Paper: *Problems and potential in valuing multiple outputs: Externality and public-good non-commodity outputs from agriculture,* José Manuel Lima e Santos, Instituto Superior de Agronomia, Lisboa.

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Emternalities Vs. Externalities: Calling attention to the multiple non-commodity inputs question

ABSTRACT. Lima e Santos' paper addresses the nature of the valuation problem in the context of joint, multiple, commodity and non-commodity, outputs from agriculture. The objective is to "design policies for welfare-increasing moves of that multiple-output bundle, or even to select a welfare-maximizing bundle". This discussion paper is intended at showing that (a) multiple, commodity and non-commodity, inputs to agriculture matter; (b) production of multiple outputs from agriculture is jointed to multiple inputs to agriculture; (c) empirical evidence does exist with respect to the valuation of multiple, commodity and non-commodity, inputs to agro-processes. While multiple non-commodity *outputs* are *externalities*, multiple non-commodity *inputs* are *emternalities*. In conclusion, designing policies disregarding multiple-input bundles or taking them into account as fixed may lead to further policy failures.

1. ISSUE AND POLICY CONTEXT

From the perspective of economic accounting, the size of agriculture is conceptually defined to include only goods (food and fiber) and services ("agri-tourism") that are bought and sold in market transactions (with few exceptions). Economic accounts generally "record and measure activities that pass through the marketplace, while most of the activities that raise environmental concerns—from air pollution to appreciation of pristine wildernesses—take place outside the market" (Nordhaus and Kokkelenberg, 1999:19). As a consequence, an important part of the very picture of agriculture is missing if not only multiple effects of agriculture on society and the environment but also natural inputs to agriculture are omitted in retaining conventional market-based accounts for agriculture. These omissions impact on policies in as much as by underestimating valuable nonmarket components in decision making processes, they overstate the role of market goods and services in economic welfare, providing misleading measures with respect to the overall performance of agriculture, especially in relation with sustainability concerns.

Expanding conventional accounts and standard valuation models by expanding their boundaries to include measures of these "missing residuals" provides a better estimate of the seize, functions, and growth of agriculture in relation with society and the environment. In this respect, the output side is concerned with the valuation of *externalities* and public-good non-commodity outputs from agriculture while the input side is concerned with the valuation of *emternalities* and public-good non-commodity inputs to agro-processes. Valuing multiple, non-commodity, joint inputs to agriculture constitutes the purpose of this discussion paper.

2. EMTERNALITIES VS. EXTERNALITIES

Emternalities are a semi counterpart to economic *externalities*. They represent and are a measure of the "environmental fraction" that goes through economic processes, is embodied in multiple commodity and non-commodity outputs, but which is not captured by commercial markets. In contrast, *externalities* stand for and dimension non-commodity outputs that spill over commercial markets.

Because commercial markets do not capture emternalities, neither prices nor economic values are available. Analysis of the agricultural sector in terms of emternalities—in supplement to that of externalities—is a significant issue because the free environmental fraction embodied in agro-products (commodity and non-commodity outputs) might prove significant, and the environmental pressure of the sector is particularly obvious.

An overview of emternalities and externalites is given in Fig. 1. The particular prefix "em-" aims at emphasizing the "into" attribute of emternalities (as a variant of "en-", *em-* refers to "put into").

3. JOINT INPUT AND OUTPUT BUNDLES

A further analytical issue lies in joining multiple, commodity and non-commodity, input and output bundles. The point is that externalites should be assessed as joint products or services, i.e. as a special case of joint production (Buchanan, 1966). A general externalities joint production model can be used that shows joint inputs as $-q_{hj}$ ($h \neq i$) using a production function for j as the one that follows (Pillet, 1980):

F_{ij} (q_{ij}, Z_{kv}, $-q_{ij}$, $-q_{hj}$) = 0, and F_{rj}(Z_{jv}, $-q_{hj}$) = 0 where r = v+1 = 2, …,R; q_{ij} = commercial outputs vector of j; Z_{kv} and Z_{jv} being matrices of externalities (received by firm j/produced by firm j).

Fig. 1 — Emternalities Vs. externalities

4. SOME EMPIRICAL EVIDENCE ON THE EMTERNALITY SIDE

Emternalities are evaluated in energy, eMergy and then GDP$-value terms, eMergy being a quantitative tool for valuing natural ecosystems interacting with economic systems. The economic system itself is considered an ecosystem using free environmental flows as non-commodity inputs into agricultural production and use. Several studies are available (see References). Table I shows results as emternality fractions into multiple inputs to agro-processes (externality ratios) for different agro-processes and regions worldwide. These values matter.

Table I: Empirical valuation of emternalities in different agro-processes and regions

Region	Agro-processes	Emternality Ratios
Geneva, Switzerland	Vineyard cultivation	19.3%
Florida, USA	Tomato	5.8%
	Corn Grain	55.4%
	Sugarcane	34.1%
Takamatsu, Japan	Rice	13.1%

Source: Pillet *et al*., forthcoming (original analyses by G. Pillet, S. Brandt-Williams and G. Pillet & T. Murota)

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