INTERNATIONAL TRADE AND THE ENVIRONMENT

Proposals for a reserch agenda

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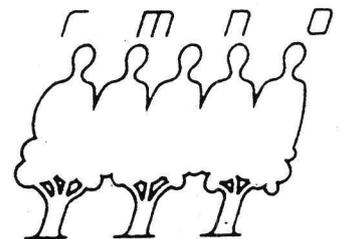
Effects of changes in production and trade flows on the economy, the environment and nature

Programming study of NRLO, RAWOO and RMNO, Part 2

NRLO
Nationale Raad voor Landbouwkundig Onderzoek

rawoo

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FOREWORD

This report is the second part of a joint programming study on International Trade and the Environment initiated by
National Council of Agricultural Research (NRLO)
Advisory Council for Scientific Research in Development Problems (RAWOO)
Advisory Council for Research on Nature and Environment (RMNO)

This part of the study provides a proposal for a research agenda on the effects of changes in production and trade flows on the economy, the environment and nature. The first part of the study, carried out in 1992, deals with the analytical framework for studying interactions between trade and environment and discusses major policy issues in this field (NRLO report no.92/19).

The research was carried out by a research team of Wageningen Agricultural University (LUW), the Institute for Environmental Studies of the Free University Amsterdam (IVM-VU) and the Agricultural Economics Research Institute (LEI-DLO) consisting of

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The councils are grateful for the work done by the research team and the Steering Committee.

The councils have studied the first and second parts of the study and support the findings and recommendation. The councils are of the opinion that the proposed research projects fit well with the advisory report "Sustainable development in an open economy" submitted by the Advisory Council for Research on Nature and Environment to the Ministry of Education and Science in 1994.
In particular the projects 2a, 2b, 2c and 3b fit well in the theme "Patterns of Production and Consumption" whereas the projects 1b, 3a and 3c should have a place in the theme "Environment and Economics". These projects deserve priority.

Since the proposed projects address questions of an international nature it is recommended to give priority to international co-operative efforts. Peer reviewing by international experts is recommended.

Prof.Dr.Ir. A. Rörsch   Prof.Dr. D.B.W.M.   Prof.Dr. J.B. Opschoor
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Chairman NRLO   Chairman RAWOO   Chairman RMNO

SUMMARY

Introduction

International trade is an important field where the interrelationship between the economy, nature and the environment attracts increasing attention. The recommendations of Agenda 21 of the 1992 UNCED conference on the environment, the successful completion of the Uruguay Round of GATT negotiations in 1993, and the ongoing proposals for reform of EU agricultural policy, have put issues of trade and the environment high on the policy agenda. The growing need for information on and analysis of these issues require clear research priorities, and poses a challenge to find new solutions for trade, nature and environmental problems in open societies, with a keen eye on efficiency and distributional aspects.

The present study, the second part of a programming study, attempts to formulate proposals for a research agenda regarding the effects of changes in production and trade flows on the economy, the environment and nature. To arrive at such an agenda, this study builds on four elements. First, it draws on the analytical framework for studying interactions between trade and environment as well as major policy issues developed in the first part of the programming study, and on the conclusions and recommendations made in that study. Second, policy needs and issues are established on the basis of interviews and documentation collected. Third, current research priorities and capabilities of national and international research institutes are assessed. Finally, three major research themes in the field of international trade on the environment are distinguished. Under these broad research themes, a number of research questions and preliminary research proposals are formulated.

Most of the proposals for research in this study deal with complex scientific and policy issues in the area of trade, natural resources and the environment. In their present form, research proposals only serve as a first step in the analysis and clarification of such issues. Although many research questions reflect a policy concern with major trade-and-environment problems, with the development and choice of appropriate instruments, and their effectiveness in particular cases, the research proposals identified in this study are in no way meant to suggest immediate policy solutions for the wide range of problems covered. Rather, the proposals emphasize the need for further analysis, identify the necessery steps to be taken to clarify a problem, and argue the need for selectivity, in many instances on a case-by-case basis.

Themes and approaches

In its recent study *Sustainable Development in an Open Economy*, RMNO distinguishes three broad priority themes for the study of environmental economics:
I.   Production and consumption patterns: (international) interactions between the economy, the environment and development.
II. Environment and the business enterprise: a dynamic perspective.
III. Environment and the economy: institutions and instruments.

Research priorities and proposals for the research topics of this programming study fit well into the research priorities formulated by RMNO. Issues and research questions with regard to international

trade, the environment and nature are mainly dealt with under theme I, but some match with themes II and III as well. Both the RMNO-study and the present study share an emphasis on *strategic* research, as opposed to strictly (policy-oriented) *applied* research or strictly *fundamental* research.

For the purpose of this study, policy issues and strategic economic research on trade and environment are classified under their broad headings:

I. Impact of international trade (and trade policies) on the environment.

II. Impact on the environment (and national and international environmental policies) on international trade.

III. Instruments, mechanisms and institutions to reconcile international trade, the environment and nature.

This classification is consistent with the analytical framework and policy analysis in the first part of the programming study, *International Trade and the Environment*, and enables research questions to be formulated under a limited number of priority research *themes*. To elaborate possible research questions which can be formulated under the priority research themes, three methodological *approaches* to the analysis of trade and environmental problems are distinguished:

1. Model studies, including possibilities to modify existing economic and trade models and physical flows models.

2. Case studies of life-cycle analysis.

3. Fundamental-strategic studies to support policy and applied research.

Issues and ongoing research

To a considerable extent, policy issues as perceived by national and international organisations define the need for information on and economic analysis of trade and environment. To identify those needs, interviews were held and relevant policy documents consulted. The impact of trade (policies) on the environment, theme I, constitutes a major policy issue. Particularly, attention is focused on the environmental impact of the recent revisions of the Common Agricultural Policy, and the impact of the implementation of the Uruguay Round agreement. Sensitive environmental effects include land use and soil degradation. Sensitive economic sectors include agriculture, energy, transport, and waste management. It was often argued that more attention should be paid of dynamic effects of technological innovation and diffusion. The position of less-developed countries (LDCs) should receive special attention. Some interesting issues that were raised were: the impact of stricter GATT disciplines on export controls of LDCs on sustainable natural resource management; the effects of the TRIPs (trade-related intellectual property rights) agreement on biodiversity; the impact of trade bans on tropical timber on deforestation; and the environmental effects of reducing tariff escalation and barriers against labour-intensive imports from LDCs.

With respect to theme II, the impact of the environment (and environmental policies) on trade, the international competitiveness of economic sectors, and market access of LDCs to Western markets are major policy issues. With respect to market access of LDCs, priority is given to eco-labelling schemes, packaging and recycling requirements. Within the EU there is concern about the impact of national environmental policies on competitiveness. The importance of subsidiarity to the formulation of environmental policy might increase in the years to come. Linkages between agricultural and

environmental policies may cause difficulties, because major parts of agricultural policy are determined at the EU-level. Changing consumer preferences for "environmentally-friendly" products may affect trade flows. Presently, French farm products are losing traditional markets in Germany to domestically-produced "organic" products.

Instruments, mechanisms and institutions to reconcile international trade and the environment (theme III) mainly concern the internalization of external effects; the extent to which environmental standards should be harmonised across countries; ways and means to arrive at co-operative, positive incentive-based, environmental agreements with LDCs; and types of policy instruments to achieve environmental objectives without defying international agreements.

A review of on-going research on trade-and-environment issues shows that academic research capacity in the Netherlands is limited and restricted to a few issues only. Part of the research is funded by NWO through its (modest) environmental economics research programme "International Environmental Economic Relations and Policy", which supports fundamental rather than strategic research. Excellent research work is carried out by international research institutes and organisations, in particular at the OECD and the World Bank. Research activities cover both conceptual analysis and modelling excercises, and can in a number of cases draw on core funding.

Towards a research agenda

The interviews held at national and international organisations show a considerable scientific and policy interest in a variety of trade-and-environment issues. Although these issues cover a wide range of problems requiring different research approaches, an attempt was made to derive from these issues a limited number of research questions under each of the three priority themes. The research questions formulated under the three major research themes define in broad terms the need for research on trade and environment.

Formulating research questions is the first step towards identifying preliminary research proposals. A total of eleven such proposals are suggested, reflecting the three approaches to the analysis of trade and environment problems distinguished in this study. The proposals serve as examples of research possibilities, and are intended to guide future research, not to limit it. No attention is paid to research proposals in the field of climate studies and global change (including problems of (de)forestation) because research in this area is funded by other programmes. Research involving large and elaborate modelling excercises that would require considerable manpower is recommended to be carried out in direct co-operation with international organisations responsible for funding. The following eleven preliminary research proposals, which constitute a first research agenda in terms of research themes and approaches, are formulated:

Model studies:
1a The impact of GATT, CAP and environmental policy on EC agriculture: a modelling approach;
1b Production, trade and environmental effects of domestic policies using an environmental AGE model for the Netherlands.

Case studies of life cycle analyses:

2a   The economic and environmental impacts of the globalisation of horticultural production;

2b   Environmental, economic and social impacts of international trade of "non-hazardous" waste for recycling purposes between industrialized and developing countries;

2c   Soil degradation in LDCs, international nutrient flows and trade liberalisation;

2d   Environmental effects of anti-processing tendencies and barriers against labour-intensive imports from developing countries.

Fundamental-strategic studies:

3a   International trade and nature conservation;

3b   International trade, international transport and its environmental effects;

3c   Links between environmental cooperation and trade;

3d   Instruments in environmental policy and agricultural trade;

3e   Trade agreements, environmental policy and the innovation process in agriculture.

Recommendations

The following recommendations with regard to the implementation of the research proposals are made:

1.   Considering the small and scattered research capacity for the study of trade and environmental problems, the growing need for (policy) analysis of a variety of issues, and the increasing attention paid by international organisations to questions in this field, it is recommended to strengthen the strategic research capability in the area of international trade, the environment and nature within the proposed national research programme on environmental economics.

2.   To stimulate and strengthen strategic research on trade and environment, the organisation of research can in several aspects be instrumental. In many areas, both the quality and scope of the research can be enhanced when close co-operation between scientists of different specialisations is pursued. Such co-operation may involve economists from different sub-disciplines, but also co-operation of economists with researchers from technical and bio-physical disciplines, and co-operation between scientists oriented towards fundamental-strategic and more applied economic research.

3   Co-operation between research groups of different universities and non-academic institutes can be conducive to create a minimum critical mass of research capacity in particular fields. In addition, incentives should be created to stimulate the (continued) participation of Netherlands-based researchers in international programmes through a proper selection of research themes, proposals and approaches, international co-funding of relevant research projects, and direct participation in international programmes. When core funding in such programmes is limited, participation has the additional advantage that international research priorities can possibly be co-determined via external funding. Many of the research questions and proposals in this study match well with the research priorities and programmes of a number of international organisations. Finally, special efforts should be undertaken to include both PhD and post-doctoral research work in the organisation of a research programme.

4.   Especially in the area of trade and environment, the role and position of less-developed countries calls for special attention. Explicit consideration of the interest and priorities of LDCs in the formulation of a research agenda, and active co-operation of researchers and research institutes in LDCs is therefore recommended.

CONTENTS

ACRONYMS AND ABBREVIATIONS

AGE   Applied general equilibrium model
BuZa   Ministry of Foreign Affairs
BST   Bovine Somatropine
CAP   Common Agricultural Policy (of the European Union)
CBS   Central Bureau of Statistics
CEC   Commission for the European Communities
CGE   Computable general equilibrium
CPB   Central Planning Bureau
EU   European Union
EZ   Ministry of Economic Affairs
GATT   General Agreement on Tariffs an Trade
IFPRI   International Food Policy Research Institute
IIASA   International Institute for Applied Systems Analysis
IVM-VU   Institute for Environmental Studies, Free University Amsterdam
LCA   Life cycle analysis
LDCs   Less-developed countries
LEI-DLO   Agricultural Economics Research Institute
LNV   Ministry of Agriculture, Nature Management and Fisheries
LUW   Wageningen Agricultural University
MEIN   Committe Environmental Economics in the Netherlands
NRLO   National Council of Agricultural Research
NWO   Netherlands Foundation for Scientific Research
OECD   Organization for Economic Cooperation and Development
PPMs   Processing and production methods
PPP   Polluter pays principle
RAWOO   Advisory Council for Scientific Research in Development Problems
RMNO   Advisory Council for Research on Nature and Environment
TRIPs   Trade-related intellectual property rights
UNCED   United Nations Conference on Environment and Development
UNCTAD   United Nations Conference on Trade and Development
USDA/ERS   US Department of Agriculture, Economic Research Service
VROM   Ministry of Housing, Physical Planning and Environment
WRI   World Resources Institute
WTO   World Trade Organization
WWF   World Wide Fund for Nature

1. INTRODUCTION

1.1 Background

This study is the second part of a programming study on international trade, the environment and nature. The first part of the programming study deals with a framework for analysing the effects of changes in production and trade flows on the economy, nature and the environment and is, to a large extent, based on a review of recent literature. The results of that study were presented as NRLO report *International trade and the environment* (NRLO report no.92/19).

The present study attempts to formulate proposals for a research agenda. To arrive at such an agenda, the study builds on the analytical framework developed in the first part of the programming study. In addition, three more elements are considered: (1) current research priorities and research capabilities, (2) policy needs and issues as formulated by a number of national ministries and international organisations, and (3) plans and priorities at international organisations and important national research institutes. Concurrent with the present study, the Advisory Council for Research on Nature and Environment (RMNO) has further specified research priorities for the entire area of environmental economics and developed a comprehensive research programme. Where appropriate, it is indicated how the results of this study can be incorporated in the research programme recommended by RMNO.

1.2 Conclusions from the first part of the programming study

In the previous study a number of conceptual issues regarding sustainable development, international trade and the environment were analysed. Based on this analysis, major environmental and trade policy questions were examined and the links between them illustrated with several case studies. From the discusssion of theoretical and policy issues, the following conclusions can be drawn and recommendations for further work be formulated.

1. Most of the links between international trade and the environment are indirect. Changes in international trade flows may affect production, consumption, income, resource use, and technological change in the trading countries, which in turn are likely to influence environmental quality. Direct effects of international trade concern mainly transport-related environmental effects. An assessment of the overall environmental and welfare effects of a change in trade (e.g. trade liberalization) requires a careful specification of these direct and indirect relationships in empirical models.

2. In the absence of adequate environmental policies, a change in international trade may have negative effects on the environment if it increases levels of economic activity or if it shifts economic activities to areas with lower environmental carrying capacities. On the other hand, it may have positive effects on the environment if it increases resource use efficiency, or if it shifts economic activities to areas with larger environmental carrying capacities. In addition, trade-

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induced changes in income and income distribution may affect opportunities for environmental management. *A priori*, it is uncertain which effect will prevail in a specific situation.

3. If changes in international trade increase environmental damage through changes in production and consumption, measures to restrict trade are usually not the first-best policy instruments to counteract this damage. First-best policy instruments address environmental consequences of production or consumption directly, by internalising environmental considerations in production and/or consumption decisions. Trade instruments are usually poor substitutes for environmental policies. Only in certain cases can they complement such policies.

4. Environmental effects of trade-related activities (transport, storage, infrastructural facilities, etc.) are often neglected in studies on international trade and the environment. Further research into the quantitative significance of trade-related environmental externalities is needed.

5. It is important to assess the entire life cycle of a commodity from raw material to final product, since different types of environmental problems (e.g. resource depletion, pollution, waste disposal) may arise at different stages. Because of international trade, these environmental problems may be located in different countries. Removal of trade barriers, and the anti-processing tendencies often implied in these barriers, will therefore have important effects on the intra-sectoral pattern of trade flows as well as on the location and magnitude of environmental problems related to each processing stage.

6. Domestic or local environmental effects should be distinguished from international (transborder) and global environmental effects. As no supranational enforcement authority exists, international policies should be based on international agreements between sovereign states.

7. As regards national environmental problems, international harmonization of environmental standards is generally not desirable. Differences in national priorities and in capacities to cope with environmental and natural resource degradation justify variations in environmental standards across countries. On the other hand, harmonization of the form of environmental policy (principles and measures) is highly desirable. Tensions between trade and the environment may be reduced by global adherence to the polluter-pays-principle (PPP).

8. The benefit-cost ratio of measures to address international or global environmental problems may differ between countries. For tackling these problems, positive incentives (e.g. financial assistance, transfers of environment-friendly technology) may be needed to achieve cooperation of countries for which additional benefits are low. Adherence to the PPP will generally lead to the non-cooperation of these countries. Negative incentives (e.g. discriminatory trade restrictions on unrelated products) may not be the best way to promote cooperation.

9. Agricultural production in developing and developed countries causes a number of specific environmental problems, primarily related to the use of land and industrial inputs, that differ from environmental problems in other sectors of the economy. Models of interrelationships between international trade and the environment should take these differences between sectors into account in order to provide a solid basis for policy decisions.

10. The analysis of interaction between environment and international trade in agricultural products should preferably be undertaken in a general equilibrium framework to account for important feedback effects in terms of factor reallocation and remuneration (e.g. land rent changes and set-aside in industrialised countries, farm income changes in developing countries). These models may be supplemented with partial models containing more detailed analyses of the agricultural sector or specific products. It should, however, be noted that dynamic processes driving economic growth, such as technological and institutional development, are not adequately captured by existing models. Separate studies are needed to analyse the effects of environmental and trade policies on such processes.

11. Current studies on environmental effects of trade liberalization in agricultural products suffer from a number of shortcomings (insufficient product and process differentiation, large geographical aggregates, different assumptions about environmental measures, partial equilibrium approach). For this reason, the generally positive conclusions about the environmental effects of agricultural trade liberalization need some qualifications. Further research is needed to address these shortcomings.

12. Research on environmental effects of trade liberalization should pay particular attention to the effects on soil degradation in developing countries, which is often considered the most threatening environmental problem in these countries. Empirical work on the magnitude and direction of these effects is limited.

13. The introduction of national environmental policies results in shifts in actual comparative advantages. The extent to which existing models of international trade can be accomodated to include the effects of such policies should be investigated.

14. International agreements and proposals concerning transborder and global environmental effects differ widely in scope. Appropriate models will have to be developed to describe the relationships between the most important components of a multilateral agreement, international trade in related (and in the case of sanctions: unrelated) commodities, and the resulting environmental impacts. Game theoretical considerations may be helpful in analysing the negotiating process leading up to possible agreements. The analysis of international environmental policies is likely to raise a number of fairly new issues with respect to international trade and the environment. Part of the research in this field will therefore be of a more theoretical nature.

15. Modelling of the linkages between international trade and the environment is not independent of the nature of the policy questions to be analysed. National environmental policies typically affect international trade through changes in production, consumption and, consequently, income. As a first approach, ecological variables and their relationships with economic variables can be added to sectoral or sub-sectoral models. Existing models as developed by various research institutes provide a useful starting point for further work. Problems which arise when linking economic and environmental models include differences in spatial and time dimensions.

16. Modelling the impact of trade liberalization on environmental and natural resource degradation can start from a number of existing and fairly detailed studies on trade liberalization, in particular

in agricultural products. The limitations of the present studies are well-known (conclusions 10 and 11) and constitute an obvious starting point for future research.

17. At present, research on international trade and the environment is being conducted by various research institutes, and duplication of work should be avoided as much as possible. In particular, it is recommended to liaise, where necessary, future work with the current research efforts at the OECD. This applies especially to on-going work in the Agricultural and in the Environment Committee, the Joint Session of the Trade and Environment Experts, and the Economic Department's GREEN model. Furthermore, it is desirable to establish contacts with research institutes in developing countries, in order to discuss their potential contributions to research questions that concern in particular these countries.

1.3 Overview of the present study

Options for a research programme on the effects of changes in production, consumption and trade on nature and the environment are explored in chapter 2. First, the three broad priority themes for the study of environmental economics as proposed by RMNO are discussed. Research priorities and proposals to be developed in this study appear to match well with the priorities set by RMNO. Next, research possibilities are indicated based on present research capacity in the Netherlands and possible approaches (applied-strategic and fundamental-strategic) to research on issues related to trade and environment. The chapter concludes with three priority themes for research proposals on international trade, nature and the environment, and briefly indicates research approaches to be applied.

In chapter 3, elements for a research agenda are developed. To a considerable extent, policy issues as perceived by national and international organisations define the need for information on and economic analysis of trade and environment. These policy issues are structured using the classification of the major priority themes established in chapter 2. A review of ongoing research on trade-and-environment issues shows that while much excellent research is carried out by international organisations, academic research capacity in the Netherlands is limited and confined to a few issues only. On the basis of the theoretical analysis carried out during the first phase of the study and interviews held and documentation collected for the present study, a number of research questions are derived for each of the three priority themes. The chapter concludes with the formulation of several preliminary research proposals in which one or more research questions are elaborated. The research proposals are classified by major research theme and research approach, and together make up a first research agenda.

The preliminary research proposals, which serve as examples of a research agenda and are not intended to limit but to guide future research, are presented in chapter 4. Research proposals follow a common format. The main research questions are outlined first and subsequently elaborated. Next, the policy relevance and scientific interest are indicated. Finally, suggestions with regard to the research methodology or approach to be used are provided where appropriate, and references to some major studies in the field and data sources that could be used are presented. Chapter 5 contains a number of conclusions and recommendations on the follow-up and organisation of the proposals for research on international trade, nature and the environment.

Most of the proposals for research in this study deal with complex scientific and policy issues in the area of trade, natural resources and the environment. In their present form, research proposals only serve as a first step in the analysis and clarification of such issues. Although many research questions reflect a policy concern with major trade-and-environment problems, with the development and choice of appropriate instruments, and their effectiveness in particular cases, the research proposals identified in this study are in no way meant to suggest immediate policy solutions for the wide range of problems covered. Rather, the proposals emphasize the need for further analysis, identify the necessery steps to be taken to clarify a problem, and argue the need for selectivity, in many instances on a case-by-case basis.

2. OPTIONS FOR RESEARCH

2.1 Research priorities RMNO (MEIN II)

In response to the Netherlands' National Environmental Policy Plan (1989), the Science Budget 1990 expressed the desirability to strengthen and internationalize the study of environmental economics in the Netherlands. Thereupon the Ministry of Education and Science set up the Committee Environmental Economics in the Netherlands (MEIN), chaired by Professor J.B. Opschoor. The Committee reported in September 1991.[1] In July 1993 six ministries[2] involved asked the Advisory Council for Research on Nature and Environment (RMNO) to elaborate on the 25 recommendations of the Committee MEIN. The RMNO brought the analysis of the Committee MEIN up to date and further specified the research priorities for the research area of environmental economics (MEIN II).[3]

RMNO distinguishes three broad priority themes for the study of environmental economics:

I. Production and consumption patterns: (international) interactions between the economy, the environment and development

Research in this theme is focussed on the integration of physical flows (matter, energy) into econom-(etr)ic models. Material balances can be developed for the global, the (pan) European, and the national level.

At the global level, integration should be pursued between material balances and models of international trade. Integrated models can be used to develop alternative scenarios for the global use of renewable and non-renewable environmental resources; to assess the direct and indirect use of regions (or individual countries) of the global environmental utilization space; and to assess policy alternatives in the areas of international trade and investment, development cooperation and environmental and nature conservation agreements.

At the (pan) European level, the analysis should focus on economic sectors such as agriculture, transport, industry, energy and on waste. Research should investigate options to minimize the consumption of primary natural resources, the need for transport and the production of wastes. It should address both substitution possibilities in production and consumption.

At the national level the greatest level of detail can be accomplished. Research should focus on processes, products (life-cycle analysis), sectors or industrial complexes.

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[1] Committee MEIN (1991), *Environmental Economics in the Netherlands*, Ministry of Education and Science, Zoetermeer

[2] The Ministries of Education and Science; Economic Affairs; Agriculture, Nature Management and Fisheries; Transport and Public Works; Housing, Physical Planning and Environment; and the Directorate General for International Cooperation of the Ministry of Foreign Affairs.

[3] RMNO (1994), *Sustainable Development in an Open Economy*, February 1994.

II. Environment and the business enterprise: a dynamic perspective

Business enterprises play a key role in the attainment of sustainable development. At the end of the day, they decide what is produced, where it is produced, and how it is produced. They have a major influence on the direction and speed of technological innovation and diffusion. Research should focus on the dynamic interplay between company behaviour and strategies, (international) environmental policy, competiveness, and changes in the international patterns of trade and specialization.

III. Environment and the economy: institutions and instruments

Research in this theme will not only analyse traditional policy instruments, it will also model and analyse 'new' institutional arrangements (ecotax, joint implementation, tradeable emission permits, public-private partnership, environmental damage fund, and so forth). In its models, this research will not only focus on the traditional economic actors (consumers and producers), but it will also explicitly include governments, (international) public bodies, consumer and citizen groups, utilities, public-private organizations and the like. Research is needed on the global, (pan) European, and national levels. Research should focus on the efficiency, environmental effectiveness, and equity (within and between generations) of traditional and 'new' institutional arrangements.

The research priorities and proposals for the research topic of the present programming study, viz. effects of changes in production and trade flows on the economy, the environment and nature, formulated in the next sections of this report, match very well with the research priorities formulated by RMNO in the above-mentioned document. Research questions formulated with respect to international trade, the environment and nature in the present report are mainly dealt with under theme I, but some fit into themes II and III as well. The two programming studies also share their emphasis on *strategic* research, as opposed to strictly (policy-oriented) *applied* research or strictly *fundamental* research. The emphasis is on finding new solutions for environmental problems in a dynamic and open society, with a keen eye on efficiency and distributional aspects (sectoral, North-South, intergenerational).

2.2 Research possibilities and approaches

Research capacity on trade and environment in the Netherlands is mainly located in universities and specialised research institutes. Among the latter some are able to mobilize a substantial critical mass of research capability if sufficient funding is available over an extended period of time. As a rule, however, the research capacity in this specific area is fairly limited in almost all universities and research institutes in the Netherlands. For this reason, proposals to embark upon new, comprehensive models to analyse the relationship between international trade, the economy, the environment and nature are largely outside the scope of this programming study when constructing and maintaining such models would involve considerable funding. Only large (inter)national research institutes have access to such funding possibilities. Climate studies and global change are not considered either in this report, because research in this area is taken care of by other programmes.

In terms of *applied-strategic* research the findings of the first part of the programming study suggest that the following approaches to research are considered important for the purpose of this study. First, is it feasible to adjust existing models of the economy, international trade or specific raw materials so as to take into account effects of changes in production, consumption and international trade on nature and the environment? In other words, is it possible to link environmental and nature variables to such models? Examples are the agricultural models of LEI-DLO, ECAM, models of Tyers and Anderson, IIASA and OECD. An evaluation of available modelling tools is included in the Annex at the end of this study.

Conversely, economic variables may be integrated into physical flows models. In this context, special attention will be paid to research possibilities regarding life-cycle analysis of products (raw materials, processing, transport trade, consumption, waste disposal and recycling) and which extends over different countries. Trade theory focusses on trade flows, but environmental policy is often directed at product chains. Life-cycle analysis undertaken from an economic point of view can be expected to give better insight into the effect of policy instruments, the role of technology, the effect of anti-processing tendencies in tariff structures, and spatial interactions, including the role of transport.

Finally, well-selected case studies may facilitate the interaction between economists and physical flows experts in developing a suitable framework (including modelling) for analysis.

A large number of research questions are conceivably of a more *fundamental-strategic* nature. These questions relate to areas such as welfare economics, insitutional economics and possibly game theory, and may contribute to a better understanding and selection of applied-strategic research issues. Examples of fundamental-strategic research questions are:
- How to deal with (international) external effects when (international) institutions necessary for first-best policies are not in place?
- Which strategies are conceivable to achieve a better (international) institutional framework to deal with trade and environmental questions?
- Are there possibilities to implement and operationalize the concept of international merit goods?
- What are the implications of internationally different preferences for environmental goals?
- To what extent is it possible to value nature in an operational way so as to include it in the (international) analysis of effects of economic activities?
- Are there ways to integrate measures to conserve nature and the environment in trade and incomes policy for agriculture without endangering the principles of environmental policy (PPP) and international trade rules (GATT)?

Research in the field of international trade and the environment can be carried out following different methodological *approaches*. Earlier work on the programming study suggests that at least three approaches to the analysis of trade and environmental problems are required to elaborate the possible research questions which can be formulated under the priority research themes:
1. Model studies, including possibilities to modify existing economic and trade models and physical flows models.
2. Case studies of life-cycle analysis.
3. Fundamental-strategic studies to support policy and applied research.

Depending on policy issues, defining the need for information and analysis (section 3.2), data availability, ongoing research elsewhere (section 3.3) and modelling requirements, research questions and preliminary proposals will be identified under each of the three themes based on specific research approaches (sections 3.4 and 3.5). In general, the research proposals under approaches 1 and 2 fit well into research theme I of MEIN II, although they also contain elements that correspond with priority theme II of MEIN II. The research proposals under 3 have strong similarities with the research of theme III of MEIN II.

2.3 Priority research themes

The recent RMNO report *Sustainable Development in an Open Economy*[4] distinguishes a total of 40 research themes in the field of environmental economics categorised by 10 major research areas. International trade and the environment is explicitly mentioned under research area 9. Spatial aspects. National and international environmental policy is included under research area 5. Policy. Other aspects of trade and environment figure under most of the remaining eight research areas. Environment and development is mentioned explicitly under areas 7. Modelling and 8. Institutions.

In this study, policy issues and strategic economic research on the subject of international trade and the environment will be classified under three broad headings:

I.   Impact of international trade (and trade policies) on the environment

II.   Impact of the environment (and national and international environmental policies) on international trade.

III. Instruments, mechanisms and institutions to reconcile international trade the environment and nature.

Such a classification is consistent with the analytical framework and policy analysis in the first part of the programming study, and enables research questions to be formulated under a limited number of priority research *themes*. The different *approaches* for analysing research questions that fit into these themes were indicated in the precious section. The three priority research themes can be described as follows:

Research Theme I: Impact of trade (and trade policies) on the environment

It is increasingly recognised that international trade and trade policies may have environmental effects, both positive and negative. A further understanding of these relationships is needed in order to enhance the positive and mitigate the negative effects. The research should especially address the market and government or intervention failures with which the negative environmental effects are linked. Market failures occur when (inter)national markets do not reflect environmental values. Government failures occur when public policies introduce new or exacerbate existing distortions. This research theme focuses on understanding and correcting these failures at the national level, the international level and at the level of international cooperation, agreements and institutions.

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[4] RMNO (1994), *op. cit.*

Research Theme II: Impact of the environment (and national and international environmental policies) on trade

Environmental policies will affect trade relations and the international pattern of specialisation, not as an end in itself, but as an inevitable side effect. It is, therefore, of great importance to gather insight into the relationships between environment(al policies) and changing trade relations in order to optimise the environmental objectives without losing the benefits of an open international trading system. The major research question concerns the design of environmental policies and the desired level of international coordination so as to avoid unwanted and counterproductive trade effects. In addition, attention should be paid to the impact of different environmental policy instruments in this respect, and the modalities of the victim- and polluter-pays principles. It is important that this research theme takes a dynamic perspective, and addresses technological development and changing comparative advantages.

Research Theme III: Instruments, mechanisms and institutions to reconcile international trade and environment

At least at two levels, tensions between trade and environment need to be overcome to create a sustainable and open international trading system. First, there is the level of principles and concepts. Environmental policymakers and those involved in the freeing of world trade make use of different and sometimes incompatible conceptual frameworks and principles. Research should be directed towards the development of shared principles and concepts, and the translation thereof in international rules. Examples are the (internationally expressed) desire for integrated life cycle management and rules for (internationally agreed) product standards and production methods. Second, problem-solving research is needed at the level where the hidden and open trade and environment conflicts manifest themselves. These conflicts relate to the allocation of pollution abatement costs, life-cycle management, eco-labelling, packaging, recycling and the use of trade measures for environmental purposes. The challenge consists in the formulation and elaboration of internationally accepted guiding principles and rules in such a way as to ensure that they are not only compatible, but also mutually support and reinforce each other.

3. ELEMENTS OF A RESEARCH AGENDA

3.1 Introduction

The research agenda for the study of trade and the environment should be based on scientific desiderata and possibilities, policy questions prevalent at ministries and international organisations, and should take account of ongoing research, both in the Netherlands and abroad. The Terms of Reference of this programming study indicates a fair number of policy questions that could be considered. They include general questions such as the effects of trade liberalisation on nature and the environment and the trade and social-economic effects of environment and nature protection measures, to more specific questions such as the relation between export production and soil degradation in countries with a weak institutional infrastructure, the desired level of international harmonisation of environmental standards and issues relating to international negotiations on trade and environment.

It appears that most trade-and-environment issues can be classified under three broad headings: (i) the impact of trade (and trade policies) on the environment; (ii) the impact of the environment (and national and international environmental policies) on trade; and (iii) principles, instruments, mechanisms and institutions to reconcile international trade and environment. This classification will be used to structure the policy issues and to draft the research themes.

In this chapter, the major policy issues on trade and environment are presented in section 3.2. Section 3.3 provides a brief overview of ongoing research in the area of trade and environment in the Netherlands and in international organisations. In section 3.4, research questions are formulated on the basis of the interviews held and documentation collected. The research questions are grouped into three major research themes. Then, section 3.5 develops research priorities for a Dutch research programme. Finally, section 3.6 matches the research priorities with the research approaches identified in Chapter 2.

3.2 Policy issues on trade and environment

The purpose of *strategic* economic research on trade and environment is to contribute to a better understanding of the processes and institutions involved, and ultimately, although sometimes indirectly, to contribute to the correction of market and policy failures in this area. Because of this task, academic interest alone is not sufficient to direct the research. To draft an agenda for strategic economic research it is necessary to identify the major policy issues concerning trade and environment in the medium to long term.

In the course of the drafting of this programming study, major policy issues were identified through the collection of relevant policy documents and through interviews with a fairly large number of representatives of national and international organisations.[5] For the Netherlands, we have benefited from an inventory made by RMNO, which included, *inter alia,* research priorities for the area of trade and

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[5] A list of consulted persons and organisations is provided at the end of this chapter.

environment. Important policy questions identified by RMNO relate to the possibilities to *strengthen* national competitiveness by a swift introduction of stringent environmental standards, the efficiency of environmental policy instruments in an open economy and the international comparison of environmental policy instruments, and the environmental impacts of international transport.

The major policy questions expressed by representatives of international organisations are presented below under the three broad headings identified in section 2.3. A summary is presented in table 1.

I Impact of trade (and trade policies) on the environment

The environmental impact of trade policies is a major policy issue. Particularly, attention is focused on the environmental impact of the recent revisions of the Common Agricultural Policy (EC: DG VI and XI), and the impact of the implementation of the Uruguay Round agreement (WWF, UNCTAD, OECD). Sensitive environmental effects include land use and soil degradation. Sensitive economic sectors include agriculture, energy, transport, and waste management. It was often argued that more attention should be paid to dynamic effects on technological innovation and diffusion. The position of less developed countries (LDCs) should receive special attention. Some interesting issues that were raised were: the impact of stricter GATT discipline regarding export controls of LDCs on sustainable natural resource management (WWF); the effects of the TRIPs (trade-related intellectual property rights) agreement on biodiversity (WWF); the impact of trade bans on tropical timber on deforestation (World Bank); and the environmental effects of reducing tariff escalation[6] (UNCTAD, OECD) and barriers against labour-intensive imports from LDCs (WRI). One World Bank officer argued that not too much attention should be paid to unintended side-effects of international trade, as this could divert attention from the real cause of environmental problems: the absence of environmental policies directly addressing the source of the externalities.

II Impact of the environment (and national and international environmental policies) on trade

The international competitiveness of economic sectors and market access of LDCs to Western markets are major policy issues. With respect to market access of LDCs, priority is given to eco-labelling schemes, packaging and recycling requirements (GATT, UNCTAD). Within the EC there is concern about the impact of national environmental policies on competitiveness. The importance of subsidiarity to the formulation of environmental policy might increase in the years to come. Linkages between agricultural and environmental policies may cause difficulties, because agricultural policy is mainly determined at the EU-level (EC). Changing consumer preferences for "environmentally-friendly" products may affect trade flows. Presently, French farm products are losing traditional markets in Germany to domestically-produced "organic" products (EC: DG XI).

III Instruments, mechanisms and institutions to reconcile international trade and environment

The major policy issues concern the internalization of external effects; the extent to which environmental standards should be harmonised across countries; ways and means to arrive at co-operative, positive incentive-based, environmental agreements with LDCs (UNCTAD, World Bank, GATT, WRI); and types of policy instruments to achieve environmental objectives without defying international agreements.

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[6] Tariff escalation occurs when nominal import tariffs (and hence effective protection) increase with the degree of processing, creating effective imports barriers for *processed* goods from LDCs.

Table 1 : The main trade-and-environment policy issues mentioned by a number of international organizations

Organisation	Trade -> environment	Environment -> trade	Reconciliation
European Commission [1)]	Environmental impact of Common Agricultural Policy [VI,XI]; Environmental impact of agricultural subsidies [XI]; Transport [XI]; Content of pollution in traded products [II]; Trade-related impact on land use [VI]	Impact of national environmental policies on trade (e.g. pesticides) [VI]; Competitiveness of EC agriculture [VI]; Impact of changing consumer preferences for 'environment-friendly' products [XI]	Internalization of external effects [I]; Harmonization of standards [I]; PPMs [I]; The role of trade measures for environmental purposes in second-best world [II]; How to arrive at international agreements [II]; Compensation to LDCs for environmental measures [XI]
WWF	Environmental impact of Uruguay Round implementation; Impact of other trade policies and agreements; Environmental impact of GATT discipline on export controls (LDCs); TRIPs and biodiversity	Competitiveness issues (how to avoid that fears on competitiveness hinder strict environmental policies? e.g. aluminium, chemicals, fertilizer)	Criteria for trade-related environmental measures, PPMs, Harmonization; Environmental principles in GATT/WTO; Transparency & public consultation
GATT	Environmental impact of trade in services, e.g. energy and transport; waste disposal	Trade impact of eco-labelling, packaging & recycling; National environmental regulations; Trade provisions in multilateral environmental agreements	Ways and means to bring environment into the market mechanism, e.g. by paying for environmental services of LDCs (carbon storage, biodiversity)
UNCTAD	Impact of Uruguay Round implementation on sustainable development LDCs; Effects of trade liberalization; Barriers to introducing environmentally-sound technologies in LDCs	Market access of LCDs; Eco-labelling, packaging, recycling	Basic principles; Internalization; Positive incentive-based mechanisms for LDCs
OECD	Impact of changing trade patterns; Impact of tariff escalation; Trade, environmental policies and technological innovation and diffusion; Transport; Waste management	Competitiveness; Choice of policy instruments	Distinction between national environmental standards and protectionism
World Bank	Impact of structural adjustment programmes; Impact of bans on tropical timber on deforestation; Agricultural trade liberalization and land use (including soil erosion); Trade and technological transfer; Not too much attention for unintended side-effects of trade: direct instruments should be used	Market access of LDCs	How to arrive at co-operative agreements with LDCs?

WRI	Effects on resource depletion of barriers against labour-intensive imports from LDCs; Transport; In agriculture: the dynamic effects of policy distortions (including re-search and development)		Assessment of environmental and full resource costs to encourage governments (especially in LDCs) to adopt sound environmental policies
IFPRI	Trade and soil degradation		

[1]   Discussions were held with representatives of several Directorates: I is External Economic Relations; II is Economic and Financial Affairs; VI is Agriculture; XI is Environment.

NB: The policy issues listed in the table represent the opinions of the intervewed persons; they do not necessarily reflect the views of the organisations in question.

3.3 Summary of ongoing research

3.3.1 Research in the Netherlands

According to the RMNO/MEIN II report, the focal points of academic research into international trade and the environment are Wageningen Agricultural University, the Free University Amsterdam, and the Catholic University Brabant in Tilburg.[7] The research projects range from short-term policy studies to longer-term PhD-research. An example is the research by Kox *et al.* (Free University) into the possibilities of so-called 'green' commodity agreements. The total academic research capacity devoted to trade and environment is, however, limited to about three man-years in all.

There is also some general environmental research with an international trade component. Of special interest is also the work on international nutrient balances in agriculture by SOW-VU, and the research for *Stichting Tropenbos* which, *inter alia*, pays attention to the links between deforestation and international timber trade. Outside the universities, research on trade and the environment is carried out by the Agricultural Economics Research Institute (LEI-DLO).

3.3.2 Research in international organisations

Much excellent research on the subject of trade and environment has been carried out by OECD and the World Bank. Research activities can be broadly divided in conceptual analysis (e.g. OECD on PPMs and optimal instrument choice), and modelling exercises with Computable General Equilibrium (CGE) models including one or more environmental variables (OECD, World Bank). There is considerable scientific and policy interest in the field of trade and the environment, but sometimes empirical research is hampered by insufficient theoretical analysis and lack of data (World Bank). There is a growing interest at international organisations in research into the effects of economy-wide

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[7] RMNO (1994), op. cit.

policies (structural adjustment programmes) in LDCs on the environment (World Bank, OECD Development Centre, IFPRI). Trade policies constitute an important element of these research programmes. A summary review of ongoing research at a number of international organisations is presented in table 2.

Table 2 :   Ongoing trade-and-environment research at a number of international organizations

Organisation	Department	Research projects
OECD	Agriculture	The 1995 work programme is expected to include: (a) links between Uruguay Round outcomes and the environment; (b) the effects of domestic environmental policies on trade; (c) global and multilateral issues affecting other sectors as well as agriculture
	Trade	Conceptual work and case studies on PPMs; Developing guidelines for "reviewing" the impact of trade policies on the environment, and the impact of environmental policies on trade; Research in the areas of transport and waste management; Research on optimal instrument choice.
	Environment	Preparation of guidelines on trade-and-environment issues for the OECD-ministers council in June 1995.
	Development Centre	The 1993-1996 Research Programme includes: Environmental policy, trade reform and development in the Pacific Basin (CGE model study incorporating Mexico, Costa Rica, Chile, Indonesia, Thailand and China); Assimilation of sustainable and environmentally sound agricultural technologies in LDCs; Renewable resources management and (trade) policy in LDCs; There is no active global modelling work at the moment.
World Bank	Policy Research Department, Trade Policy Division	Research on economy-wide policies and resource degradation by Ramon Lopez: theoretical work and case studies on Ghana and Ivory Coast; The development of an integrated theoretical model of international trade and environmental flows by Arvind Panagariya.
	Policy Research Department, Public Economics Division	Two projects: (a) do environmental protection measures in industrialized countries lead to more or less pollutive industries in LDCs? (findings: it makes no difference), (b) do foreign direct investments in LDCs seek out more pollutive industries? (findings: little or no evidence)
	Environment Department	Effects of economy-wide policies (including trade policies) on the environment, with a focus on agriculture; Long-term research on desertification and dryland management issues with trade links (Machakos District in Kenya). Follow-up is expected in West Africa.
WRI		The effects of agricultural policy on soil erosion in the U.S; Research on 'win-win' situations.
IFPRI	Environmental and Production Technology Division	Effects of economy-wide policies (including trade policies) on soil degradation and improvement; Development of regional models to examine the sustainable development of fragile lands.
WWF		Country case studies on the impact on Northern' countries agricultural policies on deforestation in the South; Various policy research projects.

3.4 Research questions by theme

The policy issues identified in section 3.2 are classified under three broad headings: impact of trade (policies) on the environment; impact of environment(al policies) on trade; and ways and means to reconcile trade and the environment. These headings can also be used to classify research on the subject of trade and the environment.

On the basis of the interviews held and documentation collected during this programming study, and the theoretical analysis carried out in the first phase of this study (NRLO, 1992), the following research *questions* can be formulated under the three major research *themes*.

I *Impact of trade (policies) on the environment*

1 What is the impact of changes in trade patterns on environmental quality and resource use? What are the environmental effects of trade liberalization in agriculture and other sectors?

2 What is the impact of changes in trade patterns and trade regimes on technological innovation and diffusion? Does free trade slow down technological innovation (because of the Pollution-Haven effect) or does it encourage technological innovation and diffusion? What is the role of multi-national companies?

3 What are the environmental effects of the prevalent structure of trade barriers? What are the effects of tariff escalation on environmental problems at different product life cycle stages? To what extent do anti-labour barriers against imports from LDCs lead to increased natural resource depletion?

4 What is the pollution content of international trade flows? To what extent does the pollution content of imported goods differ from that of exported goods for specific countries? How strong is the 'pollute-thy-neighbours-through-trade' effect?

5 How strong are the environmental effects related to international transport? What are the full costs of various transport modes? What are the effects of internalization on patterns of production and trade and on the environment?

II *Impact of environment(al policies) on trade*

6 What is the impact of environmental protection on international competitiveness? For example, is it possible to maintain an ecologically sustainable **and** competitive agricultural sector in Europe? What are the effects of strict environmental policies on the pollution-intensive and pollution-abatement sectors in the Netherlands and Europe, and what is the impact on growth and employment on balance?

7 What is the impact of different policy instruments on international competitiveness and environmental quality? What are the possibilities of market-based policy instruments and self-regulation? What are the consequences of (having to use) second-best instruments, and how to minimize their costs.

8 What is the optimal policy level for dealing with different environmental problems? The optimal policy level depends on the regional scale of the environmental problem. Which institutions fit which problems best? What are the next-best institutions and how to minimize efficiency losses of second-best solutions?

9   What is the link between environmental policy and technological innovation and diffusion? Can environmentally induced technological innovation turn strict environmental protection into a competitive advantage?

10 What are the consequences of Western environmental policies for LDCs? What is the impact of strict Western product (and production) standards on market access and development of LDCs?

III   Reconciling international trade and environment

11 How can the costs of resource degradation and future scarcity be internalized in world market prices? The Polluter Pays Principle is a generally accepted principle to internalize external costs. However, how to deal with situations where the costs and benefits of environmental measures are very unevenly distributed between countries? How can the costs be measured, especially in cases of extreme uncertainty and/or irreversibilities?

12 Should environmental standards be harmonised internationally? If so, for which problems, which type of standards (ambient, emission, PPMs) and at what level?

13 How can the concept of integrated chain management be operationalized in an international context? In the presence of differences in capacity to cope with environmental and natural resource degradation, countries will display differences in comparative advantages justifying variations in environmental standards across countries.

14 How to distinguish between strict domestic environmental standards and protectionism; and how to avoid the protectionist abuse of environmental standards? How to deal with the precautionary principle?

3.5 Towards a research agenda

On the basis of the research questions, 11 preliminary research proposals have been formulated. These proposals, which constitute elements of a research agenda, are not intended to *limit*, but to *guide* future research in the area of international trade and the environment. The research ideas are elaborated in chapter 4. Arguments for the selection of the research proposals are included under the headings policy relevance and scientific interest, where an outline of the main research questions is presented. The 11 research proposals are:

Model studies:

1a   The impact of GATT, CAP and environmental policy on EC agriculture: a modelling approach;

1b   Production, trade and environmental effects of domestic policies using an environmental AGE model for the Netherlands.

Case studies of life cycle analyses:

2a   The economic and environmental impacts of the globalisation of horticultural production;

2b   Environmental, economic and social impacts of international trade of "non-hazardous" waste for recycling purposes between industrialized and developing countries;

2c   Soil degradation in LDCs, international nutrient flows an trade liberalisation;

2d   Environmental effects of anti-processing tendencies and barriers against labour-intensive imports from developing countries.

Fundamental-strategic studies:

3a International trade and nature conservation;

3b International trade, international transport and its environmental effects;

3c Links between environmental cooperation and trade;

3d Instruments in environmental policy and agricultural trade;

3e Trade agreements, environmental policy and the innovation process in agriculture.

3.6 Matching research themes and research approaches

In Chapter 2, three different *approaches* (modelling, life-cycle analysis, and fundamental-strategic research) were advocated to carry out research on the subject of trade and environment. In this section we indicate how these research approaches correspond with the major research themes and the research questions, summarized in section 3.4 above. Table 3 presents a matrix which confronts research themes and questions (rows) with research approaches (columns). The cells of the matrix contain numbers corresponding to specific research ideas presented above.

Table 3 : Matching research themes and research approaches

Research themes	Research questions	Research Approaches		
		Model studies	Case studies (LCAs)	Strategic, theoretical studies
I Impact international trade on environment	1	1a, 1b	2a, 2c	
	2			3e
	3		2d	
	4		2c	
	5			3b
II Impact environment on international trade	6	1a, 1b	2a	
	7			3c, 3d
	8			3c
	9		2b	3e
	10		2a, 2b, 2c	3a
III Reconciling trade and environment	11			3a, 3c
	12		2a	3a
	13		2a, 2b	3d
	14		2a	3a, 3d

Table 3 shows that all research themes and questions are addressed with at least one research idea. However, other ideas could be also be fitted into the matrix, preferably combining research questions and approaches not yet covered by our provisional research ideas (empty cells).

Annex: List of consulted persons and organisations

European Union (EU), Brussels
- DG I (External Economic Relations)   H. van Vliet
       N. Christoforides
- DG II (Economic and Financial Affairs)   K.J. Munk
       M. Mors
       G.J. Koopman
       J. Scherp
- DG VI (Agriculture)   H. Versteylen
       M. Scheele
- DG XI (Environment)   B. Delpeuch
       M. Debois
       C. de Vries
- DG XII (Science, Research and Development) D. Diane

GATT secretariat, Geneva   R. Eglin

International Food Policy Research Institute (IFPRI), Washington, D.C.
- Environment and Production
  Technology Division   S. Scherr
       S. Vosti

Ministry of Agriculture, Nature Management and Fisheries, The Hague
- Directorate International Affairs   G. Meester

       A. Vermue

OECD, Paris
- Agricultural Directorate
  - Policies Division   W. Legg
         R. Steenblik
         L. Maier
  - Quantitative Analysis   D. Diakosavvas
- Trade Directorate   E. Moisé
- Environment Directorate   C. Stevens
- Development Cooperation Directorate   D. von Felbert
- Development Centre   D.W. Roland-Holst

UNCTAD, Geneva   R. Vossenaer

<u>University of Groningen</u>
-       Faculty of Economics   C.J. Jepma

                                                        D. van Soest

<u>World Bank, Washington D.C.</u>
-       International Economics Department,
        -   International Trade Division   P. Low
-       Environment Department
        -   Pollution and Env. Econ. Division   M. Munasinghe
-       Operations Evaluation Department
        -   Agriculture & Human Dev. Division   J. English
-       Policy Research Department,
        -   Trade Policy Division   M. Schiff
        -   Public Economics Division   G. Eskeland

<u>World Resources Institute (WRI),</u>
<u>Washington D.C.</u>   R. Repetto

<u>World Wide Fund for Nature (WWF),</u>
<u>Gland</u>   C. Arden-Clarke

4. PROPOSALS FOR RESEARCH PROJECTS

The present chapter presents a number of preliminary research proposals in which one or more of the research questions listed in section 3.4 are elaborated. The research proposals are classified according to research approach. Together they make up a first research agenda.

The research proposals follow a common format. First, a brief list of main research questions is presented. After that, a more detailed description of the proposed project is given, starting with an elaboration of the research questions. Next, the policy relevance and scientific interest are indicated. Finally, suggestions with regard to the research methodology or approach to be used are provided where appropriate, and references to some major studies in the field and data sources that could be used are presented.

Proposal 1a Policy modelling for EC agriculture

1. TITLE

THE IMPACT OF GATT, CAP AND ENVIRONMENTAL POLICY ON EC AGRICULTURE: A MODELLING APPROACH

2. OUTLINE OF THE MAIN RESEARCH QUESTIONS

The overall objective of the proposed study is to develop a modelling tool which is appropriate to assess the impact of GATT, CAP and environmental policies on EC agriculture and patterns of trade. The study is to build upon the agricultural models that are available yet and upon the evaluation of such models from the present programming study. Models need to be adjusted in order to link environmental policy and CAP to EC agriculture.

The study is proposed to have two subsequent but interrelated parts:
-    The first part of the study does focus on a qualitative assessment of linkages among GATT, CAP and environmental policy and their impact on EC agriculture.
-    The second part is aimed to operationalise the modelling instrument. A start will be given towards a product-oriented apprach with a limited number of casestudies, to be followed by a modelling stage.

3. DETAILED DESCRIPTION

3a. Elaboration of the main research questions

In order to realise the research effort the following key questions need to be addressed:
1   A limited number of agricultural products (three to four case-studies) will be identified and elaborated during the first stage of the project. These case-studies are aimed to assess linkages with GATT, CAP, environmental policy and the allocation of production. The role of these products in global trade flows need to be considered. The case-studies of agricultural products might focus on:

(a) Tomatoes. They are grown in northwestern Europe under glass with high energy demands as well as in the Mediterranean regio. This product also depends on export markets from outside the EC (e.g. Morocco). Direct energy needs for production and indirect energy consumption for transport and processing need to be considered.

(b) Pigs. Forthcoming environmental regulation in several countries on the treatment of animal manure might largely distort competitiveness of intensive livestock production in the years to come. Linkages with CAP and GATT negotiations need to be considered because of their possible impact on the price of raw material of feed concentrates.

(c) Dairy products (e.g. milk). Linkages with regulation to diminish nitrate pollution and market regulation among others need to be made.

(d) Cereal crops. The impact of market regulation and environmental policy (e.g. pesticide usage) need to be considered.

2   The second stage of the project will include the identification of strong and weak points of the available models in order to examine interactions among GATT, CAP and environmental policy and their impact on EC agriculture. This will provide the essential elements on the adjustments required of the available agricultural economic modelling tools. Limitations on the kind of instruments and policy objectives will be identified as well.

3   The third stage of the project will consider operationalisation of the modelling tool. This part of the study will build upon the major findings of stages 1 and 2 and the findings of the programming study.

3b.   Policy interest

The main objective of the study is to examine the impact of scenarios of GATT-trade liberalisation, CAP-reform and environmental policies on EC agriculture. Such work is of policy interest from various perspectives.

-    Linkages among CAP and environmental policy and their impact on agriculture in the EC is gaining importance, both from an agricultural and an environmental perspective. This will most likely also hold for the proposed study:
     - First, the proposed work is to contribute to the Fifth EC Environmental Action Programme. The aim is to achieve an ecologically sustainable economic development.
     - Second, the EC Agricultural Council declared in 1992 to make environmental protection an integral part of the Common Agricultural Policy. Cross compliance between objectives of policy increasingly becomes important in an EC context.
-    Linkages among trade liberalization under GATT with CAP reform and environmental policies.

3c.   Scientific interest / innovative aspects

Several models are available to examine linkages among CAP and EC agriculture (e.g., ECAM, SWOPSIM). Assessments to link GATT, CAP and environmental policy with EC agriculture are rather scarce. The study is aimed to contribute to that research gap.

3d   Research methodology

The first part of the study (stages 1 and 2) mainly require desk research and consultation of the appropriate Ministries to identify the critical linkages among GATT, CAP and environmental policy. Links with modellers should be organised from the very beginning in order to consider any constraints from the models available and also to identify options for adaptation of these models. The second part of the study (stage 3) does mainly require an input from modellers.

3e   Relevant literature and data sources

The project will require data from various sources, both from Member States as well as from the CEC.

Folmer, C. *et al.* (1993) CAP reform and its differential impact on member states. Agricultural Economics Research Institute, The Hague (mimeographed).

Haley, S.L. (1993) Environmental and agricultural policy linkages in the European Community: The nitrate problem and CAP reform. U.S. Department of Agriculture, Economic Research Service, Agriculture and Trade Analysis Division, Washington D.C.. Working Paper 93-3.1.

Proposal 1b Environmental AGE model

1. TITLE

PRODUCTION, TRADE, AND ENVIRONMENTAL EFFECTS OF DOMESTIC POLICIES USING AN ENVIRONMENTAL AGE MODEL FOR THE NETHERLANDS

2. OUTLINE OF THE MAIN RESEARCH QUESTIONS

The main research question is how to model the interface between economic activity (production and trade) and the environment in the Netherlands economy. This has not been done before because, inter alia, of insufficient data, imperfectly understood environmental responses and the complexity of the problem. Developments in applied general equilibrium theory and the availability of new environmental data make it possible to incorporate the interface between economic activity and the environment into a national multi-sector model. In this research the possibility of adapting existing applied general equilibrium (AGE) models for the Netherlands in order to incorporate information from the Environmental Accounts for the Netherlands (CBS) will be examined. The final purpose of this exercise would be the construction of a real environmental AGE model.

3. DETAILED DESCRIPTION

3a. Elaboration of the main research questions

There are three available AGE models for the Netherlands which could be adapted for this purpose. The first is a model originally developed by Keller (1979) but which is extended at the Central Bureau of Statistics (Zeelenberg, et al., 1991). The second is the MIMIC model developed by the Central Planning Bureau (see Gelauff, 1992). The third model is WAGEM (Wageningen Applied General Equilibrium Model) developed by Peerlings (1993). These models have their strong and weak points with regards to the incorporation of environmental variables.

The Keller and MIMIC models focus on tax issues. Clearly, the design of these models reflects their purpose, requiring for example considerable disaggregation over households. The Keller model is not much used currently, whereas MIMIC is frequently used at the Central Planning Bureau to support politicians in policy decisions on tax issues.

WAGEM has a different purpose. It studies the effects of changes in agricultural policies on Dutch agribusiness, and traces these effects throughout the economy, including factor use and trade. The model includes a disaggregation of the agricultural sector and focuses on agricultural policy instruments.

A study of the potential for adapting one of these models to incorporate environmental effects would begin by identifying the requirements for building an environmental AGE model. The list of requirements should incorporate the desired level of aggregation (e.g. the inclusion of different agricultural industries), a rather detailed modelling of trade relations (e.g. disaggregation of the "rest of

the world"), intertemporal relations (e.g. stocks of pollution) and the possibility of including different policy instruments.

These requirements would then be used to examine the feasibility of adapting each of the three models. The result of this first stage of the project would be a ranking of the usefulness of the three models as a basis for an environmental AGE model. The second stage of the project would involve constructing the model.

3b. Policy interest

An environmental AGE model would permit the simulation of the effects of both economic and environmental policy changes within the Netherlands on production, trade, welfare and environmental variables. It could be a useful tool for policy-makers in the Netherlands in designing and evaluating policy. For example, the net economy-wide effects of various policies for reducing CO_2, SO_2 and NO_x emissions could be determined. Furthermore, the effects of environmental policies directed specifically at the agricultural sector, such as different manure policies, could be assessed for the Dutch livestock industry, agribusiness and agricultural exports. Similarly, the effects of trade policies on both economic and environmental variables could be measured.

3c. Scientific interest / innovative aspects

Environmental accounts have only recently become available. An AGE model which makes use of these data is not yet available, although for CO_2 alone there are a few examples (e.g. GREEN developed by the OECD). Thus from the scientific point of view, the research will cover new ground, and exploit a newly available data base.

3e. Relevant literature and data sources

The environmental accounts for the Netherlands are published by the Central Bureau of Statistics (CBS) for 1989. These environmental accounts (NAMEA) incorporate environmental indicators designed at the CBS in cooperation with the Netherlands Ministry of Physical Planning and the Environment (VROM), and allow them to be related to economic indicators. Moreover the CBS has developed a Social Accounting Matrix (data source for AGE models) for the same year. The existence and mutual consistency of these data sets make the adaption of an environmental AGE model possible.

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Proposal 2a   Globalization horticulture

1.   TITLE

THE ECONOMIC AND ENVIRONMENTAL IMPACTS OF THE GLOBALIZATION OF HORTICULTURAL PRODUCTION

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

I.   Which changes are taking place in the international patterns of production, consumption and trade in horticultural products and what are the main causes of these changes?

II.   Is the international competitiveness of the Netherlands' horticultural sector threatened by domestic environmental regulation?

III.   What will be the environmental effects of changing production and trade patterns, both at home, in emerging producer countries, and on the global environment?

IV.   Is it possible to reconcile environmental concerns and free trade in horticultural products?

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

The horticultural sector is a sector where changes in trade and environmental policies will most probably have far-reaching consequences (Van der Woerd en Rosdorff 1993). The new Dutch environmental measures will most likely influence/change the current production methods. An important issue is in which way and to what extent the environmental regulations will affect the international competitiveness of the Dutch horticultural sector. Among the strengths of the sector are a good infrastructural network, a good geographical position in Europe, high quality products, and a high level of technical know-how. The weaknesses of the Dutch horticultural sector are relatively high labour costs and high energy costs.

Moreover, the ongoing European integration, the democratisation process in Eastern Europe, the liberalisation of international trade in conformity with the Uruguay Round agreement will most likely have their impacts on current international trade patterns. The relatively high and stable world market prices for horticultural products make them an interesting alternative for current cash crops in developing countries with a suitable climate and low labour costs. Since the end of the 1980s several developing countries have started with the cultivation and exportation of cut-flowers, for instance Colombia and Kenya (Albers 1993, Verhaegh et al. 1992).

The Netherlands' horticultural sector is increasingly subject to stringent environmental regulations. This will most likely affect current production methods and, hence, costs (Van der Woerd, Rosdorff, 1993). Given the increased competition on world markets, what effects would the stricter environmental policies have on the competitiveness of the sector?

Eco-labelling schemes have been initiated to induce environmentally cleaner production processes. As eco-labelling is based on life-cycle analysis it has to assess environmental effects in the entire chain of production, transport, consumption and waste. Non-discrimination between foreign and domestic production (national treatment) would require that foreign producers would have equal access to the eco-label. Obviously, the eco-labelling scheme would then have to assess and weigh environmental impacts in (non-European) foreign countries.

3b. Policy interest

This project focuses on strategic policy questions that will be on the (inter)national policy agenda the coming five years. It addresses competitiveness, PPMs, eco-labelling, and it has a definite North-South dimension. Moreover, it addresses a whole array of environmental issues, such as energy use, pesticide-residues, water pollution, soil degradation, and transport externalities. It addresses the relative merits of different types of policy intervention.

3c. Scientific interest / innovative aspects

An important field in which the interrelationship between economy and environment attracts increasing attention is international trade. When environmental policies are absent or insufficient, changes in international trade patterns may have negative welfare effects because of increased environmental degradation. Positive welfare effects occur if changes in trade enhance resource-use efficiency, or shift economic activities to areas with larger environmental endowments. In addition, trade-induced changes in income and its distribution may affect opportunities for environmental management and sustainable development. A priori, it is uncertain which effect will prevail in a specific situation: it is an empirical question.

The scientific challenge is to combine life cycle analysis with a comparative (environmental) advantages approach. Moreover, as the study aims to be forward-looking, technological innovation and diffusion should be included in the analysis.

3d. Research methodology

The obvious research methodology would be a case study approach. It would encompass the collection of economic and environmental data of production processes (including transport to the consumer markets) of (a number of) horticultural products in the Netherlands and one or two emerging competitors in the South (e.g. Colombia, Morocco, Kenya). It would then, perhaps heroically, relate the environmental effects to the environmental endowments and preferences prevailing in the different producer countries. It would then compare the dynamic economic, environmental and welfare effects of non-intervention with several policy options, including subsidies to Dutch producers, trade measures, an international agreement to maintain minimum environmental standards (with or without compensation), and eco-labelling.

3e. Relevant literature and data sources

Albers, K. (1993) Guan rozen zonder doornen; de opmars van de Colombiaanse bloemenindustrie. In: *Onze Wereld* 4: 59-61.

Berenschot (1992) De internationale concurrentiepositie van de Nederlandse bloemenveilingen. Berenschot, Utrecht.

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Igbedioh, S.O. (1991) Minimizing environmental and health effects of agricultural pesticides in developing countries. In: *Ambio* 6: 219-221.

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Woerd, K.F. van der, S. Rosdorff (1993) MIOW-Analyse voor de glastuinbouw. IVM, Vrije Universiteit, Amsterdam.

Proposal 2b   Recycling non-hazardous wastes

1.   TITLE

ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF INTERNATIONAL TRADE OF "NON-HAZARDOUS" WASTE FOR RECYCLING PURPOSES BETWEEN INDUSTRIALIZED AND DEVELOPING COUNTRIES

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

I.   What are the economic, social and environmental impacts of international trade of "non-hazardous" waste materials for recycling purposes between industrialized and developing countries?

II.   At present, what are the type of constraints which limit this type of trade?

III. Should these constraints be lifted? and if so, which strategies can be employed?

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

For several reasons, recycling is particularly important in developing countries. First, ecological vulnerability allows only limited exploitation of local natural resources. Since the shortage of foreign currency constraints import, a lack of raw materials persists. Consequently, the life cycle of existing resources need to be extended. Secondly, the unfavourable economic conditions of extreme poverty and large unemployment in developing countries could be improved by activities such as recycling.

Although the technical aspects of the actual recycling process may not differ significantly from production in industrialized countries, in developing countries it originates from a totally different necessity, depending on local conditions and complexities. Important is the fact that recycling in most developing countries, in contrast to reclamation in the industrialized world, is mainly a market regulated phenomenon with a comprehensive trade and production system all of its own, which is expanding and developing rapidly, without any governmental support. This implies that the recycling industry in developing countries has great potential.

Nevertheless, certain alarming developments within the recycling sector in developing countries should not be ignored. Firstly, many entrepreneurs complain about the decrease in quality of raw materials supply. Too often waste is not cleaned properly, causing loss of quality and limiting the potential for recycling. Beside improved decontamination, more often fresh or primary waste of higher quality should be mixed with secondary waste which has already been recycled, in order to maintain quality. Unfortunately, the amount of fresh waste available in developing countries is limited. This might imply the need to increase the extent of waste imports.

As environmental regulations in industrialized countries oblige producers and consumers to manage their waste, and costs are often too high to make non-subsidized recycling attractive there, large

quantities of separated valuable waste are available which can not be reprocessed cost-effectively. Given the relatively small investments for reprocessing equipment, the current excess in capacity and the abundance of labour, expansion of the recycling activities in some large developing countries (e.g. India, China) through increased waste trade, are possible.

However, the danger of harming the domestic waste sector within developing countries needs to be kept in mind. If international trade of recyclable materials enhances rapidly, the price of secondary materials will decrease substantially. As a result, the local recycling sector will be bypassed. As profit margins are already limited, this could lead to the disintegration of the local collection network. In fact, examples already exist where private waste collectors collectively forced their government to put a ban on the import of recyclable waste.

Another indirect effect of international trade of recyclable materials is its possibly restraining effect on the development of waste prevention procedures in industrialized. If a trade "leakage" exist, entrepreneurs might prefer to export the waste instead of to invest in relatively expensive preventive capital. Regarding this linkage, also potential policy conflicts exist, such as the packaging covenant versus the promotion of waste recycling in the Netherlands.

3b. Policy interest

I   Policy interests for industrialized countries:
-      A short term solution can be found for the problem of the rapidly increasing amounts of separated waste, for which no economic incentives exists for recycling in the North. The collection system of recyclable waste could be expanded and refined, since a larger range of waste materials (including plastics) would become suitable for recycling; however
-      Increased international trade of recyclable materials can cause entrepreneurs to restrict their investments in waste prevention.

II   Policy interests for developing countries:
-      The prior advantage for developing countries to promote the import of recyclable waste materials are the arguments of employment creation and poverty revelation. At present, employment in the recycling sector of developing countries is insecure because of the strong fluctuations of local supply of waste materials. Import could partially stabilize this insecurity;
-      By importing recyclable materials the existing recycling industry will be able to create scale-benefits and to promote innovations; however
-      As mentioned before, great care must be taken with regard to the domestic recycling system. Sudden increase of recyclable waste supply could have a depressing impact on the selling price for domestic waste and thereby imports may indirectly harm the network; and
-      The international trade of waste may also generate negative side-effects. Because current legislation is not clear about what is meant by the terms "recyclable" and "hazardous", sometimes waste is imported which can endanger health and the environment in the importing country.

3c. Scientific interest / innovative aspects

International trade of "non-hazardous" waste materials for recycling purposes between industrialized and developing countries is a subject which is hardly researched. Most of the research on international trade of waste focuses on the hazardous part of the issue. In fact, research on recycling may not neglect this category, because the term 'recyclable' is applicable to many waste materials. Also the present research on recycling activities in developing countries focuses on domestic waste and has hardly investigated international transactions. Yet, already a considerable amount of waste is internationally traded for recycling purposes. The impacts of this trade, both on industrialised and developing countries, are largely unknown. Other interesting subjects related to this issue are trade liberalization, poverty, informal sector, and sustainable industrial development.

3e. Relevant literature and data sources

Abert, J.C. (1983) Resource recovery: economic and institutional aspects. In: *Conservation & Recycling*, 6(3): 139-144.

Beukering, P.J.H. van (1994) The recycling sector in Bangalore: an economic analysis of different types of formal and informal entrepreneurs, recovering urban solid waste in Bangalore (India). In: *Resources, conservation and recycling* (forthcoming).

Vallette, J. and Spalding, H. (1990) *The international trade in wastes: a Greenpeace inventory*. Greenpeace U.S.A., Washington D.C..

Proposal 2c Soil degradation in LDCs

1. TITLE

SOIL DEGRADATION IN LDCs, INTERNATIONAL NUTRIENT FLOWS AND TRADE LIBERAL-
IZATION

2. OUTLINE OF THE MAIN RESEARCH QUESTIONS

I.   Will world market price increases resulting from agricultural trade liberalization in industrialized
     countries have a positive or a negative effect on soil conservation in developing countries?
II. What will be the effect of changing relative crop prices on soil degradation in developing
     countries?
III. In view of the diversity of soil characteristcs within countries and regions, what is the appropriate
     scale of analysis of soil degradation problems?
IV. How will the international pattern of nutrient flows be affected by shifts in production and
     consumption resulting from agricultural trade liberalization?

3. DETAILED DESCRIPTION

3a. Elaboration of the main research questions

Soil degradation in developing countries is affected by many factors. Perhaps the most important one is
the quality of the resource land. Poor soils are much more sensitive to erosion, nutrient depletion or
other processes of degradation than relatively rich soils. The better the quality of the soil, the more
likely farmers are to invest in conservation measures. Land ownership obviously also plays a crucial
role in soil conservation decisions. Another key factor is the (absence of) farmers' awareness of soil
mining. At the macro level, population growth (and policy), agricultural input prices, and prevailing
environmental policies are important factors. The proposed study will focus on still another set of
determinants of soil degradation, namely changes in (relative) prices of agricultural products as affected
by international trade liberalization.

Studies on the effects of trade liberalization in agricultural products by OECD-countries indicate that
world market prices of agricultural products will rise. Whether or not these higher prices will lead to
increased soil degradation in developing countries is unclear. In the first place, it depends on the extent
to which world market prices are transmitted to domestic prices. Agriculture in most countries is
subject to considerable intervention, which creates a gap between world prices and domestic prices, and
which generates cross-country variations in prices. Secondly, it depends on the effect of changes in
domestic agricultural prices on soil degradation. In the literature it has been claimed on the one hand
that higher agricultural output prices in developing countries would encourage soil conservation
practices of farmers (Repetto), and on the other hand that higher prices would stimulate soil mining for
quick, big crops (Lipton). Other authors take intermediate positions.

Part of the controversy in the literature can be explained from the fact that different aspects of the relationship between soil degradation and price changes are addressed. For analysing the effects of trade liberalization on soil degradation, it may be useful to distinguish four different elements that are affected by price changes:

(1) The weighing of current against future production
(2) Changes in farm practices and input use
(3) Decisions with regard to productivity and conservation investments
(4) Changes in the private discount rate of farmers induced by income changes

Trade liberalization in OECD-countries also leads to a shift in relative prices between export and non-export crops within countries.Farmers may respond by adjusting their crop mix when relative prices change. A shift towards export crops may have important consequences for soil quality, because different crops have different effects on soil degradation. At the macro-level, a shift towards export crop production means that nutrients subtracted from the soil are exported out of the country and hence are removed from the ecological system. When no extra fertilization is applied to compensate for these losses, soil nutrient depletion will be the result.

The present international pattern of agricultural trade leads to increasing nutrient shortages in many LDCs and to increasing surplusses of nutrients in high income countries. In the latter, water and air pollution and problems of manure disposal are the result. Trade liberalization will undoubtedly have important effects on this pattern of nutrient flows.

3b. Policy interest

The most threathening environmental problem in developing countries is probably the deterioration and loss of arable land. Government macro-economic, agricultural and environmental policies have important effects on soil degradation. Local factors like resource quality, systems of land ownership, or awareness of soil mining determine to a large extent the outcome of such policies. The proposed study intends to provide more insight into the effects of price changes resulting from agricultural trade liberalization on soil degradation, taking into account these differences in local circumstances.

3c. Scientific interest / innovative aspects

Available studies of the effect of price changes (and agricultural trade liberalization) on soil degradation in developing countries are of a partial nature, adressing specific elements of the relationship. A major purpose of the proposed research project is to come to a farm-level model that combines different aspects (overcultivation, changing farming practices, conservation investments, changing farmer discount rates) of the relationship into a comprehensive model.

Several authors have stressed the strong need for empirical work on the effect of price changes on soil conservation. Case studies may provide empirical estimates of the unknown parameters of the farm model of soil conservation. The resulting empirically validated model may be used to assess the effect of price changes resulting from agricultural trade liberalization on soil degradation in different developing countries.

3d. Research methodology

Several levels of analysis may be distinguished:

(1) The (inter)national level: Analysis of the effect of trade liberalization on world market prices and of changes in international nutrient flows.

(2) The sectoral level: Analysis of effect of policy changes on domestic prices, aggregate production and cropping patterns, and land use.

(3) The farm household and soil level: Analysis of effects of (relative) price changes on soil degradation and conservation measures; non-agricultural activities, consumption, and income play an important role.

Different model types will be needed for each level. Although each level should be considered, the focus should preferably be on the development of empirically-validated farm household models. The unknown parameters may be estimated through detailed case studies.

3e. Relevant literature and data sources

(1) Relevant literature

Barbier, E.B. (1990) The farm-level economics of soil conservation: The uplands of Java. In: *Land Economics* 66: 199-211.

Barrett, S. (1991) Optimal soil conservation and the reform of agricultural pricing policies. In: *Journal of Development Economics* 36: 167-187.

McConell, K.E. (1983) An economic model of soil conservation. In: *American Journal of Agricultural Economics* 65: 83-89.

Mundlak, Y. and D.F. Larsen (1992) On the transmission of world agricultural prices. In: *World Bank Economic Review* 6: 399-420.

Reardon, T. and S.A. Vosti (1992) Issues in the analysis of policy on conservation and productivity at the household level in developing countries. In: *Quarterly Journal of International Agriculture* 31: 380-396.

(b) Data sources at (inter)national level

Oldeman, L.R., R.T.A Hakkeling and W.G. Sombroek (1991) *World map of the status of human-induced soil degradation. Revised 2nd edition.* ISRIC (International Soil Reference and Information Centre), Wageningen and UNEP, New York.

Stoorvogel, J.J. and E.M.A. Smaling (1990) Assessment of soil nutrient depletion in Sub-Saharan Africa: 1983-2000. Report 28. The Winand Staring Centre, Wageningen, The Netherlands.

Dümmer, I.M. (1992) Nutriëntenstromen wereldwijd. In: Verslag 64e tropische landbouwdag. NiLi-KGvL, Wageningen and KIT, Amsterdam.

Schiff, M. and A. Valdés (1992) *The political economy of agricultural pricing policy. Volume 4: A synthesis of the economics in developing countries.* Johns Hopkins University Press, Baltimore. (Appendix: Direct and total nominal protection rates, by country, product, and year)

Proposal 2d Trade barriers against LDC imports

1. TITLE

ENVIRONMENTAL EFFECTS OF ANTI-PROCESSING TENDENCIES AND BARRIERS AGAINST LABOUR-INTENSIVE IMPORTS FROM DEVELOPING COUNTRIES

2. OUTLINE OF THE MAIN RESEARCH QUESTIONS

I.   What are the effects of anti-processing tendencies implied by trade barriers for specific products on the pattern of trade flows and the location and magnitude of environmental problems at each processing stage?

II. What are the consequences of barriers against labour-intensive goods from LDCs for natural resource depletion?

3. DETAILED DESCRIPTION

3a. Elaboration of the main research questions

In recent decades, comparative advantage has shifted toward the developing countries for a range of labour-intensive products and resource-based manufactures that were once produced more efficiently in the industrial countries. In order to protect their declining industries, industrial countries typically have set their tariffs on processed products much higher than on raw materials. Besides, non-tariff barriers such as 'voluntary' export restrictions or regulations affecting quality standards and health and sanitary requirements have increasingly been used to protect domestic manufacturers from foreign competition.

Different stages of the product life cycle (input, processing, final product) are related to different types of environmental effects (resource depletion, pollution, waste disposal). This means that the structure of tariffs and other trade barriers has important consequences for the location and magnitude of different types of environmental effects. Reduction of anti-processing tendencies may lead to different choices with regard to the places where production at each stage will take place, and hence to changes in the resulting pattern of international trade flows. Assuming no changes in technology, this means that the the corresponding international pattern of environmental effects related to each stage (and to international transport) will change accordingly. In addition, increased international competition is likely to stimulate efficiency in processing industries, which means that the total use of raw materials in production is likely to diminish.

Import restrictions on labour-intensive goods from LDCs have important environmental effects as well. Since developing countries have a comparative advantage in labour and in natural resources, raising barriers against labour-intensive imports will imply a shift towards producing resource-intensive goods in LDCs. Increased natural resource depletion will be the result. Rapid population growth rates in LDCs tend to strengthen these adverse environmental effects.

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The purpose of the research is to acquire more insight into the potential environmental effects of reducing anti-processing tendencies and restrictions on labour-intensive imports, and to obtain empirical estimates of the strength of these environmental effects.

3b. Policy interest

Assessments of the (national or global) welfare implications of protecting domestic industries in industrial countries should consider environmental effects as well effects on incomes and prices. The proposed research intends to gain insights into the effects of the main characteristics of the present structure of protection on domestic and international environmental problems, and to obtain empirical estimates of these effects.

3c. Scientific interest / innovative aspects

Except for a few case studies on e.g. tropical timber, the environmental effects of the prevailing structure of trade barriers in international trade have hardly been studied thus far. Existing studies on the subject are of a qualitative nature, based on broad generalizations of locally observed environmental effects of industrial protection. There is a strong need for quantitative studies that give insights into the changes in production and trade at the global level and the environmental effects related to these changes that will result from changing the existing pattern of trade barriers.

3d. Research methodology

Research on this topic should preferably take place at two levels. First, research is needed on international trade flows for specific products (and life cycle stages of products) and how these are affected by the present structure of trade barriers and industrialized and developing countries. Available models of international trade should be examined for their ability to analyse these relationships. Second, specific case studies on a few products and countries are needed in order to examine in more detail the nature of environmental externalities at each processing stage, and how these are influenced by protective government policies. Changes in (environmental) technology that may result from reducing protection should be a major point of attention.

Tropical timber could be an important case study, because of the prevailing high tariffs on processed wood products, the possibilities of linking-up with ongoing research in this area, and because of its (environmental) policy relevance. The case of tropical timber should preferably be contrasted with one or more cases of commodities with relatively high barriers at the lowest levels of processing (e.g. goods with a high agricultural component). Suggestions made by interviewed persons are sugar, dairy, cotton, leather, rubber, cocoa, and fruit juice.

3e. Relevant literature and data sources

Finger, J.M. and S. Laird (1987) Protection in developed and developing countries - an overview. In: *Journal of World Trade Law* 21, 181-199.

Jepma, C. (1993) *Deforestation in the humid tropics: A socio-economic approach.* University of Groningen.

Mather, A.S. (1990) *Global forest resources*. Belhaven Press, London.

Repetto, R. and M. Gillis (eds.) (1989) *Public policies and the misuse of forest resources.* Cambridge University Press, Cambridge, U.K..

Proposal 3a   Nature conservation

1.   TITLE

INTERNATIONAL TRADE AND NATURE CONSERVATION

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

I   What are the main linkages between international trade and nature conservation?
II   Which principles should guide the reconciliation of international trade and nature conservation?
III   What is the scope and effectiveness of trade measures for (international) nature conservation?

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

Because of falling transport costs and the electronic-information revolution, the world's *economies* are linked closer than ever. Companies are competing in a global market-place; national frontiers are loosing their significance. At the same time, the awareness of *ecological* interconnectedness is growing. On the one hand, through the links of international commerce, economic decisions in one nation may affect the ecology of a much larger part of the world. On the other hand, one nation's interference with its ecology may produce ecological and economic wrinklings way beyond its own territory. These mutual linkages between economy and ecology call for a careful re-examination of trade and environmental policies. UNCED calls for a mutual enhancement of trade and the environment.

But, do the principles that are emerging to solve the tensions between trade and environmental pollution (polluter-pays principle, distinction between national, transboundary and global pollution; distinction between product and production method), equally apply to national and international nature conservation ? Is there need for other and/or additional principles?

1.   The external costs of pollution should be internalized in market prices by applying the "polluter-pays principle". Is its natural-resource analog: the "user-pays principle", equally well fitted to solve problems between trade and nature?

2.   The strict distinction between product and production and processing method is not always satisfactory to the public, in particular with respect to the trade of animals and plants caught in the wild. A large number of nature-related trade measures do in fact address production methods: either because of the dangers of ecological disruption or because of the perceived cruelty of certain methods of catch, storage and transport (the animal rights issue).

3.   In the practical implementation of the synthesis between trade and environment, a distinction is made between domestic and transboundary or global environmental problems. For pollutants this distinction is more or less clear, but how to define "domestic" and "international" nature conservation

concerns? What one country may call a "Concern of Humankind", another country may call a "Domestic Affair". What are the criteria and who is to decide?

4. What is the scope and effectiveness of (unilateral or multilateral) trade measures for nature conservation? What are their economic consequences? When are they covert protectionist' trade barriers? Are there feasible alternatives?

3b. Policy interest

Nature conservation policies may collide with trade policies in a variety of ways. First, nature conservation policy may directly address trade flows with the objective of promoting nature conservation abroad. Examples are trade measures aimed at protecting exotic endangered species of fauna and flora and the Netherlands' resolution to ban the imports of unsustainably produced tropical hardwoods as of 1995. Second, the design of nature conservation policies aimed at protecting domestic fauna and flora may be influenced by commitments concluded within multilateral trade agreements or within the context of regional economic integration (EU).

3c. Scientific interest / innovative aspects

International trade and nature conservation is a research subject with ecological, economic, moral, political, and (international) legal aspects. It touches on the very essence of sustainable development. The purpose of this project would be to unravel the various aspects and to develop an analytical framework to deepen our insights in this sensitive area.

3e. Relevant literature and data sources

Arntzen, J., I.Hemmer, O.Kuik (eds.) (1992) *International trade and sustainable development.* VU University Press, Amsterdam.

Barbier, E.B., J.C. Burgers, T.M. Swanson, D.W. Pearce (1990) *Elephants, Economics and Ivory.* Earthscan Publications Ltd, London.

Barbier, E.B. and M. Rauscher (1992) Trade, Tropical Deforestation and Policy Interventions, Discussion Paper No. 15. Beijer Institute, Stockholm.

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Regeringsstandpunt Tropisch Regenwoud, (1991) Tweede Kamer, Vergaderjaar 1990-1991, 21517, nrs 2-3, Den Haag.

Verbruggen, H. (1991) Contours of a sustainable international trade system. In: *Internationale Spectator,* 45, 686-691.

Proposal 3b   International transport

1.   TITLE

INTERNATIONAL TRADE, INTERNATIONAL TRANSPORT AND ITS ENVIRONMENTAL EFFECTS

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

The research issue evolves from developments in two different areas, international trade and environmental policy, which may conflict; trade liberalization will obviously result in an increase of commodity flows which is, because of the environmental impacts due to transport, at variance with the objectives of environmental policy. The question is "how do these developments conflict and to what extent can this conflict be mitigated?".

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

The analysis involves a number of research topics related to commodity flows:
- what are their environmental impacts?
- what are their economic characteristics, in particular the costs of transport versus value added ("trade elasticity for transport costs")?
- what are the trends in their developments - rates, modal splits, transport technologies - and the environmental aspects involved?
- how might they be affected by environmental measures?
- what will be the economic impact of environmentally hampering of international transport?
- which might experience major impacts?

3b.   Policy interest

Removal of trade barriers is a means to stimulate economic development, however, environmental policy, affecting the transport sector, will raise a new barrier: increased transport costs. Clearly there is a societal interest in the eventual outcome of both developments. From the policy point of view it is of interest:
- which sectors (commodity flows) are hampered in their developments by environmental restrictions;
- which sectors are major in contributing to environmental problems;
- which measures are appropriate for addressing identified problems.

3c.   Scientific interest / innovative aspects

Studies made to obtain **comprehensive** detailed information about type of commodity and environmental aspects due to its transport are not known. LCA studies are related to the area in as much as

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environmental aspects of transport are assessed. With respect to transport, the critique on LCA studies as being static and not accounting for technological changes, is also relevant.

3d.   Research methodology

The research involves characterization of commodity flows with respect to the volume of trade in physical terms, the countries of origin and the transport mode. Such information, combined with technical data (emission factors), make possible the calculation of the emissions relating to each commodity flow involved. Trade statistics will be the main source of basic information, emission factors are well known (in most cases transport modes will be known, at least for extra-european trade). Economic statistics and related literature are also the main source for economic data related to commodity flows. Interviews of sector-specific industrial and merchant associations might add relevant information.

The next step - the choice how to model - requires reviewing existing models and deciding on their use. Top-down models which may be appropriate, producing information about commodity flows, are use in transportation studies in the process of planning of infrastructure (rail traffic, inland shipping, road traffic). These models can easily be extended to capture environmental pollution. In the Netherlands such type of model is used by NEA, a consultancy bureau for transport issues. Their Transport Economic Model (TEM II) was recently used to create freight-transport scenarios derived from CPB's long term scenario's (NEA, 1992, NEA, 1993). These scenario's encompass calculations of emissions to the atmosphere.

These models use a typical top-down method, the effects of environmental measures on transport are not modeled. These aspects are, in principle, comprised in the models producing the economic scenarios. Nevertheless, these models are useful in assessing the magnitude of environmental pollution in the perspective of total environmental effects. It is an obstacle that these models may be not available for scientific research.

Bottom-up commodity specific "models" can be constructed from the specific information gathered in the first steps of the present research idea. The methodology to design such models depend on the type of commodity and the available data and, therefore, may vary widely.

3e.   Relevant literature and data sources

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Proposal 3c   Environmental cooperation and trade

1.   TITLE

LINKS BETWEEN INTERNATIONAL ENVIRONMENTAL COOPERATION AND TRADE

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

The textbook case for free trade assumes the absence of externalities in both production and consumption. When externalities are present, the first-best situation involves full internalisation of externalities at source in conjunction with the maintenance of free trade between countries.

Two types of second-best situation may be envisaged:

- failure of some countries to implement first-best internalisation policies
- departures from free trade policies as a means of enforcing international environmental agreements

The first case has already been widely studied in the literature (see NRLO, 1992). Even when the effects of the uncorrected externalities are exclusively domestic, friction in trading relations results and third countries exert pressure for trade measures to enforce a "level playing field". When the effects are transnational, then third countries are motivated by environmental rather than commercial reasons to seek international agreements to control the behaviour of externality-generating countries (Blackhurst and Subramanian, 1992).

This leads to consideration of the second case, and the focus of this research proposal: under what conditions, if any, will trade measures be part of a second-best solution to the problem of establishing an international environmental agreement?

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

The difficulties of establishing and maintaining cooperative international environmental agreements have focused interest on the conditions under which such agreements can be reached and are self-enforcing. Motivation for cooperation can vary greatly between countries, as illustrated by Mäler's (1989) study of the disparity in incentives amongst European countries for cooperating in an abatement agreement. In such cases, cooperation might be encouraged by the offer of side payments or other positive incentives, including trade concessions, or the threat of sanctions, not least sanctions relating to trade either in the products concerned or other products (Blackhurst and Subramanian, 1992). It has also been noted by various authors that, once a cooperative agreement has been reached, trade sanction threats may act as a deterrent to free-riding amongst cooperators and other trade measures might be used to prevent the agreement being undermined by non-cooperators.

There is a degree of consensus in the literature favouring positive rather than negative incentives and enforcement measures, and non-trade instruments in preference to trade instruments. This concurs with the position of the GATT (GATT, 1992). Some authors have, however, pointed out difficulties with side-payments and have given cautious consideration to the potential of trade measures to enforce agreements in situations still to be determined (see for example Folmer, 1993).

Vanzetti (1994) considers the impact of trading blocks on the feasibility of reaching and maintaining a cooperative international agreement on environmental standards and measures. Since self-enforcing cooperative agreements can be reached more easily the smaller the number of parties, he considers a multi-stage negotiating process, first within, and then between groups of countries.

The existence of trading blocks and the use of trade sanctions or concessions necessarily imply a departure from free trade. However, given that reaching and maintaining international environmental agreements is not costless, the question arises of the most appropriate instruments for achieving a second-best solution, and of the conditions, if any, under which the appropriate instrument might be found in the domain of trade policy. There is a need for more analysis of these alternatives.

3b. Policy interest

These issues are already on the international policy agenda. The positions of trade interests and environmentalists tend to be determined by a subset of the issues involved. Policy-oriented scientific research should make a valuable contribution.

3c. Scientific interest

Continuing development of the theoretical core of the subject area.

3d. Research methodology

Theoretical development of the links between trade and the environment in a dual-objective international bargaining framework, in order to investigate the possibility and consequences of second-best outcomes, using appropriate analytical methodology that includes game-theoretic and public choice perspectives.

3e. Relevant literature

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Proposal 3d Environmental policy instruments

1. TITLE

INSTRUMENTS IN ENVIRONMENTAL POLICY AND AGRICULTURAL TRADE

2. OUTLINE OF THE MAIN RESEARCH QUESTIONS

- What is the relation between the Polluter-Pays-Principle and instruments in agriculture used to reduce deterioration of the environment;
- What are potential conflicts between instruments used in national environmental policy and international trade agreements;
- What is the nature of instruments in environmental policy in agricultural trade;
- What is the relation between potential policy instruments and available modelling tools;
- What will be the impact of instruments in environmental policy on agricultural trade.

3. DETAILED DESCRIPTION

3a. Elaboration of the main research questions

Growing concern on environmental problems caused by agriculture has led to the introduction of physical regulation and legislation to control agricultural pollution in several countries. Packages of control measures are developed including objectives to reduce emissions. More often than not, these objectives are to be achieved by command and control measures. Recently, more attention is paid to the use of economic instruments to control environmental deterioration by agricultural activities.

Environmental problems in agriculture reflect the price system's inability to achieve the socially optimal production allocation. In order to correct these market imperfections, economic instruments like charges and taxes can be applied. Economic instruments in agriculture used to reduce deterioration of the environment are considered to be more effective and efficient in meeting the environmental policy objectives than the more widely used environmental regulations. Furthermore, the use of market-conformed instruments meets the Polluter-Pays-Principle (PPP). The PPP has been adopted as a guiding principle in environmental policy by the OECD as well as by the EC. However, its actual use in agriculture has been very limited until now. Therefore, the EC (in the fifth action programme 'Towards Sustainability, 1992) as well as the OECD (in various publications and unpublished papers) are proposing to broaden the range of instruments from legislation towards market-conformed instruments.

However, environmental policy may influence trade pattern directly and/or indirectly. Instruments - physical regulations as well as economic instruments - applied in environmental policy may have negative effects on the competitiveness of agricultural producers. Producers may ask for support measures or even protection at the border because they feel being discriminated against foreign competitors who face less strict environmental standards. On the other hand, imports may face restrictions when domestic environmental policy is aimed at reducing consumption. Then foreign suppliers may feel discriminated and may challenge the trade restrictions.

The General Agreement on Tariffs and Trade (GATT) in which the world's trading rules are laid down, is primarily concerned with preventing discrimination between home products, imports, and exports. However, measures taken to protect the environment which might discriminate between countries and markets may be acceptable under Article XX of the GATT, when certain conditions are met. This means there is still some room for environmental policy although it may distort trade. Differences in interpretations of the rules may result in conflicts between countries about the use of instruments in environmental policy.

From the above, the tensions between trade and environmental policy may be clear. The potential trade restricting effect of instruments used in environmental policy may limit their application. The question is which instruments are most appropriate to meet the Polluter-Pays-Principle. The instruments are aimed to reduce negative environmental consequences of agricultural production. Meanwhile they also should hamper trade to a minimum extent.

3b. Policy interest

There is much concern over the potential impact of national environmental policy on international trade. Such a policy might act as a trade barrier. Policy makers are calling for research focusing on the consequences of instruments applied for environmental purposes for international agricultural trade. Research should identify the nature of instruments in national environmental policies and the consequences they may have for international trade in agricultural commodities. Trade agreements, like the one in GATT recently signed, are aimed to level out trade barriers. Such agreements may restrict the potentials for environmental policy. Global adherence to instruments allowed to use in environmental policy are not made yet. Such adherence will be needed when environmental issues will be more in front of the trade discussions in a next GATT round.

3c. Scientific interest / innovative aspects

The application of instruments in environmental policy is high on the national policy agenda. Concern is expressed about the implications of instruments used for international competitiveness and trade patterns. Linkages among those instruments and international trade are scarcely known. This study is aimed to contribute to that gap.

3d. Research methodology

The concept of the Polluter-Pays-Principle will be considered by literature research. Potential use of instruments in agriculture to protect the environment within the concept of PPP shall be identified. Discussions with experts can be used to examine whether the possibilities of applying instruments will fit in the PPP-concept. Furthermore, international trade agreements need to be analyzed for the limitations they set to measures taken to protect the environment. Focus will be on the GATT.

After the relation between the PPP-concept and potential instruments in environmental policy is elucidated, the focus will be on the nature of such instruments and their impact on agricultural trade. This will be done by analyzing the possible consequences of applying instruments identified for

international agricultural trade in a qualitatively, theoretically way. It needs to be stressed that this analysis will relate to agricultural outputs as well as in inputs.

Available modelling tools are surveyed in order to see whether they are suitable to be applied in assessing options for instruments in environmental policy for agricultural trade. Research will be done into the model requirements so that those models can contribute to assessments regarding agricultural trade and environment. This part of the research proposal will proceed with the evaluation of available modelling tools, already started with in the programming study.

Proposal 3e   Innovation processes in agriculture

1.   TITLE

TRADE AGREEMENTS, ENVIRONMENTAL POLICY AND THE INNOVATION PROCESS IN AGRICULTURE

2.   OUTLINE OF THE MAIN RESEARCH QUESTIONS

International trade agreements and environmental policy both induce innovation in agriculture. The proposed study is to examine their impact on the technological innovation process and the adaptation processes in agriculture. A series of consistently organized case-studies on the inducement of innovation are proposed. These are aimed to increase the understanding of the extent that a sub-optimal technological innovation might result from environmental policy and trade agreements.

3.   DETAILED DESCRIPTION

3a.   Elaboration of the main research questions

The inducement of technological innovation responds to environmental policy as well as to international trade agreements. The adaptation and organisation of new technologies in agriculture also needs to be considered for several reasons. First, farmers may wait with investments because of uncertainty on future policy. Second, farmers may wait with new investments because of loss of present capital. The impact of trade agreements on the innovation process may however differ from the impact of environmental policies. Environmental policy for example may induce emission-reducting technologies whereas liberalization of agricultural markets may primarily induce cost-reducting technologies. Possible tensions of this kind need to be considered in the study.

The objective of the proposed study is first to examine the impact of agricultural policy and trade on the environment and second to examine their impact on technological innovation in agriculture. The main objective of the study is to examine the impact of trade and environmental policy instruments on technological innovation in agriculture. This examination will be elaborated by some case-studies. They should support insight into the extent to which environmental policy instruments induce technological innovation in agriculture.

3b.   Policy interest

Meeting environmental standards requires major adjustments of farming practice during the years to come. Technological innovation is considered to be critical in order to diminish deterioration of the environment. Changes in environmental policy may therefore depend to a large extent on the availability of technological innovation. Also, policy may limit or even counteract the inducement of technological innovation.

The study is to examine the impact of linkages among the kind of policy instruments used to meet environmental objectives and their impact on technological innovation in agriculture. The study furthermore allows to examine the extent to which trade agreements and environmental policy cause a sub-optimal inducement of new technologies in agriculture.

3c.   Scientific interest / innovative aspects

Agricultural policy and competitive advantages of regions have largely contributed to concentration of agriculture. Competitive advantages were improved through innovation, rationalisation of production processes and integration of chains in the production processes. This caused a major deterioration of the environment. Numerous policies were identified during the past decade in order to diminish deterioration of the environment. Environmental policy and CAP may largely affect technological innovation in the EC.

3d.   Research methodology

It is proposed to elaborate the main research questions through a series of consistent case-studies. Examples might be the role of BST and cattle farming, manure policy in the Netherlands, energy prices in horticulture under glass, and integrated farming practice in arable crop production of the Netherlands.

5. CONCLUSIONS AND RECOMMENDATIONS

An important conclusion emerging from this programming study concerns the small total research capacity available for the study of trade and environmental problems. Strategic research in the Netherlands in this field is limited in scale, both in universities and research organisations, confined to a few issues only, and largely dependent on external funding. As a result, research is either of a fundamental nature or fairly applied. It is therefore recommended to strengthen the strategic research capacity in the field of international trade, the environment and nature within the proposed national research programme on environmental economics.

Policy issues and research questions mentioned by a variety of national and international organisations can be divided into three major research themes. (1) The impact of international trade (and trade policy) on the environment. (2) The impact of the environment (and national and international environmental policies) on international trade. (3) Instruments, mechanisms and institutions to reconcile international trade, the environment and nature. It is strongly recommended to aim at a speedy implementation of the proposed research agenda. The need for policy analysis in the field is growing fast and requires an increasing strategic research capability of high quality reflecting different methodological approaches. Excellent research on trade and environment is now carried out by international organisations with which research groups in the Netherlands at present could fruitfully link up.

To stimulate and strengthen strategic research on trade and environment, the organisation of research can in several aspects be instrumental. In many areas, both the quality and scope of the research can be enhanced when close co-operation between scientists of different specialisations is pursued. Such co-operation may involve economists from different sub-disciplines, but also co-operation of economists with researchers from technical and bio-physical disciplines, and co-operation between scientists oriented towards fundamental-strategic and more applied economic research.

Co-operation between research groups of different universities and non-academic institutes can be conducive to create a minimum critical mass of research capacity in particular fields. In addition, incentives should be created to stimulate the (continued) participation of Netherlands-based researchers in international programmes through a proper selection of research themes, proposals and approaches, international co-funding of relevant research projects, and direct participation in international programmes. When core funding in such programmes is limited, participation has the additional advantage that international research priorities can possibly be co-determined via external funding. Many of the research questions and proposals in this study match well with the research priorities and programmes of a number of international organisations. Finally, special efforts should be undertaken to include both PhD and post-doctoral research work in the organisation of a research programme.

Especially in the area of trade and environment, the role and position of less-developed countries calls for special attention. Differences in terms of preferences with respect to environmental priorities, access to international markets, international trade and environmental agreements, and in particular access to research funding, justify explicit consideration of the interests of LDCs in the formulation of a research

agenda. To this effect, active co-operation of researchers and research institutes in LDCs is recommended.

For reasons of efficiency and cost-effectiveness, overlap with other national programmes is to be avoided. Hence, no attention is paid in this study to research proposals in the area of climate studies and global change. Research involving large and elaborate modelling exercises that would require considerable manpower is recommended to be carried out in direct co-operation with international organisations responsable for funding.

ANNEX: EVALUATION OF AVAILABLE MODELLING TOOLS

Introduction

The integration of environmental issues in the available models for EC-agriculture will gain importance during the years to come. It is preferred to make use of the available modelling tools rather than to propose the development of new models. This approach allows to build the work upon the expertise in economic modelling which was achieved during the past few decades.

The main objective of this part of the paper is to review some selected models on agriculture in the EC. All of the models mentioned focus on agriculture in the EC. Some of them even cover a broader spatial resolution. Several of them are primarily developed to examine the impact of market and price policy on agricultural practice. An evaluation of the models selected will be based on (i) technical description, (ii) identification of their potential use in the framework of trade and the environment. The spatial and temporal coverage of the model will also be examined as well as the kind of policy questions examined so far.

The basic problem to be discussed is whether the models on EC agriculture, presently available, do potentially meet the requirements for environmental policy. Policy targets set by the Fifth Environmental Action Programme on Sustainability are critical in that respect. Linkages among agriculture, trade and the environment will be considered. We will limit ourselves to the three issues of environmental concern (nutrients, pesticides, and energy) which to a large extent result from farming practice. Policy targets are formulated on the occurrence of leaching of nitrate and pesticides to water. Energy is considered because of its linkage to transport and their emissions. Policy targets related to energy issues and climate change are not considered because of the diffuse sources from these issues and the rather limited contribution of the agricultural sector.

Description of the models

This section includes a technical description of the models selected. Emphasis is on the main characteristics of the models that are important in assessments among agriculture, trade and the environment. We will therefore limit the technical description to product specification, spatial resolution, temporal coverage and the projections made so far. A summary of these characteristics is given in table 1.

The European Community Agricultural Model (ECAM)

ECAM is a recursively dynamic, applied general equilibrium model designed to evaluate policy changes of the Common Agricultural Policy (CAP) on EC-agriculture (Folmer et al., 1993). It is a joint effort of the Centre for World Food Studies (SOW-VU), the Agricultural Economics Research Institute (LEI-DLO), and the Central Planning Bureau (CPB).

ECAM describes the intra-EC market clearing at given international prices and policy interventions. It covers the EC excluding Greece, Portugal and Spain and distinguishes 19 agricultural commodities, one non-tradeable, national non-agricultural and one tradeable non-agricultural commodity. It operates at national level with a consumer demand and an agricultural supply module as basic elements, the parameters of which have been obtained through time series estimation.

Table 1   Technical description of the models considered

Item of model	ECAM	SWOPSIM	Tyers/ Anderson	WALRAS	Becker
Product specification (number of commodities)	19	22	7	2 sectors	19
Spatial resolution	EC-9	11 world regions (incl. EC)	30 world regions (incl. western Europe)	7 world regions (incl. EC)	NUTS-I
Temporal resolution	Dynamic	Comparative static	Dynamic	Dynamic	Comparative static
Projections made	CAP reform	CAP reform	Market liberalization	Agricultural policy in OECD countries	CAP reform

ECAM has been validated over the period 1982-1992. Model outcomes over this periode, the so-called base-run, have been compared with historical data. By calibrating, checking and updating estimations, assumptions and data with the historical data, ECAM is able to represent the mechanism of EC agricultural policy adequately but the picture of EC agriculture that results is bound to be a global one. Among others, this is because the model cannot display every detail of the complex set of regulations of EC policy, and ECAM does occasionaly use commodity aggregates which do not appear as such in the statistics.

World policy simulation models by USDA/ERS

SWOPSIM (Static WOrld Policy SImulation Model) has been developed at the USDA and is a modeling framework rather than one particular model (Roningen, 1986). The framework is used to examine implications of worldwide agricultural trade liberalization on agriculture. It is a static, multi-product, multi-region partial equilibrium model which can be solved to determine changes from the base year due to endogenous shocks such as changes in demand, supply, or policy. SWOPSIM has 22 output commodities, although output-input relationships between the commodities can be incorporated,

as is the case between livestock products and feed grains. The model does not include tropical products. The model includes 36 linked country or region models. The world is divided into 11 regions: 7 represent the industrial market economies, 3 characterize developing countries, and 1 describes the centrally planned economies.

SWOPSIM is designed to determine the worldwide effects of uni- or multilateral liberalization of agricultural trade. It concentrates on market effects of removing assistance to agriculture in industrial market economies. The model simulates the liberalization effects on supply, demand and trade, on domestic and world prices, and on economic welfare. Reported results are not to be interpreted as forecasts of the impact of trade liberalization implemented at some time in the future. Rather, simulations need to be seen as an attempt to simulate what a historical period would have looked like with a different set of policies in effect - all other conditions unchanged - after full adjustments had occured.

TEPSIM (Trade and Environmental Policy SImulation Model) is an application of SWOPSIM, created by Hartmann (1992). It is a multi-output-multi-input model that can be utilized to simulate the trade and welfare effects of environmental standards on agricultural trade. The TEPSIM model consists of 20 commodities and three regions, the US, the EC and the Rest of the World. TEPSIM includes five inputs apart from feed inputs for the EC and the US region. These are nitrogen, other fertilizer, pesticides, arable land and pasture land. The model is used by Hartmann in analyzing the effects of enforced limitation of nitrogen use on supply and net exports of agricultural products in both major trading regions, the EC and the US, and the effects on world market prices and economic welfare.

Tyers and Anderson

Tyers and Anderson developed the GLS (Grain, Livestock and Sugar) model. This is a dynamic model, that includes 30 countries or country groups (Tyers and Anderson, 1992). Commodity coverage is limited to the major temperate commodities, namely wheat, coarse grains, rice, ruminant meat, non-ruminant meat, dairy products and sugar. The model is used in running various trade liberalization scenarios. It is able to simulate the effects of agricultural policy and structural changes on world food markets. The model concentrates on price policies as the major instrument for government intervention. Other policy instruments (land set-aside, stocks, quotas on production and trade) are depicted as a combination of a price distortion and an income transfer. Liberalization is considered to be represented by a lowering of the producer-to-border price ratio.

OECD-models

The Multilateral Trade Mandate (MTM) model was developed by the OECD in the mid 1980s and is continually being updated both in terms of model structure and data used. It is a medium term, comparative static model with 18 countries and 18 categories, reporting outcomes after adjustment over five years. The design of the model was very much influenced by the need to quantify the impact of a reduction in agricultural protection on domestic and international commodity markets. The model has been used to examine a variety of scenarios related to hypothetical reductions of protection rates in OECD countries. The model has been extended and revised to provide more detailed information on the implications of agricultural policy reform, including those for the use of individual agricultural inputs.

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WALRAS (World Agricultural LibeRAlization Study) is a general equilibrium model developed by the OECD. It has been developed with the explicit objective of quantifying the economy-wide effects of agricultural policies in OECD countries. The model is comparative static in nature and is aimed to provide long-term assessments. WALRAS covers Australia, Canada, EC, Japan, New Zealand and the US, along with a residual aggregate, the so-called Rest-of-the-World (ROW). Agriculture is split into two sub-sectors, namely livestock and other agriculture, while there are also three major food processing industries, namely meat, dairy and other food.

A desire in the 1990s to link the outlook and monitoring work of the OECD with its policy analysis has led to the development of an entirely separate model within the OECD known as AGLINK. The model differs from the MTM model in a much fuller econometric specification of agricultural sectors in the countries modelled rather then relying on reduced form elasticities. AGLINK also differs in being dynamic rather than comparative static, allowing for annual commodity projections and policy analysis over various time horizons.

Becker model

A regionalized agricultural production model of the EC was developed by Becker at the Institut für Betriebswirtschaft in Braunschweig (Germany). The model does link supply of agriculture and demand for factor inputs. It has been used to assess the impact of changes in input and output prices on supply, use of chemical inputs and the environment. The model is already used to assess the consequences of a reduction of mineral inputs and changes in market and price policy on agricultural practice and the use of chemical inputs in the EC (Becker, 1992).

The production and input structure of the model is linked to nutrient balances. Therefore, it can assess the impact of price policy alternatives on the balance of minerals like nitrogen, phosphorus and potassium. Demand and supply elasticities are calculated from the REGIO-databank for the years 1982 to 1989. The model simulates projections over a period of four years, including technical developments (Becker, 1992).

The use of agricultural economic models to analyse international trade and environment

All of the models mentioned above focus on agriculture in the EC or cover a broader spatial resolution (see also table 1). All of them are primarily developed to examine the impact of market and price policy on agricultural practice. In the Becker model and in TEPSIM, environmental inputs are explicitly part of the examination. These two models link agriculture, trade and environment. The Becker model does assess the impact of agriculture policy changes on input use. TEPSIM on the other hand does provide a tool to analyse the effects of environmental policy (enforcing limitation of nitrogen use) on agriculture.

At first sight, TEPSIM and the Becker model may be suitable modelling tools to assess the impact of agricultural production and trade on environment. These models might be able to examine policy questions relating to trade and environment in a more appropriate way than models which explicitly exclude from agricultural inputs. But the use of these models - any agricultural economic models - in

analyzing relevant aspects of international trade and environment depends on whether such models are able to fit to policy questions on these field. Let us therefore have a closer look on some requirements the models need to comply with.

Model requirements

Requirements of models refer to several aspects. First, there is the detail of region and of product. The more specific a model, the better it may fit to policy questions at the field of trade and environment. Most environmental problems arise locally (for instance, water pollution because of leaching of nitrate). This means that modelling tools need sufficient spatial detail, at least enough to catch local environmental problems related to agricultural activities. At the same time, environmental problems are of a transboundary nature. So, models also have to cover broader spatial resolution in order to analyse the linkages among agriculture and the environment in one country and those in an other country. Also important to be considered is the link with trade. Spatial detail of the models differ from the EC as a whole (SWOPSIM and the model from Tyers and Anderson) to regions (Becker model). OECD models and the ECAM model distinguish among countries. The Becker model seems to be the most detailed one with regard to regionality, and covers the whole EC-12. Further on, the model includes 19 agricultural products and three inputs apart from feed inputs. Compared to the other models mentioned, Becker's product detail is considered to be significant.

Secondly, it is recommended that studies in the field of agriculture, trade and the environment allow to examine the issues of energy, minerals and pesticides. Energy is important because of its direct and indirect effects. It determines product location and trade through its influence on transport costs. Transport costs are often disregarded in models used in studies of international trade, although they may have substantial impact on product location and trade flows, depending on product type and stage of processing. The role of transport in agricultural models needs special consideration. Models reviewed above do not include transport costs in an explicit manner. The issues of minerals and pesticides are also important in the field of trade and environment. Minerals are important because of transboundary pollution. Pesticides are important because of requirements on residues in food quality and the need to achieve a significant reduction of pesticide use per unit of land. This means that in modelling tools input-output relations should be captured explicitly with regard to fertilizers and pesticides. The production and input structure of a model should be linked to nutrient balances. This enables to assess the impact of price policy alternatives on the balance of minerals and on the use of pesticides.

Thirdly, models should give notice to technological development. The role of technology and its impact on agricultural productivity is considered in some agriculture models. ECAM, for example, does consider increase of yields. The role of policy-induced technological innovations in agriculture is considered to a limited extent. Among others, technological development in agriculture is and will be influenced by agricultural as well as by environmental policy. Assistance to the sector has had a positive effect on technological development. It is however unclear which effect measures to protect the environment might have on technological change in agriculture. Those policies might hamper developments but can also act as a stimulus for sustainable agriculture, i.e. lead to more environment-friendly production methods. But before technological development can be captured adequately by existing

models, studies are needed to analyse the effects of environmental, agricultural and trade policies on such a process.

Instruments in environmental policy and its implication for modelling tools

The most important issues in environmental policy relate to the use of energy, minerals and pesticides. Goals to reduce environmental degradation can be achieved by various policy instruments. In some countries, there is a wide range of instruments in force already. Present policy should be evaluated according to several criteria which need to be considered, including their effectiveness and efficiency, the extent that the Polluter-Pays-Principle is met, as well as their impact on competitiveness, employment and purchasing power. Also important is that a policy needs to be consistent with fiscal and budgetary policy of a country as well as with EC-policy and EC-rules (Brouwer and Jenkins, 1993). Moreover, such instruments need to be consistent with international rules. Model simulations may be helpful in achieving better understanding of the impact of instruments in environmental policies on agriculture. Obviously, the development of models which capture the effects of alternative environmental measures has barely begun.

Growing concern on environmental problems caused by agriculture has led to the introduction of physical regulation and legislation to control agricultural pollution in several countries. Packages of control measures are developed including objectives to reduce emissions. More often than not, these objectives are to be achieved by command and control measures. Recently, more attention is paid to the use of economic instruments to control environmental deterioration by agricultural activities. The use of economic instruments might be more effective and efficient in meeting the environmental policy objectives than the more widely used environmental regulations. Furthermore, the use of market-conformed instruments meets the Polluter-Pays-Principle (PPP). The PPP has been adopted as a guiding principle in environmental policy by the OECD as well as by the EC. However, its actual use in agriculture has been very limited until now. Therefore, the EC (1992) as well as the OECD (1991) are proposing to broaden the range of instruments from legislation towards market-conformed instruments. Economic instruments could distinguish between environmental charges and taxes, marketable permits, and deposit-refund systems (OECD, 1991).

However, environmental policy may influence trade pattern directly and/or indirectly. Instruments - physical regulations as well as economic instruments - applied in environmental policy may have negative effects on the competitiveness of agricultural producers. Producers may ask for support measures or even protection at the border because they feel being discriminated against foreign competitors who face less strict environmental standards. On the other hand, imports may face restrictions when domestic environmental policy is aimed at reducing consumption. Then foreign suppliers may feel discriminated and may challenge the trade restrictions.

From the above, the tensions between trade and environmental policy may be clear. The potential trade restricting effect of instruments used in environmental policy may limit their application. The question is which instruments are most appropriate to meet the Polluter-Pays-Principle. The instruments are aimed to reduce negative environmental consequences of agricultural production most effectively. Meanwhile they also should hamper trade to a minimum extent.

The role of instruments set to achieve environmental objectives will remain high on the policy agenda. Research has to be done into the effects of economic instruments and/or command-and-control on the environment and on agriculture. Model studies may appear to be very suitable tools to assess the consequences of applying one instrument or another. At the same time, it should become clear which kind of national environmental policies are allowed and which are considered to be protective. In the field of trade and environment the topic of the impact of instruments in environmental policy on agricultural trade will be in the spotlights in the years to come. Simulations with a quantitative model can be helpful in gaining a better understanding of the consequences of alternative environmental policy instruments on agricultural production and trade.

Recommendations

1   The modelling tools presently available do not allow to examine the impact of CAP, GATT and environmental policy on the allocation of agricultural production in the EC. The role of transport and energy related matters are not considered explicitly in the available models. Linkages among transport and environmental quality however are important to the issue of trade and the environment. The existing economic models should be improved such that they contribute to the understanding on linkages among agriculture, international trade and the environment.

It is recommended to develop a modelling tool to quantify the impact of CAP, GATT and environmental policy on the allocation of agricultural production in the EC. It is also recommended to develop this tool for assessments at the level of Member States. This recommendation fits to research themes I (the impact of trade on the environment) and II (the impact of the environment on trade).

2   The selection of policy instruments towards the achievement of environmental objectives are strongly affected by international agreements on trade and the enviroment. The available models do not allow to quantify the impact of policy instruments on the allocation of agricultural production and the subsequent linkages among trade and environment issues.

It is therefore recommended to initiate research on the selection of the appropriate policy instruments that do not distort international agreements. Research should also examine the impact of instruments on the environment and patterns of trade. This recommendation fits to research theme III (instruments, mechanisms and institutions to reconcile international trade and environment).

3   International trade agreements as well as environmental policy induce technological innovation in agriculture. Policy may limit or even counteract the inducement of technological innovation.

It is recommended to initiate research on linkages among environmental policy and trade agreements on technological innovation in agriculture. This recommendation fits to research theme I (the impact of trade on the environment).

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