have developed a project for the construction of a bi-national Geographical Indication to enhance the value of sheep meat. The agroecosystem was analyzed to obtain a system performance as a component of quality (largely symbolic) of the product. This indicator could be used as a seal of Geographical Indication (Designation of Origin and Geographical Indication), that includes the creation and preservation of agroecosystems, components that are not currently considered in seals of quality certifications. Consumers mistakenly assume that seals of quality indicate protection of the agroecosystem. This paper proposes the utilization of Emergy Synthesis as a methodology to characterize the efficiency and conservation of agroecosystems in Argentina’s Central Mesopotamia Region and Brazil’s Alto Camaquã Region. These agroecosystems are the source of sheep meat. The community practices, which are applied in the process, have an inner value. Information about the production systems was collected through surveys in both territories and then processed. Results show that the use of Emergy Synthesis allowed to identify that the percentage of Renewability (% R), Environmental Loading Ratio (ELR) and Emergy Yield Ratio (EYR) were able to express the interaction between the local community and the agroecosystem that produce sheep meat. Those indices confirm that both agroecosystems show similar performances in the two territories and help preserve local biodiversity. These indicators showed that they can offer technical support to agroecosystems processes differentiation through seals based on quality aspects and heritage.

INTRODUCTION

The construction of local identities in the rural media is based mainly on the historic relationship between the people, their land and the labor processes that created their own cultural landscapes and agroecosystems, particularly regarding know-how and management (Acosta Naranjo, 2007). Therefore, we may say that an agroecosystem is the result of specific practices and management that a local community employs by controlling the energy flows to produce. However, at the same time these actions modify the ecosystem service supply, altering the cycles of recovery and storage of materials, influencing agroecosystem permanence and regulating ecosystem services (Gómez Sal, 2012).
The assessment processes of territories and their products, particularly food, are increasingly centered on natural aspects and the impact productive activities have on the durability of agroecosystems. In fact, in recent decades, consumers value aspects such as rural image, local cultural imprint and crafts, effect of food on human health and environmental impact of production processes (Sylvander B., 1995, Poulain F., 1997, Muchnik J. et al., 2005).

Moreover, in the context of the reflection about rural territorial development, increasing concern about the relationship between product and territory has led to acknowledge local products and agroecosystems as important components of local heritage (Bustos Cara et al., 2004).

The development of seals of quality like Designation of Origin and the use of Collective Trademarks makes it possible to communicate the objective (objectifiable) and symbolic quality of local products (Casabianca F. and Valseschini E., 1996, Champredonde and Muchnik, 2012), derived from the link with the territory.

Often, natural, traditional and environmentally friendly products are associated with these kinds of seals and trademarks. However, analyzing various cases of Designation of Origin in Latin America, Champredonde M. and González Cosiorovski J. (2013) reveal the impossibility for every differentiation project to comply with the five main types of positive territorial impacts. The authors identify social, cultural (including identity and heritage), economic, technical and environmental factors. The most cited example is the Designation of Origin Tequila, which successfully achieved its economic objectives but presents important deficits in social, cultural and environmental aspects (Bowen and Zapata, 2009).

That is to say, seals of quality do not always take into consideration the creation and preservation of agroecosystems of origin of the products as a part or attribute of their quality, symbolic in this case, although consumers assume they do.

For this reason and in the context of an assessment process of sheep meat in the Central Mesopotamia Region in Argentina and the Alto Camaquã Region in Brazil, researchers of the Argentine Instituto Nacional de Tecnología Agropecuaria (INTA) and the Brazilian Pesquisa Agropecuaria (EMBRAPA) worked on generating descriptors of the environmental performance of agroecosystems of origin of sheep by using Emergy Synthesis in order to respond to the following research premises:

1. What parameters/indicators would be appropriate to represent symbolic quality?
2. Which environmental performance differences can be identified between Argentine and Brazilian agroecosystems?

**OBJECTIVE**

The objective of this work is to describe and analyze the functioning and energetic dynamics of the agroecosystems of origin of sheep in both countries using Emergy Synthesis to create indicators for the description of the relationship ‘man-nature’ in order to represent the symbolic quality of the product in the assessment of food production processes.

**METHODOLOGY**

**Site Description, Natural Resources and Production System**

In the present work, we studied the ‘Cattle-Sheep Raising’ system that produces ‘Central Mesopotamia Lamb’ and ‘Alto Camaquã Lamb’.

In Argentina, this production system is developed in south-central Corrientes Province and north-central Entre Ríos Province (Fig. 1). The geographic coordinates for the studied area are 60° to 58° longitude West and 32° to 28° latitude South. The research work comprises an area of approximately 2,800,000 ha, located in the south-central province of Corrientes and includes the departments of Curuzú Cuatiá, Mercedes, Sauce, Monte Caseros and Paso de los Libres (Figure 1). The territory is characterized
by warm weather with subtropical variations and lacks a dry season (http://www.argentina.gob.ar/pais/57-geografia-y-clima.php); average annual rainfall is 1250 mm and average annual potential evapotranspiration 950 mm (Murphy, 2008). The ecological features of the area are the Espinal, characterized by shrubby grassland and low hills, and the central Mercedes plateau with rocky outcrops and open grasslands with a single stratum (herbaceous). The production system includes both cattle and sheep raising on natural grassland (Pizzio, 2014, personal interview). Establishments belong to two categories: small and medium producers and big producers. Small and medium farmers work an average surface of 603 ha, with cattle and sheep grazing together with a load of 0.86 EV; a load relation of 24% for sheep and 76% for cattle. Big producers work an average surface of 2391 ha, with a load of 0.76 EV, and a load relation of 19% of the total for sheep and 81% for cattle. Feeding consists of grazing on natural pastures. The marketed product is the milk lamb (Rivero, 2014, Personal interview).

In Brazil, the system is developed in the Alto Camaquã Region, located within the geographical coordinates 30º 25’ to 31º 33’ latitude South and 52º 48’ to 54º 12’ longitude West on the Crystalline Shield [Escudo Cristalino] geological formation; the area corresponds to the municipalities of Bagé, Caçapava do Sul, Encruzilhada do Sul, Lavras do Sul, Piratini, Pinheiro Machado and Santana da Boa Vista, comprising a territory of 867,000 ha. Weather is subtropical or moderate with an average rainfall of 1,300 mm to 1,500 mm throughout the region, although long periods of low water levels are frequent. Vegetation belongs to the phytogeographical types Savannah. In this territory, over 70% of the establishments are small with average surfaces of up to 170 ha, where cattle-raising families develop sheep and cattle production on a diet of natural pastures and a joint grazing system (IBGE, 2006). Sheep production activities are exclusively raising; that is, they produce 32 kg to 35 kg live lamb (for wool and meat).

Figure 1. Mesopotamia Region-Argentina, location of the production systems analyzed.
Figure 2. Alto Camaquã Region- Brazil.

Data Collection

Information on the production systems was collected by surveying 16 sheep farmers in the Argentine territory and 12 sheep farmers in the Brazilian territory. To avoid distortions in the results, two average production models were analyzed in the Argentine territory: (a) medium producers (200-1000 ha) and (b) big producers (> 1000 ha). For the Brazilian territory, data is presented as average. The information was processed following the emergy method (Odum, 1996) and different indicators were obtained and based on Rótolo et al., 2015; Lomas et al., 2007; Rótolo et al., 2007; Odum et al., 2003; Ortega et al., 2003; Ulgati y Brown, 1998.

RESULTS AND DISCUSSION

Figure 3 shows a flow chart describing how the system works in the two countries. Table 1 shows in absolute terms the parameters of the studied systems classified by categories: Renewable Natural Resources (R), Nonrenewable (NR) and Economic Contributions (F). The main R contributions to the Argentine system are given by pastures and by rainfall in the Brazilian System. The incidence of NR is higher in the Brazilian System due to a greater loss of soil from erosion, associated with steep slopes and plots of land cultivated with maize for food supplement.

In relative terms (%) according to the source of the contributions (Figure 3) the composition of the emergy cost shows that the absolute differences found in the contribution of R (Table 1) are minimized, observing a similar behavior of the system in the Argentine and Brazilian territory. In both territories, over 70% of the system is supported by R. The differences between the systems are given by a higher use of NR and lower F contributions in the Brazilian System in comparison with the Argentine. The situation is coherent with the type of family production and subsistence in the Brazilian territory in contrast with the type of family capitalized business in the Argentine territory.
Figure 3. Generic Emergy Flow of Argentine and Brazilian Cattle-Sheep Systems.

Table 1. Argentine and Brazilian Cattle-Sheep Production System Parameters.

<table>
<thead>
<tr>
<th>SYSTEM PARAMETERS</th>
<th>Arg. Medium Farmers</th>
<th>Arg. Big Farmers</th>
<th>Braz. Average Farmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergy Cost (U=I+F)</td>
<td>1.62</td>
<td>1.45</td>
<td>4.39</td>
</tr>
<tr>
<td>Renewable Resources (R)</td>
<td>1.14</td>
<td>1.14</td>
<td>3.30</td>
</tr>
<tr>
<td>Non Renewable Resources (NR)</td>
<td>0.11</td>
<td>0.06</td>
<td>0.95</td>
</tr>
<tr>
<td>Nature Contribution I=(R+NR)</td>
<td>1.25</td>
<td>1.20</td>
<td>4.25</td>
</tr>
<tr>
<td>Materials (M)</td>
<td>0.07</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>Services (S)</td>
<td>0.29</td>
<td>0.19</td>
<td>0.06</td>
</tr>
<tr>
<td>Contribution from the Economy (F= M+S)</td>
<td>0.37</td>
<td>0.24</td>
<td>0.14</td>
</tr>
</tbody>
</table>
Similar value indicators were obtained for systems in the two territories analyzed. Argentine medium farmers present an intermediate situation between Argentine big farmers and Brazilian farmers. Values are shown in Table 2.

The indicators showed a high Percentage of Renewability (%R>70%), indicating that two thirds of the energy needed to produce is supplied by R; low dependence of external economy has shown a high Emergy Yield Ratio (EYR>4), for each unit supplied by the external economy system, the environment supplies more than four. Consequently, low value of Emergy Investment Ratio (EIR) indicates high use of natural resources versus the contributions from the economy in order to obtain the product, i.e. a small investment could contribute to develop the activity. The low Emergy Loading Ratio (ELR) indicates low environmental stress derived from the activity. Similarly, the Environment Sustainability Index (ESI) shows that this activity makes good use of the benefits provided by local renewable resources (Ecosystem Services) with low utilization of imported inputs and local nonrenewable resources.

Table 2. Emergy Indicators - Argentine and Brazilian Cattle-Sheep System.

<table>
<thead>
<tr>
<th>EMERGY INDICATORS</th>
<th>Argentine System</th>
<th>Brazilian System</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Renewability (%R)</td>
<td>70%</td>
<td>79%</td>
</tr>
<tr>
<td>Yield Ratio (EYR)</td>
<td>4,3</td>
<td>5,8</td>
</tr>
<tr>
<td>Investment Emergy Ratio (EIR)</td>
<td>0,3</td>
<td>0,2</td>
</tr>
<tr>
<td>Environmental Load Ratio (ELR)</td>
<td>0,4</td>
<td>0,3</td>
</tr>
<tr>
<td>Emergy Sustainable Index (ESI)</td>
<td>10,1</td>
<td>21,5</td>
</tr>
<tr>
<td>Emergy per unit (UEV)</td>
<td>1,62E+15</td>
<td>1,45E+15</td>
</tr>
</tbody>
</table>
The differences found in the systems of the two territories analyzed are the result of the productive rationality that characterizes each of them, which at the same time determines production objectives and practices, Family-Subsistence in Brazil and Family-Business in Argentina.

CONCLUSIONS

Emergy Synthesis may be regarded as an efficient tool to reflect and express the environmental performance of an agroecosystem in the seals of quality of products. The indicators obtained in this study show that the system has the ability to capture the environmental work required to produce sheep meat, which is performed by ecosystem services. The results from Percentage of Renewability (%R) and Environmental Loading Ratio (ELR) have particularly shown to be suitable indicators to express the environmental performance and quality of systems whose products could be labeled to certify their symbolic quality as products with local roots.

The two systems analyzed showed a strong interaction between sheep production and local resources (a particular landscape and specific agroecosystem). Sheep production is also associated with a low environmental impact, despite the fact that, in making the product, the environmental contribution is higher than the contribution from the economy. Both systems have similar environmental performance, despite having their own characteristics and specific methodological managements. Therefore, it is relevant to preserve these agroecosystems and landscape identities. The results showed a need for further debate with local actors about the high risk of permanently losing important elements of local identity such as landscape, traditional production methods and products with a particular quality associated with the territory such as the lightweight lamb.

A strategy to achieve this goal is to communicate its significance through environmental performance indicators in seals of quality as Geographical Indications and Territorial Seals. Emergy Synthesis is a suitable methodology to show environmental contributions as a form of the symbolic quality in order to be included in a differentiation process of sheep meat.

Based on quantitative scientific methods, verifying that in both territories these productive systems contribute to sustainability and preservation of local biodiversity constitutes an important contribution that makes it possible to technically endorse the processes of differentiation through seals of quality.

Furthermore, these contributions can be quite effective in reinforcing the notion in the local community and other territories that social and historically constructed practices for the appropriation of natural resources are important contributions of their societies and make their products unique. This way, in processes that generate constant feedback, preservation of the environment and production efficiency can offer mechanisms of valorization for the economic, ecological, social, technical and cultural components of original products provided by traditional production systems.

REFERENCES


Pizzio, R. 2014. Comunicación personal. INTA- EEA Mercedes


