

Management for Sustainable Agriculture. A New Paradigm in the Balance Sheet: A Case Study¹

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Abstract

The paper focuses on the introduction of environmental accounting at micro-economic level by using a modified traditional balance statement. A panel test provides a first attempt to give a monetary value to positive and negative environmental impact of vineyard cropping. The results are meant to be included in a modified balance sheet. An innovative "genuine income" for farms has been developed and used to analyse the panel test results.

Problem and objectives

The need and the great scope of introducing environmental accounting at both macro and micro levels has finally acquired a widely agreed meaning in terms of necessary and indispensable instrument to effectively take account of the valuable role of the natural capital and its flow of economic functions -resource supply, waste assimilation and aesthetic commodity- in the economic process. The micro-economic contribution is particularly felt as the starting point since it is at the farm level that the interaction with the environment occurs. The farm level is the dimension where the production process takes place according to economic appraisal, generating positive and negative impacts on the environment. Along with positive and negative externalities, environmental impacts can also directly affect the rentability of the farm causing them, thus showing how environmentally targeted investments and agricultural activities may represent a suitable way of action. By the same token if monetary values of environmental impacts were to be calculated and inserted in the farm balance a clearer view of a more complete assessment would allow a wider spectrum of innovative economic considerations.

Material and methods

The case study to be presented is an active part of **E.A.R.T.H. (Environmental Accounting Research Team Harbinger)** supported by **C.N.R (National Research Council)** whose objective is to find a standard methodology and the systematisation of the environmental effects (positive and negative) into the farm management. It is about giving a practical coherence to a new paradigm of the production cost and farm balance, relative to the by now verified validity of both the possibility of measuring environmental impacts and the new

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monetary valuation techniques based on the principle of **willingness to pay (WTP)**. It involves the adoption of a modified balance sheet to analyse several farms cropping vineyard with different degree of intensity over an area of about 30 hectares. In this context modification to balance scheme and farm production cost are meant to internalise farm management impacts. The "polluter-pays principle" might become a new paradigm of the farm production cost and of the net income of the balance statement.

Result and discussion

The traditional balance statement of a farm includes operating management and financial and fiscal management. If we take into account the environmental costs and benefits, in addition to financial and fiscal aspects, there is the environmental balance, that is an algebraic addition of positive and negative environmental impacts, and the accounting of environmental taxes or other economic instruments. Therefore, this would effectively appear as a new paradigm of the production cost, and of the balance statement of the net income. The most important problem is the monetary measurement of the positive and negative environmental impacts, and today the above-mentioned methods can be helpful tools. Taking into consideration that a monetary evaluation of all the impacts is not possible, as this is an on-going field of research (Pearce, 1991), when the valuation methods improve, environmental costs and benefits will have a specific monetary place in the farm balance statement. The proposed systematic and methodological approach seems to be valid, as shown in Figure 1.

In order to provide a first attempt to give a monetary value to environmental impacts due to farm activities a **panel test** was submitted to a group of students of our Faculty of agriculture. We took a vineyard as a concrete case study. The questionnaire to be filled in was composed of a series of questions regarding a qualitative judgement about the environmental impact of some of the main cultural practices involved; it was also asked to give a monetary value of the eventual positive or negative environmental impacts for each operation. The results are shown in **tab. 1**. For each cultural practice the average monetary value per hectare was calculated. The algebraical sum provide the value of the environmental impact of one hectare of vineyard, according to the students' perception. The result is negative, meaning that a negative value should be accounted in the environmental section of the modified balance sheet.

This panel test is not a proper contingent valuation. In fact it was not asked to say their willingness to pay for reducing some cultural practices or willingness to accept for forgoing some cultural practices but simply a value judgement on the environmental impact of them. This implies the fact that students were not affected by an income constraint. It is however interesting to note that this kind of answer can provide a value that links the physical impact to its economic effect. Especially when the answer is given by people of the agricultural sector, the value obtained can be thought of being composed of the effect on the farm rentability and of the farm's external costs. The answer reflects not only the external costs of the farm's activity but also what it is perceived as detrimental to the farm itself, since it is well known that some practices have a direct effect on the "environment" pertaining the farm, for instance soil fertility.

| ITEM | KIND OF MANAGEMENT | VALUATION METHODS |
|------------------------------------|---------------------------------|-----------------------------|
| <u>Sale proceeds</u> | | |
| +House-hold consumption | | |
| +Stock variations | | |
| +Livestock variations | | |
| +Livestock purchase | | |
| <u>Gross output</u> | | |
| -Resources utilized | | |
| -Utilities | <i>Operating</i> | <i>Traditional monetary</i> |
| -General and land expenses | <i>Management</i> | <i>methods</i> |
| -Other production costs | | |
| +Hires to outside parties | | |
| <u>Added value</u> | | |
| -Hired labour | | |
| -Social charges for family labour | | |
| -Depreciation | | |
| <u>Operating income</u> | | |
| +Financial revenues | | |
| -Financial charges | | |
| +Rents to outside parties | <i>Financial and Fiscal</i> | <i>Traditional Monetary</i> |
| -Rents from outside parties | <i>Management</i> | <i>methods</i> |
| -Farm taxes | | |
| <u>Temporary net income</u> | | |
| +Positive environmental impacts | | <i>Monetary methods</i> |
| -Negative environmental impacts | <i>Environmental Management</i> | <i>based on WTP</i> |

Figure 1: Final systematic and methodological proposed approach

The panel test above has to be meant as a primitive attempt, but not without meaning since as it will be shown, the concept of "genuine income" for farm allows for this kind of considerations.

Table 1: Panel test results

| OPERATIONS | N° Interviews | Qualitative | | Average monetary (Value Lit/ha) |
|--------------------|------------------|-------------|--------------------------|------------------------------------|
| | | Positive | Envir.impact Negative | |
| estirpation | 17 | 13 | 6 | 41.000 |
| rotary hoeing | 17 | 13 | 6 | -34.000 |
| fertilisation | 17 | 4 | 15 | -94.000 |
| fungicidal trea.nt | 17 | 3 | 16 | -121.000 |
| chopping | 17 | 13 | 6 | 79.000 |
| mechanical weeding | 17 | 13 | 6 | 48.000 |
| TOTAL | | | | -81.000 |

Having shared some opinions with Prof. David Pearce about the green accounting, we came to the definition of "**genuine income**" for farms. This concept is rooted on the principles of green national product in a perspective of using the results of the micro-level to record the agricultural component of green macro-accounting. Thus the model and rational for green net national product can be used to obtain a "genuine income" for farms (gFY- green farm income). **The basic equation would be:**

gFY = Financial value added - depreciation on farm machinery and buildings - depreciation on environmental assets - damage done to the environment + environmental assets created.

$$\text{or} \quad \mathbf{gFY = FVA - DEPm - DEPnr - DAMenv + APPenv}$$

Data on FVA and DEPm are obviously available from the conventional farm accounting.

In a perspective of sustainable development that considers the economic role of the natural capital, DEPnr has effectively to be considered as a depreciation allowance for the use of renewable and non-renewable resources involved in agricultural production. If DEPnr can be more easily understood at a macroeconomic level where would include, for example, any user cost component of energy or more importantly, the value of any excess harvesting of wood, any soil depletion, any excess catch of fish etc, some explanation are needed at the micro-level. Basic equations will be **renewable resources:** $DEPnr = (p - mc)(H - g)$ where rnr = renewable natural resources, p = price of renewable resource, mc is marginal cost of harvesting (usually approximated by average cost), H is the harvest rate, and g the growth rate of the renewable resource. If all renewable resources are harvested sustainably $H = g$ and this expression will be zero.

exhaustible resources: $DEPenr = (p - mc)Q$ where Q is the amount consumed, p is the price of the resource ('ex mine', ie not including any taxes or subsidies), mc is the marginal cost of extraction. This approach is the 'net price' approach of Hartwick and others. As for the exhaustible resources that are consumed by the farm - eg fossil fuels- $DEPenr$ can be easily found and be used as an input at the macro-level where would represent a component of the savings that a nation should reinvest in order to fulfill the sustainability principle.

Concerning renewable resources, the value of $DEPrnr$ is less clear above all when considering the farm level. At a national level what is recorded are resources on the market such as fish and wood whose value of $(p - mc)$ can be found and $(H - g)$ readily understood. At the farm level the evidences are less clear since very few resources involved are marketed and so evident. If we rule out $(p - mc)$, $(H - g)$ can be intuitively thought of as the positive or negative effects of cultural practices on the resource base capable of providing renewable services, for example soil fertility or even a broader meaning of agricultural fertility where all biotic and non biotic components of the agro-ecosystem are included. Soil depletion, reduction in organic matter are tangible examples to which should also be added bio-diversity erosion, the effects on useful entomo-fauna and so on.

The panel test above is meant to catch these important aspects especially when the environmental impacts are likely to affect the farm's rentability.

DAMenv would refer to $WTP * e$, where WTP is the shadow price of damage (=willingness to pay measure), and e is the level of emissions. Such damages would include any external costs generated by agricultural activities.

APPenv would mean any value attached to the planting of trees, creation of walls, improvements to cultural assets etc. Technically should be valued by WTP of people for an improved environment on the farm.

Conclusions

The micro-economic dimension represents the level where the interaction with the environment occurs, so as to justify and motivate the implementation of environmental accounting at the farm level. A modified balance sheet has been introduced where the financial and fiscal management comprise the environmental balance as an algebraic addition of valued positive and negative environmental impacts and the accounting of taxes or other economic incentive instruments, thus showing how the "polluter pays principle" might become a new paradigm of farm production cost and of the net income of the balance statement.

A panel test, although not a proper contingent valuation, provided a first attempt to give a monetary value to environmental impacts due to the farm's activities concerning vineyard cropping. The results are likely to comprise some important aspects related to the perception of the economic effects of the farm's environmental impacts. A theoretical "genuine income" for farms shows that two environmental components should be detracted from the farm's financial added value, that is the depreciation of natural capital and the external damages due to cultural practices. The panel test results are likely to comprise these two aspects, especially the former for its connection to the farm's rentability. The creation of new environmental assets (**APPenv**) is taken into account when considering the "genuine income" which would correspond to the positive environmental impacts of farm activities to be included in the modified balance sheet. Some further studies and research are undoubtedly needed still at this first stage.

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