EX-ANTE INTEGRATED ASSESSMENT OF THE ECONOMIC AND ENVIRONMENTAL PERFORMANCE OF AGRICULTURE:

THE CASE OF ROMANIA'S ACCESSION TO EU'S COMMON AGRICULTURAL POLICY *

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ABSTRACT

Joining the Common Agricultural Policy of the European Union will undoubtedly have important consequences for the economic and environmental development of Romania's rural areas. However, the economic benefits that the CAP would bring to new entrants would ultimately depend on the conditions and settings under which the next candidate countries are to finally join the policy. In addition, the changes in agricultural production patterns brought about by further efforts to increase efficiency and by the process of joining the CAP will have both positive and negative environmental effects. Yet again, the net environmental effects are to be determined by the production methods supported by the national government and the EU through its CAP, and also by the environmental institutional and regulatory framework in place at the moment of accession. Hence, the paper attempts to undertake a systematic integrated assessment of the long-term economic and environmental implications of the country's accession to the EU's Common Agricultural Policy. The research argues that if the main structural constraints existent in the agrarian sector were to be corrected until the moment of accession, EU and CAP integration is predicted to bring overall economic benefits to agricultural producers. These are likely to exert an overall increasing pressure on the rural natural resource base. The growth, industrialisation, modernisation, market concentration and intensification of agriculture accelerated by the country's accession to the CAP may pose environmental threats in terms of an increase in chemical input usage in arable cropping and a rise in animal density in ruminant livestock farming. However, the transfer of the CAP regulatory framework entailing a greater consideration of environmental issues may substantially mitigate potential negative effects and enhance positive outcomes. This will depend upon the extent to which adequate regulatory measures are adopted and supported by both the CAP and the institutions and people at home.

1 INTRODUCTION

The continuous eastward enlargement of the European Union (EU) combined with the extension of the Common Agricultural Policy (CAP) poses a further challenge to both existing and new incoming members. EU accession negotiations with Romania officially started in February 2000 following Romania's submission for EU membership in 1995 and have been concluded in later 2004. It is evident that successful restructuring towards a market-oriented economy and rapid economic development are key issues for the prospects of Romania joining the EU in 2007. These are particular relevant to the agriculture sector that continues to be largely under-productive, over-employed, dominated by subsistence and semi-subsistence farming with negative implications for the adoption of adequate environmental management practices. In addition, agriculture plays an important role in Romania's overall transition process to a market-driven economy. The sector distinguishes itself from those of other Central and Eastern European

* Paper prepared for the European/EAAE PhD Workshop, Wageningen, 22-23 September 2005. The paper summarises the PhD research that I am currently undertaking. Further details/explanations of any aspect brought here into discussion may be obtained from the author.

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(CEE) countries through its sheer size in relative terms, absorbing a substantial amount of human resources and producing a significant volume of the country's total output. In other words, the high shares of agriculture in Romania's total area (62%), national product (14%), and total active labour force (40%), render the sector salient economic and environmental dimensions both for researchers and policy-makers involved in agricultural development.

The paper is structured into five sections. The next section states the main research objectives, section 3 presents the methodology, section 4 discusses the results, whereas section 5 concludes.

2 RESEARCH OBJECTIVES

This paper seeks to assess two main objectives. First, it attempts to estimate the impacts that Romania gaining EU membership and benefiting from CAP implementation might have on the economic performance of the agrarian sector. And second, it sets to investigate how the respective predicted economic changes are likely to influence the agriculture-environment relationship and contribute to the sustainable development of rural areas. The paper formulates certain assumptions regarding the economic situation and environmental regulations in place related to agriculture at the moment of accession. This is because both the CAP and the restructuring process of the Romanian agricultural sector are subject to fast changing developments. Furthermore, the predicted transformations of the agriculture-environment relationship are highly dependent on the economic settings and the environmental institutional and regulatory framework in place at the moment of accession. For example, the long-term economic impacts are associated with the major assumption that farmers are able to respond correspondingly to the price incentives provided under EU accession.

3 METHODOLOGY

The methodology employed envisages a two-step procedure. The first step examines main economic changes that would occur in the agricultural and food sectors when a shock such as EU accession is administered into the national economic system by deploying general equilibrium modelling techniques. Applied general equilibrium (AGE) modelling represents a powerful tool for assessing future likely economic changes due to upcoming or hypothesised policy shocks. It entails the main advantage of considering the complex simultaneous linkages, interactions and feedback effects between various sectors, institutions and factor resources within an economy, as well as the inter- and intra-industry trade links with other economies across the globe. Hence, in this phase a single-country AGE model for Romania is constructed to estimate medium to long term changes in production and trade patterns from incorporating agriculture into EU and CAP structures. The second step would investigate the transmission mechanisms and effects of the predicted economic changes on agri-environmental related variables. In other words, a

causal chain analysis[3] would take estimates from own research and from the literature of changes in agricultural production patterns incurred by EU accession and would link these to environmental elements. Furthermore, the causal chain analysis would also consider the impact of regulatory (legal and policy) changes on the environmental status with the final objective of identifying likely transformations in the agriculture-environment relationship. The combination of quantitative and qualitative or descriptive approaches allows for an inter-disciplinary, integrated and systematic trade-off analysis of the anticipated economic and environmental implications of EU enlargement for the Romanian agrarian sector.

The assessment of economic and environmental effects centres on six core indicators (table 1). These are evaluated according to a scale of significance, which in turn is based upon a set of significance criteria.

Table 1: Core indicators, scale of significance and significance criteria employed in the integrated assessment analysis

Core indicators Economic indicators: ▪ Trade ▪ Production ▪ Private welfare/real income Environmental indicators: ▪ Quality of the environment (soil, water and air) ▪ Quantity of natural resources (soil and water) ▪ Biological diversity
Scale of significance ▪ Positive/negative greater significance: + +/- - ▪ Positive/negative lesser significance: + / - ▪ Non-significant: 0
Significance criteria ▪ Direction of change ▪ Magnitude of change ▪ Post-accession time horizon ▪ Extent or coverage of the effect*

Source: Author's table, drawing on the SIA methodology developed in Kirkpatrick, Lee and Morrissey (1999); Notes: *Applicable particularly when evaluating indicators for the agricultural sector as a whole.

Three indicators pertain to the economic dimension and cover impacts on trade, production, and real income/private welfare effects. The other three indicators refer to environmental impacts in rural areas in terms of changes in the quality of the environment (soil, water, air), the quantity of natural resources (soil, water), and biological diversity. The integrated assessment mainly refers to primary agricultural activities and all indicators are assessed for the agricultural sector as a whole, as well as at a more disaggregated level across

[3] "The fundamental purpose of the causal chain analysis (CCA) is to identify the significant cause-effect links between a proposed change in an existing [new] trade agreement […] and its eventual economic, environmental and social impacts (*i.e.* its impacts on sustainable development)" (Kirkpatrick and Lee, 2002: 31).

eleven major agrarian activities.[4] The choice of indicators reflects the research objectives of the thesis that aims to undertake an integrated approach to evaluation. In other words, the set of indicators was chosen so that it not only balances the analysis of economic impacts with the discussion of environmental effects, but also provides a systematic approach to linking the economic dimension of analysis with the environmental dimension. More specifically, established linkages between economic indicators, such as alterations in agricultural trade and production patterns, as well as welfare changes, and their potential environmental impacts allows for their effective integration within a causal chain analysis.

There are three levels of significance (non-significant, lesser significant and greater significant) and each may be associated with positive or/and negative impacts (table 1). A double plus/minus is associated with the greater significant level, a single plus/minus with the lesser significant level and a zero with the non-significant level. The scoring and the assessment in general are performed relative to the base situation, which assumes that Romania will not join the European Union and that overall current economic and environmental trends pertaining to agriculture will continue into the future. The impact significance is determined according to four criteria: direction of change, magnitude of change, post-accession time horizon, and the extent or coverage of the identified effect. The post-accession time horizon refers to a medium to long term run (more than five years since accession). The fourth significance criterion (extent or coverage of the effect) is mostly relevant when assessing the impacts at an aggregate agricultural sectoral level and the extent to which agrarian sub-sectors/commodity are affected.

4 RESULTS

The paper develops an applied general equilibrium model for the Romanian economy with an emphasis on agricultural activities. This is performed in order to quantitatively evaluate potential economic impacts in terms of reallocation of resources, changes in trade and production patterns and income effects that may arise from joining the European Union and placing Romanian agriculture under the CAP umbrella. The disaggregation of the Romanian economy focuses mostly on agricultural sectors that include in this case both primary agricultural and food processing activities. The numerical Social Accounting Matrix (*i.e.* the database) employed in this model is based on 1997 data and is derived from a SAM for Romania developed in Banse (2001).[5] Further on, the estimated economic impacts are linked to potential environmental outcomes largely based on a qualitative impact assessment analysis.

[4] These include: wheat, other cereal grains, vegetables/fruits/nuts, oilseeds, plant-based fibers, other crops, cattle/sheep/goats/horses, other animal products, raw milk, and wool/silk-worm cocoons. In addition, the economic assessment also focuses on seven major downstream food-processing sectors. This is attributed to the strong economic inter-linkages between primary and processed agricultural activities, the significant relevance of changes in food-processing production patterns in influencing farming output, trade and agricultural income, and the fact that CAP measures generally envisage both raw agricultural commodities and processed food. The seven food-processing activities considered in the economic assessment are bovine/sheep/goats/horse meat, other meat products, vegetables oils/fats, dairy products, sugar, other food products, and beverages/tobacco.

[5] The team employed the database/sectoral aggregation format used by the GTAP (Global Trade Analysis Project) model. The GTAP model represents a global applied general equilibrium model frequently employed in the AGE literature by various authors and developed by a group of researchers at Purdue University under the coordination of Thomas Hertel.

4.1 Assessing the economic impacts

The model is single-country, comparative static, with constant returns to scale and perfect competition in production. The development of an applied general equilibrium (AGE) model with a focus on Romania's agricultural and food sectors is intended not only to contribute to the modelling literature, dealing with EU's next phase of eastward expansion and CAP implementation, but also to tackle an issue of current interest for both researchers and policy-makers involved in agriculture and economic development. The AGE model for the Romanian economy is based on Walrasian tradition and on the Arrow-Debreu simultaneous general economic equilibrium conditions. The economy is disaggregated into twenty-three industries that produce goods and services by employing three primary factors of production[6] and intermediate inputs. All commodities and services are used both in production and consumption. Producers maximise profits subject to a constant returns to scale production technology (with CES in value added) and operate under perfect competition settings implying that the best they can do is breakeven at equilibrium prices, which they take as given. Each production sector displays a nested (hierarchical) production function structure. The supply of factors is endogenised by accounting for the existence of unemployment. Exchange rates are flexible, whilst foreign prices are exogenously set in the baseline, reflecting the inability of Romania to influence world prices by altering its trading position (the small open economy assumption). Hence, the terms of trade faced by the small country do not change in the baseline (Södersten and Reed, 1994). A "double Armington" assumption on bilateral trade streams is employed. The "double" approach reflects an Armington aggregation at the border, where products are differentiated according not only to their region of origin (the original Armington assumption shaped by elasticity of substitution values) but also to their market destination (shaped by elasticity of transformation values).[7] These apply in a two-stage manner sometimes referred to as a "two-tier decision process" (Donnelly *et al*, 2004). First domestically produced goods are differentiated from imports, and respectively, goods produced for domestic use are differentiated from exports. Second, imports, and respectively exports, are imperfect substitutes across the four foreign trading regions. The Armington assumption solves the problem of cross-hauling[8] encountered in trade data, which under perfect competition is inconsistent with traditional Hecksher-Ohlin trade theory (Petersen, 1997).

[6] Land enters as a primary factor of production only in agriculture, whilst labour and capital (with the exception of government capital which is sector specific) are mobile across sectors. Though agricultural land is sector specific for the agricultural sector as a whole, at the subsectoral level this is allowed to shift from one crop or grazing activity to another farming occupation. In other words, the supply response of individual agricultural activities is larger than for the sector as a whole (Hertel and Tsigas, 2002).

[7] The double Armington approach and the introduction of product differentiation across market destination according to constant elasticity of transformation supply functions is argued by the fact that Romania's exports to industrialised countries tends to be of a higher quality and standards than those targeting the domestic market.

[8] Cross-hauling refers to the fact that countries often trade with each other goods and services that belong to the same category. Thus the Armington assumption is particularly relevant where some aggregation occurs. In other words, the Armington assumption may account not only for differences in product quality according to source of origin but also for differences in the type of products traded within the same commodity grouping/aggregated sector.

The model performs a comparative static analysis associated with two equilibrium outcomes induced by two scenarios, namely alternative versus baseline. The baseline scenario is constructed over a fifteen-year period (1997-2011) and the main assumption is that Romania does not join the European Union. Other assumptions shaping the baseline scenario take account of real domestic economic growth developments, the liberalisation of trade in manufactures/services between Romania and EU-25 members, an adjustment in border protection levels on trade flows in agro-food commodities between Romania and its trading partners (also reflecting the realisation of CAP reforms), and changes in domestic support measures forwarded by the Romanian government. The alternative scenario entails in addition to the baseline scenario the process of Romania joining the EU-26 club of members comprising the EU-15, the CEEC-10 and Bulgaria, with a focus on CAP related issues. In addition, welfare and budgetary transfer side effects resulting from the adoption of CAP market (trade and domestic support) measures considered in the alternative scenario have been explicitly considered in the model. These refer to the transfer of tariff revenue raised by Romania on agro-food imports from non-EU members to the CAP budget, the financing of agri-food export subsidies, of the single-farm (direct) payment and of other domestic support related payments from CAP budgetary resources.

The following paragraphs pinpoint the key economic impacts and core economic indicators in terms of changes in production and trade patterns, as well as welfare effects associated with the overall scenario of CAP extension to include Romania's farmers. The section ends with a discussion on the scale of significance of the core economic indicators considered in the assessment.

Economic impacts for primary agricultural activities are summarised and displayed in table 2. Romanian agriculture is hypothesised to benefit and grow with its incorporation into the Common Agricultural Policy of the European Union. In other words, the overall economic accession impact on agriculture is likely to be positive and significant. At the aggregate level, agricultural production is likely to increase, though moderately (by 1.5 percent relative to the baseline). Agricultural trade is predicted to greatly intensify, particularly with the EU-26 member states. Exports to EU-26 increase by 140 percent (almost 2.5 times), whereas imports increase by around 85 percent (to the detriment of trade with non-EU members). Welfare gains, measured by the equivalent variation, due to the incorporation of Romanian agriculture into EU structures are predicted to amount to 1.8 percent of the baseline GDP. The magnitude of welfare change is slightly larger than other estimates provided in similar studies for other CEE countries, which tend to converge towards the value of one percent of GDP. Earnings from factors employed in agriculture are hypothesised to increase by around 9 percent with CAP accession relative to the case of no accession. Both aggregate welfare gains and increases in earnings from factors employed in agriculture are expected to accrue largely due to increased access to EU's agricultural and food markets for domestic producers, which represent a large proportion of the working force relative to other CEECs. Further positive impacts, but to a lesser extent, are fostered by the partial removal of non-tariff barriers, the selective subsidisation of agricultural production and exports financed from CAP budgetary sources, and the inflow of cheaper imports from the EU. Welfare losses are mostly incurred by trade diverting

effects, an increase in border protection against non-EU members for some commodities, and the transfer to the EU budget of tariff revenue resulting from importing agro-foods from the rest of the world.

Table 2: Economic impacts of Romania's accession to the CAP

– percentage (absolute) changes relative to the baseline -

Sector/commodity	ECONOMIC INDICATORS				
		TRADE			
	PRODUCTION	Exports to EU-26	Exports to RoW	Imports from EU-26	Imports from RoW
TOTAL AGRICULTURE	+ 1.5 (1881.4)	+ 139.4 (2552.5)	- 31.1 (-483.5)	+ 85.7 (1246.6)	+ 21.5 (704.0)
Sugar cane & beet	+ 12.3 (217.5)	-	-	-	-
Cattle, sheep, goats, horses	+ 10.4 (964.3)	+ 302.8 (826.3)	- 47.1 (-202.7)	+ 5.3 (8.0)	- 1.2 (-0.3)
Wheat	+ 4.2 (780.4)	+ 650.5 (1020.2)	- 70.6 (-351.5)	+ 194.4 (358.4)	-
Other cereal grains	+ 4.0 (677.2)	+ 93.6 (503.4)	+ 41.0 (146.5)	- 3.4 (-11.4)	+ 66.5 (184.9)
Raw milk	+ 2.0 (427.8)	- 3.0 (-0.6)	- 7.7 (0.0)	+ 139.3 (66.5)	+ 127.6 (5.3)
Other animal products	- 0.3 (-76.8)	+ 17.7 (65.0)	- 28.2 (-15.5)	+ 189.5 (73.6)	+ 62.9 (75.7)
Vegetables, fruits & nuts	- 1.9 (-263.9)	+ 51.2 (131.7)	- 43.2 (-51.1)	+ 322.0 (262.8)	+ 2.7 (5.9)
Other crops	- 2.3 (-298.5)	+ 16.0 (10.9)	- 13.7 (-1.6)	+ 224.7 (325.0)	+ 103.3 (186.7)
Wool, silk-worm cocoons	- 6.1 (-78.9)	- 0.1 (0.0)	- 4.9 (-2.8)	+ 52.1 (18.6)	+ 44.7 (41.9)
Oil seeds	- 8.0 (-145.4)	- 22.7 (-24.8)	- 29.7 (-6.7)	+ 151.8 (74.4)	+ 8.7 (23.5)
Plant-based fibers	- 24.3 (-322.4)	+ 58.1 (20.2)	+ 44.3 (1.9)	+ 73.2 (70.7)	+ 56.6 (180.4)

ECONOMIC INDICATORS	
WELFARE / REAL INCOME	
Aggregate private welfare	Earnings from factors employed in agriculture
1.8 (% of GDP) (6,185.5)	8.7 (5,697.6)

Source: Author's modelling results; Notes: All changes in agricultural output and trade, and earnings from factors employed in agriculture are expressed in percentage terms relative to the baseline. Changes in aggregate private welfare measured by the equivalent variation are expressed as a percentage of the baseline GDP. The numbers in brackets represent absolute changes, measured in constant 1997 billion ROL.

Further looking into the structural effects or the changes in output disposition across main agricultural activities, one can observe that the extension of the CAP is likely to bring greater benefits or opportunities mainly to Romanian producers of those goods that might enjoy enhanced access to European markets and higher support levels under the CAP regime. Thus, according to table 2, agricultural

production growth is predicted to occur (in descending order) in particular for sugar beet, livestock (bovine, ovine, and horses), cereal grains, and raw milk. Moreover, the predicted opportunities offered to agriculture are due to spread on average to most domestic farmers (provided they are all able to benefit), as the likely winning sectors contribute with a large share to total farming output. It is important to note that Romania is able to expand its sugar and milk sector to its full potential due to the apparently non-binding agreed quotas, with positive implications for raw sugar and raw milk production.

Agricultural trade significantly intensifies with overall export growth outpacing overall import growth in terms of both percentage and absolute changes (table 2), leading to an improvement in the total agri-trade balance, particularly with EU members. Commodities for which reciprocal trade restrictions are still substantial prior to accession, such as wheat and livestock on the export side, and vegetables and fruits, wheat and other crops on the import side, experience with accession the largest variations in trade volumes, especially with respect to the EU region (table 2). Where the absolute value of changes in exports is greater than that of changes in imports, net exports increase and Romania becomes a more significant net-exporter of the respective commodities (*e.g.* wheat, other cereal grains, and ruminants). On the contrary, for cases where the vice-versa occurs, the trade balance position deteriorates (*e.g.* vegetables and fruits, other crops, oilseeds, plant-based fibers). In addition, increases in export prices with the opening up of EU's markets have a stronger direct and positive impact on producer earnings in comparison with the indirect negative repercussions brought about by import price drops due to Romania's preferential unilateral trade liberalisation. This is why the positive output effects of increased foreign market access outweigh the negative production effects of cheaper imports coming from the EU.

Consequently, producers and exporters of the above mentioned favoured commodities are likely to be provided with the highest opportunities stemming from implementing the CAP in the Romanian agrarian context. This is emphasised in the case of small open economies that are able to improve their terms of trade, by being offered a better price with the elimination of foreign barriers on their exports, which otherwise would not have been the case should they act on their own as price takers (Wonnacott and Wonacott, 2005). However, enhanced market access opportunities could have been even greater for these sectors if they would have been better integrated into international trade structures. For example, a further particular characteristic relevant to the Romanian case is the domestic wheat sector that will not be able to benefit from increased tariff rates applied on imports from non-EU members. This is due to the non-existence of import flows of wheat from the rest of the world in the benchmark year.

On the contrary, some agricultural activities, for which the EU already practises a more liberalised trade with non-members, are predicted to contract, to the benefit of the favoured sectors. For example, the absence of CAP border protection measures for plant-based fibers combined with their increased vulnerability towards intensified competition (reflected by the relative higher import tariff rates before accession, the substantial share of their imports in domestic demand and high Armington elasticities) induces the sector to record the biggest output drop due to EU accession across all agricultural activities (table 2). Oilseeds and wool producing sectors also face zero import tariffs in the EU before Romania's

accession, do not receive any export subsidies, and in addition are provided with low levels of domestic support. This induces a fall in both trade and production levels of the respective farming activities, which are expected to be the next in line after plant-based fibers to suffer from incorporating Romanian agriculture into EU structures (table 2). These are followed in terms of percentage changes from the baseline by other crops and vegetables, fruits and nuts, sectors that again face in Romania relative higher import tariff rates before EU accession and receive limited protection under the CAP umbrella.

The impact significance of the economic indicators under investigation is displayed in table 3 (second column) and refers both to the overall likely development of Romanian agriculture and to the performance of major farming activities.

Table 3: The significance of economic impacts

Economic indicators*	Impact significance	Exemplification of likely medium to long term impacts
Trade (overall volume)	++	Higher integration into trading structures (increase in total exports and imports), particularly with EU member states.
Trade (trade balance across commodity groupings)	++ / – –	The trade balance improves particularly for those commodities likely to benefit the most from EU accession (*e.g.* wheat, other cereal grains, ruminants) / the trade balance deteriorates particularly for commodities favoured to a lesser extent by the CAP (*e.g.* vegetables and fruits, other crops, oilseeds, plant-based fibers).
Production (overall volume)	+	Moderate increase in the overall farming activity.
Production (output disposition across commodity groupings)	++ / – –	Growth and specialisation particularly in sugar beet, ruminants, cereal grains and raw milk production / Contraction of farming activities not significantly benefiting relative to other sectors from accession-induced supply incentives (*e.g.* plant-based fibers, oilseeds, wool & silk-worm cocoons, other crops, and vegetables & fruits).
Welfare/real income (Aggregate private welfare)	++	Welfare gains at the national level (measured by the equivalent variation) are predicted to amount to 1.8 percent of the baseline GDP.
Welfare/real income (Sectoral agricultural real income)	++	Earnings from factors employed in agriculture are hypothesised to increase in real terms by around 9 percent relative to the baseline.

Source: Based on the author's estimations and analysis;
Notes: *Measures used to express the economic indicators are displayed in brackets and are discussed with reference to different commodity grouping/sectoral classification aggregation levels. Hence different measures for the same indicator (*e.g.* production) may exhibit different levels of impact significance depending on the type of measure and sectoral aggregation employed.

Relevant measures are discussed for each of the three core economic indicators, *i.e.* trade, production and welfare/real income. They consist of the overall impacts on the volume of agricultural trade (exports and imports) and production, changes in the trade balance and changes in the composition of production across the commodity groupings (*i.e.* output disposition), national economic private welfare effects, and sectoral agricultural real income impacts (first column in table 3). The third column of table 3 provides

exemplifications, which, in fact, summarise the nature and significance of main economic impacts resulting from Romania's accession to the CAP. The evaluation of significance takes a medium to long post-accession time-horizon perspective, and assumes, according to the modelling assumptions, that markets pertaining to agriculture function properly and that supply responds correspondingly (no specific economic stress at the time of accession). In the case above, it is argued that all the assessed economic indicators are of greater or lesser significance, reflecting the important impact that accession to the CAP may have, at least in terms of opportunities and challenges. The incorporation of Romanian agriculture into the CAP will have greater significant positive impacts on overall private welfare, earnings from agriculture, and on trade and production indicators of particular "CAP favoured" commodity groupings that cover a large proportion of overall farming activities. Nonetheless, some agricultural sectors are hypothesised to experience an increase in their vulnerability due to lower border protection rates and a subsequent increase in competition. In other words, the incorporation of Romanian agriculture into EU structures is likely to induce an overall positive and significant economic impact.

4.2 Assessing the environmental impacts

Ecological impacts are assessed in this chapter mainly by referring to three core environmental indicators: changes in the quality of the environment (soil, water and air), changes in the quantity of natural resources (soil and water), and changes in biodiversity.

The point of departure undertaken in the environmental analysis is the OECD (1994) study that initially proposed the classification of trade-related environmental effects into five types: product effects, technology effects, scale effects, structural effects, and regulatory effects. The respective classification is adapted here to the specific context of CAP accession-induced environmental impacts and consequently refers to only four types of cross-cutting effects.[9] These include scale effects induced by the change in the overall level of farming activity, structural effects associated with specialisation and changes in output disposition across agricultural sectors, technology effects stimulated by likely alterations in farming technologies uses, and regulatory effects that tend to have a mitigating impact on all previous cross-cutting effects through the integration of environmental regulations into agricultural production systems.

Quantitative information on likely changes in the level of total farming activity and in the disposition of output across agricultural sectors that are linked to environmental outcomes is provided by the modelling application (table 2).[10] Nevertheless, alterations in the type of farming technologies, as well as

[9] Product effects are not included here as these mainly refer to changes in flows of trade-intensive products across countries that are more or less environmentally harmful and thus tend to overlap in this analysis with technology effects, for example, in the sense of increased imports of farm machinery from the EU.

[10] Absolute changes in production volumes (in terms of 1997 constant billion ROL) are considered when potential environmental effects are discussed. Absolute changes are preferred to percentage changes when evaluating environmental impacts, because the scale of production volume changes provides a better insight into the importance of output effects for the natural resource base, than do percentage changes. For example, a sector (*e.g.* sugar beet) might witness a significant shift in production volumes in percentage terms, whereas because of its small contribution to total agricultural output, it registers much lower changes in absolute terms.

potential changes in farming methods and management practices, are brought into discussion without these being quantitatively estimated. This is because the type of technology, methods and management practices that Romanian farmers are likely to adopt with EU integration are difficult to reasonably capture within a static modelling framework or to numerically estimate. The major assumption made here is that farmers' response to increased output prospects will be mainly carried out through greater intensification.[11]

According to table 4, impacts of CAP accession on the agriculture-environment relationship will be mixed, *i.e.* both positive and negative. Furthermore, the significance level of each core environmental indicator will depend on the importance of each (scale, structural, technology and regulatory) transmission channel in shaping the respective effects. In the case of soil quality and quantity, the predicted changes in production patterns (*i.e.* output increases of ruminants and cereal grains) may have greater significant negative impacts, particularly in terms of nutrient and heavy metal induced contamination effects, salinisation and loss of soil through erosion effects. Negative but lesser significant impacts on soil resource stocks are hypothesised in terms of land abandonment or land conversion to non-agricultural uses.

Table 4: The nature and significance of main environmental impacts

Core environmental indicators	Impact significance	Exemplification of likely longer term impacts
Environmental quality (impacts on soil)	--	▪ Higher soil contamination rates due to excessive nutrient and heavy metal levels in soil, associated with more intensive production of ruminants and cereal grains;
	-	▪ Higher soil acidification rates due to greater ammonia emissions and acid rain associated with a growth/intensification of ruminant livestock production;
	--	▪ Higher soil salinisation rates due to increased irrigation water applied particularly in cereal grain and sugar beet production;
	--	▪ Greater soil degradation impacts due to land abandonment of less naturally fertile areas (grasslands) or of areas cultivated with crops not benefiting from CAP accession;
	-/0	▪ Greater soil compaction impacts due to the commercialisation of agriculture and introduction of heavy machinery;
	+	▪ Decrease in desertification risks due to the likely increase in overall irrigation water application rates.
	++	▪ Increased soil fertility due to increased but not excessive nutrient application through fertilisers or animal manure;
	+	▪ Lesser risks of intensive agro-chemical use and enhanced scope for the promotion of organic farming associated with the contraction of plant-based fibers, vegetables and fruits, and other crops;
	++	▪ Positive technology, income and regulatory effects.

[11] For instance, Spain and Greece, which displayed, at the time, agrarian structures similar to those of Romania, experienced greater post-accession intensification effects of particular farming activities, with dramatic environmental consequences, such as water pollution, soil erosion and overgrazing (Bureau, 2002).

Environmental quality (impacts on water)	--	▪ Higher water contamination rates with nitrates (including eutrophication) due to higher and concentrated amounts of ruminant animal waste, and due to higher synthetic fertiliser application rates per hectare of land cultivated with cereal grains;
	--	▪ Higher water contamination rates with pesticides applied particularly in cereal grain and sugar beet production;
	--	▪ Higher water contamination rates with harmful soil sediments and mineral salts due to increased irrigation
	-	▪ Higher water acidification rates due to greater ammonia emissions and acid rain associated with the growth/intensification of ruminant livestock production
	+	▪ Lesser risks of water contamination with agro-chemicals and enhanced scope for the promotion of organic farming associated with the contraction of plant-based fibers, vegetables and fruits, and other crops;
	++	▪ Positive technology, income and regulatory effects.
Environmental quality (impacts on air)	-/0	▪ Increase in GHG emissions/air pollution due to a rise in domestic/international transportation of agri-goods;
	-	▪ Increase in GHG emissions and odour pollution due to more concentrated and higher ruminant animal manure output;
	++	▪ Positive technology, income and regulatory effects.
Natural resource stocks (impacts on soil)	-	▪ Depletion of soil resources through land abandonment/conversion effects of less naturally fertile areas or areas cultivated with crops not benefiting from CAP accession, unless they are replaced with other crops;
	--	▪ Loss of soil through erosion due to the growth and more intensive production of cereal grains and sugar beet;
	+	▪ Positive technology, income and regulatory effects.
Natural resource stocks (impacts on water)	-	▪ Depletion of water resources due to increased agricultural activity and higher water requirements for crop irrigation and livestock production;
	+	▪ Positive technology, income and regulatory effects.
Biological diversity	--	▪ Loss of terrestrial and aquatic wildlife (flora/fauna) due to increase in water/soil contamination rates and land abandonment impacts in biodiversity rich areas;
	-	▪ Decline in agricultural flora and fauna genetic diversity due to specialisation impacts;
	++	▪ Positive technology, income and regulatory effects.

Source: Author's analysis

The less significant scoring is largely due to the fact that the contraction of some agricultural activities would not necessarily imply the abandonment of land or the conversion to non-agricultural uses, but also the conversion of land towards cultivation with other crops favoured under the CAP regime. However, greater significant positive impacts on soil quality are also likely to occur. These largely refer to increased soil fertility through greater nutrient application for cereal grains and sugar beet,[12] and income, technology and regulatory effects. The latter effects are hypothesised to have however a lesser significant

[12] Improved soil fertility may in turn enhance soil structure stability and help reduce the vulnerability of soil to erosion factors (FAO, 1999).

impact on the stock of soil resources, as this environmental indicator is primarily linked to the natural and agronomic conditions depicting the Romanian rural landscape. Some positive impacts may occur with the increase in the use of irrigation systems and the associated decrease in desertification risks (particularly relevant for generally very dry areas, such as those situated in the South-East of Romania). Other positive impacts may be associated with the contraction of some sectors (plant-based fibers, vegetables and fruits, and other crops), if this results in less agro-chemical use, reduced contamination risks and the promotion of organic farming in line with demand patterns for organic food, particularly from EU consumers.

The quality of water may experience, on one hand, greater significant negative impacts due to higher risks of contamination with nitrates and pesticides, leading to important eutrophication effects, and higher exposure to harmful soil sediments and mineral salts resulting from greater irrigation practices. A major contributor to water pollution relates to greater output emissions from animal waste associated with higher production and greater intensification of ruminant livestock, particularly when appropriate waste disposal practices are lacking (Rae, 1999). On the other hand, greater significant positive impacts may arise because of potentially important income, technology and regulatory effects. Moreover, positive impacts on water quality (but of lesser significance) may as well occur with the hypothesised contraction of some sectors, such as plant-based fibers and vegetables and fruits, if this again results in lesser risks of contamination from agro-chemicals and enhanced scope for the promotion of organic farming.[13] The depletion of water resources due to higher water usage required for crop irrigation and livestock production is considered to be of lesser significance, because Romania may be regarded as a country where water availability on average is not a critical issue. Though greater income, enhanced technologies and better regulations may improve the adoption of more water efficient farming strategies, income, technology and regulatory effects have been scored as lesser significant positive impact. This is because changes in water availability are primarily driven by natural factors. Biological diversity is also hypothesised to experience both greater significant negative and positive impacts. The former mainly include the loss of terrestrial and aquatic wildlife due to the increase in water/soil contamination rates and land abandonment impacts in biodiversity rich areas, whereas the latter refer to beneficial income and technology effects.

There are no likely greater significant negative impacts on the quality of air triggered by CAP accession. This is largely because the potential relative contribution of ruminant animal waste to total GHG emissions and odour pollution is likely to be limited and probably of lesser significance. Hence, lesser negative significance is also attributed to soil and water acidification effects triggered by livestock growth/intensification driven ammonia emissions coupled with acid rain. Biodiversity impacts, viewed as a product specialisation-induced decline in agricultural flora and fauna genetic diversity, are also graded with lesser negative significance. This is attributed to the fact that, though specialisation effects may be important, production growth is still likely to occur, in addition to sugar beet, for a wide range of cereal grains and ruminant animals. Hence, the genetic diversity of crop plants or farm livestock may not greatly

[13] For example, Pimentel *et al* (1992) argue that vegetables/fruits receive the highest dosage of pesticides with consequently higher impacts on the environment. Hence, a contraction in this sector may entail some environmental benefits.

diminish. Lesser negative significant or non-significant impacts are further hypothesised for soil and air quality. Soil quality impacts are expressed in terms of compaction effects, which are likely to be of lesser importance relative to other identified environmental effects. Air quality impacts may arise due to agro-trade/transportation driven GHG emissions, which are however a small share in total emissions.

Finally, the overall hypothesised significant pressure of agro-industrialisation and agro-commercialisation on the environment may be contained or even reversed to a positive net impact, with the support of the regulatory measures for environmental protection that are supported under the CAP umbrella. In other words, the reformed CAP (in particular "cross-compliance" and second pillar measures) partially provides the necessary regulatory, financial and supportive framework for those wishing to adhere or convert to more extensive or sustainable farming practices. Though this might diminish the danger of the Romanian agricultural sector falling into a prolonged "unsustainable farming trap", it may prove insufficient to avoid following the path of boosting farm income through excessive intensification, unless effective policy measures and appropriate institutional forms are consistently adopted by the government at home.

Furthermore, an important caveat applies to this analysis. The paper has addressed environmental opportunities and threats that may particularly hold in the long-term, as the environmental assessment has been connected to accession-induced changes in agricultural production levels projected in the medium/long run by the general equilibrium model. However, developments in the agriculture-environment relationship may differ in the post-accession short to medium term period, in particular if Romanian agriculture continues to encounter important structural difficulties and supply response barriers, such as the predominance of a large subsistent and semi-subsistent under-productive farm sector. Agricultural growth and specialisation outcomes predicted by the model, the assumed intensification effects and the associated environmental impacts may thus not necessarily provide a complete picture, particularly in the years immediately following accession.[14]

5 CONCLUSIONS

The paper finds that there may be substantial opportunities for output growth and intensified trade due to CAP enlargement particularly for domestic agricultural producers of sugar beet, ruminant livestock, cereal grains, and raw milk. These may trigger overall a new surge in the intensification of currently extensive farming practices with negative long-term implications for the environment. Though agri-environmental measures promoted by the CAP may partially mitigate potential negative ecological impacts, they may not be sufficient for overcoming the environmental threats that EU accession may pose with the (re)industrialisation and chemical-input intensive commercialisation of agriculture. Setting agriculture into a sustainable evolutionary path additionally requires to be heavily endorsed by the government at home and

[14] However, the existence of important structural and institutional barriers and the issue of limited farmers' supply responsiveness to the incentives provided by the accession to the CAP have been fully acknowledged and discussed in detail in the PhD thesis.

the Romanian society at large. This implies accelerated capacity building and institutional strengthening to effectively implement CAP measures and pursue local specific policies that promote market integration, farm modernisation and environmental protection. It would also require strong domestic political willingness that furthers economic structural change and environmental protection, a change in the population's value systems towards a more nature-friendly behaviour, and greater public engagement in policy making and capacity building.

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