

Evaluating Ukraine's Agro-Industrial Sector: Comprehensive Assessment with the View of Sustainability Improvement and European Integration

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by
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Declaration

I, the undersigned, declare that this dissertation is my original work, gathered and utilized especially to fulfil the purposes and objectives of this study. It has never been presented for the degree in this or any other university, neither published at any organization. I also declare that the publications cited in this work have been personally consulted.

Signature

Date

Name

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Staff of the Chair of Environmental Planning

ERM Study course

And, of course, my dear family...

Dedication

This thesis is dedicated to my dearest people – the family. Without their continuous support, this work would never have been done. I thank them with all my heart for their love, enthusiasm and all the countless valuable pieces of advice they offered me along the way.

Abstract

Being one of Ukraine's major sources of economic revenue, the country's agro-industrial sector proved, at the same time, to be perhaps the most vulnerable branch of economy in the times of political and social turbulence. While the state is searching for the ways of strengthening its positions at the global market, its agricultural potential to a considerable extent remains both under- and misused. Based on comprehensive historic analysis, this research establishes the origins of the current situation and assesses the possibilities of positive change. Utilizing the experience of other European countries' with regards to making agriculture more sustainable and competitive in the modern world, the author describes the ways of applying these practices against the background of Ukrainian socio-political system.

Drawing knowledge from the experience of Strategic Environmental Assessment (SEA) worldwide, this research aims at harmonizing their methods with evaluation demands in Ukrainian agriculture. It discusses and criticizes the existing assessment approach and suggests measures necessary for making it more comprehensive. The author offers profound analysis of Ukrainian agricultural policies to date, reviews national regulating directives and outlines country-specific challenges as to improving agricultural sustainability.

In order to provide Ukrainian decision-makers with a clear and all-round tool for assessing the advances and failures of the acting state policies in the AIS, a set of reliable indices for evaluating agricultural performance has been developed by the author, which is largely based on the widely-acknowledged Driving Force – State – Response framework offered by the Organization of Economic Cooperation and Development (OECD) and Human Development Index (HDI) from United Nations Development Programme (UNDP) methodology. At the same time, the newly developed set takes into consideration the peculiarities of Ukrainian socio-political setting.

Three major categories of indicators were chosen as a backbone for further elaboration, namely economic, social and political. Therefrom results a list of twelve relevant indices. At the concluding stage of the research, they were processed and transformed to three top-level indices: *Economic Development Index*, *Environmental Situation Index* and *Social Development Index*. These three indices are intended for clear and illustrative presentation of the current situation for high level decision-makers and governmental bodies. Methodology utilized for the purposes of this research with necessary adaptation and fine tuning can also be used with other set of initial data, indicators and indices. Application field can also be downscaled from the highest (national) to the lowest (regional) level by adapting the indicator-indices system to the initial input data. This will considerably simplify the compilation and presentation of regional reports and will provide transparency for interregional comparison within the country.

Kurzfassung

Als eine der staatlichen Haupteinnahmequellen der Ukraine, hat sich der landwirtschaftlich-industrielle Sektor vermutlich gleichzeitig auch als verletzlichster Wirtschaftssektor in politisch und sozial unruhigen Zeiten herausgestellt. Während der Staat nach Wegen zur Stärkung der eigenen Stellung auf dem Weltmarkt sucht, bleibt das eigene landwirtschaftliche Potential leider zu einem bemerkenswerten Teil unter- und gar mißbewirtschaftet. Auf Grundlage einer ausführlichen historischen Analyse ermittelt diese Forschungsarbeit die Ursprünge der aktuellen Lage und eruiert die Möglichkeiten für einen positiven Wandel. Unter Nutzung der Erfahrungen anderer europäischer Länder bei ihrer Gestaltung einer nachhaltigeren und konkurrenzfähigen Landwirtschaft in der modernen Welt, beschreibt die vorgelegte Dissertation, vor dem Hintergrund des sozio-politischen Systems in der Ukraine, Wege diese Verfahren praktisch anzuwenden.

Mithilfe des Wissens aus weltweiten Erfahrungen mit der strategischen Umweltprüfung (SEA) zielt diese Forschungsarbeit auf eine Harmonisierung jener Methoden mit dem Bewertungsbedarf der ukrainischen Landwirtschaft ab. Sie diskutiert und kritisiert die vorhandenen Bewertungsmethoden und empfiehlt Maßnahmen diese aussagekräftiger zu machen. Die Arbeit bietet eine tiefgreifende Analyse der aktuellen ukrainischen Landwirtschaftspolitik, bewertet die nationalen Regulierungen und umreißt landesspezifische Herausforderungen bei der Verbesserung der Nachhaltigkeit in der Landwirtschaft.

Um die ukrainischen Entscheidungsträger mit einem klaren und allumfassenden Werkzeug für die Bewertung der Fortschritte und Fehlschläge auszustatten, wurde eine Reihe zuverlässiger Indizes zur Bewertung der landwirtschaftlichen Leistungsfähigkeit durch den Autor entwickelt, welche weitgehend auf dem anerkannten "Driving Force – State – Response" – Ansatz der Organization für wirtschaftliche Zusammenarbeit und Entwicklung (OECD) sowie HDI Methode von UNDP basiert. Gleichzeitig berücksichtigt diese Reihe von Indizes die Besonderheiten der ukrainischen sozio-politischen Situation.

Drei Hauptgruppen, die wirtschaftlichen, sozialen und politischen Indizes, wurden für die ausführliche Darstellung ausgewählt. Daraus ergab sich eine Liste von zwölf Kennzahlen. In der Abschlußphase der Forschungsarbeit wurde diese Liste zu drei Hauptkennziffern verarbeitet: wirtschaftliche Entwicklung (*Economic Development Index*), Lage im Bereich Umwelt (*Environmental Situation Index*) sowie soziale Entwicklung (*Social Development Index*). Diese drei Kennzahlen sind als klare und anschauliche Darlegung der aktuellen Situation für hohe Entscheidungsträger und Regierungsbehörden gedacht. Die Methodik welche für diese Forschungsarbeit eingesetzt wurde, kann ebenfalls mit anderen Ausgangsdaten, Indikatoren oder Kennzahlen angewandt werden. Das Anwendungsgebiet kann dabei durch Anpassung des Kennzahlensystems an die Ausgangsdaten von der höchsten (nationalen) Ebene auf die niedrigste (regionale) Ebene herunterskaliert werden. Dies wird die Erstellung und Präsentation von regionalen Berichten deutlich vereinfachen und für Transparenz beim Vergleich zwischen den Regionen im Land sorgen.

Аннотация

Являясь одним из основных источников экономического дохода в Украине, агропромышленный комплекс (АПК) страны, в то же время, оказался областью экономики, наиболее чувствительной к стрессу в период политических и социальных потрясений. В то время, как государство изыскивает способы упрочения своего положения в условиях глобального рынка, его сельскохозяйственный потенциал остаётся, к сожалению, в значительной степени недо- и неконструктивно задействуемым. Основываясь на всеобъемлющем историческом анализе, данное исследование указывает на подоплёку создавшейся ситуации и оценивает потенциал позитивных изменений. Используя опыт других европейских стран относительно повышения устойчивости и конкурентоспособности сельского хозяйства в современном мире, автор работы описывает пути применения подобной практики с учётом условий функционирования украинской социо-политической системы.

Черпая знания из опыта имплементации оценки воздействия на окружающую среду и стратегической экологической оценки (SEA) другими государствами, данное исследование нацелено на гармонизацию этих методов к оценочным нуждам в области украинского сельского хозяйства. Работа обсуждает и критически оценивает существующий подход к оценке деятельности АПК и предлагает меры, необходимые для того, чтобы сделать данную оценку более всеобъемлющей. Автор проводит глубокий анализ действующих на данный момент в Украине стратегий развития сельского хозяйства, оценивает регулирующие директивы и очерчивает специфические для государства проблемы на пути к улучшению сельскохозяйственной устойчивости.

С целью предоставления украинским ответственным руководителям в правительстве чёткого и всестороннего инструмента для оценки достижений и просчётов действующей государственной политики в отношении АПК, автором была разработана система индикаторов для оценки сельскохозяйственной деятельности, основанная в значительной мере на общепризнанной структуре «движущая сила – состояние – реакция» Driving Force – State – Response), предложенной Организацией экономического сотрудничества и развития (ОЭСР), а также методология расчета индекса развития человеческого потенциала от ООН. В то же время, созданная в рамках данного исследования система учитывает особенности украинского социально-политического устройства.

В качестве основания для последующей разработки, автором были избраны три основных категории индексов: экономические, социальные и политические. На их основе была разработана система из двенадцати соответствующих индексов. На заключительной стадии исследования, они были обобщены и трансформированы в три индекса высшего порядка: индекс экономического развития (*Economic Development Index*), индекс ситуации состояния окружающей среды (*Environmental Situation Index*) и индекс социального развития (*Social Development Index*). Эти три индекса имеют своей целью чёткую и наглядную презентацию текущей ситуации для ответственных руководителей высшей ступени и государственных органов управления. Методология, задействованная в данной работе также может быть

использована для иных систем исходных данных, индикаторов и индексов. Сфера её применения может быть переведена из высшего (национального) уровня в более низкий (региональный) посредством адаптации системы индексов к начальным входным данным. Это позволит значительно упростить составление и подачу региональных отчётов и обеспечит прозрачность сопоставления межрегиональных показателей внутри страны.

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List of Abbreviations and Acronyms

Acronym	English	Russian
AC	Accession Country	Страна-кандидат в ЕС, СК
AEI	Agro-environmental Indicators	Эколого-сельскохозяйственные индикаторы
AGGEI	Greenhouse Gas Emission Index (agricultural sources)	Индекс выброса парниковых газов (из сельскохозяйственных источников)
AIC	Agro-industrial Complex	Агро-индустриальный комплекс
AIS	Agro-industrial Sector	Агро-индустриальный сектор
API	Agriculture Production Index	Индекс сельскохозяйственного производства
BAT	Best Available Technology	Наилучшая доступная технология
BIA	Business Impact Assessment	Оценка хозяйственного воздействия
bln	Billion	Миллиард, млрд.
CAP	Common Agricultural Policy (EU)	Общая аграрная политика (ЕС)
CBD	Convention on Biological Diversity	Конвенция по биологическому разнообразию
CDM	Clean Development Mechanism (UNFCCC)	Механизм чистого развития (Рамочная конвенция ООН об изменении климата (РКИК))
CEE	Central and Eastern Europe	Центральная и Восточная Европа, ЦВЕ
CFCs	chlorofluorocarbons	Хлорфторуглероды, ХФУ
CIS	Countries in Transition	Страны с переходной экономикой
CO ₂	Carbon Dioxide	Углекислый газ
DDI	Demographic Dynamics Index	Индекс демографической динамики

List of Abbreviations and Acronyms

DSR	Driving Force-State-Response	Движущая сила-состояние-реакция
EBRD	European Bank for Reconstruction and Development	Европейский банк реконструкции и развития, ЕБРР
EC	European Community	Европейское экономическое сообщество, ЕЭС
EE	Ecological Expertise	Экологическая экспертиза
EEA	European Environment Agency	Европейское агентство окружающей среды, ЕАОС
EfE	Environment for Europe (UNECE)	Окружающая среда для Европы (ЕЭК ООН)
EFTA	European Free Trade Association	Европейская ассоциация свободной торговли, ЕАСТ
EIA	Environmental Impact Assessment	Оценка воздействия на окружающую среду
EIB	European Investment Bank	Европейский инвестиционный банк, ЕИБ
Eionet	European environment information and observation network	Европейская сеть по экологической информации и наблюдению
EIS	Environmental Impact Statement	Отчёт об оценке воздействия на окружающую среду
EU	European Union	Европейский Союз, ЕС
FAO	Food and Agriculture Organization	Продовольственная и сельскохозяйственная организация ООН, ФАО
FSI	Food Sufficiency Index	Индекс обеспеченности продовольствием
GAO	Gross Agricultural Output	Валовой сельскохозяйственный продукт
GDP	Gross Domestic Product	Валовой национальный продукт, ВВП
GDPI	Gross Domestic Product Index	Индекс валового национального продукта

List of Abbreviations and Acronyms

HDI	Human Development Index (UN)	индекс развития человеческого потенциала(ООН)
HSI	Hospital Sufficiency Index	Индекс обеспеченности больничными местами
HIA	health impact assessment	Оценка влияния на здоровье
IA	Impact Assessment	Оценка воздействия
IFOAM	International Federation of Organic Agriculture Movements	Международная Федерация Органического Земледелия
kg	Kilogramme	Килограмм, кг
l	Litre	Литр, л
LEI	Life Expectancy Index	Индекс ожидаемой продолжительности жизни
MAP	Ministry of Agrarian Policy of Ukraine	Министерство сельского хозяйства Украины
mio.	Million	Миллион
ms/ha/year	Cubic meter per hectare per year	Кубометров на гектар в год (м ³ /га/г)
NGO	Non-governmental Organization	Неправительственная организация
NH ₃	Ammonia	Аммиак
NIS	Newly Independent States	Новообразованные независимые государства
OAI	Organic Agriculture Index	Индекс органического земледелия
OECD	Organization for Economic Cooperation and Development	Организация экономического сотрудничества и развития, ОЭСР
OVOS	Assessment of Ecological Impacts	оценка воздействия на окружающую среду
Pb	Lead	Свинец
PPP	Policies, Plans and Programmes	Политики, планы и программы
PSR	Pressure-State-Response	Воздействие-состояние-реакция
PUI	Pesticides Usage Index	Индекс применения пестицидов

List of Abbreviations and Acronyms

REC	Regional Environmental Centre for Central and Eastern Europe	Региональный экологический центр Центральной и Восточной Европы
RNFE	Rural Non-farm Employment	Занятость сельского населения вне сельского хозяйства
SARD	Sustainable Agriculture and Rural Development	Устойчивое сельское хозяйство и сельскохозяйственное развитие
SEA	Strategic Environmental Assessment	Стратегическая экологическая оценка
SEE	Strategic Ecological Expertise	Стратегическая экологическая экспертиза
SIA	Sustainability Impact Assessment	Оценка воздействия на устойчивое развитие
SMFI	Soil Mineral Fertilization Index	Индекс использования минеральных удобрений
ths	Thousand	Тысяча
SO ₂	Sulphur Dioxide	Сернистый газ
UAA	Utilized Agricultural Area	Обрабатываемые сельскохозяйственные площади
UAH	Ukrainian Hryvnia (Ukrainian currency unit)	Украинская гривна
UNCSD	UN Commission on Sustainable Development	Комиссия ООН по устойчивому развитию, КУР
UNDP	United Nations Development Programme	Программа развития ООН, ПР ООН
UNECE	United Nations Economic Commission for Europe	Европейская экономическая комиссия ООН, ЕЭК ООН
UNECE EPR	United Nations Economic Commission for Europe Environmental Performance Reviews	Экологические обзоры ЕЭК ООН
UNEP	United Nations Environment Programme	Программа ООН по окружающей среде, ЮНЕП

List of Abbreviations and Acronyms

USSR	The Union of Soviet Socialist Republics	Союз Советских Социалистических Республик, СССР
VR	Verhovna Rada (Supreme Council of Ukraine)	Верховная Рада Украины
WB	World Bank	Всемирный банк, ВБ
WCI	Water Consumption Index	Индекс потребления воды
WHO	World Health Organization	Всемирная организация здравоохранения, ВОЗ
WTO	World Trade Organization	Всемирная ассоциация торговли
WWTI	Waste Water Treatment Index	Индекс очистки сточных вод

1 Thesis Overview

Introduction

More than two decades have passed since the Berlin Wall fell down and signaled the start of a vast variety of changes throughout the former Socialistic Block. These changes affected society in a multitude of ways. They set into action the transformation in all social, political and economic sectors – starting from people’s mentality and cultural outlook, through principles of social organization and functioning of political and economic system on both regional and state levels, and ending up with lifting of political borders between countries and their economies.

Ukraine is one of the former Soviet republics and the focus area of this doctoral thesis. The country became independent in 1991 and remains until now in the process of reforming its state, industrial, agricultural, private and other sectors on its way to market economy.

In this research the focus is placed primarily on how changes affected the environmental, economic, social and political situation with regards to Ukrainian agro-industrial sector (hereinafter AIS).

The study offers a profound review and analysis of the functioning of food and agro-industrial sector in Ukraine. It assesses the current situation with special emphasis on economic, agricultural and environmental policy and the form of state governance and support in the given field, analyzes its readiness to act on European and global open markets and summarizes a set of critical issues for Ukrainian decision-makers to address. It reviews agricultural policies and the status of current rural economic, environmental and social infrastructure.

Very often decision-makers, such as ministry officials and regional governors do not possess sufficient knowledge with regards to specific numbers and data, and since the success and effectiveness of the whole agricultural branch is dependent on their decisions, it is critical to provide them with easy to understand indicators. Therefore, an indicator set for evaluating performance in the AIS for officials at all levels is to be developed which will be able to offer a clear picture of the existing situation in economic, environmental and social fields of the AIS.

1.1 Objectives and relevance of the thesis

The thesis offers multilateral analysis of the current situation in Ukrainian AIS. It explains the driving forces, pressures and causes of the existing condition which have formed within the time span from 1991 and until present. The innovative approach for a high level indices set for monitoring and evaluating the situation in the AIS is elaborated. It refers to indicators which describe the existing situation from three key perspectives that are needed to assure the realization of sustainable development in rural sector. These are selected environmental, social and economic indicators, processed in a way so as to offer a clear and transparent evaluation of the AIS for decision-makers and the government. The aim is to provide the above-mentioned target groups with a

comprehensive, fast response index set, which will allow them to efficiently evaluate the current state of the art within the minimum time possible. The issues of aggregate and complex development with accent on sustainability of the agriculture and rural area as parts of whole agro industrial sector are reviewed and analysed.

The focus is also placed on Ukraine's prospective integration into the European Union in the context of existing lines of the country's agrarian policy. The study considers the ways Ukrainian agriculture can meet the standards which would be sustainable and compatible to EU requirements at the same time, and standards as to the products quality and realization of international trading operations.

The beginning of the 21st century in Ukraine is characterized by congregation of two transitional processes preconditioned by global changes both within the country and in the modern world in general. Firstly, a general active transition to the new information-industrial and innovative society is taking place. Parallel to this, Ukraine is currently in the process of transition from administrative planned system to socially-oriented and effectively regulated market economy based on modern scientific achievements. The importance of the above-mentioned problems is indubitable nowadays, when the process of integration between European countries is so intensive. Ukraine joined the World Trade Organization (WTO) in 2008 and thus entered both European and global market system as an equal partner. In Western Europe, new tendencies are coming into effect and in order to comply with them, Ukrainian government has to reconsider its national policies, including, among others, agricultural policies.

The goal of the present research is thus to develop a comprehensive theoretical and methodological approach for transparent and easy evaluating environmental, economic and social aspects in the functioning of the AIS. Recommendations towards increasing production efficiency in the conditions of transition to market economy are to be worked out.

In order to reach this goal the study needs to:

- generalize theoretic approaches and elaborate on the political-economic essence of the categories of "efficiency" and "sustainability";
- define indicator set and criteria of efficiency measuring and evaluation for state control in the agrarian sector;
- analyze the available theoretic and methodological research regarding the enhancement of agricultural production;
- outline the ways and work out the proposals for enhancing the efficiency of agricultural production.

Main objectives of the research are thus to:

- explain the main reasons, which caused a continuous crisis in Ukrainian AIS;
- give an overview of crucial changes, which took place in Ukraine during transition period;
- analyze the existing agricultural situation in Ukraine;

- point out the guiding principles of Ukrainian agrarian reform;
- analyze Ukrainian agricultural potential and determine the strategy for its realization;
- monitor and evaluate the ecological and socio-economic impacts and changes caused by the agrarian reform;
- develop a comprehensive indicator set for the evaluation of ecological, social and economic components in the functioning of the AIS;
- present Strategic Environmental Assessment (SEA) and Assessment of Ecological Impacts (OVOS) as instruments for ensuring environmental protection in the AIS;
- work out government-targeted recommendations for further improvement of the country's agricultural policies;
- introduce the concepts of sustainable land management and organic agriculture against the background of Ukrainian AIS.

1.2 Overview of Research Methodology

This study was performed in close collaboration with international experts, local professionals from the Dnipropetrovsk State Agrarian University and the National Mining University of Ukraine, research universities in Kiev, as well as with a range of working groups from the Ministry of Environmental Protection, the Ministry of Agrarian Policy of Ukraine and the Ministry of Economics and Statistics of Ukraine.

Theoretic and methodological bases of the given research lie in the use of dialectic method and systematic approach to the study of environmental and economic processes with connection to social indicators for life quality in rural sector, as well as on theoretic positions regarding the efficiency of agricultural production developed by Ukrainian and foreign scientists.

In order to obtain the necessary information on all the above-mentioned aspects, detailed analysis of numerous literary sources, which enabled the author to receive the up-to-date and the most reliable data concerning the topic of this thesis, was carried out. Various methods of research were used:

- Analyzing specialized literature, periodic and electronic sources, and press reviews.
- Studying reports compiled by the Ukrainian Department of Reformation of the AIS.
- Collaborating with the Ministry of Economics and Statistics of Ukraine, the Ministry of Environmental Protection, the Ministry of Agrarian Policy of Ukraine and interviewing officials in charge.
- Investigating agricultural land market transformations in Ukraine since the initiation of the agrarian reform in 1991 and until the present time.
- Studying the quality of agricultural soils, their fertility, use of different fertilizers and the consequences of their application.

OECD-based methodology used for processing the indicator system combined in this research with strategic environmental assessment as well as with human development index, provided the author with the possibility to analyze statistic data, merge them to

top-level indices and reveal the internal structure of the observed processes and phenomena.

1.3 Contents of the thesis

In order to provide the reader with a clear and easy to use structure, the thesis is divided into seven thematic chapters.

In the first Chapter (Thesis Overview) the overview of thesis objectives and methodology is offered, alongside with research relevance. A detailed presentation of research design and description of methods used for data collection are given. The role of domestic and foreign documentary data analysis is explained. The purpose research stays at legislative and governmental bodies such as the Ministry of Environmental Protection of Ukraine and the Ministry of Agrarian Policy of Ukraine, as well as at the Department of Management and Economics and the Chair of Natural Resources Protection of National Mining University of Ukraine and Dnipropetrovsk State Agrarian University is explained.

Chapter 2 (Contemporary Agriculture: The Agenda) offers an insight into the major challenges in modern global agriculture and possible ways of enhancing its sustainability with regards to agricultural technology, institutional support, and policy making, with a special focus on prospective advantages of a wider spread of organic farming.

Based on the concepts presented in Chapter 2, Chapter 3 (Ukraine and Its Agricultural Potential) concentrates on enhancing sustainability in Ukrainian agriculture. It begins with a general introduction to Ukraine as a state, its geographic location, administrative structure, and role in the European and World economy is presented. Overview of the significance of the AIS in Ukraine's economy, major reasons for economic and agricultural crisis and main principles of the agrarian reform introduced in 1991 are offered. This chapter provides information on statistic data for agrarian and food sector and the welfare of rural population. The description of the agrarian reform is given, main guiding principles for the reformation are mentioned, analyzed and evaluated. The importance of sustainable agriculture and its potential for Ukraine are explained, organic agriculture projects and plans are discussed. Tasks and principles of the First National Strategy towards sustainable agriculture are elaborated. Standards, certification and perspectives for state regulation of the AIS are outlined. Possibilities of elaboration of national regulating directives are laid down. Opportunities for the development of domestic organic agricultural production and its promotion to Ukrainian and foreign markets are presented.

Chapter 4 (Strategic Environmental Assessment and Its Possible Application in Ukrainian Agro-Industrial Sector) offers definition, aims and application methodology of SEA as a tool of policies evaluation, impacts assessed within its scope are described as well. Major legislative documents dealing with assessing sustainability in various sectors of economy (EU Directive 2001/42/EC and Kiev SEA Protocol) are reviewed, with a special emphasis on sustainability in agriculture.

Further on, Chapter concentrates on SEA as a possible instrument for evaluating the AIS in Ukraine. Ukrainian legislation is explained; comparison of EIA, SEA, traditional

assessment of environmental impacts (OVOS) and Ukrainian system of ecological expertise (EE) is made.

Chapter 5 (Indicators for Evaluating Agricultural Performance) is devoted to analyzing the essence and applicability of various indicators for the assessment of sustainability in agriculture. It provides the reader with definitions and understanding of indicators, describes types of indicators, levels of indicators and respective requirements. The indicator approach offered by the Organization of Economic Cooperation and Development (OECD) and the relevant Driving Force – State – Response model are presented and explained, as well as selection criteria for agro-environmental indicators. A set of indicators to address agro-environmental issues of relevance for policy-makers is outlined.

Chapter 6 (Mathematical Model for Top-level Indices) represents the concluding part of the given research and describes a set of indices developed by the author with the purpose of assessment of agricultural performance in Ukraine. The set involves three major categories of indicators – economic, social and political – based upon which is a list of twelve relevant indices that were processed based on OECD approach. Further on, these indices were processed and transformed to three top-level indices: *Economic Development Index*, *Environmental Situation Index* and *Social Development Index*, which help illustrate the existing situation in Ukrainian AIS and aim at providing decision-makers and governmental bodies with guidelines as to possible improvements.

The analysis is followed by Chapter 7 (Conclusions and Recommendations) where the final result obtained from analysis, assumptions, reviews and calculations in other chapters are presented as well as final recommendations, have been made. At the final part of the thesis List of References and Annexes are presented.

1.4 Research design and methods of data collection

In order to obtain information necessary for the research, a combined approach was introduced, which provided the author with an opportunity to assess the various data and professional knowledge of special readings by domestics and international experts, as well as through collaboration with officials in charge, legal institutions and universities, NGOs and independent experts.

1.4.1 Literature Analysis

Obviously, main sources of theoretic knowledge and practic experience are to be found in the printed professional literature. The latter provides comprehensive analytical and methodological bases necessary for understanding the principles according to which the agricultural branch in general and agroproduction in particular evolve and function. Publications by such universally recognized experts as Riki Therivel, Thomas B. Fisher, Aleg Cherp and others assist the reader in understanding the principles behind the various processes and phenomena typical of the realm under study.

1.4.2 Documentary data

Analyzing statistic reports by the State Statistic Committee of Ukraine makes it possible to trace the development of national agriculture and markets for the key grain, oil and vegetable cultures. Studying this data and comparing the obtained information with correspondent climatic conditions, political decisions and initiatives undertaken by the government allows us to follow respective correlations and use them for the development of strategic recommendations for achieving desired objectives on both national and regional levels. Studying the reports on Ukrainian AIS published by the World Bank Organization for Economic Co-operation and Development (OECD) and the Unit for Environmentally and Socially Sustainable Development for Europe and Central Asia Region has proved extremely practical for understanding Ukraine's agricultural potential, the ways of making this potential work as well as measures for stimulating agricultural growth and improving rural life. Annual reports by the Ministry of Economy and European Integration of Ukraine enables us to analyze continuous development of key economic indicators for agricultural products and the dynamic role of agro-production in the country's GDP.

1.4.3 Field Trips to Ukrainian Authorities and Universities

Repeated research trips to the National Mining University of Ukraine (September 2003, September 2005 and March 2007) helped to collect information concerning the environmental situation in Ukraine in general and the condition of agricultural lands in particular. The research was carried out in close cooperation with the Chair of Ecology (Head of the chair – Professor A.I. Gorovaya) and the Institute of Economics (President – A.I. Sharov, Head of the Chair of Foreign Economic Activities– I.I Pavlenko).

Further research was conducted in collaboration with the Chairs of Rational Use of Soil and of Agricultural Management of Dniepropetrovsk State Agrarian University.

1.4.4 Research at the Ministry of Environmental Protection of Ukraine (April 2005)

During the research at the Ministry of Environmental Protection of Ukraine the following activities have been performed: interview with decision makers, acquisition of expert point of view and opinions on studied phenomena, analysis of acting policies, plans and programs in environmental, land use and agricultural sectors as well as collection of the information essential for elaboration of indicators to be used for the assessment of agricultural policies, plans and programs was carried out jointly with the Ministry's Department of Land Resources and Department of Ecological Safety Regulation.

2 Contemporary Agriculture: The Agenda

2.1 Modern agro-production: intensive versus organic agriculture

Over the past century, modern agriculture has brought about tremendous increases in yields of most crops, due to a combination of several changes in agricultural policies. The more important ones are widespread use of genetically improved crops, increased use of mineral fertilizers, the general application of pesticides, and greater use of irrigation and drainage to improve water relationships.

The two world wars were responsible for development of a number of chemicals now being used as fertilizers. Synthetic nitrogen capability built up for military purposes supplied very inexpensive nitrogen that could be used in the form of anhydrous ammonia, nitrogen solutions, ammonium nitrate, or urea, or it could be combined with phosphates to produce dry mono- or diammonium phosphate. Likewise, the increased production of acids made it possible to produce relatively cheap high-analysis superphosphates. Facilities used to manufacture various organic compound for war use were converted to the production of a number of pesticides, with DDT, 2,4-D, and organophosphate insecticides being some of the more conspicuous examples.

Several other changes in this period increased the efficiency of farmers work. The shift from man and animal power to that of machines enabled the grower to efficiently farm much larger acreage at lower costs. Developments in large-scale machinery and the changing economics of using this machinery along with the freeing of acreage devoted to maintenance of draft animals aided the huge development of monoculture. The newer machinery, capable of quickly working extensive areas, was more adaptable to the cultivation of large fields. As a result, the hedgerows between small fields were eliminated. At the same time, some of the large machinery, with its considerable cost, was less adaptable to cultivating a variety of different crops in the same year. Also, a more rapid write-off of the cost of the machinery was possible if only one crop was cultivated, justifying the use of monoculture. Much of the increase in production has been due to expanded use of irrigation, which became available in areas, some of which had normal amounts of yearly rainfall but lacked sufficient quantities for certain crop-growing periods. Expansion of irrigation was accelerated by development of portable lightweight aluminium pipe that could be easily moved from field to field, and self-propelled units that automatically irrigated large acreage .

Yet, huge increase in food production has not come without some costs, and certain problems became apparent rather early. The use of large scale machinery favoring increased field size, accompanied by elimination of hedgerows and the sods used to support draft animals, led to considerable erosion by wind and water. The adaptation of monoculture has tended to provide a less stable agriculture because the single crop makes in more vulnerable to market fluctuations. Also, monoculture appears to aggravate instability because it has led to more pest problems and greater soil degradation due at least partially to the fact that continuous cultivation to produce one crop reduces soil organic matter.

The use of artificial fertilizers has received its share of criticism. The degree varies with the source. Proponents of organic farming, who use solely animal manure and composted

materials and those who have belief that plants can only safely use organic fertilizers are the loudest in their criticisms. Some of other opponents claim that artificial fertilizers are harmful to both plant and animal life. It is argued that foods grown with such fertilizers, if not actually toxic to life, are less nutritious. Some criticism has come from ecologists concerned with adverse soil physical changes and the harm to environment caused by the unlimited use of chemicals; another serious claim is that agro-production is that irrigation, which is now used on one-third of productive land, cannot be used indefinitely. The history of irrigation is replete with failures due to soil waterlogging, salinization of soils or the water source, and depletion of water supplies (Wolf, B., Snyder G.H., 2003, pp. 1-3).

Over the years, as problems arose with intensive agriculture, there have been attempts to find the answers in organic farming, which can be defined as a production system that avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotation, crop residues, animal manure, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral bearing rocks, and aspects of biological pest control to maintain soil productivity, supply nutrients and control insects, weeds and other pests (Eggert, F.P., Kahrmann, C., 1984, pp. 98-99).

2.2 Transition from conventional to sustainable agricultural system

Within the past decades, various definitions for sustainable agriculture have been proposed. From a grower's point of view, any system is sustainable if it keeps the farm in business. From a larger-term view, a more politically sensitive definition may be one offered by Letey (Letey, J., 1994, p. 23), which states that sustainable agriculture is "an integrated system of plant and animal production practices having a site-specific application that will, over a long term: (i) satisfy human food and fiber needs; (ii) enhance environmental quality and the natural resource base upon which the agricultural economy depends; (iii) make the most efficient use of non-renewable resources and on-farm resources and incorporate, where appropriate, the natural biological cycles and controls; (iv) sustain the economic viability of farm operations; and (v) enhance the quality of life for farmers and society as a whole".

Global agriculture is facing many demands. It must provide food, fiber, industrial products and ecosystems services. It is safe to say that the world will face increasing social, political and economic disruption if a more complete agenda for agriculture is not addressed by combined public, commercial and civil sector initiatives. Conditions and trends that require specific attention include:

- Food security – a distant vision for much of the world's population.
- Poverty, particularly in rural areas, resulting from underemployment and low agricultural productivity.
- Competition intensifying for finite land and water resources.
- Agriculture sharing an environment burdened by rapidly increasing human activity.
- Social and political changes not keeping pace with globalized agriculture's changing commercial structure: (i) centralization brings problems of monopoly control and loss of checks and balances; (ii) inappropriate farm enterprise scale causes instability at

both extremes; (iii) the advent of industrial-scale enterprises reduces community integration, undermining rural community structure and economics (Harwood, R.R., 2001, pp. 7-8).

To meet escalating world food needs by the sustainable intensification of agro-production, priority setting in the key areas of agricultural technology, institutional support, and policy making, at all levels from local to global, must shift from a focus on growth to a focus on social equity and environmental improvement. This fundamental shift will require commitment to basing development programs on a flexible approach that recognizes the complex and unpredictable process of dealing with agro-ecological systems, and with the individuals and communities that are directly involved in managing these systems. In fact, what happens on a small scale for an individual farmer or farming community is true on a global scale: that making the transition from conventional production-oriented agriculture to an agriculture focused on social, environmental, and economic sustainability involves many challenges and often may impose significant short- to mid-term costs in order to achieve long-term gains. Accordingly, in order to ease the strains of transition, significant changes must be made in the three areas of major importance: in agricultural research and technology; in institutional support; and in public policy. Without well-managed support from all these areas working together as an integrated system, the strains of transition imposed on farmers and their communities would at best delay the transition to sustainable agricultural intensification and at worst abort the transition altogether (Harsch, J., 2001, pp. 32-33).

Thus, it can be said that achieving sustainable agro-ecosystems at a minimum requires a three-part focus on social equality, including poverty reduction and resolution of land tenure issues; environmental improvement, urgently needed to avoid incalculable costs of further environmental degradation; and profitability, in order to provide both the incentive of improved returns to farmers and the prospect that short- and mid-term public-sector financial investments in agriculture will be repaid (Harsch, J., 2001, p. 35).

Although much of the world's agricultural sector is private, its development cannot be left to the magic of the marketplace alone. Agricultural growth is dependent on levels of investment in agricultural research and rural infrastructure that the private sector has insufficient incentive to provide. This is because they can only capture part of the benefits from these kinds of investments. The public sector has to play a key role in providing what have traditionally been "public goods" and this requires deliberate public policies and investment programs and appropriate and effective institutions to implement them. The most important can be grouped under the four "I's" necessary for agricultural growth.

- **Innovation.** Investments in agricultural research and extension to provide a continuous stream of yield-enhancing technologies that can be profitably adopted by farmers. This is specifically important because land and water are increasingly scarce in many countries and future agricultural growth will increasingly have to come from yield-enhancing technologies on already cropped land. Private sector can play an increasing role in undertaking the needed research.
- **Infrastructure.** Investments on physical infrastructure, especially irrigation, roads and electricity; and in human infrastructure, especially education, nutrition, and health of rural people to increase their well-being and productivity.

- **Inputs.** policies and investments to assure that farmers have access to: key farm inputs (irrigation, water, fertilizers, seeds, etc.); efficient rural financial markets that can provide them with a broad range of financial services at minimum costs, and land through efficient sale and lease markets. Government's role in these cases is primarily to create an enabling environment for the private sector to function efficiently.
- **Institutions.** The securing of property rights to land, encouraging farmers to make long-term investment in land intensification and conservation and increasing their access to long-term credit to finance these investments. Strengthening of public institutions that provide key public goods and services so that they perform efficiently and are accountable to the people they are intended to serve (Hazell, B.R., 2001, p. 192).

If the management of natural resources is to be improved, economic and social incentives must be changed in appropriate ways. Several factors impinge on the incentives for managing natural resources and these can be influenced by policy-makers. They include the following:

- More attention needs to be paid in agricultural research to sustainability features of recommended technologies, to broader aspects of natural resource management, and to the problems of resource-poor areas. In intensive farming systems, more attention should be given to safe and sustainable methods of pest control and to soil and plant nutrient problems.
- Farmers' property rights over their resources must be assured.
- Management improvement of state-owned resources must be improved through institutional reforms and greater devolution to user groups.
- Improvement of the management of the relevant public institutions that regulate natural resources (e.g. irrigation departments) is needed.
- Price distortions that encourage excessive use of modern inputs in agriculture must be corrected, e.g. by removing subsidies on fertilizers and pesticides.
- Resource monitoring systems need to be established to track changes in the condition of key natural resources.
- Farmers need to be educated about environmental effects of their actions.
- Sites of particular environmental value must be identified and specifically protected (Hazell, B.R., 2001, pp. 194-195).

There is a very wide range of stakeholders with vested interest in the development and outcomes of sustainable agriculture. These would include: farmers and farmers' organizations, NGOs, the private sector, researchers, national governments, national civil sectors, global civil sectors, and global agencies. Each of these sectors of society has different levels of involvement and expectations from the practice of agriculture. Important is that they all be aware of the need for a balance in the trade-off between different sustainable agriculture outcomes as well as the need to evaluate these outcomes over a variety of temporal and spatial scales, especially with regard to ecosystems resilience, i.e., the ecosystem's capacity to return to its optimal range of performance after displacement by perturbation, and to develop appropriate indicators to measure these outcomes (Terry, E.R., 2001, p. 200).

All this said, it has to be kept in mind that even though past patterns of agricultural growth have sometimes lead to negative environmental effects and to continued poverty among rural people, this is not an inevitable outcome of agricultural growth. Rather, it reflects inappropriate economic incentives for managing modern inputs in intensive farming systems, insufficient investment, inadequate social and poverty concerns, and political systems that are often biased against rural people. With appropriate government policies and investments, institutional development, and agricultural research, there is no reason why agricultural development cannot be more effective in simultaneously contributing to growth, poverty alleviation, and environmental sustainability (Hazell, B.R., 2001, pp. 197-198).

In order to better understand peculiarities of Ukrainian AIS, next chapter will provide general information and data about Ukrainian geographic location, administrative structure and demographic situation. Also discussion on state, progress and strategies for enhancing sustainability of Ukrainian agriculture against the country's economic, social and political background is presented in following Chapter 3 (in particular, subchapters 3.5 – 3.7).

3 Ukraine and its Agricultural Potential

3.1 Background: Geographic location

Ukraine is traditionally considered part of Eastern Europe, although geographically it is located in Central Europe. It neighbors on Russia on the North-East to the South, Belarus on the North, Poland and Slovakia on the West, Hungary, Romania and Moldova (including the breakaway Pridnestrovie) on the South and has access to the Black Sea and Sea of Azov (see Figure 1). The city of Kiev (Kyiv) is both the capital and the largest city of Ukraine.



Figure 1. Political map of Europe
Source: (EDINPHOTO, 2009)

3.2 Administrative and demographic structure

Ukraine is a unitary state comprised of 24 regions (oblasts), the autonomous republic of Crimea, and two cities with special status: Kiev, its capital, and Sevastopol, which hosts the Black Sea Fleet of the Russian Federation under a leasing agreement expiring in 2017. Ukraine accounts for 608 districts (*rayons*), including city/town districts; 1,344

urban settlements, including 454 cities and towns; as well as 28.621 villages (VR Database: Regions of Ukraine and their divisions, 2008) It is a semi-presidential republic with separate legislative, executive and judicial branches. The country is home to 46 mio people, 77,8 percent of whom are ethnic Ukrainians, with sizable minorities of Russians, Belarusians and Romanians. The Ukrainian language is the sole official language, while Russian is also widely spoken and regarded by a considerable part of the population as a second mother tongue.



Figure 2. Administrative structure of Ukraine
Source: (INFOUKES, 2009)

Despite general decrease in population in the past decade, the country ranks fifth in Europe. Ukraine's labor force (men 16-60, women 16-55 years old) is estimated at the level of 22 mio citizens (47.8 % of all population) in the year 2007 (State Statistics Committee of Ukraine, 2008).

The population distributed with approximately two thirds residing in urban areas (31,6 mio), and one third in rural zones (14,6 mio) (see *Table I* in Annex). Ukraine has one of the lowest densities of population in Europe (80 residents per square kilometer) and has a great potential for population growth and immigration (All-Ukrainian population census, 2008).

With the area of 60,37 mio hectares (603,7 thousands square kilometers) Ukraine is largest country located completely in Europe, and is only smaller than the European part of Russian Federation. It is rich in such natural resources as forests, ore, water and soils suitable for agricultural activities and endowed with a very favorable climate. The country has a huge area of exceptionally fertile soils designated for agriculture, 41,8 mio hectares (418 thousands kilometer squared) of which about 80% (or 33 mio hectares) is

arable, and of this area, more than 50% is comprised of deep black “*chernozem*” soils (State Statistics Committee of Ukraine, 2008). Thanks to this, Ukrainian agriculture has an outstanding potential of becoming one of major driving forces for the country’s economy.

Alongside metallurgical industry AIS makes up a significant proportion of GDP (according to reports of the State Statistics Committee of Ukraine of various years, up to as much as 25%), provides with a job population of rural areas and possesses the potential to be a important export earner. In the years of transition it has also played an significant role as a network for social safety by absorbing surplus labor into natural farming, and slowing down the tempo of urban-rural migration seen in similar economic critical conditions. But all in all, high Ukraine’s agricultural potential is very underutilized.

3.3 Agricultural potential

Ukraine has great initial conditions for realization of its agricultural potential. Major plane landscape, huge fertile soils area, favorable natural climatic and rainfall conditions provide possibilities for the growth of various agricultural crops and cattle-breeding on grasslands. As said above, agricultural lands occupy almost 42 mio hectares which comprises 70% of the total area of the country. The undeveloped agricultural lands (i.e. those not utilized for agricultural purposes, but having all necessary qualities for such use) comprise as little as 2.5% of the total. Another key aspect of Ukrainian agricultural lands is their high proportion, more than eight tenths of total arable lands; remaining part of the soils is distributed between pastures (11,4%), grasslands (5,1%) and perennial (2,7%). However, fertile soils must be safeguarded against unsustainable use and possible hazardous impacts and activities which ruin topsoil cover and result in humus losses (Shpichak, A.M., 1997).

With policies aimed at harvest increase and calculated investments, Ukraine can significantly raise its grain harvest and gain global market share in an environment of growing global demand. While generating attractive investment and employment climate in the AIS that can yield significant income, trade and financial benefits, Ukraine is capable of making a considerable contribution to the international effort of managing food crisis. Taking advantage of this opportunity will require a significant change in policies and corresponding investment increases.

Continuously growing prices on agricultural produce are causing perceivable difficulties worldwide and threatening to drive a considerable number of people to the verge of the poverty. At the same time, this situation poses a major opportunity for Ukraine, a net grain exporter with a significant exploitable yield gap and one of the few countries that are in a position to increase net exports and make up for possible deficits elsewhere in the world. Increases in agricultural output can be achieved through the expansion of arable land-use or through intensification. (Sabluk, P., 1995) (Mazur, A.G., 2000).

An appropriate agricultural policy framework and public investment program would provide incentives for critical private investments required to build up Ukraine's export-oriented and competitive AIS. Increased productivity in agriculture will also make Ukraine less vulnerable to low harvests. The country’s acceptance into the WTO and

negotiations on a free trade agreement with the EU provide key stimulus to the necessary reforms, and the Ministry of Agrarian Policy of Ukraine (hereinafter MAP) has already taken several initial steps. Key reform and investment areas include: trade policies (including free export); transport; storage; infrastructure of market information and agricultural statistics; institutional framework for land market; access to finance and risk management instruments; research and vocational training of agricultural specialists and farm managers; veterinary and food safety control system.

The impact of increasing domestic food prices should be eased off by targeted social assistance programs, accompanied by tighter macroeconomic management aimed at reducing overall inflation and ensuring that the gains from responding to this important economic opportunity for Ukraine are equally shared. Ukraine already operates a number of targeted social transfer systems that are quite efficient at identifying and supporting the most vulnerable population groups, such as the so-called "last resort" program for the very poor, which has a targeting efficiency of 73% among the poorest fifth of the population. Support to single mothers and young children (0-3 years) is also effective. These programs can be scaled up to support those most affected by growing food prices (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008). This would be cheaper and more sustainable than the blanket increases in all social payments implemented in recent years. At the same time, various benefits that do not effectively target the poor, such as housing subsidies, can be scaled back.

A recent EBRD/FAO report (European Bank for Reconstruction and Development / Food and Agriculture Organization: Fighting Food Inflation Through Sustainable Investment, 2008) identifies Kazakhstan, Russia and Ukraine as some of the few countries where both an expansion of arable land-use and considerable intensification could take place without serious consequences for the environment. As net exporters of grains and oilseeds these three countries can have a crucial impact on the situation in the world's food market, while generating considerable gains in terms of export revenue, economic growth and rural development.

Only very few countries are in a position to significantly increase net exports and make up for emerging deficits elsewhere. Increases in agricultural output can be achieved through the expansion of arable land use or through intensification. FAO estimates that more than 80 percent of the projected expansion in arable area is expected to take place in sub-Saharan Africa and Latin America. While this expansion will bear its own environmental risks (esp. through the destruction of rain forests), only 20 percent of the overall increase in crop production will come from expansion. The largest part, 80 percent, will have to come from intensification through higher yields per crop and more crops per year (multiple cropping, reduced fallow). Figure 3 shows for the example of wheat that Ukraine is a country with a significant exploitable yield gap (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

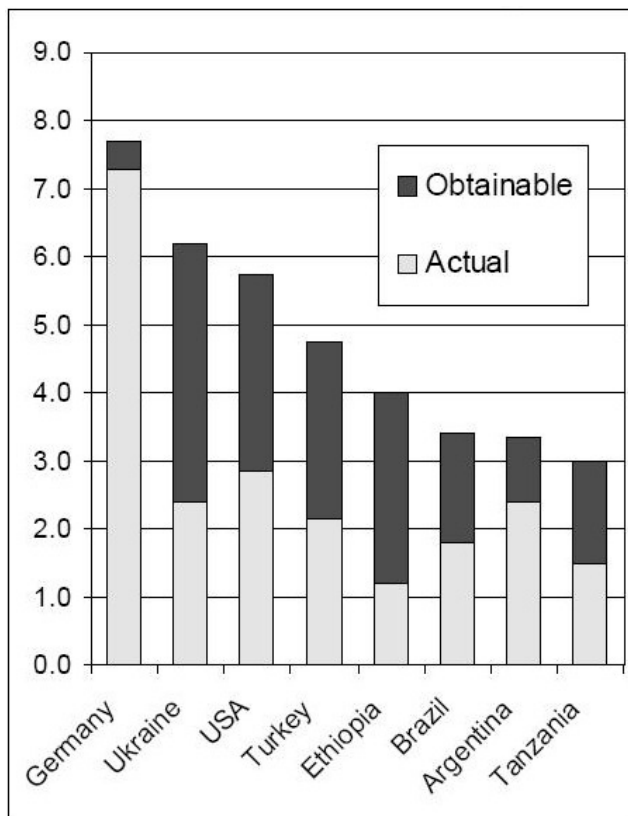


Figure 3. Exploitable yield gaps for wheat: actual versus obtainable yield (tons/ha)
Source (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008)

Ukraine's yields and production of major grains has stagnated since the 2004/05 harvest, and reduced drastically due to the drought in 2007/08. Production of oilseeds, especially rapeseed, has seen significant expansion, however primarily based on increased acreage rather than significant average yield increases. The forecast for 2008/09 is currently positive, with wheat expected to rebound to the highest level of production since 2002/03, and acreages and yields of all crops expected to increase over the previous year (Rynki i prognozy, 2008) (see Table 1).

Export quotas have reduced export volumes and led to an increase in grain stocks in Ukraine to levels that are considerably higher than was the case in the past. With closing stocks of 3.27 million tons of wheat and 4.17 million tons of grains total, Ukraine now stores 26.5 percent and 15.4 percent, respectively, of its annual demand (Table 2), which is broadly in line with the global average of 20 percent of cereals stocks to use ratio (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

Both yields and agricultural areas in Ukraine can be expanded considerably provided that farmers be subject to appropriate incentives. On the occasion of a regional conference on "Fighting food inflation through sustainable investment" in London in March 2008, FAO in collaboration with EBRD prepared an updated assessment of regional grain production and its potential. According to these analyses, average grain yields fell by 11% in the transition period, from 2.96 to 2.64 t/ha between 1992/94 and 2004/06. Forecasts call for a relatively modest increase of 4% to 2.75 t/ha by 2016, while the maximum potential projection based on yields in France corrected for the fact that Ukraine receives less

precipitation suggests that a 71% increase to 4.5 t/ha is possible. Combined with acreage expansions of 13% (forecast) and 21% (maximum potential projection), these yield increases would lead to an expansion in production of between 18 and 103%. Similar forecasts and projections could be generated for oilseeds (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

Increased production will largely translate into increased export potential. Domestic demand in Ukraine will not significantly limit exports if production grows. Firstly, the overall population of Ukraine is forecast to decline. Secondly, regional per capita incomes will increase, and resulting increased meat consumption will boost demand for feed grains. However, this will likely be offset by improved feed conversion ratios. Overall, domestic demand will increase slowly in relation to forecast growth in grain production.

The absorptive capacity of world markets is high, and will not limit Ukraine's ability to export. According to FAO's Food Outlook (November 2007), Ukraine is currently the 8th largest exporter of wheat with 1.5 mio. tons behind USA (31.5), Canada (14.5), EU (11.3), Argentina (9.0), Russia (11.2), Australia (9.9), Kazakhstan (8.6) and China (2.6), and ranks 10 for overall cereals exports. FAO projections that the world will need an additional 1 billion tons of grain by 2030 suggest that Ukraine will have no problems exporting the production increases that could occur in the coming years (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

Generally, it can be said that compared with almost two decades of talk about agricultural potential in Ukraine, actual performance has been disappointing, as other transformation economies with less natural advantages in agriculture have performed much better, one of the major reasons for this being constant political turbulence in Ukraine. Whether or not the existing potential is finally realized depends largely on the future political stability in general and on the consistency of Ukrainian government's approach towards the development of AIS in particular.

Table 1. Production of major crops in Ukraine, 2002-2008
(World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008)

Year		02/03	03/04	04/05	05/06	06/07	07/08	08/09
Wheat	acreage (ha)	6784	2625	5633	6453	5211	5971	6725
	yields (t/ha)	2.91	1.62	2.93	2.78	2.65	2.29	2.8
	production (mill. t)	19.76	4.25	16.53	17.91	13.81	13.70	18.85
Barley	acreage (ha)	4287	4719	4460	4266	5194	4150	4335
	yields (t/ha)	2.29	1.58	2.38	2.07	2.18	1.48	2.16
	production (mill. t)	9.83	7.45	10.62	8.82	11.30	6.15	9.35
Corn	acreage (ha)	1151	2016	1680	1648	1800	1900	2035
	yields (t/ha)	2.72	2.85	4.14	3.99	3.42	3.32	7.70
	production (mill. t)	3.13	5.75	6.95	6.57	6.16	6.30	
Tot. grain	acreage (ha)	14500	11282	14032	14433	14018	13553	14832
	yields (t/ha)	2.5	1.8	2.71	2.55	2.45	2.08	2.6
	production (mill. t)	36.27	20.32	37.96	36.82	34.40	28.20	38.62
Sunseed	acreage (ha)	2890	4020	3650	4250	4520	4090	4250
	yields (t/ha)	1.21	1.14	0.93	1.18	1.27	1.19	1.25
	production (mill. t)	3.50	4.59	3.40	5.05	5.75	4.86	5.31
Rapeseed	acreage (ha)	n.a.	54	106	202	405	945	1605
	yields (t/ha)	n.a.	0.94	1.17	1.43	1.61	1.17	1.49
	production (mill. t)	n.a.	51	124	289	652	1106	2391

Table 2. Grain and wheat supply/demand balances in Ukraine (million tons, 2003/04 – 2007/08)
(World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008)

Year	Grains, total					Wheat				
	03/04	04/05	05/06	06/07	07/08	03/04	04/05	05/06	06/07	07/08
Opening stocks	2.03	1.34	2.47	2.70	2.75	1.43	0.93	1.29	1.98	1.90
Crop	20.32	37.96	36.82	34.40	28.20	4.25	16.53	17.91	13.81	13.70
Imports	3.73	0.16	0.19	0.19	0.23	3.40	0.005	0.01	0.01	0.025
Supply	26.07	39.46	39.47	37.29	31.18	9.08	17.46	19.21	15.80	15.62
Exports	2.89	11.28	13.24	9.79	3.33	0.05	4.33	6.48	3.30	1.00
Demand	24.73	36.99	36.77	34.54	27.01	8.15	16.18	17.23	13.90	12.35
Closing stocks	1.34	2.472	2.70	2.75	4.17	0.93	1.29	1.98	1.90	3.27
Stocks/demand (%)	5.4	6.7	7.4	8.0	15.4	11.4	8.0	11.5	13.6	26.5

3.4 Economic and agricultural crisis in Ukraine

The process of economic transition has been difficult for the AIS. Unfortunately, food and agricultural sectors fell into a deep crisis in 1990 – 1999, in which period the output of primary agricultural sector in Ukraine declined drastically by 51%. At the beginning of transition period, agriculture accounted for 18.6 % of GDP. Ukrainian AIS has experienced one of the most severe and continuous economic crises of any economy in the ex-Soviet Union republics or other Eastern European countries.

By 1999, the share of agriculture in GDP has decreased to 13.6%. With the agricultural output recovering in 2000–2002, its share of GDP increased to 14.6% in 2002, and to 17.5% in 2006 (State Statistics Committee of Ukraine, 2008).

Until the years 2000–2002, when the situation in agricultural indices started to show signs of improvement after a decade of disappointing outcomes, the output of Ukrainian AIS demonstrated continuous growth by annual 10% for two following years. Unfortunately, poor weather conditions in the year 2003 potentially influenced by global climate change caused a decline in agricultural GDP by the dramatic 18%. In 2004 and the following years agricultural GDP steadily increased as a result of positive reforms (see Tables II - XII in Annex).

The crisis essentially came as a result of a collapse in general economy after breach of economic relations within the Soviet infrastructure, but the decline was made deeper and longer than in other transition economies by inert and passive policy reforms for most of the 1990s.

Basic reasons for the crisis can be summarized as follows:

- fallibility of the normative/legislative base for AIS development compiled in the mid-90s;
- slow rates of land and property relations reformation;
- ineffectiveness of collective property, bankruptcy of state sector farms due to breach of state funding;
- wrong tax policy and crediting overpressure on agriculture producers;
- absence of land market and producers' rights to dispose their land at their own discretion;
- underestimation of theoretic and practice experience gained by other countries with economies in transition;
- disregard of necessity for positioning agriculture as one of the leading sectors of Ukrainian economy;
- unattractiveness of investment climate in Ukraine, imperfection of tax system for foreign companies.

Fortunately, in the concluding six years of the reform (1998-2004), the situation in the AIS began to stabilize, building on the more stable trade policy and programs for rural sector development. The AIS in Ukraine was poised for a period of improved efficiency and growth, largely thanks to considerable state subsidies (see Figure 4).

The Ukrainian government provides financial support to the agriculture in a form of direct subsidizing to this sector and in a form of indirect subsidies. According to the existing in Ukraine practice the country's government provides its support to the agricultural producers in different forms. The main forms of the state support to agriculture come as a state financing of:

- land plants development programs;
- cattle breeding and live stock breeding programs;
- fishery development programs;
- reclamation projects development and environmental programs;
- financial support to agricultural producers through special loans;
- gardening sector support programs;
- veterinary development and safety protection programs;
- agricultural science development;
- rural infrastructure development;
- rural sector's social infrastructure development programs;
- programs on support to producers of agricultural equipment. (Ustenko, 2004).

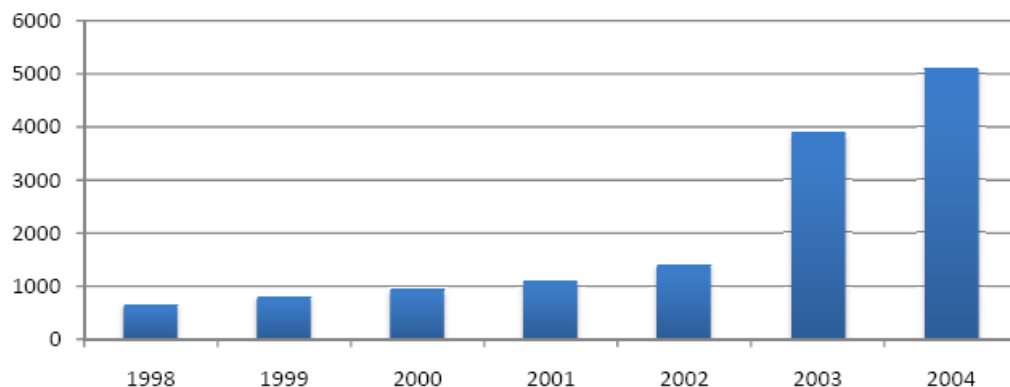


Figure 4. Subsidies to Agriculture in 1998-2004 (mio UAH)
Source (Ustenko, 2004), (State Statistics Committee of Ukraine, 2008)

In order to increase efficiency within the agricultural sector of Ukraine and, in particular, to put in order all issues related to subsidies for this sector the Law "On encouraging agricultural development in 2001-2004", 2001 was introduced by the Supreme Council of Ukraine. This Law envisaged introduction of supportive prices for agricultural products and presumes income support to the producers through state subsidies. However, the amount of agricultural subsidies to the Ukrainian producers was rather virtual than the real one. These were not transfers of the financial assets from the state budget to budgets of the producers. Although the state budget has been fixing the certain funds to be transferred as an agricultural subsidy it was almost never transferred to the final recipients (i.e., agricultural products producers) in a full amount (Ustenko, 2004).

In addition to this, after the "Orange Revolution" of 2005 the situation destabilized again, major reason for this being new government's pursuit of power unaccompanied by any

factual actions towards improving the existing economic conditions, which nullified a considerable part of antecedent achievements. In recent years, the situation has generally improved, but still remains unsteady. One of characteristic features of the current transformation is a continued decline in farm employment, which brings about the acute need to avoid social problems by stimulating efficiency-driven agricultural growth, creating more labour places for off-farm employment, and improving social conditions for rural population.

Reformation of the AIS led to the introduction of new legal and organizational forms of management in rural areas. It did not, however, solve all the problems standing in the way of improved agro-production, rural population's welfare and general sustainable development at Ukrainian farms.

Formal employment among rural residents declined by 30% in the last decade of the 20th century (State Statistics Committee of Ukraine, 2009a). With the growth of efficiency in AIS the number of positions in the AIS will reduce even faster. Most of surplus labor has thus far become involved in farming on individual lands. However, with about a quarter of Ukraine's labor force residing in rural areas, subsistence farming cannot be regarded as a long-term sustainable solution. Diversification of jobs and better social conditions in rural areas are urgently needed to avoid the spread of mass poverty and large-scale urban escape, together with associated social problems. Therefore, providing employment policies for surplus rural labor and enhancing the quality of life for rural residents as well as creating favorable environment for generating new jobs and improving public services are crucial to the economic and social success of the Agrarian reform. One answer to this problem is developing rural non-farm employment (RNFE) opportunities, which can be generally seen as a pillar of rural development policy and, from a long-term perspective, a critical factor for providing rural employment and income. RNFE includes all economic activities associated with work, either waged or self-employed, located in rural areas except agriculture hunting and fishing, which can contribute to a sustainable livelihood strategy for the rural population. This is important for rural areas, but especially for agriculture, since one of the most challenging adjustments facing Ukrainian AIS today is the need to reduce hidden unemployment.

Secondly, modern and efficient agriculture is intensive in terms of inputs, services and commercial linkages. If Ukrainian agriculture is to be transformed and competitive, it will require improved linkages with input supply systems, agricultural processing chains, and systems for distributing fresh and processed products. Modern agriculture requires cooperation with the agro-industry in order to successfully meet the demanding quality and safety norms and standards of international markets. It also requires access to management, administrative and advisory services. All of these involve RNFE, in both the secondary (processing, agro-industry, etc.) and the tertiary sectors (technical, commercial and transportation services). The need for an agricultural growth strategy based on enhancing the efficiency of the AIS is clear. Without it the sector will continue to stagnate. At the same time, without medium-term improvements in the quality of rural life, the Agrarian reform program may lose credibility and political support. Simultaneous implementation of an agricultural growth strategy and a rural development strategy is therefore essential (Nivyevskiy, O., von Cramon-Taubadel, S., 2006, pp. 485-486).

Bright et al., (Bright, H., Davis, J., Janowski, M. et al., 2000) review the voluminous literature on RNFE in both developing and developed countries and make the following generalizations: Rural households in developing countries typically receive 30-35 % of their total rural income from off-farm sources; numerous studies demonstrate that there is a positive correlation of RNFE activities with: i) higher income levels of rural families; ii) higher potential for diversification of income sources; iii) higher productivity in agricultural activities.

Other studies on RNFE have shown a positive correlation between a higher diversification of non-farm activities, income and: i) educational level; ii) quality and access to infrastructure or services; iii) quality, objectives and organization of services; iv) opportunities created through local, regional and national government policies; v) access to credit and financial services. Studies on RNFE in developing countries suggest the following policies for sector promotion: Increase asset holdings of the rural community (in terms of education and infrastructure); remove land market constraints and improve access to credit for non-farm activities (Bright, H., Davis, J., Janowski, M. et al., 2000, p. 488).

In the Ukrainian context, increasing rural unemployment, unless new jobs are created, implies significant social and economic problems for the government, and increased rural-urban migration creates more stress on urban areas. RNFE opportunities can reduce these negative effects. However, promoting this concept is very difficult and not the responsibility of one ministry or one organization (e.g. any state or private organization responsible for a particular activity, be it road building, gasification, construction) but rather of the whole government, and requires coordination among different organizations and ministries. For example, micro-financing can improve access to financial resources for the rural population. These might include micro-loans for non-farm investments or micro-insurance services to improve risk management strategies. Currently in Ukraine, micro-loans are mostly neglected, since state loan program funds are targeted towards agriculture (i.e., the partial interest rate compensation program). Hence, if the credit policy is widened to include the non-farm sector, it is particularly likely to benefit local non-farm self-employment initiatives. Secure ownership and usage rights of natural resources, particularly land, would provide the capacity to respond to incentives granted by micro-financing opportunities.

It also must be remembered that competitiveness of the agricultural sector cannot be increased without the development of the industrial, commercial and service sectors that characterize modern agriculture. Technology promotion policies, human capacity building, increasing the attractiveness of rural areas to the private sector (roads, electrification, telecommunication, etc.) are of crucial importance in this regard.

Voluminous empirical evidence shows a positive effect of education and infrastructure on RNFE opportunities. Ukraine has no public institution responsible for RNFE. The ministries of industrial policy, health, and education are clearly urban-oriented, whereas the ministry of agriculture rarely looks beyond agricultural production. If such a public institution were established, the design and implementation of rural development (including RNFE) policy would be much more effective. The EU's experience, which shows that a multi-sectoral, bottom-up approach must be taken regarding rural employment promotion, rather than concentrating on just one sector, be it agriculture,

agro-food or tourism, in this regard might be helpful (von Meyer, H., Terluin, I., Post, J., van Haepere, B. (eds), 2000). Other policy lessons from the EU are that infrastructure should be improved to make rural areas attractive to business and for living. The Ukrainian government should try to improve the general conditions in rural areas and not target particular enterprises. Resources should be directed not to regions with potential for growth due to their location, comparative advantage, or other reasons, but to those which suffer from poor physical infrastructure, a poorly-trained labor force or lack of processing and marketing facilities (Nivjevskiy, O., von Cramon-Taubadel, S., 2006, p. 484).

The need for an agricultural growth strategy based on enhancing the efficiency of the AIS by increasing the pressure on less efficient farmers to leave production and make the resources that they have been using to more efficient farmers, is clear. Without it the sector will continue to stagnate. At the same time, without medium-term improvements in the quality of rural life, the Agrarian reform program may lose credibility and political support. Simultaneous implementation of an agricultural growth strategy and a rural development strategy is therefore essential.

3.5 Agrarian reform in Ukraine

The agrarian reform was launched in March 1991, but made very slow progress in the first eight years. During this period agricultural lands were transferred from state to collective ownership, which, however, resulted in very inconsiderable actual changes in the structure and functioning of collective and state-owned farms.

The first round of farm reforms in 1992-93 initiated privatization of land through the distribution of paper shares to the rural population and mandated the transformation of former collective and state farms into corporate shareholder structures.

The second round of reform began with the President's Decree of 1999, which pushed the start for intensive farms restructuring. The decree gave impulse to the Government's program of converting land ownership rights and issuing "state acts for land" (land plots) to individual land owners in rural areas. The land received through the conversion of could be used to establish a new private farm or to extend an existing household plot. Corporate farms could continue to use the land represented by privately owned land shares only provided that they signed a formal lease contract with the landowners (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, p. 1). According to local councils' reports, 58% of rural population had received the so-called "state acts" by the end of the 2003. The remodeled Land Code passed in October 2001 was a key breakthrough for land reform as it allowed ownership and transfer of agricultural lands.

As noted by Czaki and Lerman, the weak reforms, however, have failed to radically change the traditional collective organization of Ukrainian farms. Break-up and internal restructuring of large farms has been very limited. Hence it should not be a surprise that the transition process is not delivering in terms of increased profitability and efficiency (Czaki, C., Lerman, Z., 2001).

The 1999 reform has led to the emergence of a new wave of "private" corporate farms organized by a single entrepreneur on land leased from rural landowners. As of 2004

there were over 4,000 such "private" corporate farms or almost 25% of the total number of corporate farms in Ukraine. The remaining 12,000 corporate farms were organized as "business" companies (*hospodarski tovarystva*), which included joint stock companies, limited liability companies, agricultural cooperatives etc.

Presently, corporate farms control less than 60% of agricultural land (down from nearly 95% prior to the start of reforms in 1990) and contribute about 30% of gross agricultural output (down from 70% in 1990). The individual sector (consisting of the traditional household plots and the independent peasant farms that began to emerge after 1992) controls today more than 40% of agricultural land, contributing 70% of agricultural output. Within the individual sector, the main contribution to agricultural production is from household plots, not peasant farms, as they also control much more land (33% versus 8%).

Collective agricultural enterprises (CAE), the organizational form that dominated the farm structure in Ukraine between 1993 and 1999, have completely disappeared since 1999. Corporate (collective) farms are now mainly represented by limited liability companies and private lease enterprises. While the number of shareholders in corporate farms ranges from 1 to 1,600, fully 16% are single-shareholder entities and 31% have only 1 to 3 shareholders (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, pp. 1-3).

The number of independent private farms has increased sharply from about 35,000 in 1999 to 43,000 in 2004 and the average size of a private farm has increased from 29 hectares to 66 hectares within the same period. Changes in land use patterns affected production through the contribution of individual and corporate farms to gross agricultural output (GAO). Against the backdrop of generally declining agricultural production, the share of the individual sector increased from less than 30% of GAO in 1990 to 65-70% in 2003-2004. The share of corporate farms correspondingly shrank from 70% to about 30% of GAO (see Figure 5).

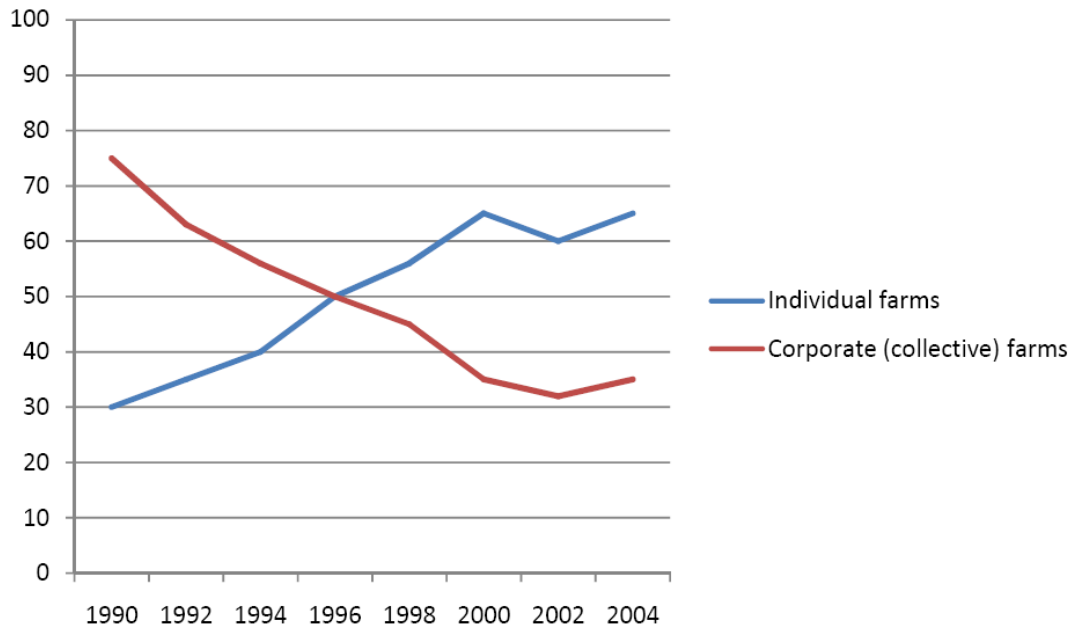


Figure 5. Shares of corporate and individual farms in GAO 1990-1994 (percent)
Source: (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, p. 30)

The growing share of individual farms in agricultural production also reflects differences in performance between individual and corporate farms. While corporate farms had dropped by 2000 to 30% of the 1990 level and remained roughly unchanged after that, the agricultural output of the individual sector in contrast remained unchanged during the first decade 1990-99 and then increased by 40% between 1999 and 2004 (Figure 6, red and blue curves for corporate and individual farms, respectively). Although the second-wave reforms have had a particularly beneficial effect on the performance of individual farms, they also have had some impact in the corporate sector. The decline in output of corporate farms stopped in 2000 and the number of unprofitable corporate farms dropped from almost 100% in 1997-99 to around 40% in 2000-2004 (although the absolute losses continued to climb) (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, pp. 31-32).

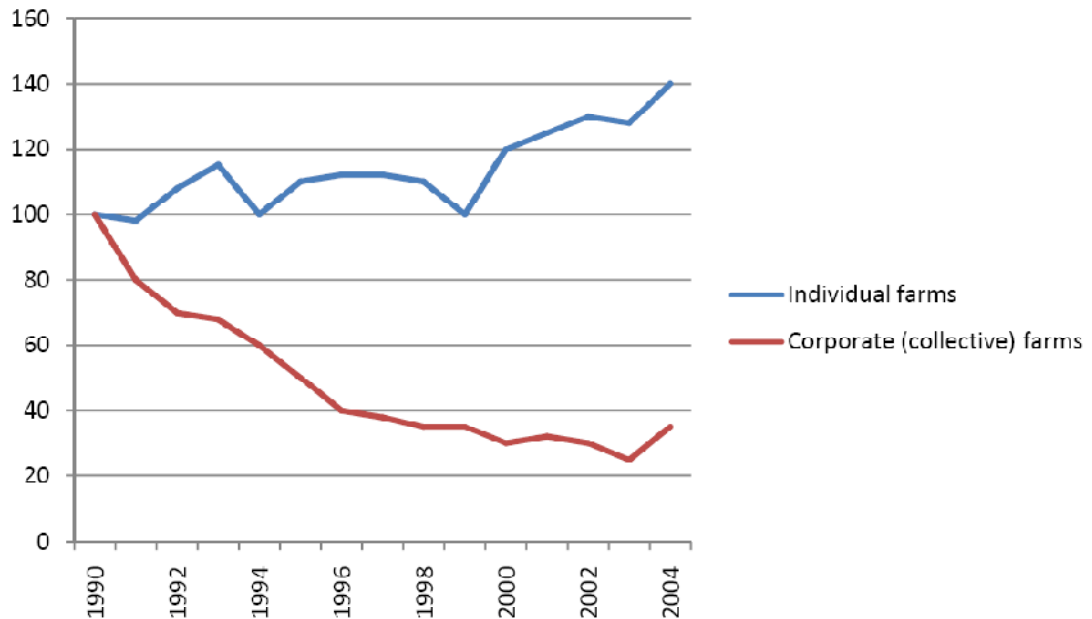


Figure 6. Change in GAO for individual and corporate farms 1990-1994 (percent of 1990)
Adapted from (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, p. 31)

The average size of a corporate farm in Ukraine has fallen from 3,000 ha in 1990 to 2,000 ha in 1998 to 1,000 ha in 2004 (Figure 6). Collective agricultural enterprises, the new organizational form that dominated the farm structure in Ukraine between 1992 and 1999, completely disappeared after 1999. Corporate farms are presently mainly represented by limited liability companies and private lease enterprises (the latter accounting for almost 25% of the total number of corporate farms in Ukraine). While the number of shareholders in corporate farms ranges from 1 to 1,600, fully 16% are single-shareholder entities and 31% have from 1 to 3 shareholders only.

During the Soviet era, large-scale farms were directly entrusted with maintaining the entire range of social services in the village. The village council was almost totally dependent for its budget on the local farm enterprise. The farm enterprise took over the functions normally fulfilled by local government, such as building roads, supplying water, gas, and electricity, and providing housing. It traditionally provided access to a range of services and benefits for its members and employees, as well as for other rural workers, including teachers, doctors, postal employees, etc., who in fact were on the state payroll and not employed directly by the farm. These social services ranged from daily necessities, such as house maintenance and repairs, heating fuel, and various consumer goods at subsidized prices, to culture and recreation, such as clubs and sports facilities. School buildings, clinics, shops, and other public facilities in the village were maintained and often built by the farm enterprise, with or without reimbursement from the government. The budget for all these benefits and services came from the operating revenues of the farm enterprise, and the farms in effect combined production functions with overall responsibility for social services in rural areas.

The reform agenda attempted to focus the large-scale farms on business and profits, which necessitated relinquishing their responsibility for rural social services. As part of

their reorganization, farm enterprises were required to transfer the responsibility for the social service infrastructure to local councils. Initially, this process moved very slowly, because the government failed to provide local councils with the requisite budgets. The situation seems to have changed quite radically since 2000. Fully 73% of farm managers surveyed reported that their social assets had been transferred to the local municipality. Of these, only 26% of farm enterprises had transferred their social assets prior to 2000; the remaining 47% transferred the social assets more recently (Figure 7). The social assets were universally transferred to the local municipality or the state free of charge (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, pp. 78-79).

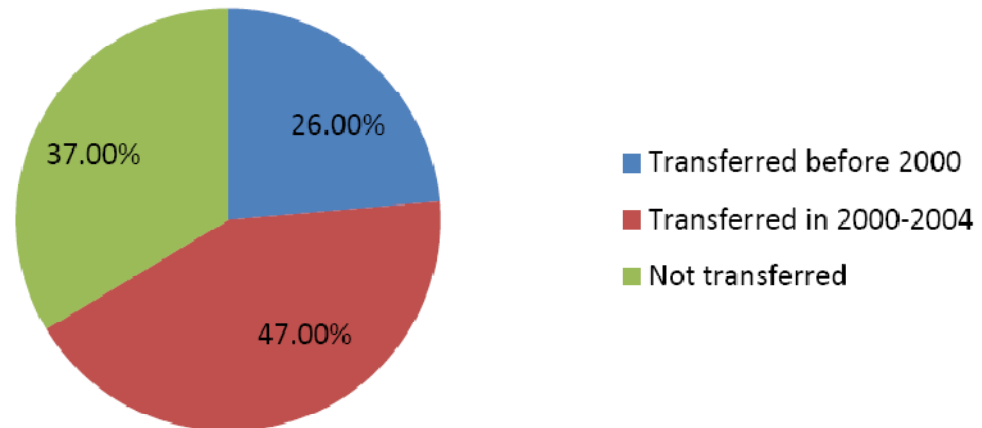


Figure 7. Transfer of social assets from corporate farms to local councils
Adapted from (Lerman, Z., Sedik D., Pugachov, N., Goncharuk, A., 2007, p. 79)

One of the major problems of the land reform and farm restructuring process thus far has been the slow pace of non-land asset distribution (e.g. machinery), which has led to concentration of the primary means of production in the hands of small groups of former collective farm insiders. In the short run this has had the effect of limiting the pool of potential land renters and placing downward pressure on land rental prices, which the government has regulated through a mandatory floor price. In the longer run it creates the risk of distorted wealth and power structures in rural areas that can result in a rapid concentration of land ownership, with negative social and economic consequences. One of the first priorities for the government over the next three to five years should be to complete the process of land parcel demarcation and issuance of state acts. In carrying out this process government policy will need to follow a middle road by preventing rapid consolidation of land in the hands of a small number of individuals or over-fragmentation of farm operating units into sizes that are not viable. One of the key factors in preventing the rapid consolidation of land ownership will be to complete the distribution of non-land assets.

Notable success of the reform can also be observed within leasing and rent markets for agricultural lands, which reacted fast and began to adequately create a new kind of profit for rural population. Rental payments per annum for an average land parcel remain low, but provide the equivalent of about two and a half months wages for an agricultural

worker. This is an indication that independent private farms are successfully taking over and profitably using land that could not be efficiently utilized by large farming enterprises.

Overall, major advantages of the agrarian reform lie in demonopolization of agriculture, its orientation not only on home but also on foreign market and gradual formation of a civilized infrastructure of agrarian market, including commodity exchanges, wholesale markets, agro-trade houses, fairs, trade enterprises, auctions, etc. State support of agriculture has become more flexible and thus effective, which went along with providing agro-producers with a freedom of choice as for forms of property, production, realization and incomes distribution. The reform also encouraged formation of free land market, land-lease relations development and stimulated credits and investments in new technologies.

The legal structure for implementation of the reform is presented in Figure 8, with the main tasks of the Department of reformation of AIS therefore lying in the creation, through the activities of the three subordinate administrations (Administration for strategy of agrarian reformation, Administration for reformation and restructuring of agro-enterprises and Administration for coordination of agricultural consulting services), of strategy and methods of agrarian land reform and further development of agriculture, and subsequent realization of the State policy of reformation of land and ownership relations, implementation of sustainable land use policy and general development of the AIS. In this process, reformation authorities of all levels (Head Department, as well as Regional and Sub-regional centers for reformation of the AIS) are expected to work jointly and direct their combined effort on taking measures aimed at increasing the level of profitability of agricultural production by means of creating and developing AIS advisory services and coordinating their work.

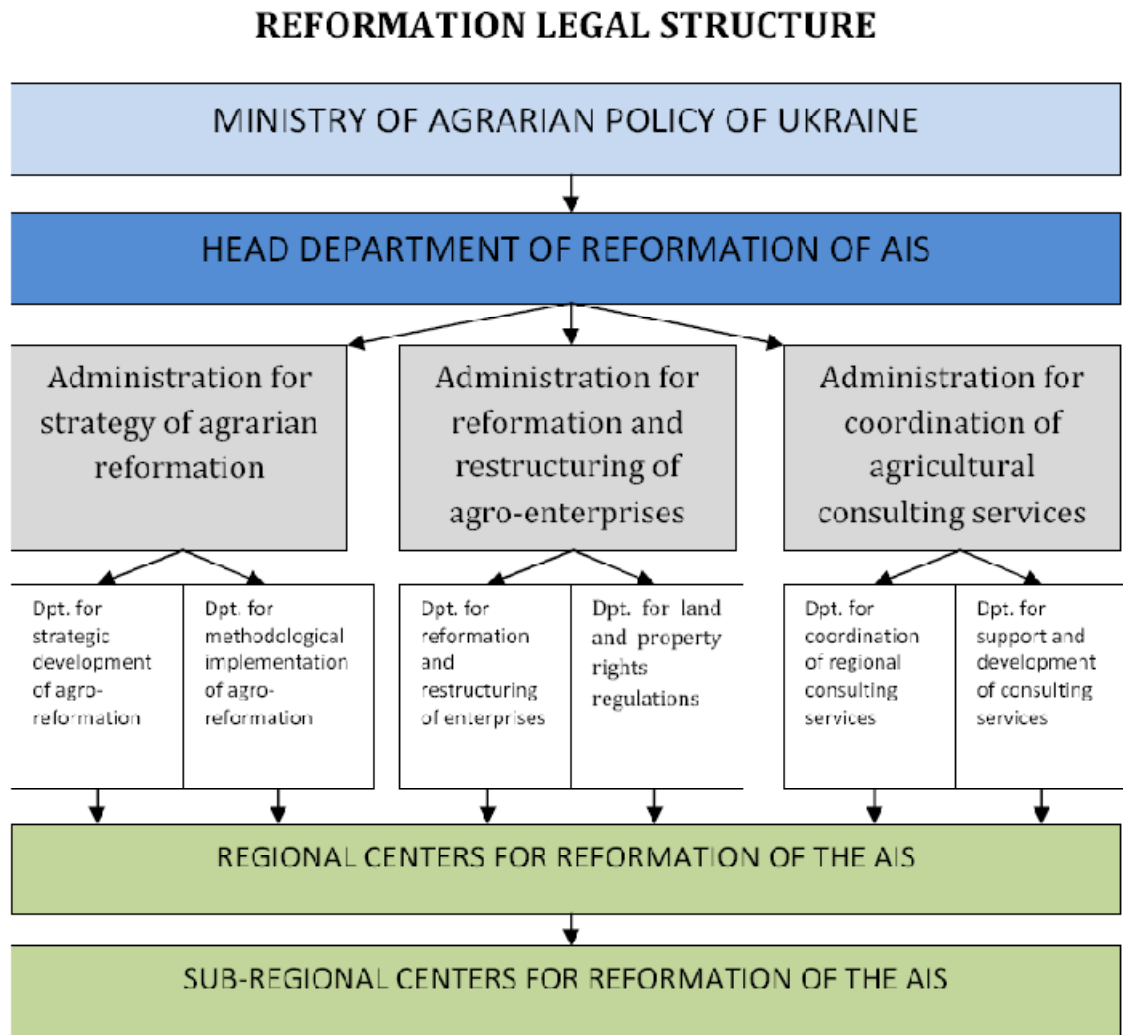


Figure 8. Legal structure for the implementation of the agrarian reform
Source: (Afanasyev, 2001)

3.6 Agricultural Policy/Strategy in Ukraine

The Government of Ukraine has established a program for the ‘Agro-industrial Sector and Development of Rural Areas’ that, if implemented, would make a significant contribution to increased sectoral competitiveness and reduced rural/urban disparities. This program based on the three pillars (i) rural development, (ii) competitiveness of agriculture, including quality and safety issues, and (iii) natural resource management and environmental sustainability includes provisions for the improvement of social and physical infrastructure in rural areas, for the development of key markets associated with agriculture (finance, land, insurance), for the adoption of international food safety and quality standards, for a transition to efficient mechanisms of state support (decoupled payments), and for increased efficiency based on innovations and knowledge transfer (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

The Ministry of Agrarian Policy (MAP) has prepared an advanced draft of a national program for rural development until 2015. Citing relevant laws such as the Law of

Ukraine "On basis principles of national agrarian policy for the period until the year 2015", the Law of Ukraine "On state support for the rural economy of Ukraine", and the Law of Ukraine "On the priority of the development of rural space and the agro-industrial sector in the national economy", MAP has prepared a detailed draft of a national program aiming at enhanced competitiveness on domestic and foreign markets, ensuring food security for the country, and the preservation of rural way of life and peasantry as the carrier of Ukrainian identity, culture, and spirituality (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

The agricultural budget has been adjusted to reflect some of the priorities and emphases in the government's program. Compared with 2007, the share of non-distortive (green box¹) expenditures in the adopted budget for 2008 increased from 47.2% to 55.6%. Rural development expenditures have been significantly increased. The government has also significantly increased resources for land market development and the eventual lifting of the moratorium of land sales. Risk management is addressed by increasing the allocation for insurance cost compensation, although the choice of instrument may need to be revisited (see for example index-based weather risk insurance). Budget allocations for research and development, and education and training have increased by 40% and 52%, respectively, but it is not yet evident that the increased budget would improve the quality of education. Support to bio-fuels production, for which UAH 15 mio. was budgeted in 2007, has been cancelled in 2008, as have subsidies for fertilizer purchases. Overall, agricultural budget allocations under the MAP have increased to 91% of total agricultural public expenditures, which makes the MAP the major authority responsible for agricultural policy and rural development (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

Thus, main principles for prospective National Agricultural Strategy are to:

- stimulate agriculture production growth and GDP;
- provide people with domestic food;
- demonopolise and decentralise the agrarian sector;
- develop the new infrastructure;

¹ "Green Box" measures as defined under the WTO Agreement on Agriculture are measures of domestic support to agriculture that have no, or at most minimal, trade-distorting effects or effects on production. Support needs to be provided through a publicly-funded government program (including government revenue foregone), not involving transfers from consumers, and the support in question must not provide price support to producers. Green box measures are exempt from reduction commitments and include (i) governmental services including research, extension advisory services, market information, pest control, inspection services, infrastructure; (ii) public stockholding for food security purposes; (iii) domestic food aid; (iv) direct payments to producers and decoupled income support; (v) government contribution to income insurance and income safety net programs; (vi) natural disaster relief including government contributions to crop insurance schemes; (vii) structural adjustment assistance through producer or resource retirement programs and investment aids; (viii) environmental programs; and (ix) regional assistance programs (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

- create more attractive conditions for foreign investors;
- form the free land market and develop land-lease relations;
- match Ukrainian agricultural products to European standards and quality requirements;
- increase credits and investments in new technologies;
- provide producers with a freedom of choice;
- increase state support of agriculture;
- raise agro-produce export;
- enhance the quality of agro-produce;
- stabilize the AIS and make it insensitive to disturbances.

A transparent, predictable and market-oriented policy framework for the agriculture sector will both increase the effectiveness of public expenditure and reduce uncertainty and risk, and hence increase private investments. A key priority is to reduce ad-hoc interference in agricultural markets and eliminate the sudden and unpredictable steps to regulate quantities and prices that make investment in Ukrainian agriculture much less attractive for investors than it could be (World Bank: Europe and Central Asia Region, Sustainable Development Unit, 2008).

Another policy priority is the completion of institutional arrangements for the registration of property rights (including land) and the removal of the moratorium on land sales. Land purchase and sale would not lead to rapid, dramatic changes, but it would set in motion a virtuous circle whereby the availability of collateral increases investment and productivity in agriculture, which in turn leads to increased land values, which make yet more collateral available, etc. It would also, together with the enforcement of bankruptcy procedures in agriculture. One of the largest handicaps facing agriculture in Ukraine is the persistence of a very high proportion of highly inefficient farms, many of which are subtracting rather than adding value as they produce (World Bank, 2008).

3.7 Towards sustainability through increased organic agro-production

3.7.1 Agricultural sustainability with the special focus on Ukraine

First steps towards the official adoption of the global sustainable development strategy on the national level were made in Ukraine in 1997-1998. This included establishment of the National Sustainable Development Commission of the Cabinet of Ministers of Ukraine and approval of “the Main Directions for the state policy in the spheres of environmental protection, disposal of natural resources, and provision of ecological safety” by Verkhovna Rada (Supreme Council) of Ukraine. This document determined the priorities and strategy for harmonious development of the state’s productive and natural-resource potential. Economic and social strategies of transition to sustainable development were legitimized by a set of official documents, the basic ones being the address of the President of Ukraine to Verkhovna Rada of Ukraine under the title “Ukraine: Advance to the XX1 Century. Strategy of economic and social policy for the years 2000-2004”, Decrees of the President of Ukraine “On the main directions of social policy for the period up to 2004”, “On the strategy of overcoming poverty”, “On the Concept of

development of the Ukrainian population's health protection" and "On the main directions of the land reform" (National Report, 2002).

The concept for sustainable agriculture was elaborated and presented by the Ministry of Agrarian Policy of Ukraine in cooperation with the Ministry of Nature and Environmental Protection and the Ministry of Economic development and European Integration. Its components are presented in Figure 9.

After prolonged discussions it was decided that organic agriculture would be a perfect solution to current agricultural crisis, since it puts very low pressure on soils and environment, provides farmers with the possibility to avoid usage of harmful and as a rule expensive pesticides and fertilizers and in the end effect produce healthy, natural agricultural products not only valuable for Ukrainian population, but also in high demand at the European and World markets. Hence, the project for developing organic production in agricultural sector was initiated.

The overall task of the project is viability improvement in the agricultural sector by developing a system of organic production. The objectives are to analyze EU experience in organic agro-production development; to prepare the concept for organic agro-production development in Ukraine; to prepare a set of proposals for the development of the legislative base regarding organic produce in Ukraine; to work out the concept for national certification mechanism; to raise public awareness concerning excellence in the field of organic agro-production; and to define key participants interested in the promotion of organic agro-production in Ukraine and form the platform for discussion and cooperation.

- Concept for sustainable agriculture for Ukraine

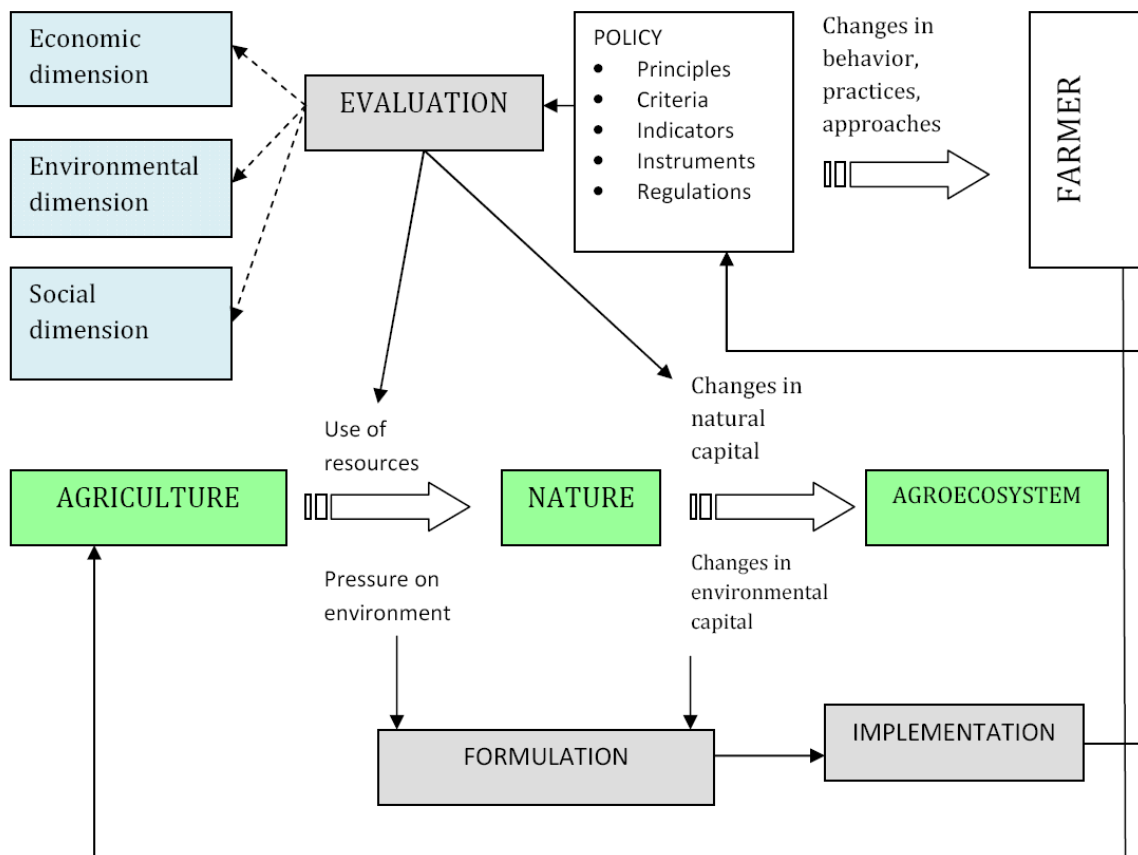


Figure: 9. Concept for sustainable agriculture for Ukraine
 Source: (Ministry of Agrarian Policy of Ukraine, 1997-2008)

The tasks are set to include two key components:

Component 1. Assisting the development of organic agro-production in Ukraine by developing law projects for organic agriculture, concepts for national certification mechanism and programs for development of organic agro-production in Ukraine.

Component 2. Raising public awareness and cooperation of key participants/actors by rising public awareness through organizing seminars, round tables, workshops and press conferences and disseminating information through mass media such as web site, leaflets and brochures.

Target groups were identified by the Ministry of Agrarian Policy of Ukraine with cooperation of the Association of Ukrainian farmers and land owners, NGOs representing interests of agricultural producer, consultancies, scientific and educational institutions, consumer associations, and local governmental bodies (Ministry of Agrarian Policy of Ukraine, 1997-2008).

3.7.2 Perspectives and problems of organic agriculture development in Ukraine

Organic agro-production in Ukraine is at the present moment in the initial stage of its development and though having a big potential, it faces a number of considerable problems.

Despite the fact that organic sector is extremely promising thanks to fertile black soils and solid traditions of agricultural production, considerable portion of tillage is subject to various levels of degradation, which reduces soil performance. Soil inspection undertaken in mid-1990s reveals that approximately 35,8% of arable land in the country is eroded, 25,46% has high pH level, 9,7% is saline and solonetz, and 8,9% is overwettered and muddy (State Statistics Committee of Ukraine, 2009a). On the other hand, as a result of protracted economic crisis owing in particular to the lack of circulating assets on farms, 1990s saw considerable reduction in use of mineral fertilizers, pesticides and other chemicals, which slowed the decrease in soils quality and intensified their rehabilitation in terms of maintaining natural fertility (Marchuk, E.K., 1995). Thus, Ukraine presently has large areas of arable land filled with black soils that can be used for organic farming within a short period of time.

Sustainable farming traditions carried out in agreement with nature are historically deep in Ukraine. In fact, the history of Ukraine per se is a history of farming and agriculture dating back to as early as the Trypillian culture of the 4th-3rd centuries BC. This was exactly the time when the main principles of the so-called renewable agriculture based on natural mechanisms of soil protection and recuperation that are still in use nowadays were introduced (Galyas, A., Kapshik, M., Bakun, Y., 2008, pp. 9-12).

Forms of agriculture in the times of the Kievan Rus (9th to the middle of the 13th century) and the Cossack state (15th- 18th century) were based majorly on the principles of harmonizing farming methods with environmental protection and the necessity for maintaining sustainable interaction between humans and nature. Later on, similar principles were followed by Sergiy Podolynskyy, the famous Australian agrarian academic and an outstanding innovator in the field of organic and biodynamic farming. Podolynskyy's concept lay in seeing the aim of human labor as directed at increasing the transforming energy of human organism with the help of which an individual obtains the amount of energy otherwise not obtainable in natural conditions without his interference (Galyas, A., Kapshik, M., Bakun, Y., 2008, pp. 9-12).

Starting from late 1970s the so-called "Poltava experiment" aimed at implementing no-till, conservation tillage, reduced tillage, ridge tillage conservation agriculture has been carried out. At its initial stage, the experiment targeted majorly the Poltava region, but then was also expanded to parts of Odessa, Kherson, Lugansk, Donetsk, Kyiv and Vinnitsa regions. It was based on the experience of overcoming the devastating consequences of wind erosion in Kazakhstan and the United States and put into action due to the wide spread of erosion and degradation processes all over Ukraine caused by overfarming, and use of overly intensive technologies characterized by high norms of mineral fertilizers and pesticides. Principles of reduced tillage farming were largely based on the ideas developed by Ivan Ovsinskyy, who started his work at the beginning of the 20th century. His ideas were introduced at a collective farm called "Obriy" – nowadays private production "Agroekologiya" in Poltava region. Key specific technology on both

of these farms includes application of soil-protecting technologies, where the soil is tilled for all crops at the sowing bed depth of up to 5 cm, whereas the soil's surface is mulched with stubble. Technical support of soil-protecting technologies is based on usage of wide-cut heavy disk harrows, wide-cut heavy cultivators, disk-crowfoot rollers, and grain packer drills or sowing machines of direct sowing. Reproduction of soil fertility through application of organic fertilizers, such as humus and non-commercial portion of the harvest (grain and leguminous crop chaff, granulated stems of sunflowers, corn, sorghum, tops of root vegetables, stalks, etc.) was essential. The enterprises also employ green manure crops after harvesting.

Also important was to make sure that standard rate of organic fertilizer input, recalculated for semi-fusty farmyard manure, is equal to no less than 24-26 tons per hectare of area under crop rotation. The farmyard manure recalculation coefficient is respectively equal to 5 for stubble and to 1.5 for green manure.

The use of synthetic mineral fertilizers was avoided. Take-up of phosphorus and potassium by plants during the first years of application of organic farming technologies was compensated by transfer of inaccessible forms of these chemical elements to the forms accessible for plants. Subsequently, phosphorite flour and sylvinitite were applied. Take-up of nitrogen was compensated by inclusion of 20% of perennial legume grasses in crop rotation system. Synthetic nitrogen fertilizers, which were applied to the soil for utilization of the harvest's non-commercial portion, completely convert to organic nitrogen after two weeks of composting with stubble.

Using, agro-technical methods (such as cultivation, bastard fallow) to protect crops from weed were used. Cruciferous green manure crops were sown, because they have allelopathic effect on weeds. Preventive agro-technical and biological methods were utilized for protection of crops from pests and diseases (Kobets, M., 2003, p. 11).²

The "Agroekologiya" continuously introduced the techniques of reduced tillage and intensive use of organic fertilizers and reducing the use of synthetic herbicides and mineral fertilizers. At the beginning of 21st century farm "Agroekologiya" from Shyshatsky rayon of Poltava region was certified by the Swiss certification agency with the purpose of increasing export turnover, especially export to the EU and Switzerland. Unfortunately, aimed volumes were not reached and due to the lack of state support and poor markets of organic products, the farm lost its status of organic agricultural producer (Galyas, A., Kapshik, M., Bakun, Y., 2008, pp. 9-12).

By 2003, the number of organic farms reached 70, covering approximately 240 000 hectares which is an index comparable with that of the neighboring European countries. At the same time, this makes up only 0,57% of total agricultural lands available in

2 Cited from (Shikula, M.K., 1998), respectively

Ukraine. Most organic agriculture farms are large or mid-scale with average size of 3 000 hectares mostly involved in grain production and focusing on harvesting wheat intended for export. Animal breeding is almost non-existing. Such one-sided development of organic agriculture reduces the profits of agricultural producers. It is obvious that trade certificate owning agents are making much more by exporting the grain than producers do.

In February 2004, the first Deputy Minister in the Ministry of Agrarian Policy (MoAP) confirmed the Ukrainian Government's strong interest in developing a comprehensive concept of organic farming and a corresponding legal framework. In 2005, a governmental programme started with the global aim of developing ecological and competitive agriculture in Ukraine. One of the objectives is the implementation of the "Ukrainian Organic Products" project with a span from 2006 until 2010. In chapter 6.2.4 and 6.3 we can observe the available results of the programme.

Based on experience in previous projects financed by SECO in other countries (Romania, Bulgaria) the project will establish a certification body which shall be owned by the actors in the organic sector (the multi-stakeholder approach). An adequate legal structure needs to be identified for this body at the beginning of the project. The services offered by the certification body will cover all types of certification needed by the market partners to sell their products on the local, as well as on the international, market, i.e. certification according to international standards, such as the EU Regulations on organic agriculture and the US-NOP, as well as private standards like Biosuisse and the recently elaborated standards of the Ukrainian BioLan association.

It is expected that the Ukrainian government will implement a law whereby inspection and certification is conducted by private bodies and not by the government. The reasons are that governmental certification would not be accepted, or would be less accepted, by the export market (the negative experience in Serbia illustrates this) and private certification requires less government spending. The initial proposals for organic market initiatives will be assessed by FiBL (the implementing Agency in the Institute for Biological Agriculture in Switzerland) and a feasibility check on the definitive proposal will also be conducted. On this basis, Organic Market Initiatives (OMIs) will be launched. The selected OMIs have an exemplary character for other local initiatives, either on the domestic or international markets, and the experiences and lessons learnt by the project will be shared with the training programme participants.

The draft legal framework shall be finalized within an EU TACIS (Technical Assistance for the Community of Independent States) project. Experience in other projects has shown that variations in the legal framework from European and international standards (Codex Alimentarius) can create unfair competition and be a barrier to the development of organic agriculture in a country. Such variations include requesting more inspections and longer conversion periods. Even more, the lack of supervisory authorities, or insufficiently qualified, supervisory authorities, which impose unjustified requirements on certification bodies or delay the process of approval/accreditation, can be a threat to the success of any project aiming to develop the organic sector.

The main objectives of the project are: to strengthen the Ukrainian organic sector; to facilitate market integration by reducing trade barriers like access to certification; to

develop organic value chains through market services and specific supports for organic market initiatives; and to improve the framework conditions for organic products. At the end of the project, Ukrainian consumers will have access to a wider range of certified organic products.

A Ukrainian certification agency is expected to be established as a professional, independent and locally owned certification organization, which offers cost-efficient and credible inspection and certification for organic products to farmers, processors and traders of all sizes. New market services for domestic and export markets will be offered, for example through the umbrella International Association of Organic Agriculture Producers “BIOlan – Ukraine”. Specific support is to be given to OMI to improve the market access of organic farmers and increase their participation at the premium price.

These aims are currently being realized by means of a range of activities including training and advisory work focused on quality management, business development, institutional building and accreditation; training, advisory work, supervision and recertification conducted jointly by two certification bodies: IMO (Switzerland) and Balkan Biocert (Bulgaria); strengthening the development of the organic market by conducting mutually reinforcing components: Market services and OMI (pilot projects); developing different services requested by the markets, as, for example, market information, promotion of organic guarantee systems, and co-ordination and participation at national and international fairs; as well as training programmes and seminars on organic production and marketing (Research Institute of Organic Agriculture (FiBL), 2005).

The next intention to speed up conversion of small-scaled farms into organic and sustainable agriculture is taking place in Lviv and Karpaty regions with the support of the American-Polish organic company “SYMBIO” which cooperates with over 300 small-sized organic farms in Poland and implements a highly effective cluster system approach for converting small Ukrainian farms to organic production of vegetables and fruit for export to the EU and the United States. Consulting activities for farmers interested in changing to organic agriculture are offered (SYMBIO, 1998-2009).

In the Ukrainian context, implementation of productivity raising measures alone is not enough for developing a whole production/consumption chain from farmer to end user. Success of organic production depends on acceptance of this produce by people, and demand from the side end customers and exporters. For this reason development of organic sales and promotion of bio-products among consumers are very important issues to be presented for consideration by Ukrainian government. Without strong and direct state support the intensive development of organic agriculture is not viable. Such supportive measures could be state subsidies, lower taxation of organic production, assistance for conversion and certification.

Formation of sustainable internal market of organic and bio-products requires strengthening the national system of organic guarantees, stimulating interest for such products and making “bio-label” trendy. Apart from that, legislation, standardization and certification systems must be aimed at setting up an international equivalent system of organic guarantees for export of bio-products from Ukraine. In the last decade a significant part of agricultural soils were cultivated without intensive use of agro-

chemicals and thus could be quite quickly and easily converted to organic agriculture. Some organic farms achieved even higher productivity than by using conventional technologies, which demonstrates that organic agriculture opens a wide variety of possibilities for large- as well as for mid- and small-scale farms. The main constraint is scarcity of buying markets. Apart from this, Ukraine needs to develop an active cooperation system for regulating the AIS organic sector, which would be able to assure synergetic effect between government policies and the market with these acting as main intermediates between producers and consumers. First steps in the discussion regarding the necessity of a national strategy for organic agriculture branch development in Ukraine were initiated in the 1990s, in cooperation with and utilizing the experience of FIBL – Switzerland (Vovk, V., Kapshtyk, M., 2004).

Main tasks were defined as introducing ecologically balanced agro-technologies and developing a set of state and governmental measures for supporting agricultural activities that help to protect and enhance biodiversity, at the same time not reducing current agricultural productivity. The focus was set on the necessity of state support and stimulation for organic agriculture, for example by creating a national certification and accreditation system with the support of IFOAM. Important instruments for realization of these tasks are changing the institutional needs and supporting biodiversity.

Farmers' attention needs to be brought to potential advantages such as economic, social (e.g. health protection) and ecologic and to intensifying, by raising public awareness, the consumption of organic agricultural products. All this is only possible on the condition that the state act as a guarantor for those who decide to switch to organic farming by certifying their products and providing them with adequate product markets.

3.7.3 Elaboration of national regulating directives

At the present moment, Ukraine is involved in the process of elaborating national regulating directives with regards to organic farming. A special working group was created that included experts from the parliamentary committee for agrarian policy, representatives of the coordinating secretariat for agrarian sector under the Ministry of Agrarian Policy and delegates from Farmers' Association. Thanks to support coming from Switzerland, this working group managed to obtain legal and political advice from the leading IFOAM experts. It was agreed that at this early stage, regulation should assist the development of organic farming and relevant consumption in the country. It is furthermore foreseen that the major law will regulate organic production and trade by securing minimal set of production and processing principles which need to be obeyed in order to have a product labelled as "organic"; and mandatory inspection of all organic products delivered to markets independently on where or not they are Ukrainian-made or imported.

The aforementioned law will provide agrarian sector with legal determinacy and production technologies defined by it will gain official recognition. This will enable the sector to strictly determine its status and guarantee that organic products supplied to the market can be trusted and are indeed characterized by a number of quality advantages in terms of consumption, particularly with regards to consumers' health. Thus, legislative regulation will help the organic sector to find its place on the market and recognition from the side of food industry and its disseminating agents, such as supermarkets.

The new law is entitled to also protect farmers involved with organic production and guarantee them fair competition with other Ukrainian and foreign producers. Such climate of protectionism will stimulate agricultural producers in resorting to means necessary for conversion to organic farming. This will also contribute to the development of AIS owing to prospective state subsidies and agro-ecological programs expected to be initiated by the Ministry for Agrarian Policy and the Ministry for Environmental Protection. According to expert evaluation performed by national and foreign specialists, there exists a considerable potential for the growth of certified agricultural production and organic food. However, this sector still remains at its rudimentary stage and is characterized by asymmetric, distorted development (Kobets, M., 2003, pp. 16-20).

Slow and asymmetric development of organic production in Ukraine is caused by the following factors:

- incompleteness of legal and normative basis which would be able to strictly define the state policy in the field of organic production, create necessary conditions for legal recognition and protection of organic products, form the national certification system, set relevant rules and standards, as well as absence of the state support and stimulation system for the field's development;
- domination of export and underdevelopment of home market and consumption of certified organic products and organic food;
- only one or two types of organic raw agricultural products, corns and oil, are predominantly produced and exported; production of other crops still stands on a very low level;
- mostly large agricultural enterprises are involved in organic production; transition among small and medium enterprises is rather limited.

Production of organic cattle is still non-existing. The processing industry for organic agriculture is not developed. Domestic and foreign investors are only planning to start the processing and production.

Public participation in promoting organic agriculture plays a very important role. Local administration and representatives of agrarians, who deal with organic agriculture, should get informational support, guidelines for organic agriculture standards, conditions of certification and marketing. European standards should be translated into Ukrainian and distributed among local regulation bodies, farmers and the wide public.

Ukrainian organic agro-producers who deal with export are usually inspected by foreign certification bodies operating in Ukraine, e.g. Control Union Ukraine, which represents the Dutch certification company Skal International, Turkish representative of the same company, Instituto Mediterraneo Di Certificazione s.r.l. (IMC), Italy, Biokontroll Hungaria Kht., Hungary, BIOS S.r.l., Italy, Bioland e.V., Germany and others.

Certification procedure is performed according to the standards of export markets, mainly with EU Resolution 2092/91 (European Parliament, 2003). Small-scale farms which converted to organic production with the technical support of the Swiss government are usually certified by the Swiss certification body Bio-Inspecta using the standards of Bio-

Swisse. In the framework of new Swiss-Ukrainian project for development of organic products market, a new Ukrainian certification body “Organic Standard Ltd.” was created, which will become official in 2011 and is expected to perform certification according to Ukrainian national standards and private standards of “BIOLan - Ukraine”, based on Bio-Swiss standards and other existing EU, USA and Japanese international standards.

Until 2011 “Organic standard Ltd.” will be working together with Swiss IMO control. Apart from that, the new company SGS-Ukraine affiliated to Swiss company SGS has been founded, which already has experience with Russian organic production markets. In the nearest future, Romanian and Moldavian certification bodies will start operating in Odessa region.

Providing informational support among science and education professionals and governmental bodies, agrarian NGO’s and other decision makers will help to create a national system of certification of organic products compatible with international standards and will allow for creation of solid and reliable export markets as well as a national market for products of organic agriculture. IFOAM Norms for Organic Production and Processing (2005), European Union Standard №2092 and standard Codex Alimentarius (Codex Alimentarius Commission, 2009) should serve as a basis of legal regulation for organic agriculture.

According to the Legislation for Organic Agriculture, passed by Verkhovna Rada of Ukraine, responsibility for developing projects regarding legislation and regulation of organic production lies on the Ministry for Agricultural Policy, which should act jointly with trade and investment companies, the association of farmers, the federation for organic agriculture, representatives of the Ministry for Agricultural Policy, State Department for Food industry, the National Agricultural University, Ukrainian Academy of Agricultural Sciences, and agricultural consultancy companies.

It is obvious that organic agriculture is very important for improving economic, social and environmental situation in Ukraine. It has the potential of stimulating complex development of the whole agriculture industry and thus contribution to protection the human health. Ukraine should introduce methods for raising public awareness about advantages of organic products, with stress on positive effects of ecologically safe and chemically clear products on human health. Development of the domestic market will require strengthening of national policy which should provide guarantees for organic products for Ukrainian consumers, create and win their trust and loyalty.

3.7.4 Promoting organic production to domestic Ukrainian and foreign markets

As said above, at the present moment, the whole organic production in Ukraine is export-oriented and based on production of organic grains and intended for the EU. In contrast to other European countries, there are no specialized shops or even shop windows and counters at the supermarkets for healthy organic products. Processing industry is also almost absent. Small scale private organic farmers are trading their products to the customer through traditional markets.

As a rule, sales people have a very vague idea about what a certified organic product is. Even among high-ranked managers in agricultural industry “healthy food” is often understood solely as that containing bio-active additive.

Conversion from traditional to organic farming in Ukraine is significantly slowed down by lack or even absence of the marketing activities and advertisement for healthy organic products. Development of domestic markets for organic products can only be achieved by promoting economic advantages of such production for farmers and supermarket owners as well as by advertising and raising customer awareness of sustainable and healthy way of life, including balanced nutrition.

It can be noted that European trend of taking care of health is gradually gaining weight among Ukrainian consumers and a slight shift towards buying healthy products is observed. There are more and more people who are able and willing to spend more money for balanced nutrition. This especially concerns purchasing healthy food for children, which means that child nutrition industry can greatly benefit first from the organic products.

Unfortunately, these tendencies do not find visible enough reflection in the media, which are to a much greater extent involved in advertising medicines, which help to minimize the effects of unhealthy lifestyle, such as smoking, alcohol consumption, fat, junk and unsystematic nutrition than promoting moderation. Indeed, very few people seem to realize that living healthily and thus avoiding the negative causes of ailments themselves makes much more sense than fighting them post factum. This important issue should by all means be monitored by the government. In order to achieve high public awareness of organic products consumption and create a demand for it, it is necessary to analyze the experience of the developed European neighbors, start an informational media campaign promoting healthy organic products and traditional dishes as opposed to junk food.

Intensive marketing activities for organic products through stock sales and supermarket chains have a great potential for creating and enhancing the domestic market, as they can ignite and raise end consumers' demand. Such promotion will stimulate healthy nutrition and in addition increase production and indirectly develop domestic processing facilities. Possible negative issue accompanying the process can initially arise due to the fact that the variety of domestic organic products is very limited. Hence, supermarkets will have to offer imported products which will in turn create considerable competition for domestic producers.

Other marketing strategies could be borrowed from Austria and Germany, where organic farmers united in associations for promoting organic products, which helped them create a common trademark, brand or even seal for ecologically clean, health-friendly organic products that are distributed through selected shops and restaurants. In Holland, farmers organized dairies, where they produce traditional sorts of cheese and quark from organic milk and sell it small shops directly at their farms or in the neighboring villages. Apart from being highly lucrative for farmers themselves, such kind of activity can be supplementary to green tourism, as an example from Spreewald region in Brandenburg, Germany, demonstrates. Cooperation between organic farmers and public or private food/meal industries, canteens such as those in schools and hospitals is also essential for

the marketing of organic products. Obviously, such measures call for more financing, which is not possible in Ukraine without attracting foreign investments.

In February 2007, during the World Congress for development of ecologically safe agriculture in Nürnberg, Germany, Ukraine was accepted as member of the IFOAM, which is of high importance for increase the production and export of ecologically certified Ukrainian products.

Equally important is to share knowledge about healthy nutrition through online clubs and forums for organic food consumers, which are now being created in large Ukrainian cities, such as Kyiv. Such clubs also become a good basis for purchasing agro-products directly from farmers.

4 SEA and its Possible Application in Ukrainian Agro-Industrial Sector

4.1 Strategic environmental assessment: definition and aims

Various arguments have been put forward for a more strategic level of environmental impact assessment (EIA), most of which relate to problems with the existing system of project EIA. Project EIAs react to development proposals rather than anticipate them, so they cannot steer development towards environmentally robust areas or away from environmentally sensitive sites. Such project-level approach thus carries two main limitations. Firstly, it disregards the aggregate effects of multiple activities on the same area. The current major environmental problems are all results of cumulative effects: depletion of the ozone layer, biodiversity decline, etc. no one single project can be considered responsible for such problems, however, they occur due to the combination of several impact sources. When projects are assessed individually, not much attention is paid to other developments (existing or planned) affecting the same area (McCold, L., Holman, J., 1995, S. 2-8). Secondly, as said above, environmental concerns come into play only at the latest stage of decision-making, and thus, EIA focuses on better execution of specific actions, but does not orientate or frame the intention (Arce, R., Gullón N., 2000, pp. 393-402). In fact, the project alternatives subjected to EIA represent the set of possible courses of action that has been pre-selected on the basis of the developer's interest and with no mandatory consideration of their environmental impacts (Geneletti, D., 2002, p. 33).

As a solution to these drawbacks, the procedure of Strategic Environmental Assessment (SEA) has been proposed, which can be defined as the formalized, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or program and its alternatives, including the preparation of a written report on the findings of that evaluation, and using the findings in publicly accountable decision-making (Thérivel et al., 1992). In other words, it is the "EIA of policies, plans and programs" (PPPs). Figure 10 demonstrates the links between PPP-making and SEA. Although policies, plans and programs are generally all described as strategic, they are not the same things, and may themselves require different forms of environmental appraisal. A policy is generally defined as an inspiration and guidance for action, and a program is a set of projects in a particular area (Wood, C., 1991, pp. 2-3). PPPs may be sectoral (e.g. transport, mineral extraction), spatial (e.g. national, local), or indirect (e.g. education, research and development, privatization).

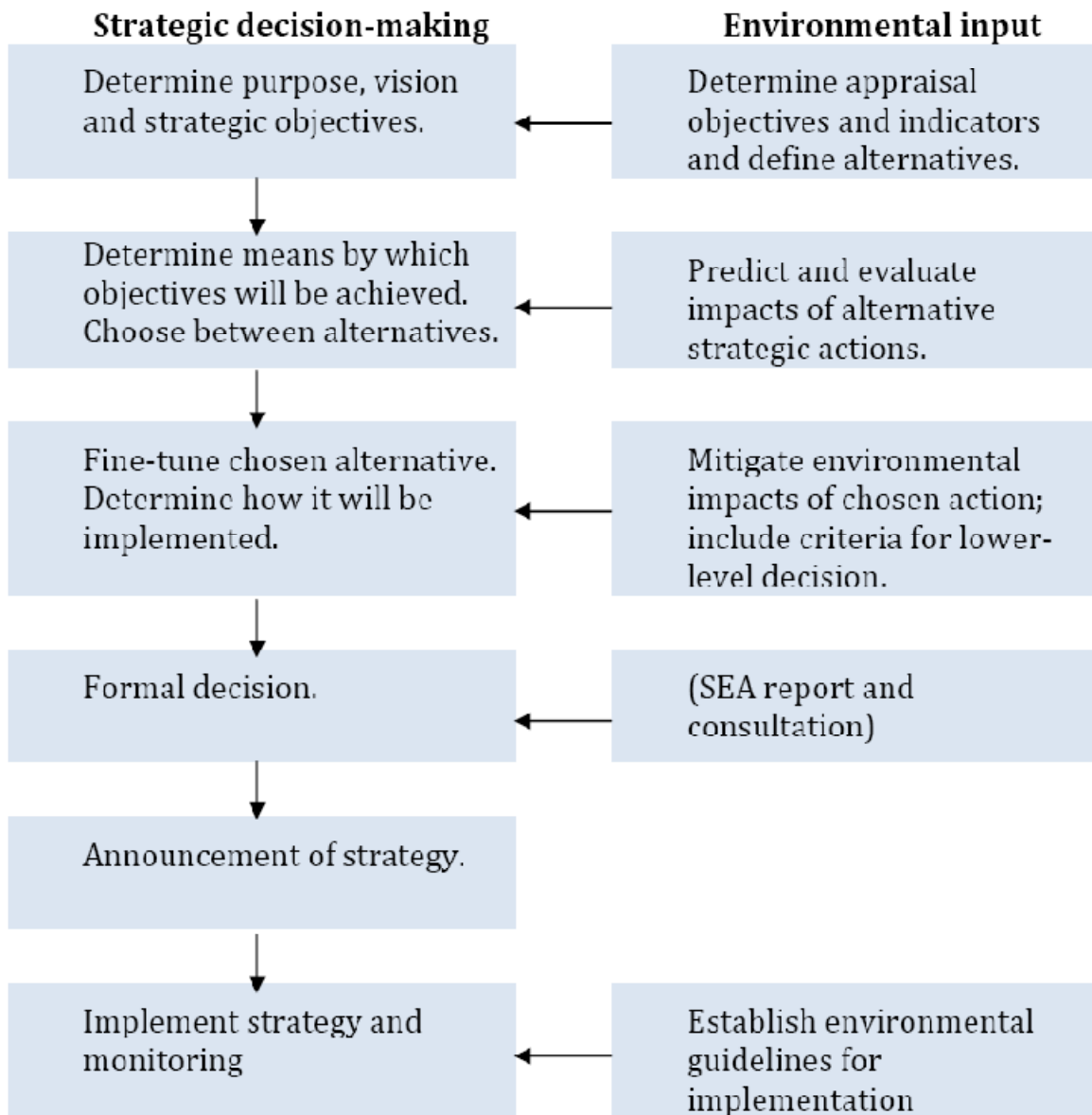


Figure 10. Links between SEA and the decision-making process
 Source: (Glasson et al, 1999, p. 402)

By its nature, PPPs are tiered (see Figure 11). The planning process can be seen as a progressive activity that starts with the formulation of policy, followed by plans and then by programs. Consequently, SEA ensures that the environmental aspects will be fully addressed at the earliest appropriate stage of the planning process (Beinat et al., 1999).

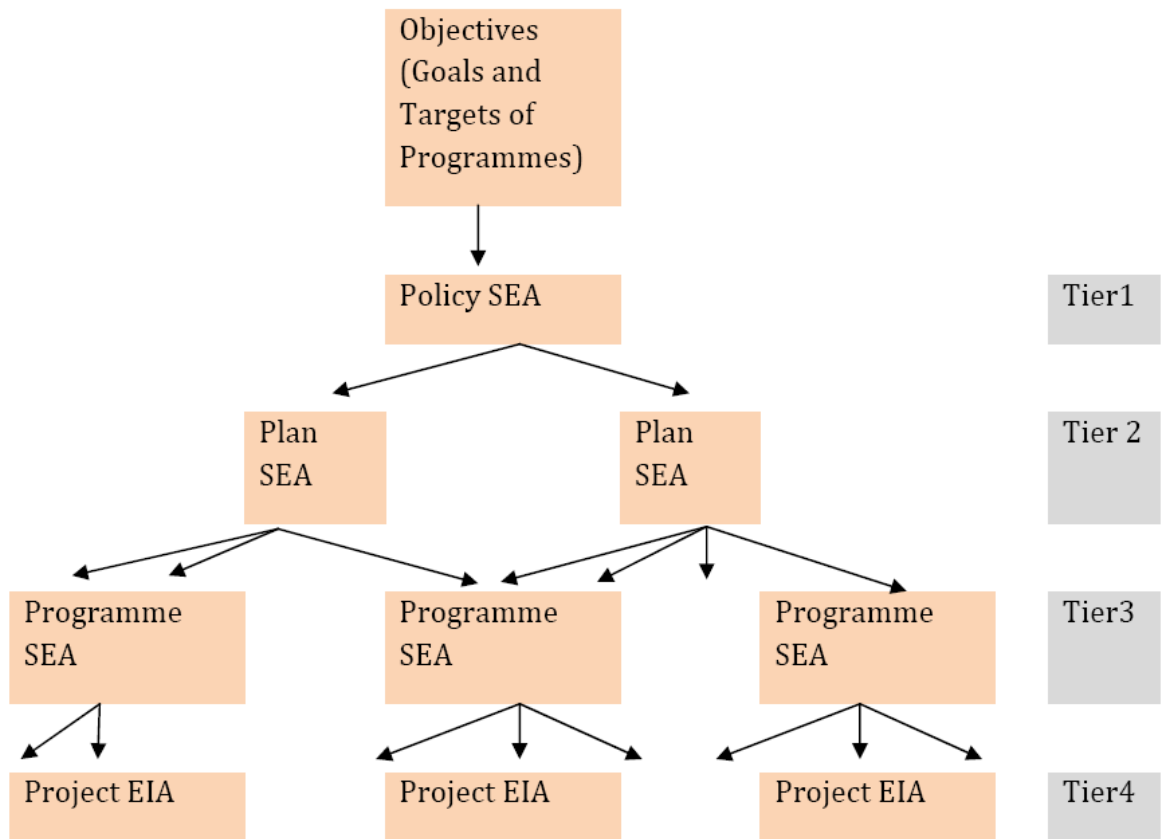


Figure 11. Tiers of SEA and EIA
 Source: (Glasson et al., 1999, p. 403)

SEA is not meant to replace EIA, but rather to complement it. This allows a suitable consideration of environmental impacts at every level of the planning process: from general policies to single projects. Consequently, EIA and SEA need to be coordinated with each other within the mentioned tiered system: each level of the planning process is to generate an environmental assessment that will be taken into account by each subsequent stage (Lee, N., George, C. (eds), 2000). However, in practice, these tiers are rather relative and devoid of clear boundaries; the dynamic nature of policy also means that many issues are likely to be redefined throughout the process, and it may be that a series of actions, even if not formally sanctioned by a decision, constitute a policy (Thérivel et al., 1992). Therefore, on the one hand, it is necessary to establish and test sound methodologies to perform SEA, on the other hand, EIA has to adapt to this new framework of tools for environmental assessment (Geneletti, D., 2002, p. 33).

EIA is to enhance its role as fundamental assessment procedure at a project level, by dealing with those issues that are too detailed to be tackled by SEA. At the same time, the presence of SEA is to lighten the burden of EIA, making some of its typical analysis

redundant. Being strategic decisions handled by SEA, EIA shall not discuss them anymore (Geneletti, D., 2002, p. 34).

Future EIA is to improve the treatment of project-level key issues, such as the evaluation of different alternatives and the proposal of mitigation measures. The adequate assessment of different project alternatives, in particular, represented one of the main limitations of past EIA practice (Hickie, D., Wade, M., 1998, S. 257-287). This can be overcome by the coupled EIA-SEA system because only similar alternatives are to be compared and evaluated during EIA, while the selection among radically different alternatives is to be made earlier by SEA. Focusing on alternatives with similar characteristics simplifies the analysis. Consequently, EIA can dwell on improving the reliability of such analyzes and on generating more comprehensive comparisons of alternatives and frameworks for decision (Geneletti, D., 2002, p. 34).

In general terms, the same procedural steps applicable for EIA also apply to SEA: screening; scoping; public consultations and hearings; environmental assessment, production of a statement (report); monitoring and reviewing, and follow-up work. Same concerns the methods of SEA. However, it is also acknowledged that SEA may require additional methods, because the topics that are addressed and the scope of some SEAs are very broad. In this respect, there is a close relationship between what type of policy, plan or program is being addressed and the type of methodological approach that is applicable. The more overreaching a policy, plan or program is, the more difficult it appears to conduct a concrete SEA procedure. There will often be considerable uncertainty which calls for more flexibility than in case of EIA. Therefore there exists the need to better identify valid indicators and reliable criteria that can be used to make credible predictions. The scoping procedure should also be utilized to determine which indicators to use for assessing which impacts (Tesli, A., 1998).

The key principle of SEA is that SEA must improve, rather than just analyze, the PPP. The emphasis should be on incorporating SEA in the formulation of the strategic action. Using the integrated model as a basis, Figure 12 demonstrates the main strategic decision-making stages and how they are affected by SEA. As we can observe, SEA's influence occurs right from the start in the improvement of the objective of the strategic action. The role of SEA in this respect is to try and reshape the strategic action objective so that it includes environmental and sustainability issues. SEA is therefore a tool for improving the strategic action, irrespective of the fact the strategic action has mainly negative or positive impacts (João, E., 2005).

SEA is not a post-hoc snapshot. It should be started early, be integrated in the decision-making process, and focus on identifying possible alternatives and modifications for the strategic action (Levett-Thérivel, 2003). If SEA is integrated in the decision-making process in this way, then by the time the Environmental Report is being written most of the work is already done.

Fischer (Fischer, T.B., 2002) considers that there are five main potential benefits of SEA:

- SEA allows for a wider consideration of impacts and alternatives.
- SEA is a pro-active tools that can be used to support strategic action formulation for sustainable development.

- SEA can increase the efficiency of tiered decision-making (including strengthening of Project EIA).
- SEA allows for a systematic and effective consideration of the environment at higher tiers or decision-making.
- More consultation and participation of the public should take place.

Therefore, it can be said that being the link between the EIA of projects, SEA is likely to be one of the most direct and effective ways of ensuring that human activities are carried out at a level that is environmentally sustainable. It can help to achieve, clearer, more environment-friendly and more publicly acceptable strategic actions that are approved more quickly (Thérivel, R., 2004).

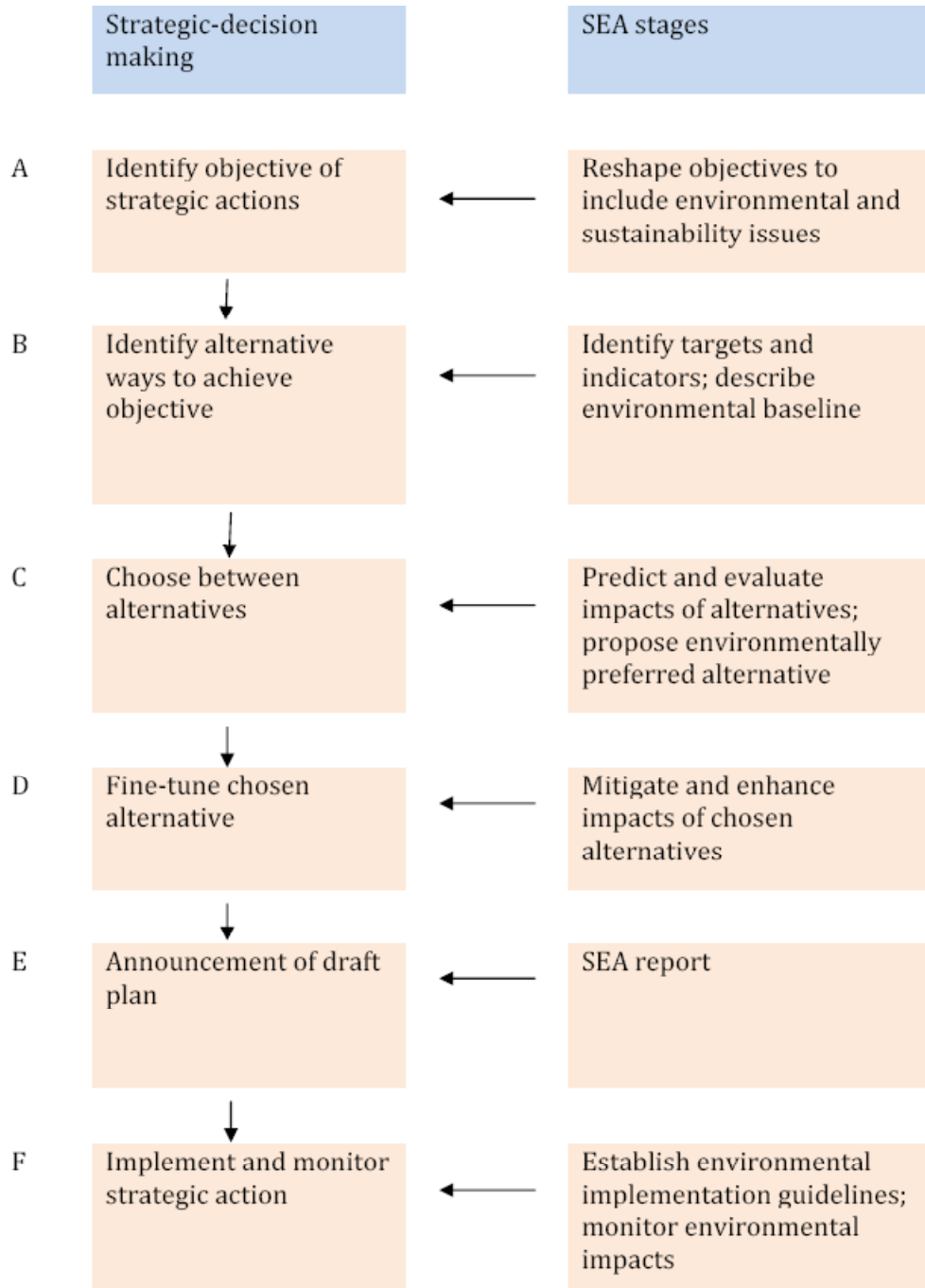


Figure 12. Key strategic-decision making stages and how they are influenced by SEA
 Source: (João, 2005)

4.2 Sustainability in agro-industrial sector: relevance of EU Directive 2001/42/EC and Kiev protocol on strategic environmental impact assessment to the convention on environmental impact assessment in transboundary context

Agricultural situation in the EU is characterized by continuous specialisation and intensification of arable and livestock farming systems on profitable areas, which lead to major losses of biodiversity and abandonment of traditionally managed areas.

The Union's major aspiration is development towards sustainability, which foresees protection and enhancement of farmland landscapes, their wildlife habitats and historic features, support of lively and diverse village-communities, guaranteeing social well-being, long-term benefits, ecological safety and high quality of agricultural products, promotion of sensitive innovative farming techniques that meet environmental, health and quality standards and improving opportunities for public enjoyment.

There are three main challenges towards achieving such sustainability:

- economic challenge - by strengthening the viability and competitiveness of the agricultural sector;
- social challenge - by improving living conditions and economic opportunities in rural areas;
- ecological or environmental challenge - by promoting good environmental practices as well as provision of services linked to the maintenance of habitats, biodiversity and landscape.

European Union agricultural development programs are mostly long-term where changes can be reviewed after 6-12 months or seasonal turnovers. They often possess a high level of inertia resulting in slow reaction to impacts and inputs and delayed monitoring and are characterised by contradictions between ecological and economic values. Objectives of such programs are mainly promoting farmers economically without recognising direct and indirect impacts on the area.

EC SEA Directive adopted in 2001 (Directive 2001/42/EC, 2001) supplements the aforementioned EIA Directive (85/337/EEC) and aims to provide for a high level of environmental protection and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programs with a view of promoting sustainable development. "Plans and programs" shall mean plans and programs, including those co-financed by the European Community, as well as any modifications to them:

- which are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government, and
- which are required by legislative, regulatory or administrative provisions (Art. 2a).

The purpose of the SEA Directive is thus to ensure that environmental consequences of certain plans and programs are identified and assessed during the preparation stage (Kläne, C., Albrecht, E., 2005, p. 26).

The public and environmental authorities must be involved and may provide their opinions, which are expected to be taken into consideration and integrated in the planning process. After the adoption of a plan or program, the public – defined as “one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organizations or groups” (Art. 2d) – will be informed of the decision and how it was made. If significant trans-boundary effects are likely, other Member States and the public must be informed and given the opportunity to provide comments that must also be integrated into the national decision-making process (Kläne, C., Albrecht, E., 2005, p. 27).

An environmental assessment shall be carried out for all policies, plans and programs,

- which are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Directive 85/337/EEC, or
- which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC (Directive 92/43/EEC, 1992).³

3 Article 6

1. For special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites.
2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.
3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.
4. If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

However, Art. 3.9 of the SEA Directive rules that the given document does not apply to Plans and Programs under the Structural Fund and under the European Agricultural Guidance and Guarantee Fund under the current respective programming periods, the reason for this being that the Directive is addressed only to the Member States and does not apply to the institutions of the Community (Kläne, C., Albrecht, E., 2005, pp. 38-39).

All this said, it can be stated that the obligation for an SEA may help avoid negative environmental effects in cases when plans and programs determine the future use of the environment. Therefore the SEA Directive has the potential to force the legislation to enact a consistent and standardized procedure for any plan or program with likely considerable environmental effects. The further consultation of the public can become the Directive's major benefit, as external expertise can be gained for better decisions and potential problems can thus be avoided or minimized. On the negative side, there is often a long time span between the SEA and the implementation of a concrete project, and assessment results are in many cases no longer up to date when the project finally commences (Kläne, C., Albrecht, E., 2005, pp. 52-53), which brings about the need for a more flexible and efficient legislation procedure that is hopefully to follow soon.

In its turn, Kiev Protocol on strategic environmental impact assessment to the convention on environmental impact assessment in transboundary context of 2003, which was signed by 36 countries and the European Community, envisages that each party which signed the convention shall endeavour to ensure that environmental and health concerns are to be considered and included to the extent appropriate in the preparation of its proposals for policies and legislation that are likely to have significant effects on the environment, including health.

In Article 4 of the given Protocol, the fields of applications are defined. The Protocol rules that projects that are likely to have significant environmental, including health, effects have to be processed by the SEA. The SEA shall be carried out for plans and programmes which are prepared for agriculture, forestry, fisheries, energy, industry including mining, transport, regional development, waste management, water management, telecommunications, tourism, town and country planning or land use, and which set the framework for future development, namely such as projects for the restructuring of rural land holdings; projects for the use of uncultivated land or

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.

Article 7

Obligations arising under Article 6 (2), (3) and (4) of this Directive shall replace any obligations arising under the first sentence of Article 4 (4) of Directive 79/409/EEC in respect of areas classified pursuant to Article 4 (1) or similarly recognized under Article 4 (2) thereof, as from the date of implementation of this Directive or the date of classification or recognition by a Member State under Directive 79/409/EEC, where the latter date is later.

seminatural areas for intensive agricultural purposes; water management projects for agriculture, including irrigation and land drainage projects; intensive livestock installations; manufacture of vegetable and animal oils and fats; packing and canning of animal and vegetable products; installations for the slaughter of animals; fish-meal and fish-oil factories; sugar factories; industrial plants for the production of pulp, paper and board; plants for the tanning of hides and skins; manufacture of dairy products or any other that requires an environmental impact assessment under national legislation.

4.3 Historical Background of SEA in Ukraine

At present there is a lack of information regarding SEA in Ukraine and the aim of this chapter is to fill this gap. This is important because the so-called Newly Independent States (NIS) of Countries in Transition (CIT), where Ukraine and other former Soviet Union states belong, are usually reviewed all together (since the initial legal bases and conditions were very similar), despite significant distinctive features of each country.

Having gained its independence in 1991, Ukraine, as well as other former USSR republics, is still very much influenced – in terms of legislative procedures and regulations – by traditions of the Soviet system. The field of environmental assessment is in this case no exception. Hence, there exists the need to briefly turn to the origin of the SEA and EIA in the Soviet Union.

It can be said that prototype EA procedures existed in the USSR since the 1970s. Some of them included SEA elements, which were basically represented by planning rules and regulations (such as standards and procedures for conducting site investigation and obtaining necessary permits); expert review procedures (carried out by the special expert committees of appropriate ministries and acting as a co-ordination and control mechanism, which addressed environmental aspects of planned activities); and the system of environmental planning called “Territorial Integrated Schemes of Nature Protection” addressing environmental issues at a more general strategic level. The latter were entirely internal government procedures, closed and non-transparent to other parties than the state itself. The procedures foresaw no independent checks, offered no defined responsibilities of participants and were inevitably characterized by a high degree of subjectivity and the discretion of officials in charge (Cherp, A., Bonde, J., 2000). What more, such sort of expertise seldom affected the existing goals of strategic plans and was incapable of bringing any significant changes to the overall system of socialistic planning (Patoka, I., 2000).

In order to overcome these hindrances, in the mid-1980s, a system of State Environmental Expert Reviews was introduced. It aimed at expanding the range of environmental assessment procedures to the extent that would cover all environmentally significant activities at both project and strategic levels; making them fully independent of the developers, and more transparent and accountable; and ensuring that environmental assessment results are actually taken into account in decision-making by giving the “conclusions” of these reviews the status of legally binding directives (Cherp, A., 2000a) and (Cherp, A., 2000b). The innovations, however, did not result in any considerable improvements, and the situation remained unchangeable until the early 1990s, when the so-called OVOS (Assessment of Environmental Impacts) was implemented as a mandatory procedure for all project developers. At the strategic level, responsibilities of

the proponents stayed unaffected until the dissolution of the Soviet Union in 1991, when the newly-emerged independent states took over the control of their own legislation and then later came up with the improved regulatory measures, more appropriate for the existing situation at the national level.

4.4 The Existing Conditions of SEA Application in Ukraine

Presently, two major regulatory systems covering the implementation of SEA are in place in Ukraine. The first one is OVOS – a “survivor” of the old times, largely burdened by the Soviet non-innovative approach, and the second is the so-called system of Ecological Expertise (EE) – a set of more dynamic and up-to-date regulatory measures. The latter encompasses scientific research and practices of appropriate governmental agencies, ecological bodies and public communities, based on inter-sectorial ecological research, analysis and assessment of strategic, project and other materials, whose realization can potentially– or does at present – negatively affect the state of the environment and health of the citizens.

EE aims at preparing the conclusions as to the conformity of the planned or the running activities to the norms and requirements of the legislation on environmental protection, rational use and recreation of natural resources, and provision of ecological safety (Thérivel, R., 1997, pp. 151-160)

Interrelations in the field of EE are regulated by the Law on Ecological Expertise, the Law on Environmental Protection, Decree about Listing Types of Activities and Objects, Considered to Have High Ecological Risk and other acts of Ukrainian legislation. Table 3 offers a functional comparison between SEA, EIA and EE (in the form the latter is presently carried out in Ukraine).

The main tasks of EE are:

- assessment of ecological risk and safety of a planned or running activity;
- organization of comprehensive scientifically-based assessment of objects of Ecological Expertise;
- examination for compliance of objects of Ecological Expertise to ecological legislation requirements, sanitary code, building code and construction regulations;
- assessment of impacts of objects of Ecological Expertise on environmental conditions, human health and natural resources;
- evaluation of efficiency, completeness, substantiation and adequacy of environmental protection measures and human health;
- preparation of objective, well-grounded, sound reports of Ecological Expertise.

The legal guiding principles of EE are:

- guarantee of safe environment for human lives and health;
- balance between ecological, economic, medical, biological and social interests and consideration of public opinion;
- scientific grounding, independence, objectivity, all-inclusiveness, alternativity, prevention and publicity;
- ecological safety, inter-sectorial and economic reasonability of realization of objects of Ecological Expertise, planned or running activities;
- state regulation;

- legality.

EE applies to the projects of legislative and other normative acts, as well as pre-project and project materials, documentation on the implementation of new techniques and technology, substances and products whose implementation can result in the violation of ecological standards, cause negative influence on the environment and endanger the health of the people. After EE is carried out, expert agencies are obliged to announce their conclusions through the mass media. In order to assess the public opinion, Ecological Expertise initiators hold public hearings or open sittings (EBRD, 1994).

In the EE Law three types of EE in Ukraine are defined: state, public and others. EE decisions are taken into account as any other state expertise. They are legally binding and must be fulfilled. Public and other forms of EE are voluntary activities. Their conclusions have the status of recommendation and could be taken into consideration by State Ecological Expertise (SEE) in the process of decision making about further realization of the examined project.

Table 3. Comparison of SEA, EIA and EE

	SEA	EIA	EE (OVOS)
Level of Application	Strategic actions (Policies, programs and plans level)	Physical projects	Physical projects, strategic actions, environmental legislative acts
Legal status	Not always obligatory.	Usually obligatory	Obligatory, but has a lot of drawbacks
Stage of decision making	As early as possible in strategic actions development process. Must precede EIA.	Usually conducted after a project design is well-advanced	Before the project implementation, in strategic actions in the development phase
Scope of analysis	Can be broad in time and space. Can consider cumulative, synergetic and indirect effects	Geographically specific. Focus tends to be on direct physical effects of the project	The terms of EE are defined by law (up to 45 days, max up to 120 days), concentrates on both strategic and project levels

Consideration of alternatives	Can define whether an initiative should go forward, plus where and what type of projects should be implemented	Focus is primarily on how to design a project to reduce adverse environmental effects.	Issues of sustainability are set as primary goals for strategic level, and minimization of impacts for project level
Procedures	Procedures must be adapted to decision making process within the relevant ministry. They include: scoping, stakeholders identification, participation, technical study on key issues, the SEA findings and conclusions.	Standard, government-wide procedures. Includes screening, scoping, mitigation, public participation, monitoring and report preparation steps.	Procedure is approved at ministerial level; it includes 3 phases: 1: check of required data for EE; 2: analytical analysis and evaluation of the object of EE; 3: preparation of the final report.
Public participation	Legally foreseen and implemented	Legally foreseen and implemented	Legally foreseen, but poorly organized due to bureaucratic hindrances leading to poor public access to information.

From the following SEE obligations, we can see, that SEA is also relevant in full or partially for the same issues.

SEE is obligatory for the following activities:

- state investments programs, projects of the development and placement the labour force; development of selected branches of national economy;
- projects of general layouts of town planning, schemes of regional planning, schemes of general layouts of industrial objects, schemes of layout of plants in industrial zones and regions, and other strategic pre-planning documentation;
- investments projects, technical-economic founding and calculations, project and working plans for construction of new and reconstruction and/or technical re-equipment of running industrial units, documentation for re-profiling, conservation and elimination of industrial or other national economy units, including military structures, which can cause negative impacts on the environment;

- projects of law-making and other legislative acts that regulate relations in ecological (including nuclear) safety, environmental protection and use of natural resources and activities, which can negatively affect the environment and human lives and health;
- documentation on implementation of new equipment, technologies, materials, which could create a potential danger to environment and human health.

According to the decisions of the Cabinet of the Ministers of Ukraine, the Government of the Autonomic Republic of Crimea, local Radas (Councils) of public Deputies or their executive committees, ecological situations, which took place in selected areas and regions, running projects and industry units including military complexes, which cause significant negative impacts on environment and humans health, can all be subjects of EE.

The procedure of EE foresees the following activities:

- Preparatory phase: auditing of presence and adequacy of all the required materials and requisites for objects of EE and creation of ecological-expert committees in accordance to legislative requirements.
- Main phase: analytical analysis of materials for EE, in selected cases – on-site monitoring and examination, and use of the obtained results for comparative analysis and evaluation of the level of ecological safety, adequacy and efficiency of the objects of EE.
- Final phase: summarizing of experts' assessment of the obtained information and the consequences of activities of objects of EE, preparation of the final report and its presentation to the interested organizations and persons.

Public ecological expertise is carried out on the initiative of public organizations in any field of activity that demands ecological substantiation. It can be pursued simultaneously with SEE, by means of enrolling representatives of the public to expert commissions, and Public EE groups. Public participation in EE procedures can be realized through expressing ideas through the mass media, filing written remarks, proposals and recommendations, enrolling representatives of the public to expert commissions, and Ecological Expertise groups.

Other forms of ecological expertise can be executed on the initiative of the interested juridical and natural persons, on the contract basis, by specialized ecological-expert bodies and organizations.

Conclusions drawn by the SEE include a brief description of the ongoing or planned activity, its impact on the state of environment, people's health, and the level of ecological risk of the measures aimed at neutralization of these possible influences. The conclusions of the SEE provide recommendations as to how the given activity can be carried out in such a way that it meets the standards of ecological safety, environmental protection and rational use and recreation of natural resources. Based on this analysis, a project or a strategic action is either accepted in its present state, or rejected and sent back to the proprietor for revision and reconsideration.

The following figure 13 shows the role of strategic environmental assessment as a regulatory and controlling instrument within the complex concept of development of agro-industrial sector. The agricultural policy and rural sector development policy are setting targets and goals for AIS development, further on the plans for achievement the goals are created and implemented. The plans are resulting in impacts caused by plans execution. The results are measured with suitable indicators and evaluated by means of SEA, which defines the rate of goal achievement and make corrective plans and policies feedback.

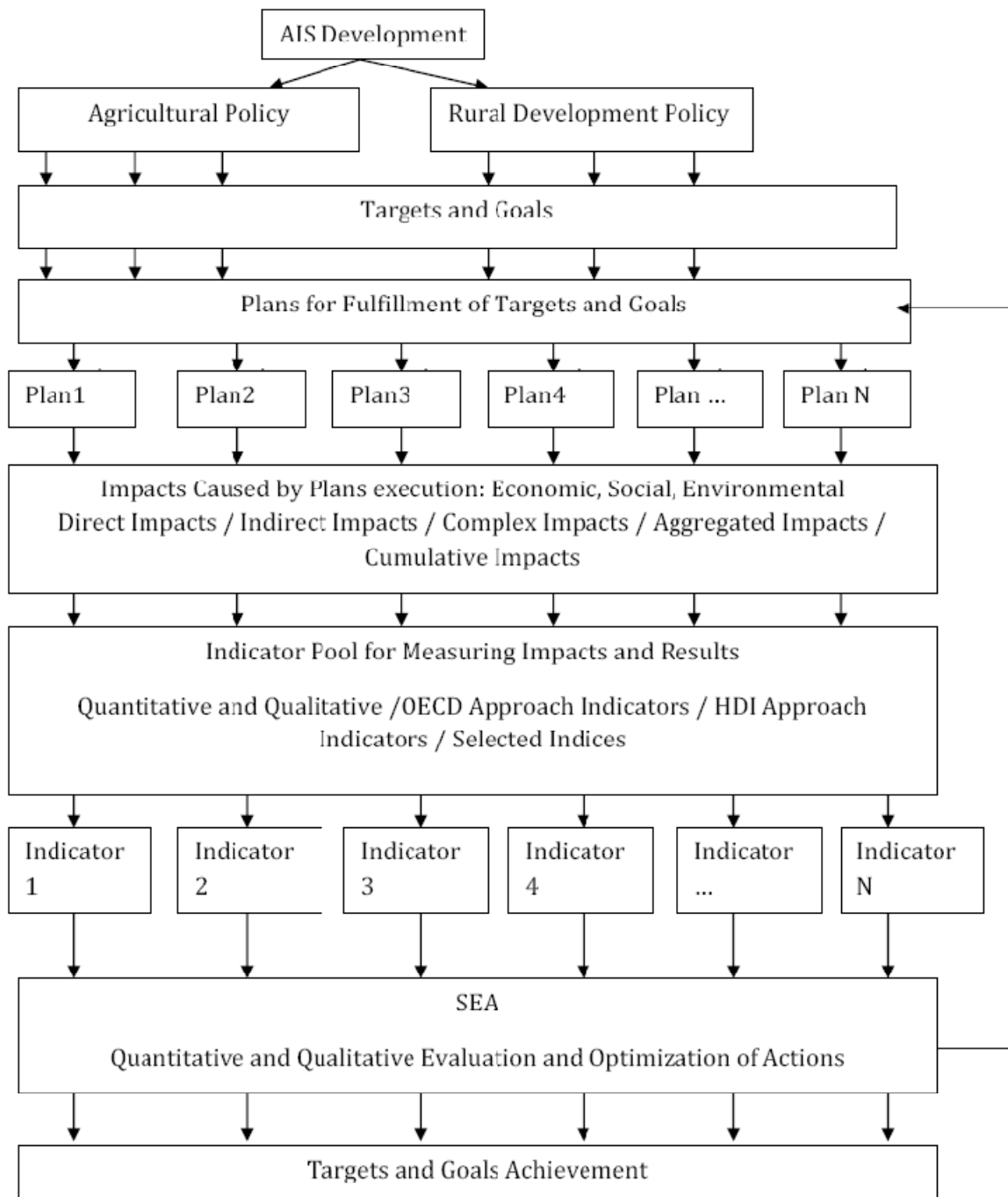


Figure 13. Function of Strategic Environmental Assessment in evaluation process

4.5 Obstacles for SEA Application in Ukraine

Despite the fact that Ukraine is one of the 36 countries that signed the Kiev SEA Protocol during the fifth Ministerial Conference “Environment for Europe” held in Kiev on 21-23 of May 2003, it is difficult to review the existing SEA capacities. SEA – as a newly introduced legal framework in the EU Member States for ecological assessment – has resulted in appreciable positive changes of the overall situation, but there still exist a number of impediments to progress in this field. The problem is that it is very difficult to talk about obstacles of SEA application due to the fact that the legal base for SEA procedure has not yet been developed in the national legislation system. However, some of these obstacles are quite evident even in the existing conditions.

After being influenced for a continuous period of time by the Soviet approach to environmental assessment, Ukraine now faces the challenge of stepping away from this long-lasting system and introducing something qualitatively new and appropriate for current conditions of the country’s development. What we see now, though, is rather copying western countries’ environmental policies and trying to impose them in the setting, which to a large degree differs from that of the Western Europe. What more, these newly introduced policies persistently continue to be based on old methodologies and standards. All this makes environmental assessment in Ukraine inconsistent and inappropriate for the existing conditions.

While most employees in the newly formed ecological NGOs are young, progressive professionals, whose philosophy and education have nothing to do with the Soviet system, the majority of the governmental decision-makers in the field of environment are representatives of the “old school” lacking flexibility and not infrequently hostile to innovations (Yaroshchuk, Y., 2003). This inevitably leads to the conflict of ideological interests, makes the government and the NGOs rivals rather than partners and creates a serious preclusion against the achievement of the ultimate common goal, which is cooperation in the field of environmental protection.

Lack of democratic tradition in the country’s politics results in low level of public participation in decision-making, and though the necessity of such participation is acknowledged by the law on Environmental Expertise, it seldom works in practice and even if it does, the public is allowed to partake only in later stages of assessment, when it is difficult to affect the process of decision-making to any significant degree.

In order to overcome these obstacles, it is crucial that legislation suitable for SEA be developed by the law-makers. Strategic assessment should be introduced into Ukrainian system of environmental, social and economic regulations at different levels. This will contribute greatly to the effectiveness of public involvement and cooperation between the different parties that are in charge of the introduction of SEA process.

4.6 Possible Levels of SEA Development in Ukraine

There are four main levels at which SEA should be implemented in Ukraine. Each of them can perform specific functions that are both relevant to this very level and contribute to the overall success of cooperation. The following activities at the different levels could be introduced in order to develop and strengthen SEA in Ukraine.

The first – ministerial – level (e.g. the Ministry of Agrarian Policy of Ukraine, the Ministry of Nature and Environmental Protection) should foresee the creation of the Institute of Environmental Policy; the elaboration of the legislative background and regulations for the SEA introduction; and the development of mechanism for SEA application in Ukrainian environmental policy. A special Department on the transition to sustainable development should be created and access to the materials on environmental policy should be provided. The mentioned Department is expected to collaborate with regional and local agricultural authorities and environmental and agricultural NGOs and consultancies. They, in turn, are responsible for providing informational resources and services, organizing round tables and carrying out training courses on sustainable development and SEA. Also, they are expected to join effort with representatives of environmental and agricultural faculties of Ukrainian universities. The latter should provide for students' participation in projects connected with transition to sustainable development and organizing courses for administrative employees of the environmental branch aimed at raising their level of proficiency (Afanasyev, V., 2005).

As can be seen, to introduce meaningful SEA provisions in Ukraine the institutional resistance to it should be overcome. In order to do this, the concept of SEA needs to be widely redefined as a tool for informing decision-makers, rather than a part of environmental permitting procedures. This is indeed a great challenge, as environmental assessment per se is regarded in Ukraine mostly as an addition to the process of issuing the final conclusions of the expertise (Cherp, A., 2000c). Presently, for the decision-makers it is basically “yes” or “no” that counts, while the underpinning of the final decision largely remains an issue of secondary importance. Joint meetings, debates, round tables will in this case help shorten a gap between old-school governmental policy-makers and the leaders of the new generation (Fischer, T.B., 1999) and (Fischer, T.B., 2002).

Appropriate skills are required within government departments and agencies as well as within the private sector (e.g. industry, environmental consulting companies) and the NGOs. There also exists the need for adequate capacity building (both human and financial) in these sectors.

Also crucial is that Ukrainian environmental legislation be harmonized with that of the European Union. Since Ukraine strives to integrate into the EU, it would offer more opportunities for the implementation of international projects and ease the bureaucratic protractedions.

Public participation should be introduced at the early stages of environmental assessment. This will benefit both project developers and those carrying out the assessment, and enable the vast public to feel involved in the decision-making process at strategic level.

As NGOs are generally more flexible and motivated than state policy-makers, their role in promotion and implementation of SEA Directive should be enhanced.

NGOs should be given more advisory power in the legislation development. This will allow saving much of the financial resources, the lack of which the government usually names as one of the most considerable constraints to the restructuring of the environmental sector (REC, 1998).

For the acceleration of environmental assessment procedures, extra funding from donor countries should be considered. In these cases, donors always require a thorough assessment of environmental impacts and thus facilitate recipient countries in developing effective implementation solutions for such evaluation.

As it can be observed from the analysis offered in this chapter, Ukraine has a very high potential in terms of sustainable development and innovative approaches in the implementation of SEA. The country still has a lot of substantial institutional and procedural difficulties to overcome, but still, it is noticeably moving forward, which is proved by the fact that the existing environmental conditions are improving steadily and that Ukraine has already joined a number of important international nature conservation, biodiversity protection and sustainable development conventions, the most recent of them being Kiev SEA Protocol.

Since AIS encompasses not only agriculture, but a diverse array of industries linked to growing and processing agricultural goods that include forestry, fisheries, water for irrigation and ground water, rural regional development and many other relevant fields, which pose significant environmental, social and economic impacts, the importance of introduction of SEA as a governmental instrument for AIS is very difficult to underestimate.

As of now, Ukraine has not yet developed any specific practice of SEA application in AIS. The sustainability of many related state policies and programmes thus remains rather questionable and non-transparent. At the same time, it has to be remembered that agro-industry can potentially result in major adverse impacts resulting from water and air pollution, disposal of solid waste, and changes in land use. Therefore, SEA seems to be an optimal tool enabling comprehensive assessment of potential impacts of intensive agricultural land-use including risk of erosion, contamination of surface and ground water from agricultural inputs, such as the use of mineral fertilizers and pesticides, changes in physical and chemical characteristics of the soil, and impacts on wildlife and native vegetation on regional and national levels. Some concerns indirect effects of the installation of a large agro-industry, such as the development of transportation facilities for delivering the products to markets, as well as impacts resulting from introduction of large-scale irrigation programs, including waterlogging and salinization of soils, increased incidence of waterborne and water-related diseases, and resettlement or changes in the lifestyle of local population (Nagarajan, V., W'O Okot-Uma, R., 1999, pp. 26-37).

Keeping this in mind, the author of the present thesis intends to elaborate on the development of specific methods of SEA application with regards to Ukrainian AIS, particularly in connection with indicators and indices presented further within the framework of current research (see Chapter 6, Mathematical Model for Top-Level Indices).

SEA makes possible to make quantitative and qualitative evaluation of results, achieved by execution of policies, plans and programmes. Based on this evaluation the intermediate results can be used for recommendations for more effective programmes fulfillment. In order to obtain precise SEA evaluation results, the suitable indicators have to be selected and put together in indicator pool. The next chapter is devoted to aspects of

indicators goals and requirements, selection criteria for agro-environmental indicators, policy context etc.

5 Indicators for Evaluating Agricultural Performance

5.1 Definition of an Indicator

An indicator is normally defined as a condition or characteristic feature, which serves as a detecting sign or helps to understand measure, quantify or qualify a certain phenomenon. Indicators help to simplify and divide processes and give characteristic of complex reality. Their place in the so-called “information pyramid” is depicted in Figure 14 below.

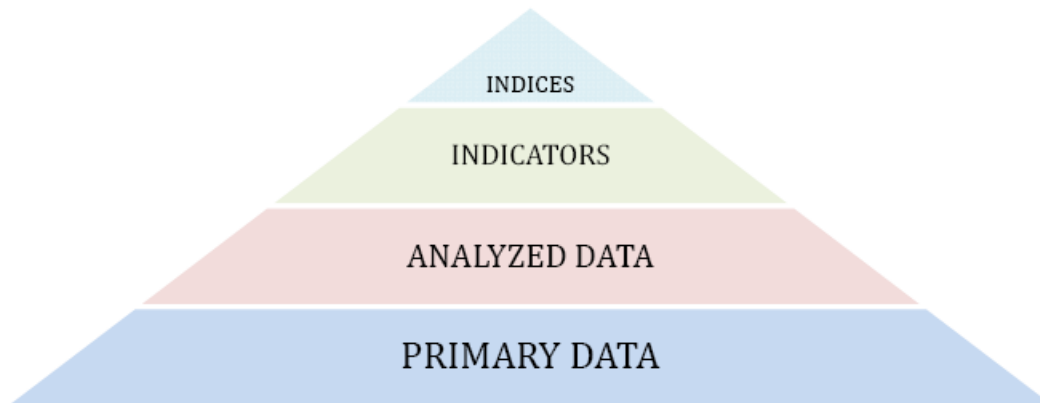


Figure 14. The information pyramid
Source: (Hammond et al. 1995, p. 43)

- The primary or so called raw data are the information or measurement of some qualities or characteristics, such as amount of tonnes of gathered harvest or sum of money received after selling the agricultural products or tonnes of used fertilizers. They provide us with a number of definite units, but do not assist in comparing or correlating the data.
- In order to use or operate with this primary data, one has to process or analyze them. There are a lot of various methods and techniques for data processing. Depending nature of the data, required outcomes and applicable standards, one can use qualitative, quantitative, area or product based analysis, such as normalization of data or data equation. The analyzed data is standardized and homogenous and thus ready to be used at next levels.
- At the next level gathered raw data are processed into indicators. These can serve for different purposes. For example, some indicators are intended for performance evaluation (how much? how far?), others are threshold indicators (minimum or maximum quantity of evaluated value), casual loops indicators (analysis of cause and its effect on evaluated process or object) or model construction and scenario indicators (what will happen under certain circumstances?).
- Index, at the next level, is a complex value which is received as a result of analyzing, processing or integrating a group of similar or compatible indicators in a single, easy to use value, such as GDP index or life quality index. The other name for such combined index is high level indicator.

A basic procedure for selection of indicators for the system includes the following steps:

- Define the goals of indicator system – in other words to understand what kind of output is desired at the end.
- Get acquainted with modern indicator approaches in order to analyze the mechanisms and define their positive and negative aspects.
- Study environmental indicator/index systems used by international organizations
- Familiarize oneself with national economic, social and environmental indicators in use.
- Create criteria for evaluation.
- Study all individual indicator descriptions before scoring.
- Score straight after reading each description and make comments.
- Select sufficient amount of indicators (min. 5-10, max. 40-50) for a draft indicator set.
- Classify scored top indicator proposals according to one of the main indicator group - economic, social or environmental and PSR or DPISR framework to ensure sufficient effectiveness.
- Complement the gaps with suitable indicators from parallel or similar projects or compatible indicator systems.
- Write descriptions and definition of dimension for each of the proposed indicators (Organization for Economic Cooperation and Development, 1997).

5.2 Requirements for Indicators

Each indicator is usually defined and constructed in order to fulfill the goal it serves. At different levels of application the standards and requirements for indicators can vary. At the lowest, “grass root” level very specific and precise indicators are used; mid-level indicators usually include data processed from lower-level indicators since the former have to describe a broader set of conditions, but not as precise as the latter.

Commonly used requirements for indicators are the following:

- validity (the data should be easy to validate and capable of giving a clear picture of measured parameters and values);
- user-orientation (this is very important since indicator should help to understand and ease the evaluation for its user; thus, choice of the right level and right dimension of an indicator is crucial for successful achievement of the set goal);
- practicability (an indicator has to be convenient for project application; it has to take into account specific requirements and needs of the existing evaluating framework);
- relevance (only use of project-relevant indicators could provide realisation of its tasks in their full capacity, and secure the maximal effectiveness; at the same time, partially relevant indicators only complicate and constrain achievement of the desired results.);
- sensitivity (an Indicator must possess the degree of sensitivity which is adequate for the measured process or object; an oversensitive indicator can be inappropriate for tracing tendencies, while an inert indicator will be of limited use for monitoring highly dynamic system);

- reliability (an indicator must be tested for reliability because if this quality is not secured, all evaluation results can malfunction and provide false outcomes; very often one indicator is enough to undermine the efficiency of the whole research);
- timeliness (an indicator is to be measured at the right time and thus be representative and deliver valuable data for the monitoring system);
- compatibility (an indicator's format must be compatible with indicator system standards and requirements in order to ensure easy data processing and avoid possible mistakes);
- feasibility (data, required for indicator creation have to be feasible and easy to obtain from the measured environment) (Organization for Economic Cooperation and Development, 1997).

5.3 Development of an indicator set for evaluating agriculture: Guidelines prepared by the Organization for Economic Cooperation and Development

5.3.1 Policy context

The growing demand for information regarding agro-industrial relationships largely reflects the highest public priority being given to environmental improvement in agriculture. The impacts of agriculture and agricultural policies on the environment – both harmful and beneficial – are recognized as a major issue for Member countries of the Organization for Economic Cooperation and Development (OECD). To identify and to better understand the effects of different policy measures on the environment, the Joint Working Party of the Committee for Agriculture and the Environmental Policy Committee have developed a set of agro-environmental indicators (Organization for Economic Cooperation and Development, 1997) that aims to:

- provide information for policy-makers and the wider public on the current state and changes in the conditions of the environment in agriculture;
- assist policy-makers to better understand the linkages between the causes and effects of the impact of agriculture and agricultural policy on the environment, and help guide their responses to changes in environmental conditions;
- contribute to monitoring and evaluation of the effectiveness of policies in promoting sustainable agriculture.

For many OECD Member countries the growing demand for indicators and other agro-industrial information is partly because governments are being required to provide EIAs of agricultural and environmental programs. At the same time, thus demand is also growing among farmers and other land users, the research community, the media, the general public and international organizations.

International environmental agreements are also leading to the increasing need for governments to monitor their progress under these agreements. The UN Commission on Sustainable Development, for example, has requested countries to use indicators in their

annual reports to measure progress in reaching sustainable development, including indicators for sustainable agriculture and rural development (SARD), as defined in Agenda 21, adopted at the UNCED Rio Summit in 1992.

Analysis to assist policy-makers is necessary because the linkages between agricultural activities and environmental impacts are complex, reflecting biological processes, variations in natural environmental conditions, socio-economic factors, agricultural and environmental policies and changes in these policies. These linkages are further complicated due to the spatial variation in the effects of agriculture on the environment within and between different countries, and because the impact of many farming practices on the environment can be gradual and cumulative over time (Organization for Economic Cooperation and Development, 1997, pp. 9-11).

5.3.2 The Driving Force-State-Response framework: scope and definitions

A major challenge is to provide a solid conceptual and methodological basis to support the empirical analysis of agro-industrial linkages, especially in terms of quantifying the impact of agricultural policies and policy changes on the environment in agriculture. In order to better understand agro-environmental linkages, and to identify and develop policy relevant indicators, OECD gave particular consideration to:

- recognizing specific characteristics of the linkages between agriculture and the environment;
- situating agriculture in the broader context of sustainable development, especially in terms of the relationships between the economic, social and environmental dimensions;

4 The OECD work to meet the requests to develop environmental indicators is mainly undertaken by the Environmental Policy Committee Group on the State of the Environment and its environmental indicators programme and associated workshops. The key objectives for this work are to develop indicators for (Organization for Economic Cooperation and Development, 1996a):

Monitoring the state and changes in the environment and related human activities, and tracking progress made, including developing environmental indicators. The indicators are included in the OECD Core Set of environmental indicators, and are used as one tool in the OECD series of Environmental Performance Reviews. These reviews cover pollution and natural resource management issues, policy integration (economic and sectoral), and international cooperation. It should be noted that these reviews do not systematically address the agricultural sector as a whole, however, agriculture has been referenced in separate sections of a number of country reviews.

Better integrating environmental concerns into economic policies in general through indicators derived from environmental accounting. This involves the development of natural resource accounts, the adjustment of national economic accounts and the creation of satellite accounts for environmental purposes; and

Better integrating environmental concerns into sectoral policies. This work typically covers sectoral trends of environmental significance, interactions between the environment and the sector, as well as economic and policy considerations.

- ensuring the framework to structure agro-environmental analysis is largely consistent with that commonly being used in other related work of the OECD and elsewhere.

Certain specific characteristics of agriculture in relation to the environment to some extent distinguish the agricultural sector from the linkages between other sectors in the economy and the environment.

Firstly, agricultural activities produce a diverse range of harmful and beneficial impacts on environmental quality. Farming can lead to deterioration in soil, water and air quality and the loss of habitats and biodiversity. At the same time, agricultural activity can contribute to environmental benefits such as acting as a sink for greenhouse gases, conserving and also enhancing biodiversity and landscape, and preventing flooding and landslides.

Secondly, the relationship between agricultural activities and the environment is frequently complex, site specific and non-linear. Agricultural activities can have impacts on the environment which are determined by different agro-ecological systems and physical attributes of the land, the prevailing economic conditions and production technology, and farmers' management practices in relation to natural conditions.

Thirdly, the agricultural sectors in most OECD countries are characterized by policies delivering high levels of support and government intervention (Organization for Economic Cooperation and Development, 1996b). Farmers' behavior can be significantly affected by these policies, in that they influence the level of agricultural production, its location, and the farming practices and management systems employed. Also changes in environmental quality can trigger market and societal reactions which may in turn influence agricultural and environmental policy decisions.

In order to foster sustainable development strategies, a clearer comprehension of the linkages between the economy, society and the environment is widely recognized. A simplified view of the main components and feedbacks which are important in the analysis of sustainability can be described as follows:

- human activities, such as agriculture and economic developments, and modifications to them in form of plans, programs and policies are linked to the
- capacity of natural systems, including agro-ecosystems, to absorb the effects of human activities on the environment, and determine
- environmental impacts, both harmful and beneficial, and the long term sustainability of the ecosystem.

Understanding this sequence, and the components and processes involved, may be expected to lead to some feedback through the modification of human activities (Midmore, P. et al., 1995). In an agricultural context this can occur through changes in farmers' behaviour and policy responses, where these are perceived of known to threaten long term sustainability, and to the extent that they are reflected in costs and market signals. The analysis of sustainability thus encompasses the:

- spatial dimension, which ranges from the field, farm, watershed, regional, national through the global scale;
- temporal dimension, in terms of the time period over which sustainability is viewed;
- societal dimension, covering economic, socio-cultural and aesthetic values and attitudes, as well as the environment.

Particular consideration was given to ensure consistency with the OECD program on developing environmental indicators and with other parallel efforts. Many of these efforts use the Pressure-State-Response (PSR) framework or some of its variations, in which indicators are then developed as follows: pressure on the environment from human and economic activities, lead to changes in the state or environmental conditions that prevail as a result of that pressure, and may provoke responses by society to change the pressures and state of the environment.

The particular framework chosen by OECD to analyze agro-industrial linkages and develop agro-environmental indicators (AEIs) is a modified form of the above-mentioned PSR, named the Driving Force-State-Response (DSR) framework, which takes into account the specific characteristics of agriculture and its relation to the environment, the consideration of agriculture in the broader context of sustainable development, and the work already underway in OECD Member countries and other organizations to develop their work on indicators.

The DSR framework consists of a vast array of human-environmental interactions, as illustrated in Figure 15, involving different feedbacks and linkages.

Driving forces are those elements which cause changes in the state of the environment. These include:

- natural environment processes and factors, including the agro-ecological system, the physical attributes of the land, meteorological conditions and random events such as earthquakes;
- biophysical inputs and outputs at the farm level, covering the use of chemical inputs, energy and water resources; farm management practices; and decisions taken in terms of the level and mix of agricultural commodities produced;
- economic and societal driving forces, encompassing reactions to economic and policy signals received from markets and governments; variations in the level and composition of farm financial resources; changes in technology; cultural attitudes and public pressure; social structures; and population growth.

The state or condition of the environment in agriculture refers to changes in environmental conditions that may arise from various driving forces. The impact of agriculture on the environment can occur both on-farm and off-farm, for example the effects on biodiversity and climate change, and operate at various temporal and spatial scales from the field through to the global scale. While the state of the environment in agriculture encompasses a wide range of different elements, it can be broadly categorized into the following sub-categories of the:

- state of the natural resources, used in agricultural production – soil, water and air – covering their physical, chemical and biological condition;
- composition, structure and functioning of the ecosystem, affected by agricultural activities, including biodiversity and natural habitats, while for some other countries the inclusion of the man-made environment, such as agricultural landscapes, is also an integral part of this sub-category;
- state of human health and environmentally related welfare, including for example the risk to human health from pesticide spraying and the public nuisance caused by odors from intensive livestock production.

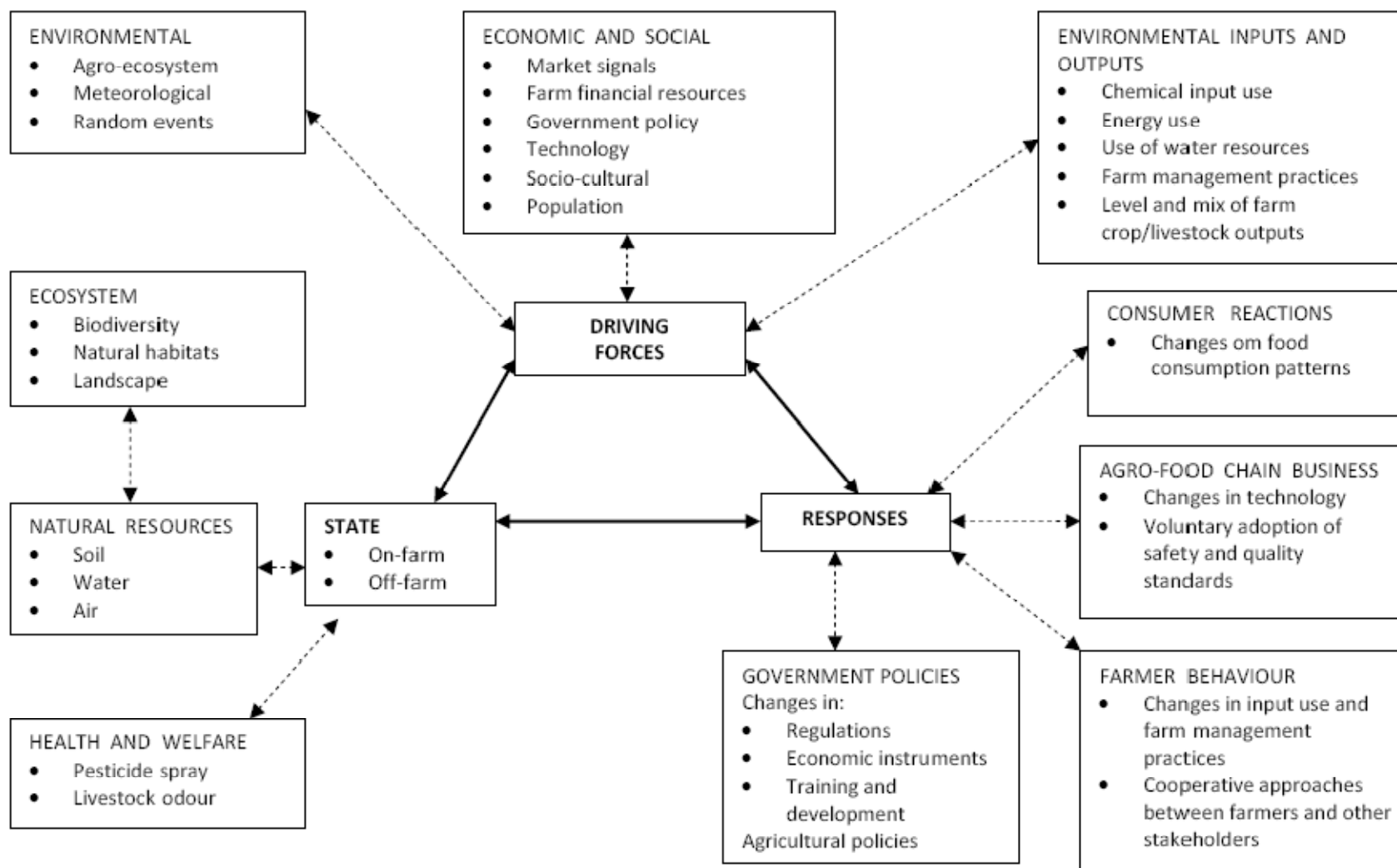


Figure 15. The DSR framework to address agro-environmental linkages and sustainable agriculture
 Source: (Organization for Economic Cooperation and Development, 1997, p.16)

An important consideration when examining the “state” component of the DSR framework is to identify the share of agriculture in the environmental media or issue concerned, and to assess its importance for policy purposes. Typically, agriculture is only one amongst other activities in the economy which has an impact on the state of the environment. It is also important to remember that while agriculture can affect the state of environment, changes in environmental conditions can impact agricultural production activities, such as through acid air emissions or ozone depletion.

Responses refer to the reaction by groups in society and policy-makers to the actual and perceived changes in the state of the environment in agriculture, the sustainability of agriculture and to market signals. The responses include:

- farmer behaviour, by changes in input use, farm management practices, such as integrated pest management, and cooperative approached between farmers and farmers and other stakeholders;
- consumer reactions, through altering consumption patterns, including preferences for “organically” produced foods;
- responses by the agro-food chain, with changes in technology to produce less toxic pesticides and the voluntary adoption of better safety and quality standards by the food industry;
- government actions, through changes in policy measures, including regulatory approaches, the use of economic instruments such as subsidies and taxes, training and information programs, research and development, and agricultural policies.

Analysis of linkages between driving forces, state and response is a key element in shedding light on the relationship between the causes and effects of agriculture’s impact on the environment to better guide policy-makers in their responses to changes in environmental conditions in agriculture. The driving forces are not always sufficient to explain changes in the state of the environment, because the environment in agriculture has the capacity to absorb some stress. Moreover, a particular change in the state of the environment may not be easily quantified and interpreted as either beneficial or harmful in all cases, especially when judgments on environmental quality are affected by evolving societal and cultural attitudes. This emphasized the importance of understanding the linkages between policies, agricultural production and environmental quality (Organization for Economic Cooperation and Development, 1997, pp. 11-19)

5.3.3 Selection criteria for agro-environmental indicators

There are potentially a large number of indicators that could be developed to help quantify the various components and linkages in the DSR framework. To assist in the choice of an operational set of indicators within this framework each indicator was examined against four general criteria:

- Policy relevance. This criterion relates to those agro-environmental issues that are identified in the DRS framework as being of importance to policy-makers. While the list of issues is evolving and must be kept flexible, those shown in Figure 16 are currently of major relevance to policy-makers in OECD countries.

- Analytical soundness. This criterion concerns, in particular, the extent to which an indicator can establish links between agriculture activities and environmental conditions, and thus refers more specifically to the attributes which provide the basis to measure the indicator. It should be possible for the indicator to explain a link between agriculture and an environmental issue which is easy to interpret and applicable to a wide set of farming systems. The indicator should also be able to show trends and ranges of values over time, which might be complemented by nationally defined targets and thresholds where these exist.
- Measurability. This criterion relates to the appropriate data available to measure the indicator. The indicator should be developed from established national or sub-national data, preferably using a long time series where this is available given the lengthy time period for many environmental effects to become apparent.
- Level of aggregation. This criterion seeks to determine at which level (i.e. farm, sectoral, regional, national) the indicator can be meaningfully applied for policy purposes and not to conceal more than it reveals. It highlights the issue of encapsulating the spatial and temporal diversity of the environment and the geographical scale of different environmental issues ranging from the farm through to the global scale. The extent to which different agro-ecological zones have varying physical resource characteristics and property rights associated with those resources can change the impact of environmental outcomes that may arise from farming in those zones (Organization for Economic Cooperation and Development, 1997).

Soil	Soil salinization, acidification, trace element balance, toxic contamination, waterlogging, all levels of soil organic matter, soil productivity, soil erosion and landslides.
Water	Surface, ground and marine water quality affected by the run-off or leaching of nitrogen, phosphorus, toxic pesticide residues, acid substances and soil sediment. The use of surface and groundwater resources, the spatial and temporal distribution of water resources, and loading and discharge of surface water.
Air Contamination	Air contamination from pesticides, soil, livestock odors, and biomass burning.
Climate change	Emissions of greenhouse gases from agriculture, agriculture as a sink for greenhouse gases, energy use.
Ozone depletion	Stratospheric ozone depletion from the use of some ozone depleting chemicals in agriculture, such as methyl bromide.
Nature Biodiversity	Biodiversity of “domesticated” plants and livestock; and “wildlife” biodiversity.
Habitats	Wildlife habitats on agricultural land, semi-natural and natural habitats.
Landscape	Landscape features arising from the interaction of topographical features, climate, distribution of biotopes, farming systems, and socio-cultural values.
Farm financial	Issues, including the financial resources available to farmers, which can influence farmer behavior in relation to the environment.
Socio-cultural	Issues, including population balance between rural and urban areas, which can influence the relationship between agriculture and the environment.

Figure 16. Selected key agro-environmental issues of relevance to OECD policy-makers
Source: (Organization for Economic Cooperation and Development, 1997, p.20)

The discussion on the level of aggregation of data is also directly related to the extent to which indicator information can be compared internationally. For most indicators different climatic and environmental conditions mean contrasting agro-environmental information across countries requires careful interpretation, especially in comparing the absolute levels of each indicator. One appropriate comparison, however, could be to compare the trends or changes in indicators over time (Organization for Economic Cooperation and Development, 1997, pp.19-23)

5.3.4 Indicators to address agro-environmental issues of relevance for policy-makers

The following agro-environmental issues have been identified by OECD Member countries as priority areas that indicators should address:

- nutrient use;
- pesticide use;
- water use;
- land use and conservation;
- soil quality;
- water quality;
- greenhouse gases;
- biodiversity;
- wildlife habitats;
- landscape;
- farm management;
- farm financial resources;
- socio-cultural issues.

These issues are all part of an evolving process, reflecting changing policy priorities and agro-environmental concerns, developments in conceptual analysis, including the DSR framework, and advances in methods of measurement. The importance of each of them may vary between countries depending on their environmental endowments, natural assets and liabilities, relative pressure on land resources, income levels, and policy priorities.

Figure 17 (based on: Organization for Economic Cooperation and Development, 1997, pp.23-46) provides an overview of major issue-related indicators comprising an indicator set developed jointly by OECD Member countries, including short technical descriptions of each agro-environmental issue and indicator descriptions.

Agricultural nutrient use

Technical background: An adequate supply of nutrients in the soil, particularly nitrogen, phosphorus, and potassium is essential to crop growth. Nutrients can be lost from the soil through crop production, leaching and soil erosion, and nitrate lost by conversion to nitrogen gases or by volatilization of ammonia. Deficiency of nutrients, however, can lead to the mining of nutrients and reduced soil quality. Soil nutrients can be replenished through the application of chemical fertilizer, livestock manure and sewage sludge (partially dried residue from sewage treatment). Other farming practices such as planting cover crops and the use of green manure also helps to mitigate the loss of nutrients and in some cases replace nutrients. Excessive nutrients in the soil can contribute to problems of eutrophication, pollution of drinking water, soil acidification and climate change. Nitrogen and phosphate nutrients associated with fertilizer, manure and sewage sludge use and excess levels of these nutrients in soils, are of greatest environmental concern.

Agricultural pesticide use

Technical background: Pesticides have contributed greatly to increased agricultural productivity and crop quality, but once in the environment can accumulate in soil and water, and damage flora and fauna as concentrations in food-chains become high enough to harm wildlife. Pesticide residues also impair drinking water quality, contaminate food for human consumption, cause adverse health effects from direct exposure to farm workers, while some pesticides contain bromide compounds which, when volatilized, convert into stratospheric ozone-depleting gases.

Indicators: The approach considered by OECD to measure the agricultural pesticide use issue involves classifying pesticide use data into different environmental risk categories, in quantity terms.

This approach combines information on pesticide use with that of pesticide chemistry which influences environmental risk, that is mobility, persistence, and toxicity.

Agricultural water use

Technical background: Water shortage can be a major impediment to agricultural production and also damage aquatic habitats and wildlife. Agriculture uses water, aside from rainfall, supplied from both surface and groundwater sources. For agriculture to tend towards the sustainable use of surface and groundwater resources, the quantity used from these sources should decrease per ton of biomass/livestock output. The need to maintain and restore the “natural” state of water resources is an integral part of water

management and sustainable agriculture practices. The intensification of agricultural practices in many countries has increased the abstraction rates of limited surface and groundwater resources.

Equally, inappropriate land management practices, such as felling trees on agricultural land, can result in problems of “excess” water with rising water tables leading to salinization and waterlogging. With the higher demand for water from industrial and public consumers, in addition to agriculture, the growing competition for water resources within the economy is of great concern to policy-makers in many OECD countries.

Indicators: Measurement of agricultural water is considered in terms of developing water balances for, both the use of surface and groundwater resources by agriculture, together with exploring possible linkages with indicators related to farm management, especially aspects of irrigation management.

Some of the indicators for measuring a water balance include consideration of various water use efficiency equations, monitoring stream and river flows (surface water) and also groundwater levels.

Other indicators include calculation of water costs per ton of crop/livestock output, and estimating the quantity of water recharged into groundwater reservoirs through certain agricultural practices as defined in the agro-environmental issue covering agricultural land use and conservation below.

Agricultural land use and conservation

Technical background:

The pattern and trends in agricultural land use can have significant impacts for natural resources, biodiversity, wildlife habitats and landscape. Changes in agricultural land use may include land permanently retired from production and maintained for environmental conservation purposes, and also the shift of agricultural land to urban, industrial and recreational uses. While agricultural land use can lead to degradation of the environment, certain agricultural practices can also play a role in conserving natural resources, such as soil quality. For example, certain nutrient management practices can help to enhance soil fertility and structure; crop and pasture land may provide wildlife habitats; and certain irrigation practices (e.g. construction of dykes) can contribute to the stabilization of river flow, help prevent floods and landslides and improve the recharge of groundwater reservoirs.

Indicators: The indicators to monitor changes in agricultural land use management may include measurement of:

- (a) land retired from production and maintained for conservation purposes;
- (b) total agricultural land area in relation to the total land area;
- (c) agricultural land per capita;
- (d) agricultural land shifter to non-agricultural uses, including abandoned farmland;
- (e) shifts in land use from wetlands to farmland.

Indicators to address agricultural land conservation cover the role of agriculture in ameliorating soil erosion, landslides and flooding, measured by the volume of:

- (a) water stored by agricultural soils and ridges and banks (flood prevention);
- (b) water penetrating into groundwater reservoirs relative to the outflow of water from agricultural lands into surface flows (sustainable agricultural water use);
- (c) soil eroded from sloping agricultural land in the case of abandonment (prevention of soil erosion and landslides).

Agricultural soil quality

Technical background:

Degradation of soil results from erosion, chemical and physical deterioration.

Soil erosion on-farm reduces land productivity, which partly depends on soil structure, tillage and water-holding capacity; and off-farm erosion affects air and water quality causing damage to aquatic habitats and human health. Erosion also reduces the capacity for soil to fix carbon dioxide and act as a greenhouse gas sink, and impairs water storage capacity in rivers, lakes and reservoirs increasing flooding and damaging water systems.

Chemical deterioration consists of the loss of soil nutrients and organic matter, and accumulation of heavy metals and other toxic elements (e.g. from the use of sewage sludge on agricultural land), leading to salinization, acidification and water logging.

To varying degrees chemical and physical deterioration of soil stems from natural processes, inappropriate irrigation and soil management practices, land clearing, excessive use of chemical

inputs, and the mis-use of heavy agricultural machinery.

Indicators: Measurement of agriculture's impact on soil quality is considered through the development of a soil risk methodology which combines indicators on the:

- (a) vulnerability of soil to various degradation processes;
- (b) extent of soil degradation;
- (c) soil management practices.

Estimated risk of soil degradation can be expressed in absolute terms (tons per hectare), classes of severity (low to excessive) or as a trend (per cent change), taking into account specific agro-ecosystem.

Agricultural water quality

Technical background:

The impact of agriculture on water quality mainly concerns the presence of excessive level of nitrogen and phosphorus, heavy metals, active pesticide ingredients, acid substances and soil sediments. Excessive nitrogen and phosphorus levels from fertilizer use lead to eutrophication which can diminish fish populations. High levels of heavy metals in water, originating from fertilizers, can enter the human food-chain through absorption by fish. Toxic contamination of water from pesticide use can result from leaching or enter directly when spraying takes place close to surface water. Acidification of water may originate from fertilizer and fossil fuel use, and biomass burning.

Soil sediments, washed by wind and rain from cropland and overgrazed pasture, can lead to water turbidity and decrease the sunlight and dissolved oxygen available to aquatic plants and fish, thus reducing fish and shellfish populations. Sediment run-offs also decreases water storage capacity in lakes and reservoirs, clogs streams and drainage channels, increases the frequency and severity of flooding and damages water distribution systems.

Indicators: The method to establish agriculture's impact on water quality involves the integration of the "state" and "risk" approached to measure surface water (rivers and lakes) and groundwater quality in agriculture:

The "state" approach measures observed data on the concentrations in weight/litre of water of nitrogen, phosphorus, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, toxic pesticide residues, bacteria, viruses, ammonium,

salinity and suspended matter resulting from agricultural activities.

The “risk” approach measures the ration of the potential contaminant concentration to the tolerable or allowable concentration, and is based on a partial budgeting method for nutrients and pesticides.

Agricultural greenhouse gases

Technical background:

The greenhouse gases (GHG) contributing to the greenhouse effect and emitted as a result of agricultural activity mainly include carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). these gases have varying global warming potentials which can be expressed in CO₂ equivalents. Agricultural CO₂ emissions occur when soil matter is oxidized and affected by cultivation or wind erosion. CH₄ is largely derived from ruminant livestock’s enteric fermentation and animal wastes, paddy rice fields, and biomass burning. N₂O emissions originate from fertilizers, animal urine, waste storage sites, biomass burning and fossil fuel use.

Indicators:

To measure the release and accumulation of agricultural greenhouse gases the OECD suggests using the net balance of release and accumulation of carbon dioxide, methane and nitrous oxide by agriculture expressed in CO₂ equivalents. This method of measurement can provide a better reflection of agriculture’s contribution to climate change than just measuring gross emissions, by taking into account the role of agricultural GHG sinks.

Agricultural biodiversity

Technical background:

A widely used definition of biodiversity includes three levels, although these are closely related, as follows:

- (a) diversity within species (genetic level);
- (b) change in the number of species and their population size (species level);
- (c) changes in natural habitats providing the necessary conditions for populations of species (ecosystem level).

At the genetic level, agriculture uses biological diversity as a reservoir of genes for improving plant and livestock productivity, although developing generic diversity has sometimes been

neglected by agriculture.

The biodiversity of “domesticated” agricultural plant and livestock species is of particular policy relevance because of the potentially higher environmental risks and costs associated with monocultural systems. Such farming systems may lead to an impact on biodiversity at the species level through exposure to excessive use of nutrients and pesticides and also in some cases “domesticated” species entering “natural” habitats and affecting the number, population and distribution of species. In turn, this leads to the impact of agriculture at the ecosystem level of biodiversity which may also involve changes to wildlife habitats through the modification of agricultural landscapes.

Indicators: Since it is possible to preserve biodiversity ex situ and in situ the indicators that could address biodiversity in agriculture need to reflect both approaches, including the measurement of the:

- (a) biodiversity of “domesticated” species in agriculture;
- (b) impact of agriculture on the biodiversity of “wild” species.

Agricultural wildlife habitats

Technical background:

Many farm practices have an impact on the quality and availability of natural habitats which can lead to effects on wildlife. For example, many bird species have become dependent on the presence of permanent pasture land, semi-natural grass-lands and small habitats in the landscape, such as hedgerows. Agriculture also impacts wildlife that is not directly present on agricultural land, but which is connected through, for example, the downstream effects of nutrients and pesticide residues in water. Agriculture can also affect “natural” habitats through the escape of domesticated species, or through increased fragmentation, which can lead to damaging impacts on species population size and distribution, and potential loss in species diversity.

Indicators: The indicators to measure agriculture and wildlife habitat may include measuring:

- (a) changes in the area of selected “large-scale” habitats in agriculture, such as woodlands, wetlands and pastures;
- (b) fragmentation of habitats both within agro-ecosystems and “natural” habitats;
- (c) length of the “contact zone” between agricultural and non-agricultural lands.

Agricultural landscapes

Technical background: Landscape can refer to a way of describing agro-ecosystems and semi-natural habitats. An agricultural landscape can also refer to the visual character of the lands including its intrinsic beauty, historical features, embodiment of cultural values, reflecting the past and present impact of land use. Specific value of landscapes depends on the patterns of land use, farm practices, composition of farming systems, and the distribution of habitats and man-made features like stone walls or historical buildings. The rate of change of these attributes determines how rapidly landscape alters, ranging from its conservation to its complete transformation.

Indicators: Indicators to measure the complexity and diversity of agricultural landscapes may include measurement through:

- (a) estimating the monetary value of landscape, using economic non-market valuation techniques, such as the contingent valuation method;
- (b) developing an inventory of physical landscape features, such as linear distance of hedgerows, monitoring trends in land use and appearance of key species.

Farm management

Technical background: Farm management refers to farmer behaviour and technology uptake through a hierarchy of practices ranging from those specific to farm inputs, environmental media such as soil, and practice such as pest control, to whole farm management.

Indicators: Indicators to assess the environmental impacts of farm management may include the measurement of:

- (a) nutrient management – the share of land which is analyzed regularly for soil phosphorus; the share of farms using a nutrient management plan; the area of agricultural land; the area which requires less than normally recommended nutrient inputs; the area of agricultural land receiving excessive nutrient inputs; and the timing of slurry application and months of available slurry storage on farm;
- (b) pest management – the share of land on which integrated pest management practices are adopted; the use of pest forecasting systems; the area of cropping land on which pesticides are not applied; and the measurement of the efficiency of pesticide spraying equipment in applying

pesticides;

- (c) soil management – the share of land on which soil conservation practices are adopted including the use of winter cover crops, and appropriate tillage practices;
- (d) irrigation management – the efficiency of water use on irrigated land in terms of the quantity of water used to produce a unit of agricultural output; and the pricing of water to agriculture;
- (e) whole farm management – the rate of adoption of farm plans or property management plans – which, when fully developed, may contain information relating to economic, farm production and biophysical or environmental factors – either approved by governments or voluntary.

Farm financial resources

Technical
background:

The linkages and feedbacks between the level and variation in farm financial resources and environmental impacts are complex. These relationships may vary considerable both within and among the countries. On the one hand, they depend on farmers' skills and ability to manage financial resources at their disposal, including their adaptability to changes in financial situation. On the other hand, the relationship between farm financial resources and the environment also depends on those influences outside of control of individual farmers, including the physical agro-ecosystem, policy, and the economic and socio-cultural context in which farms operate.

The sources of financial resources to farmers include market returns, off-farm income, loan and equity capital, and transfers from taxpayers (government budgetary support) and consumers (through market price support).

Financial resources available to the farm may affect: the ability to farm; the type, level and intensity of input use and production; the ability to acquire new technologies; the adoption, or not, of environmentally sound production methods, including farmers' attitude towards environmental risks; rates of structural adjustment including farm amalgamation, exit and entry; and the pressures for policy interventions.

Indicators:

The indicators to address the issue of farm financial resources may include measurement of:

- (a) net farm and off-farm income;

- (b) policy transfers;
- (c) average rate of return on capital employed;
- (d) average debt/equity ratio, on a per farm basis and adjusted for inflation in real terms.

Socio-cultural issues in relation to agriculture

Technical background:

Socio-cultural issues in relation to agriculture and the environment include the loss of productive agricultural land to other uses through land degradation. Also considered important are rural-urban population changes, in particular the impact of declining or increasing rural populations on the provision and quality of rural amenities, including landscape and agriculture's role in controlling forest fires.

Of additional interest is the education levels and training of farmers in terms of their awareness of environmentally friendly and sustainable farming practices and changes in farm structures, ownership patterns and the age composition of the farm population, as well as aspects related to the effects on farmers of chemicals and machinery used on farms.

Indicators:

The following indicators for assessing socio-cultural issues in relation to agriculture may be used:

- (a) land use changes, especially the transfer of agricultural land to use for urban development;
- (b) changes in population growth and composition, in particular rural-urban changes;
- (c) education and training for farmers, in relation to the adoption
- (d) of environmental plans and sustainable farming practices;
- (e) farmer health and safety related to the use of agricultural pesticides and machinery.

Figure 17. An overview of major-issue related indicators (developed by OECD)

In the future, the OECD agro-environmental indicator set will need to be regularly reviewed to reflect the emergence of any changing priorities and new concerns. The underlying priorities for OECD work on indicators will remain in informing policy-makers (within the framework of current research, Ukrainian policy-makers) and the wide public on the state of the environment in agriculture, assisting policy-makers to better understand agro-environmental linkages in agriculture with the view of improving

policy design and decision-making, and contributing to monitoring and evaluation of the effectiveness of policies in promoting sustainable agriculture within the overall context of overall policy reform.

At the same time, the overall framework and approach offered by OECD is also of potential value for many other countries. Interest in addressing agro-environmental issues, developing methods and indicators to monitor agro-environmental impact is currently of growing importance to most parts of the world.

OECD approach indicators are suitable for evaluation of the policies, plans and programmes result where aims and goals are defined with quantitative standards. Having the achievements, presented in qualitative values it is easy to measure the level of goals fulfilment. The PSR approach helps to understand the nature of results – the pressure, state or response correspondingly and possible ways of influence for improvement of given situation.

Since the fact, that for evaluation of the AIS the selected OECD indicators have to be compared with each other the author has created twelve indices, which were recalculated from qualitative values specific for measured dimensions into dimensionless values. This had been made by normalizing the values and applying the formulae which give the indices resulting values within the range from 0 to 1, and thus – making possible direct comparison of values. For calculating the values of the indices, the Human Development Index approach was implemented and adjusted for the research needs.

6 Mathematical Model for Top-Level Indices

After review of indicator requirements and definition of selection criteria, the set of indices has to be composed. Unfortunately, the State Statistic Committee of Ukraine as well as Ministries in charge are neither in possession of systematic, continuous and homogenous data records, nor provide the certain parts of the information in their disposal for open public use. Due to the lack of data and indicators which can fulfil such crucial requirements as validity, user-orientation, practicability, relevance, sensitivity, reliability, timeliness, compatibility and feasibility, the data pool was reduced to the set of twelve indices representing economic, social and environmental aspects of the Ukrainian situation in agro-industrial sector. In case of further availability of reliable data, the suggested set can be effortlessly extended or modified to the desired dimension and needs of investigation analysis.

In light of this, a set of indices was developed that:

- provides analytical information which is suitable for use for evaluators, governmental and regional policy-makers as to the current state and changes in the conditions of environment in agriculture;
- helps responsible persons in charge, or ministers and other policy-makers to clearly understand the linkages between the causes and effects of the impact of agriculture and agricultural policy on the environmental, social and economic conditions, and helps guide their responses aimed at controlling and improving the existing situation;
- contributes to monitoring and evaluation of the effectiveness of policies in promoting sustainable development in agro-industrial sector.

6.1 Methodology

In order to be able to operate, analyze and compare data of different origin and dimensions, the transformation into dimensionless value index approach, which brings the data to the comparable scale, had to be applied. After this transformation procedure, the core set of indices was defined and obtained. For the purposes of current research, the author has used a similar methodology as that utilized for calculating Human Development Index of UNDP by (Sudhir Anand and Amartya K. Sen., 1994, pp. 1-13) and applied the adjustments and adaptations necessary to provide combination of OECD methodology, PSR approach and suitability for SEA evaluation.

Due to the fact that HDI methodology of UNDP sets very high value to the literacy level of population this approach should be modified for evaluating Ukrainian AIS since national literacy level is considered to be 99% or even 100% and will provide deviation of measured values if taken into account.

For the transformation into dimensionless value index the raw data indices must be expressed in each dimension as a value between 0 and 1, where 0 stands for the worst case or critical situation, 1 – corresponds to the perfect target to achieve. This range is divided into three zones: critical, acceptable and optimal. Decision-makers should pay maximum attention to indices located in the critical zone and concentrate their effort on improving the situation in respective fields. Indices that lie in the acceptable zone do not

pose any critical threat, should nonetheless be considered for improvement. The optimal zone denotes favourable conditions in the given segment, but should be monitored on a regular basis

Indices are calculated by applying one of the two following formulae:

If the increasing value of variable indicates improvement of condition or monitored situation, then following computation is used

$$\text{Index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

When minimum value is equal to zero, the resulting formula could be simplified to the ratio of actual and maximum possible values:

$$\text{Index} = \frac{\text{actual value}}{\text{maximum value}}$$

If the increasing value of variable shown worsening of condition or situation, the following formula is used in order to keep the standard where value approaching “0” is very bad and undesirable and value approaching “1” presents the aim:

$$\text{Index} = 1 - \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}} \Rightarrow$$

$$\text{Index} = \frac{\text{maximum value} - \text{actual value}}{\text{maximum value} - \text{minimum value}}$$

To compensate the inequality of the national income distribution between various population groups, additional logarithmic transformation was introduced for calculating the indices related to Gross domestic product distribution and Agricultural production index (Human Development Report 2007/2008, 2008, p. 356). In case if index value exceeds extreme values (is less than zero or greater than one), the index value is set to the zero or one respectively.

To represent situation in the economic, social and environmental components of country's functioning, the following relevant and representative twelve key indices specific for Ukrainian AIS based on the raw statistical data, have been generated:

- Gross Domestic Product Index (GDPI)
- Agriculture Production Index (API)
- Food Sufficiency Index (FSI)
- Organic Agriculture Index (OAI)
- Greenhouse Gas Emission Index (agricultural sources) (AGGEI)
- Waste Water Treatment Index (WWTI)
- Soil Mineral Fertilization Index (SMFI)
- Pesticides Usage Index (PUI)

- Water Consumption Index (WCI)
- Demographic Dynamics Index (DDI)
- Life Expectancy Index (LEI)
- Hospital Sufficiency Index (HSI)

After defining and calculating the indices in following subchapters 6.2.1 – 6.2.12, the three top-level indices, based on twelve obtained indices can be calculated.

The following formula for calculating each of the top-level indices is used:

$$\text{Top – level index} = 1 - \sqrt[\alpha]{\frac{1}{n} \sum_{i=1}^n (1 - \text{Index}_i)^\alpha} ,$$

where:

n – number of indices used for each top-level index calculation;

Index_i – indices, included in top-level index calculation (GPDI, API, FSI, OAI, etc.);

$\alpha = 3$ – corrective coefficient introduced to increase weight of index with lower value. Thus indices with lower value (indicating worse condition, with priority for improvement), will have more significant impact on top-level index (Human Development Report 2007/2008, 2008).

For defining the thresholds for top-level indices the following formula is introduced:

$$\text{TH} = \sqrt[\alpha]{\frac{1}{n} \sum_{i=1}^n (\text{TH}_i)^\alpha}$$

where:

TH – threshold of top-level index;

TH_i – threshold of index, included in top-level index;

n – number of indices in top-level index;

$\alpha = 3$ – corrective coefficient introduced to give more weight to thresholds with higher values. It is done in order to raise the resulting requirements above average level. (Human Development Report 2007/2008, 2008).

The indices description, calculation and visualisation, can be found in following sub-chapter 6.2. Top-level indices are calculated and presented in sub-chapter 6.3.

The developed methodology can also be used with other set of initial data, indicators and indices. Model precision rises with increase of input data amount and its resolution. For

example, by providing the monthly gathered data, one can trace change in values over the year. Application field can also be downscaled from the highest (national) to the lowest (regional) level by adapting the system to the initial input data. This will simplify the presentation of regional reports and will provide transparency for interregional comparison.

6.2 Indices

6.2.1 Gross Domestic Product Index (GDPI)

6.2.1.1 Objective

GDPI's objective is to display national income in the long run and show its fluctuations within observed time scale.

6.2.1.2 PSR Relevance

GDPI is a state index.

6.2.1.3 OECD Relevance

GDPI is relevant financial resources.

6.2.1.4 Method of computation

$$GDPI = \frac{\log (GDP_{actual}) - \log (GDP_{min})}{\log (GDP_{aimed}) - \log (GDP_{min})}$$

where:

GDPI – Gross Domestic Product Index;

GDP_{actual} – the actual GDP per capita per year, UAH;

GDP_{min} – the least possible GDP per capita per year, UAH;

GDP_{aimed} – the GDP per capita per year, which is set as a target, UAH.

The logarithmic transformation compensates inequality of the national income distribution between different population categories since it is a strictly concave transformation and the average of the logarithm tends to increase as GDP is more equally distributed (Human Development Report 2007/2008, 2008, p. 356), (Sudhir Anand and Amartya K. Sen., 1994, p. 4).

6.2.1.5 Comments and limitations

The GDP Index is calculated using GDP values expressed in Ukrainian national currency (UAH) per capita, adjusted to the prices level of December 2008.

GDPI values lay in the range from 0 to 1, high values of the index show that economy produces enough income to satisfy needs of the population. GDP is measured in the national currency, in prices adjusted to a specific year.

If GDP_{actual} exceeds the GDP_{aimed} , than GDPI is set to 1, same as in HDI calculation methodology, even mathematically it is greater than 1.

According to the Law of Ukraine number: (107-17) from 18.12.2008 (Закон України Про Державний бюджет України на 2008 рік та про внесення змін до деяких законодавчих актів України, 2008) , the subsistence level for 626 UAH per month per capita (7512 UAH per year per capita). The critical/ acceptable zone threshold of 0.4 means that all population of Ukraine lives at the subsistence level with assumption of equal income distribution. The threshold between acceptable and optimal zones is set to 0.7 which corresponds to the growth of national income by five hundred percent, as recommended by the Prime Minister of Ukraine in her comments to the Law of Ukraine number: (107-17) from 18.12.2008. The highest value of 1.0 means achieving the maximum value of GDP set by the UNDP's approach.

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.7
- Optimal zone: 0.7 ... 1.0

6.2.1.6 Process of obtaining data

The data can be found in Table II in Annex, and are also available from annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.1.7 Data availability

The available data represent annual statistical information for the period of 1990 – 2008.

6.2.1.8 Estimates

For the calculation of the index in the current study, the following assumptions and estimations are used:

- The worst-case scenario: $GDP_{\min}=750$ UAH per capita per year. This value is based on the data of the United Nation Development Program (Human Development Report 2007/2008, 2008, p. 356), which defines minimum GDP per capita at the level of 100 USD what equals 750 UAH.
- The desired amount of the GDP: $GDP_{\text{aimed}} = 300,000$ UAH per capita per year. This value is based on the data of the United Nation Development Program (Human Development Report 2007/2008, 2008, p. 356), which defines maximum GDP per capita at the level of 40,000 USD per year what equals 300,000 UAH.
- All the prices are adjusted to the level at the end of 2008.

6.2.1.9 Discussion and AIS relevance

GDP is the most important element of the states wellbeing and is therefore an indispensable part of integral analysis which aims at evaluating performance in any given sector of economy including the AIS. GDPI has very high significance for evaluating the quantitative effectiveness of the national economy and is very convenient for comparison and evaluation in any system namely SEA, HDI, PSR and OECD. According to HDI methodology, on which this index calculation is based,- for the wealth component, the goalpost for minimum income is \$100, which is equal 750 UAH and the maximum is

\$40,000, which is equal 300,000 UAH . The logarithm of income is used to reflect the diminishing importance of income with increasing GDP. The national goal set for the index is feasible under condition of national political and economical stability.

6.2.1.10 Visualization of calculated values

In the following figure 18, the calculated index values based on available data are represented. From the graph one can observe that after the collapse of Soviet economy and economic relations the GDPI went down and reached the lowest value in 1996 to 2000. Although the situation tends to improve, the level of 1990 is still not achieved.

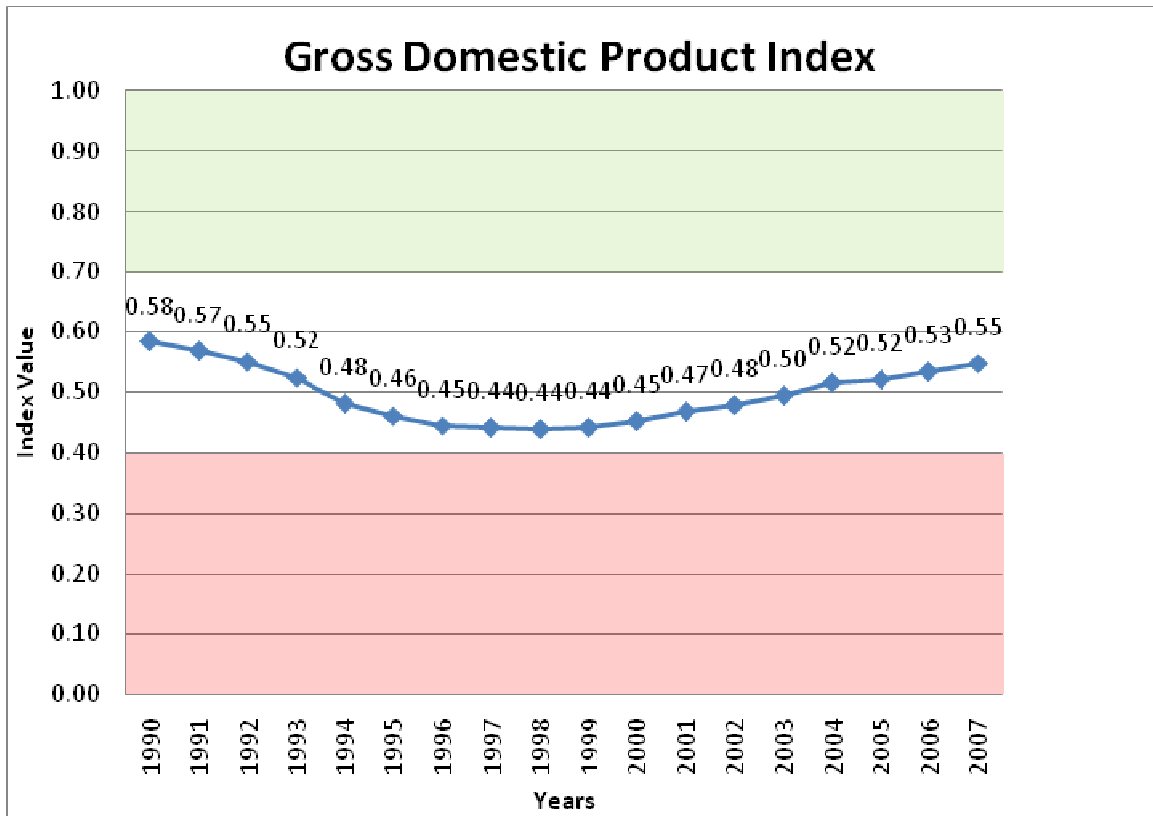


Figure 18. Gross Domestic Product Index (1990-2007)

6.2.2 Agriculture Production Index (API)

6.2.2.1 Objective

The Agriculture Production Index represents the production of goods by the agricultural sector in monetary equivalent. API delivers data for long-run fluctuation of agricultural production. By observing GDPI and API in the same time scale it is possible to evaluate relative performance of AIS.

6.2.2.2 PSR Relevance

API is a state index.

6.2.2.3 OECD Relevance

Financial resources.

6.2.2.4 Method of computation

$$API = \frac{\log (AP_{\text{actual}}) - \log (AP_{\text{min}})}{\log (AP_{\text{aimed}}) - \log (AP_{\text{min}})}$$

where:

API – Agriculture Production Index;

AP_{actual} – the actual production of agriculture, UAH per capita of rural population per year;

AP_{min} – the least possible production of agriculture, UAH per capita of rural population per year;

AP_{aimed} – the production of agriculture, UAH per capita of rural population per year, which is set as a target.

The logarithmic transformation compensates inequality of the national agricultural income distribution between different population categories since it is a strictly concave transformation and the average of the logarithm tends to increase as AP is more equally distributed (Human Development Report 2007/2008, 2008, p. 356), (Sudhir Anand and Amartya K. Sen., 1994, p. 4).

6.2.2.5 Comments and limitations

API values are located in the range from 0 to 1.

If AP_{actual} exceeds the AP_{aimed} , than API is set to 1, same as in HDI calculation methodology, even mathematically it is greater than 1

Values of the index show to the national income produced by agricultural sector of economy. The agricultural production is measured in the national currency (UAH), in prices adjusted to December 2008.

Due to transformation into dimensionless value index of the initial data, the Agriculture Production Index has the same nature and scale as GDPI, so it is possible to use the same thresholds, where:

0.4 denotes minimum acceptable threshold of agricultural production per capita at the value when rural area population of Ukraine lives at the subsistence level with assumption of equal income distribution. The threshold between acceptable and optimal zones is set to 0.7, which corresponds to the growth of national income from agricultural sector, by five hundred percent. The highest value - 1 means achievement of a goal 300,000 UAH per capita of rural population per year, defined by UNDP at the level of 40,000 USD what equals 300,000 UAH. :

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.7
- Optimal zone: 0.7 ... 1.0

6.2.2.6 Process of obtaining data

The data can be found in Table IX in Annex, and are available from annual reports and on the portal of the portal of the State Statistical Committee of Ukraine.

6.2.2.7 Data availability

The available data represent annual statistical information for the whole period of Ukrainian independence 1990 – 2007.

6.2.2.8 Estimates

For the calculation of the index in the current study, the following assumptions and estimations are used:

- The worst-case scenario: $AP_{\min}=750$ UAH per capita of rural population per year. This value is based on the data of the United Nation Development Program (Human Development Report 2007/2008, 2008, p. 356), which defines minimum GDP per capita at the level of 100 USD what equals 750 UAH.
- The targeted amount of agricultural production: $AP_{\text{aimed}} = 300,000$ UAH per capita. This value is based on the data of the United Nation Development Program (Human Development Report 2007/2008, 2008, p. 356), which defines maximum GDP per capita at the level of 40,000 USD what equals 300,000 UAH.
- All the prices are adjusted to the level at the end of 2008.

6.2.2.9 Discussion and AIS relevance

AP is very important element of the states agriculture wellbeing and is therefore an indispensable part of integral analysis which aims at evaluating performance in agro-industrial sector of economy. API has very high significance for evaluating the quantitative effectiveness of the national agricultural production and is very convenient for comparison and evaluation in any system namely SEA, HDI, PSR and OECD.

At present rural population (one third of Ukrainian population) produce approximately one fourth of national GDP (part of AIS products in total GDP). Since rural population have to meet standards of UNDP, the targeted amount of agricultural production: AP_{aimed} is set to 300,000 UAH (40,000 USD), which is the same as for national GDP and the worst-case scenario: AP_{min}=750 UAH (100 USD) per capita per year of rural population. These values are based on the data defined by the United Nation Development Program. The aimed values for agricultural production in monetary equivalent were adopted from GDP thresholds set by HDI methodology.

6.2.2.10 Visualization of calculated values

In the following figure 19, the calculated API index values based on available data are represented. From the graph one can observe that after the beginning of Ukrainian independence and economical crisis, the agricultural production was in continuous stagnation. API had reached the lowest value in 1998 to 1999. Although the situation tends to improve, the index lies very close to the critical threshold.

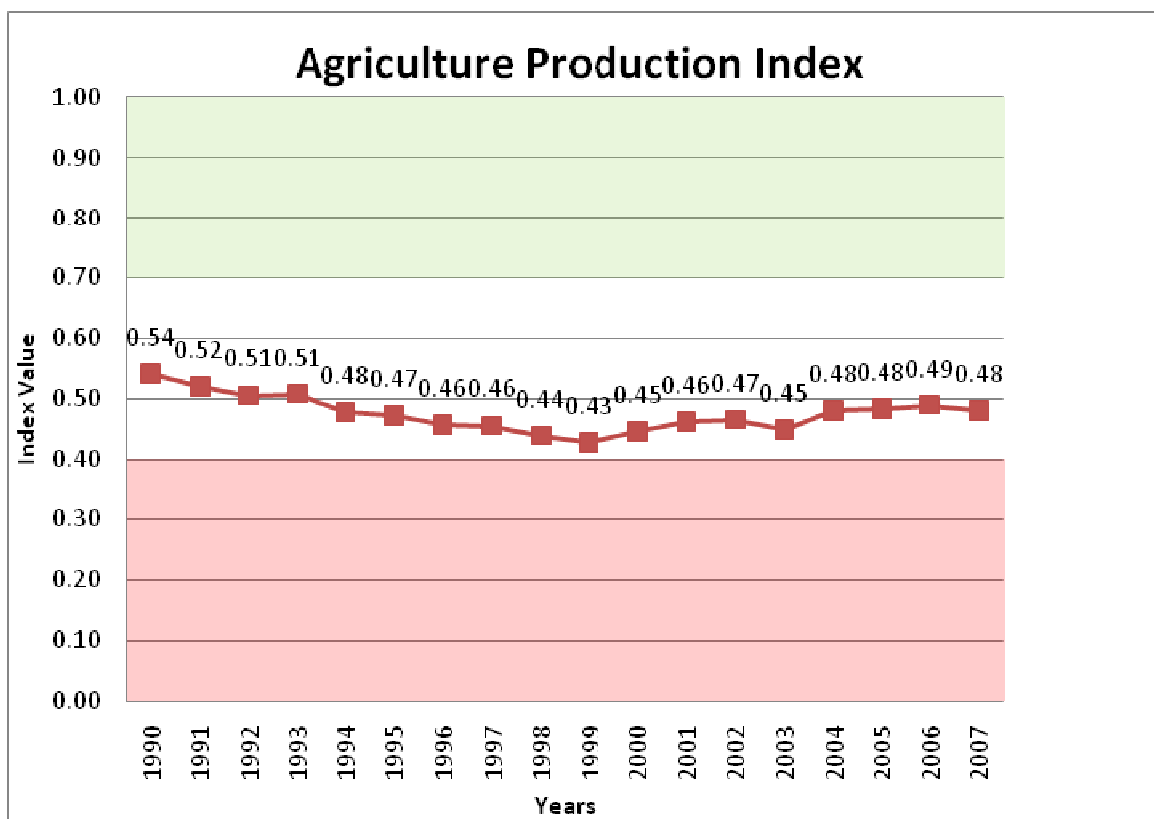


Figure 19. Agriculture Production Index (1990-2007)

6.2.3 Food Sufficiency Index (FSI)

6.2.3.1 Objective

FSI aims at representing the sufficiency for providing population with domestic agricultural food products. This is important index for sustainable development of the AIS of the country. It serves for evaluation of national food security situation.

“Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. (World Food Summit, 1996)

6.2.3.2 PSR Relevance

FSI is a state-response index.

6.2.3.3 OECD Relevance

Food security and food availability (Food and Agriculture Organisation, 2006); farm management.

6.2.3.4 Method of computation

The concept of computation of the FSI is defining the proportion between actual production of agricultural food products per year per capita and the optimal consumption norms. Additional mathematical transformation is required for normalization of the obtained results.

$$FPI^i = \begin{cases} \frac{FP^i}{FC_{opt}^i}, & \text{if } FP^i < FC_{opt}^i, \\ 1, & \text{if } FP^i \geq FC_{opt}^i \end{cases}$$

$$FSI = 1 - \sqrt[\alpha]{\frac{1}{n} \sum_{i=1}^n (1 - FPI^i)^\alpha}$$

where:

FPI^i – Food Production Index of one of the food products (meat, milk, eggs, grain, potato, vegetables, fruits). The data are available in Table VI, Table VIII in Annex;

FP^i – Annual production of a food product per capita, kg (for eggs – pieces);

FC_{opt}^i – Optimal annual consumption of a food product per capita, kg (for eggs – pieces) (see following table 4);

$i = 1 \dots 7$, where 1 represents meat, 2 - milk, 3 - eggs, 4 - grain, 5 - potato, 6 - vegetables, 7 – fruits;

FSI – Aggregated Food Production Index;

α – Corrective coefficient, similar as used in HDI methodology, which increase the weight of a product, with the most significant shortage. $\alpha = 3$.

6.2.3.5 Comments and limitations

The Optimal consumption of main food products is presented in following table 4 taken from Ivanuh et al

Table 4. Rational food products consumption
(Ivanuh, R.A., Dusanovs'kyi, S.L., Bilan, E.M., 2003, p. 180).

Food products	Optimal Ration (per capita kg/year)
Meat and meat products	80
Milk and milk products	380
Eggs	290 (pieces)
Bread and bakery	101
Potatoes	124
Vegetables	161
Fruits	90

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.8
- Optimal zone: 0.8 ... 1.0

6.2.3.6 Process of obtaining data

Raw data are available in Table VI and Table VIII in Annex; tables can be also found in annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.3.7 Data availability

The available data represent annual statistical information for the period of 1990 – 2007.

6.2.3.8 Discussion and AIS relevance

Corrective coefficient α is introduced to increase the weight of a parameter, which has the maximum deficit (shortage effect).

The food sufficiency is very important issue for Ukraine since the agricultural background and high agricultural potential were always at the level, when products of AIS were one of the important export goods. The goal set for this index is that all the seven key components listed in rational food products consumption (see table 4) will be domestically produced and available in full demand for population and thus provide national food security .

6.2.3.9 Visualization of calculated values

In the following figure 20, the calculated FSI index values based on available data are represented. From the graph one can observe that after 1990 the food sufficiency was continuously going down, with some rise in 1991 -1993. After 1999 SFI tends to improve, but still located in the middle of acceptable zone and has need for improvement.

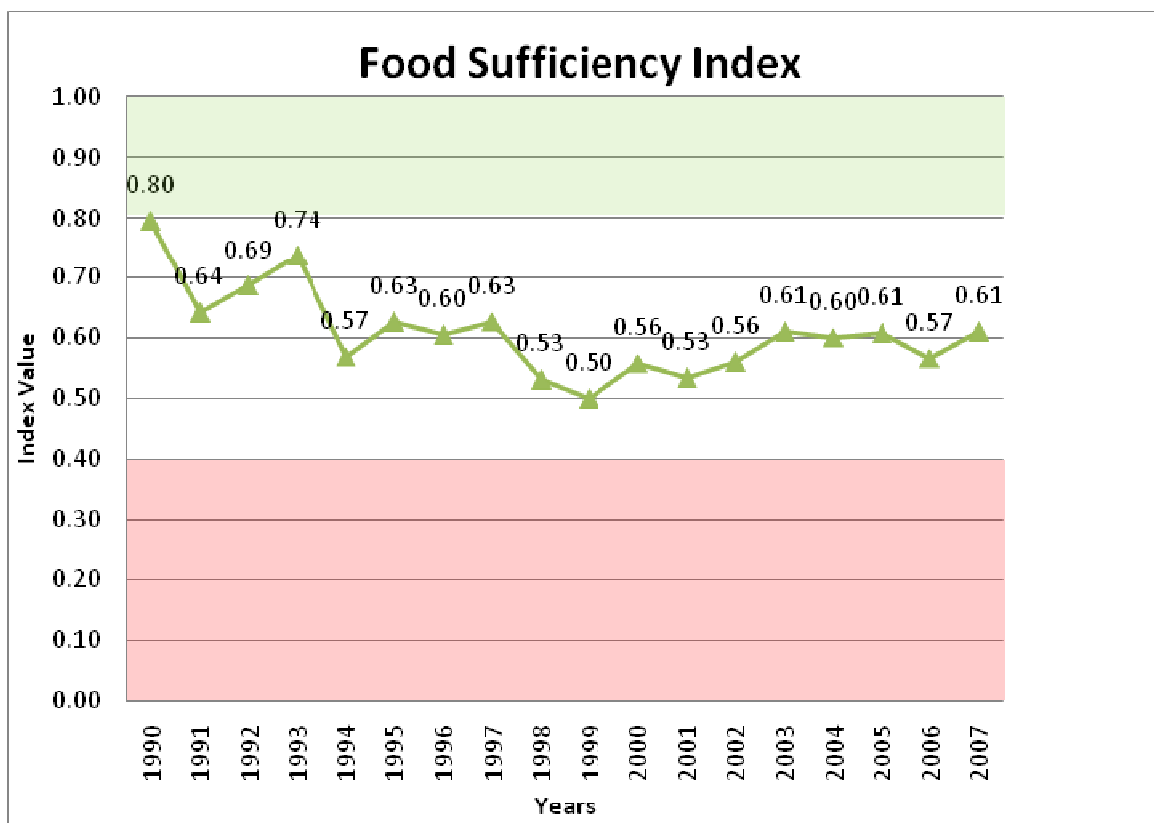


Figure 20. Food Sufficiency Index (1990-2007)

6.2.4 Organic Agriculture Index (OAI)

6.2.4.1 Objective

The Organic Agriculture Index represents the realization of the Ukrainian's potential of agricultural sector for the goals set by the Ukrainian government for products of organic agriculture.

6.2.4.2 PSR Relevance

OAI is a state index.

OECD Relevance

Land use and conservation, farm management.

6.2.4.3 Method of computation

$$OAI = \frac{OA_{\text{actual}}}{OA_{\text{aimed}}},$$

where:

OAI – Organic Agriculture Index;

OA_{actual} – area used for organic agriculture, ha;

OA_{aimed} – area targeted for organic agriculture, ha.

6.2.4.4 Comments and limitations

OAI values lie in the range from 0 to 1.

Critical zone threshold 0.4 denotes the achieving the goal set by 40% (means that 0.8 % from the whole cultivated area in 2010 will run under organic farming, and 2.8% - in 2015). Setting the threshold for optimal zone to 0.7 denotes the achieving the goal set by 70% and above (1.4% from the whole cultivated area in 2010 will run under organic farming, and 4.9% - in 2015).

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.7
- Optimal zone: 0.7 ... 1.0

6.2.4.5 Process of obtaining data

By 2003, the number of organic farms reached 70, covering approximately 240 000 hectares which is an index comparable with that of the neighbouring European countries. At the same time, this makes up only 0,57 % of total agricultural lands (or 0,72% of

cultivated agricultural area) available in Ukraine. Most organic agriculture farms are large or mid-scale with average size of 3 000 hectares mostly involved in grain production and focusing on harvesting wheat intended for export. Animal breeding is almost non-existing. Such one-sided development of organic agriculture reduces the profits of agricultural producers. It is obvious that trade certificate owning agents are making much more by exporting the grain than producers do.

Available raw data for calculating OAI can be found in tables XVI and XVII in Annex.

6.2.4.6 Estimates

According to the National Program of Agriculture Development Number 1158 from 19.09.2007, by Cabinet Council of Ukraine, the proportion of agricultural lands used under organic farming should achieve 2% from the whole cultivated area in 2010, and 7% from the whole cultivated area in 2015, resulting in 10 percent of the total production of AIS. For the calculating of the organic agriculture index, the target is set to 2% of the cultivated area. The 7% criterion of the total cultivated area will be used for the period 2010 – 2015.

6.2.4.7 Discussion and AIS relevance

Organic agriculture will significantly contribute to the sustainable development of AIS and will increase life standards of rural population.

However, the target, set by the government will require very significant increase of the cattle amount since organic agriculture foresees use of organic fertilizers instead of mineral fertilizers, which will contribute to the improvement of API. In the last twenty years the cattle amount in Ukraine had shortened dramatically and the trends still show negative dynamics.

At the same time it should be considered, that high increase of cattle population will result in Methane gas CH₄ production in very significant volumes and thus, will result in the greenhouse gasses emissions, measured by the following index – AGGEI

6.2.4.8 Visualization of calculated values

In the following figure 21, the calculated OAI index values based on available data are represented. From the graph one can observe that after before 2002 there is no data. This could be explained by the fact that during 1990 -2002, there was no extra counting of organic agriculture and certification in the country and products grown mainly at private farms counted to regular agricultural production. After 2002 situation is continuously improving, but the goals are still not achieved at satisfactory level.

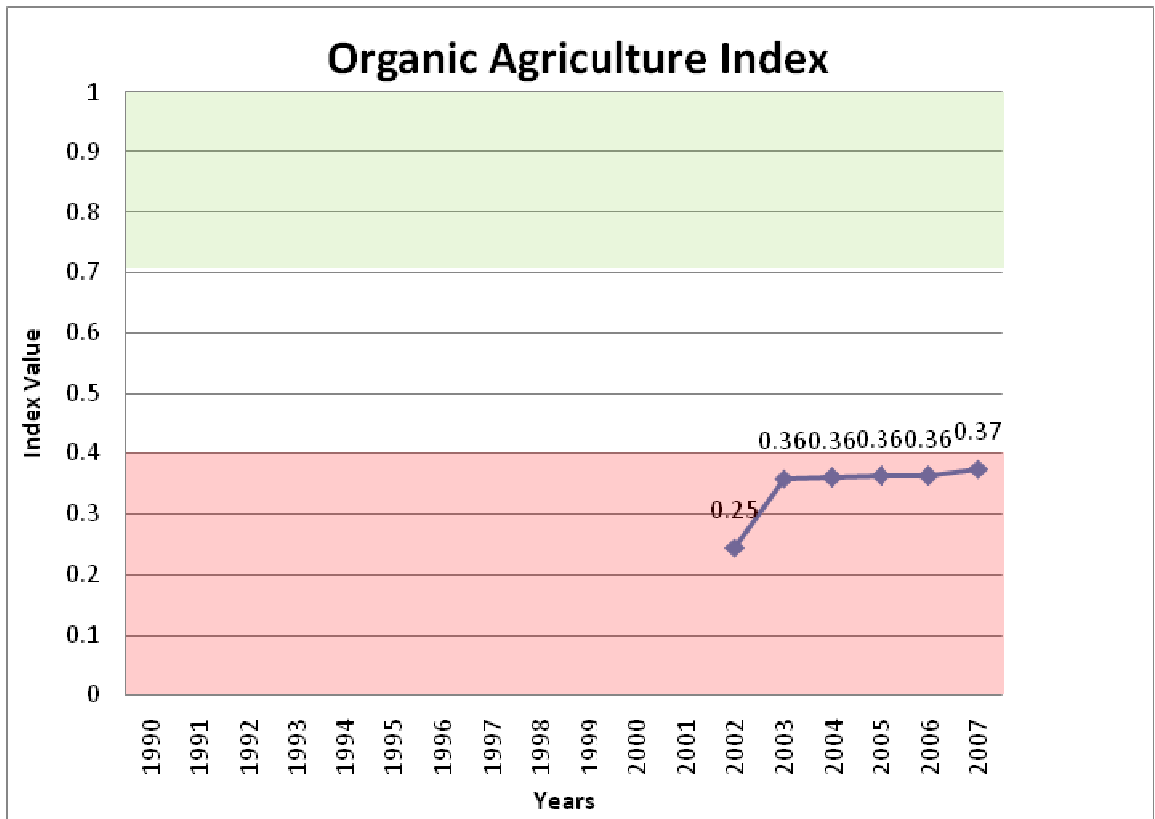


Figure 21. Organic Agriculture Index (2002-2007)

6.2.5 Greenhouse Gas Emission Index from agricultural sources (AGGEI)

6.2.5.1 Objective

The AGGEI index represents statistics of greenhouse gases emission (mainly CH₄, NO_x) that is caused by agricultural activity. GHG emission is one of the key environmental indices, which importance is defined by Kyoto Protocol.

6.2.5.2 PSR Relevance

AGGEI is a pressure index.

6.2.5.3 OECD Relevance

Agricultural greenhouse gases.

6.2.5.4 Method of computation

The method of AGGEI calculation is targeted to show the fulfillment level of thresholds set by the Kyoto Protocol. The corrective coefficient α is introduced to set AGGEI value of 0.5 to represents the requirements of the Kyoto Protocol for Ukraine.

$$AGGEI = 1 - \alpha \times \frac{AGGE}{AGGE_{KP}},$$

where:

AGGEI – Greenhouse Gas Emission Index;

AGGE – Actual emissions of greenhouse gases, mio tones of CO₂ equivalent;

AGGE_{KP} – Emission of greenhouse gases, set for the country, according to the Kyoto Protocol, mio. tones of CO₂ equivalent.

$\alpha=0.5$ – corrective coefficient for Ukraine, adopted from Kyoto Protocol.

6.2.5.5 Comments and limitations

According to the Kyoto Protocol, Ukraine agreed to keep average greenhouse gas emissions in 2008 – 2012 at the level of 1990.

The index is designed to represent deviation of the emissions from the Kyoto Protocol. The value AGGEI = 0.5 is achieved when AGGE = AGGE_{KP}, if AGGEI < 0.5, then the country exceeds its quota.

Critical zone threshold 0.4 denotes the exceeding of the Kyoto Protocol by 20%. The Protocol sets 8% reduction of GHG for the countries of the EU, which is represented by the value of AGGEI=0.54. Setting the threshold for optimal zone to 0.6 shows Ukraine's intension for achieving the best practice results.

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.6
- Optimal zone: 0.6 ... 1.0

6.2.5.6 Process of obtaining data

The data are available from the National Inventory Report of Greenhouse Gas Emissions and Removals in Ukraine for 1990 – 2004 (United Nations, 2006, p. 104) and 1990 – 2006 (Bereznitskaya, M.V., Butrim, O.V., Panchenko, G.G., Pirozhenko, Y.V., Habatyk, A.P., 2008, p. 101) and presented in Table III in Annex.

6.2.5.7 Data availability

The available data represent annual statistical information for the period of 1990 – 2006. The missing data are obtained by the linear regression method.

6.2.5.8 Discussion and AIS relevance

The greenhouse gas emission is very important issue at present time since it poses direct impacts on the climate change – one of the key problems of human beings. Ukraine can easily fulfill the norms set by the Kyoto Protocol, but mainly because of the agricultural crisis resulted in production shortage - not because of rational technologies implementation and sustainable development. This is just one very demonstrative example, when negative phenomena as economic and agricultural crisis makes positive impact on environment.

6.2.5.9 Visualization of calculated values

In the following figure 22, the calculated AGGEI index values based on available data are represented. From the graph one can observe continuous positive trend. This could be explained by the fact that during 1990 -1999 many industries went down and factories were closed. This resulted negative on GDPI, but at the same time has given the positive effect of greenhouse gas emission reduction. Although the index is in optimal zone, existing national GHG sources and emitters should be continuously improved with newest environmental friendly technologies.

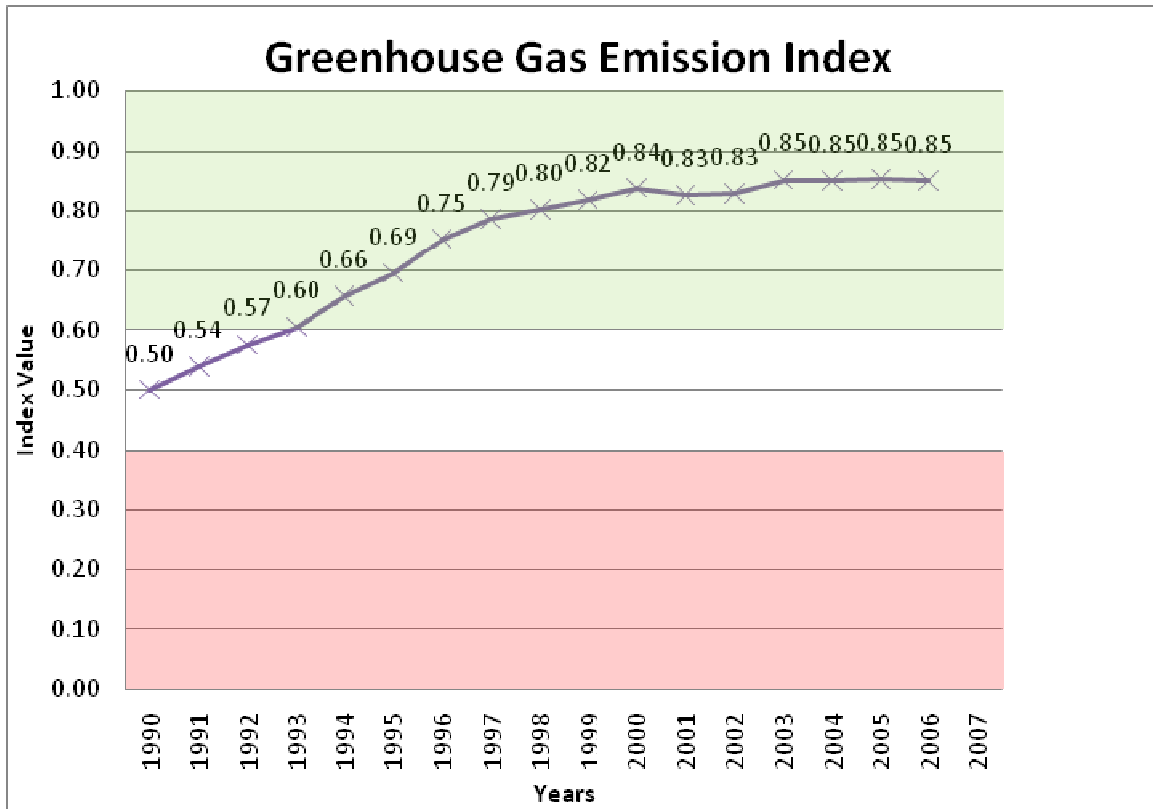


Figure 22. Greenhouse Gas Emission Index (1990-2007)

6.2.6 Waste Water Treatment Index (WWTI)

6.2.6.1 Objective

Shows the efficiency of waste water treatment by taking into account treated, partially treated and untreated water discharge.

6.2.6.2 PSR Relevance

WWTI is a pressure-state index.

6.2.6.3 OECD Relevance

Water quality.

6.2.6.4 Method of computation

$$WWTI = \alpha(\beta_w \frac{WT}{TD} + \beta_p \frac{PT}{TD} + \beta_n \frac{NT}{TD}),$$

where:

WWTI – Waste Water Treatment Index;

TD – total discharge of waste water, mio. m³;

WT – the amount of waste water, discharged without treatment, mio. m³;

PT – the amount of waste water, discharged after partial treatment, mio. m³;

NT – the amount of waste water, discharged after full treatment, mio. m³;

α , – resulting corrective coefficient;

$\beta_w, \beta_p, \beta_n$ – corrective coefficients for the waste water discharged without treatment, after partial treatment and after full treatment, respectively;

6.2.6.5 Comments and limitations

Corrective coefficients are introduced to reflect the importance of the waste water treatment in the discharge.

$$\alpha = 1.67, \beta_w = 0.1, \beta_p = 0.3, \beta_n = 0.6$$

WWTI values are in the range from 0.167 to 1.0.

- Critical zone: 0,167 ... 0.5
- Acceptable zone: 0.5 ... 0.75

- Optimal zone: 0.75 ... 1.0

The critical index value 0,167 - worst case scenario - means that all waste water discharged without any treatment, the value 0,5 denotes the situation when all waste water is partially treated (or untreated water discharge is compensated by fully treated water), the value 0,75 indicates that there is no waste water without treatment, 50% is partially treated, and the rest 50% - treated completely.

6.2.6.6 Process of obtaining data

Raw data are available from annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.6.7 Data availability

The given data for waste water discharge represent annual statistical information for the period from 1990 to 2008 and presented in Table XVIII in Annex.

6.2.6.8 Visualization of calculated values

In the following figure, the calculated index values based on available data are represented.

6.2.6.9 Discussion and AIS relevance

Waste water treatment reflects one of the aspects of the life quality issues crucial for rural area and should not be undervalued. It's very important to provide high water treatment standards for Ukrainians living in rural sector.

According to the Food and Agriculture Organization of the United Nations, agricultural water withdraw/discharge makes 52% of the overall water turnover (Food and Agriculture Organization of the United Nations - Database, 2009).

6.2.6.10 Visualization of calculated values

In the following figure 23, the calculated WWTI index values based on available data are presented. From the graph one can observe continuous negative trend with some improvements during 1999 - 2002. This could be explained by the fact that Ukrainian waste water treatment facilities are overused and should be urgently renewed and equipped with modern cleaning technologies. The index is approaching critical zone.

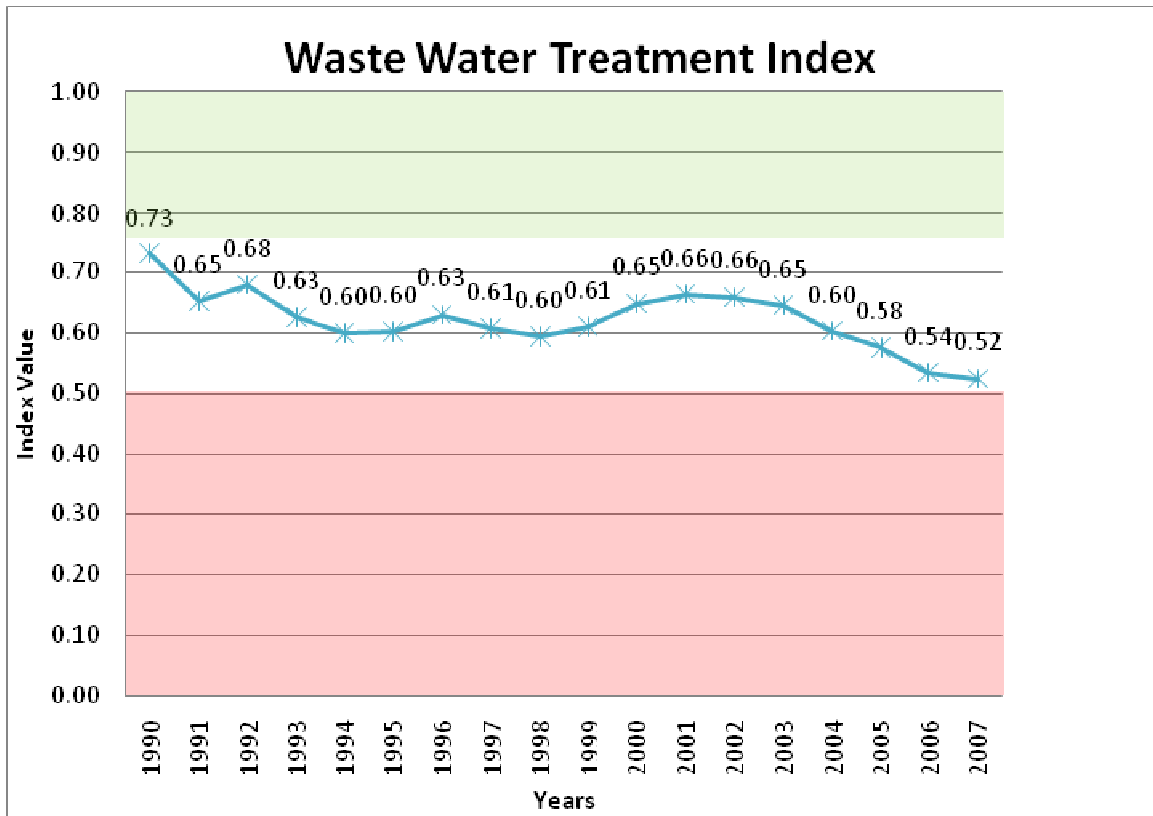


Figure 23. Waste Water Treatment Index (1990-2007)

6.2.7 Soil Mineral Fertilization Index(SMFI)

Objective

The Soil Mineral Fertilization Index represents the deviation of mineral fertilizers introduced to the agricultural productive soils from the optimum. It serves as indirect soil quality indicator (the worse the quality – the more mineral substances should be introduced to achieve the same yield). Excessive usage of mineral fertilizers imposes threat to environment and contributes to soil degradation. At the same time, decreasing amount of mineral fertilizers consumption causes depletion of nutrient substance and lowering the fertility of agricultural soils.

PSR Relevance

SMFI is pressure-state index.

OECD Relevance

Agricultural nutrient use, soil quality.

Method of computation

The method of SMFI calculation is targeted to show the fulfillment level of thresholds compared to the optimal fertilizers use as defined by Institute of Agronomy and Agrochemistry (Food and Agriculture Organisation of the United Nations, 2005, pp. 31-32).

$$SMFI = \begin{cases} \frac{SF_{actual}}{SF_{optimal}}, & \text{if } SF_{actual} < SF_{optimal} \\ 1.8 - \frac{SF_{actual}}{SF_{optimal}}, & \text{if } SF_{actual} > SF_{optimal} \end{cases},$$

where:

SMFI – Soil Mineral Fertilization Index;

SF_{actual} – actual average usage of mineral fertilizers, kg/ha of cropland;

$SF_{optimal}$ – optimal mineral fertilizer use for Ukraine, set as a reference, kg/ha of cropland. According to the Institute of Agronomy and Agrochemistry, the

annual need of Ukraine for mineral fertilizers in the 2002 to 2005 period was 4.4 million tones what corresponds to the $SF_{optimal} = 132$ kg/ha of cropland (Food and Agriculture Organisation of the United Nations, 2005, pp. 31-32) ;

the coefficient of 1.8 is introduced to the calculation for pushing the index value into acceptable or critical zones in case of over fertilization.

6.2.7.1 Comments and limitations

The SMFI values lie in the range from 0 to 1.

The index takes into consideration both deficits of mineral fertilizers introduced to the agricultural soils, which causes depletion of nutrients and over-fertilization resulting in soil contamination, salinization and threads to human and environment.

The index is designed to represent deviation of the average mineral fertilizer usage comparing to optimum. The critical threshold value $SMFI = 0.4$ is achieved when mineral fertilization input is 40% from calculated optimum or surplus of introduced fertilizers reaches the 40% over the optimum. Numerous agricultural studies show that fertilization input at the level of 140% from optimum still accepted for the short term, after surplus of 80% the situation is considered as environmental disaster. (Qiao F., 2006, p. 34)

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.8
- Optimal zone: 0.8 ... 1.0

6.2.7.2 Process of obtaining data

Data for 2003 – 2009 can be requested from the Ministry of Agrarian Policy, but exclusively by Ukrainian official governmental bodies.

The data available for free use for the period 1990-2002 is presented in the following figure and can be found in Table XX in Annex.

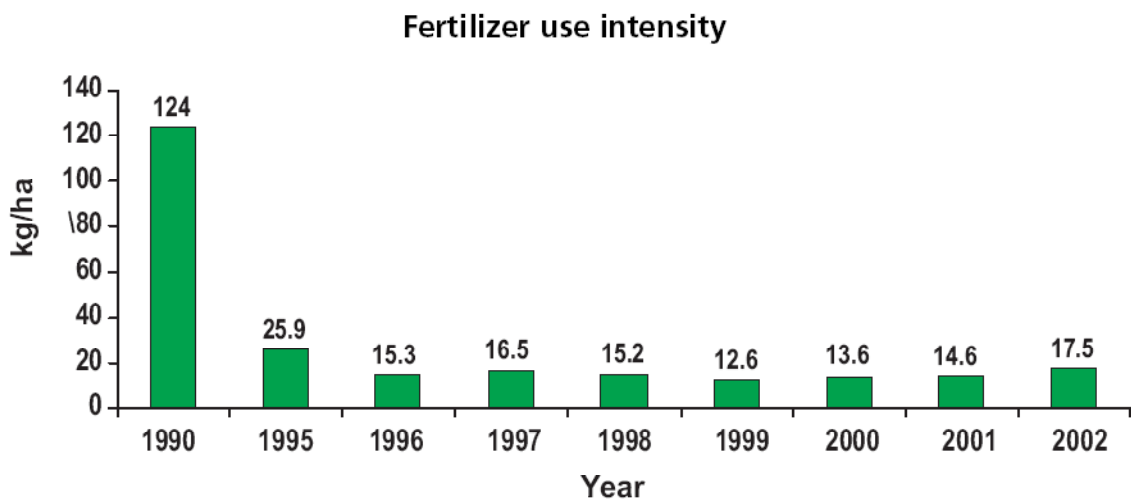


Figure 24. Fertilizer use intensity in Ukraine (1990-2002)
(Food and Agriculture Organisation of the United Nations, 2005, p. 30)

6.2.7.3 Estimates

During the last twenty years in Ukraine the significant decrease of mineral fertilizers use can be observed. According to the Institute of Agronomy and Agrochemistry, the annual need of Ukraine for mineral fertilizers is about 4.4 million tones. However, largely

because of the limited purchasing power of farmers, the total demand for all kinds of fertilizers averages about 1.2 million tones. The structure of agriculture inherited from the centrally planned system is being modified gradually, with increasing private ownership, but problems remain. As a result of the reduction in the application of fertilizers and manures, the quality of the land has deteriorated with negative nutrient balances, with a resulting increase in soil erosion and other forms of land degradation. (Food and Agriculture Organisation of the United Nations, 2005, pp. 31-32)

6.2.7.4 Discussion and AIS relevance

The importance of soil fertilization as an impact on arable lands and soils can be observed from the following data. Soil inspection undertaken in mid-1990s reveals that approximately 35,8% of arable land in the country is eroded, 25,46% has high pH level, 9,7% is saline and solonetz, and 8,9% is overwettered and muddy (State Statistics Committee of Ukraine, 2009a). On the other hand, as a result of protracted economic crisis owing in particular to the lack of circulating assets on farms, 1990s saw considerable reduction in use of mineral fertilizers, pesticides and other chemicals, which slowed the decrease in soils quality and intensified their rehabilitation in terms of maintaining natural fertility (Marchuk, E.K., 1995).

6.2.7.5 Visualization of calculated values

In the following figure 25, the calculated SMFI index values based on available data (1990 and 1995 – 2002 years), are presented. From the graph one can observe huge dropdown from 1990 to 2002, and continuous trend in critical zone. This is confirmed with national reports about soil fertility depletion. The situation requires immediate actions from the respective ministries for replenishing the soil with fertile substance.

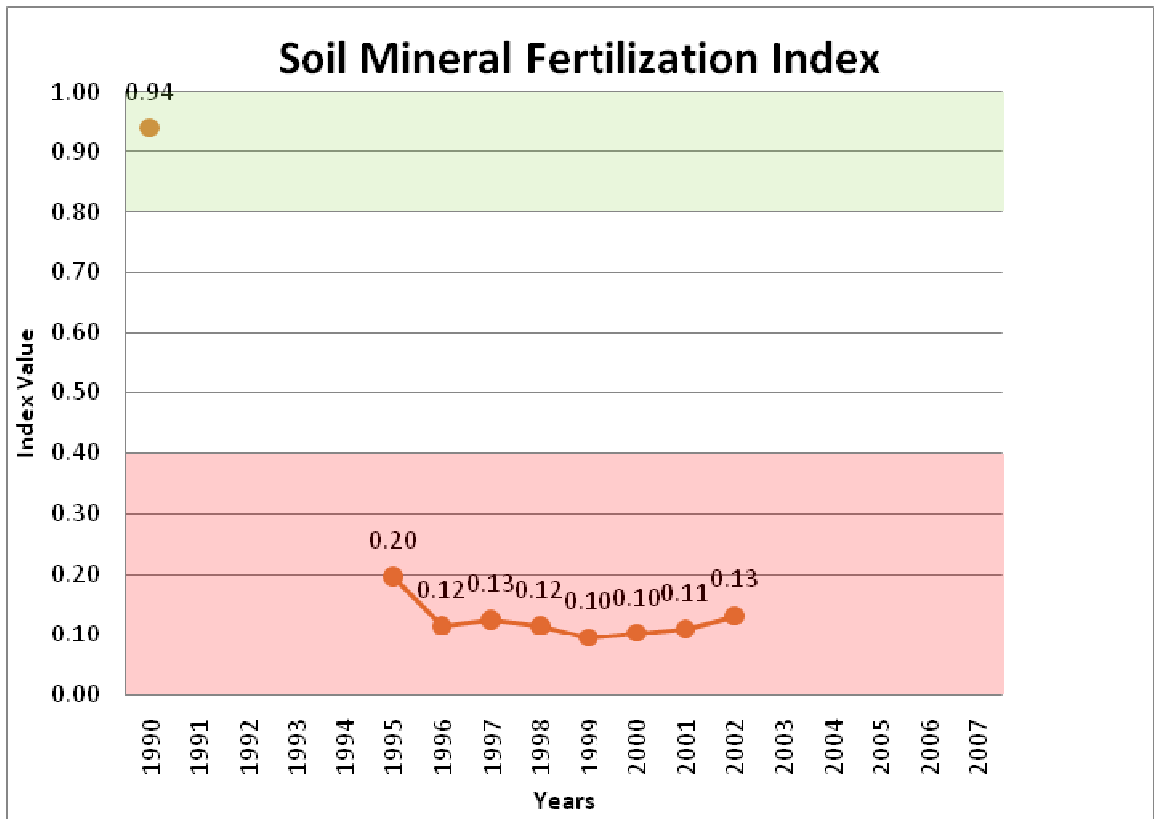


Figure 25. Soil Mineral Fertilization Index (1990, 1995-2002)

6.2.8 Pesticides Usage Index (PUI)

6.2.8.1 Objective

The Pesticides Usage Index represents the amount of pesticides introduced to the agricultural productive soils. It serves as environmental threat indicator. Excessive usage of pesticides imposes threat to environment and contributes to soil degradation. At the same time, decreasing amount of pesticides usage indicates shift towards sustainable and organic agriculture.

6.2.8.2 PSR Relevance

PUI is a pressure-state index.

OECD Relevance

Pesticide use, soil quality, water quality.

6.2.8.3 Method of computation

The method of PUI calculation is targeted to show the meeting the reduction level proposed to the European Parliament (European Parliament - Press Release: MEPs approve pesticides legislation, 2009).

$$PUI = 2 - \frac{PU_{actual}}{PU_{aimed}},$$

where:

PUI – Pesticides Usage Index;

PU_{actual} – the actual usage of pesticides, kg/ha;

PU_{aimed} – the 50% of pesticides consumption in 1992 (first year of Ukrainian independence denoted the highest level of pesticide use in Ukraine), according to European Parliament, kg/ha, which is set as a target.

6.2.8.4 Comments and limitations

If calculated index is less than zero, the PUI value is set to zero

If calculated index is greater than one, the PUI value is set to one

PUI values lie in the range from 0 to 1. If PUI value falls below 0, it's indicates the environmental disaster. According to the proposal introduced by Pesticide Action Network (PAN) to the European Parliament and best practice examples of EU, the consumption of the pesticides should be reduced by 50%. As Ukraine's policy is targeted towards integration into European Union, it's reliable to apply the same proposed guidelines for improvement.

The index is designed to represent deviation of the pesticide usage comparing to the level of 1992. The value $PUI = 1$ is achieved when $PU_{\text{actual}} = PU_{\text{aimed}}$.

The achievement of the pesticides use reduction by 20% compromisingly proposed by the Socialists to the European Parliament (Pesticide Action Network, 2007, p. 3) is set as minimum reduction level and corresponds to the $PUI=0.4$. Setting the threshold for optimal zone to 0.7 denotes the achievement of reduction by 35%.

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.7
- Optimal zone: 0.7 ... 1.0

6.2.8.5 Process of obtaining data

Official data can be requested from the Ministry of Agrarian Policy, but exclusively by Ukrainian official governmental bodies.

6.2.8.6 Estimates

The official trend for PUI shows the decrease of pesticides consumption in Ukraine during the last twenty years. This effect is explained mostly by the lack of financial resources in agricultural sector. However it has to be considered that, numerous cases of pesticides consumption could not be counted in state statistics since many farmers buying the pesticides from illegal sources and thus are not controlled.

6.2.8.7 Discussion and AIS relevance

Effective pesticide control system is absent in Ukrainian AIS. According to BAP the country is considered to be "dumping market" for illegal products (BAP, 2004)

According to FAOSTAT (Food and Agriculture Organization of the United Nations - Database, 2009), the consumption of pesticides in Ukraine in year 1992 was at the following levels:

Insecticides: 14245 tones
Herbicides: 35926 tones
Fungicides and bactericides: 16601 tones
Total: 66772 tones

Unfortunately, neither Ukraine nor European Union has strict quantitative standards and goals for the reduction of pesticide consumption. There are only the best practice examples of European agricultural practice in such countries as Denmark, Sweden and the Netherlands, where the goals for reduction of pesticides use were set to 50% and fulfilled almost completely.

6.2.9 Water Consumption Index (WCI)

6.2.9.1 Objective

Water shortage is considered a major barrier to agricultural production. The sustainable development of the agricultural sector implies decreasing of water usage. The Water Consumption Index represents efficiency of melioration as well as efficiency of water management policy in AIS.

6.2.9.2 PSR Relevance

WCI is a state-pressure index.

OECD Relevance

Agricultural water use.

6.2.9.3 Method of computation

$$WCI = \begin{cases} \frac{WC_{aimed}}{WC_{actual}}, & \text{if } WC_{aimed} < WC_{actual} \\ 1 & \text{if } WC_{aimed} \geq WC_{actual} \end{cases},$$

where:

WCI – Water Consumption Index;

WC_{actual} – the actual annual water consumption by AIS, m³/ha of irrigated area;

WC_{aimed} – the targeted annual water consumption by AIS, m³/ha of irrigated area.

WC_{aimed} – equals 0,4 x WC_{ref} is set by using the following methodology: the needed water consumption for 1 hectare consists of natural precipitations and artificial irrigation. WC_{aimed}

WC_{ref} = 26983 m³/ha of irrigated land. WC_{ref} is based on Table XV from Annex and calculated as average referenced use of water for irrigation purposes in Ukraine in 2000 – 2002.

6.2.9.4 Comments and limitations

According to the latest research in Ukrainian irrigation system management and water melioration systems it is possible to decrease water consumption in AIS up to 20% - 60% without reduction of production yields. Thus, it's viable to set these values for threshold levels.

WCI values lie in the range from 0 to 1.

The goal is to achieve $WC_{aimed} = 0,4 \times WC_{ref}$.

Acceptable zone is threshold is set to the referenced value of water consumption and thus - threshold value 0.4 denotes no reduction in water consumption compared to current value. Setting the threshold for optimal zone to 0.5 accepts that water consumption by AIS is reduced by 20%. The index value equals 1, when reduction of water consumption of 60% is achieved.

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.5
- Optimal zone: 0.5 ... 1.0

6.2.9.5 Process of obtaining data

The available data could be found in Table XV, Annex and are provided by the Food and Agriculture Organization of the United Nations Aquastat database.

6.2.9.6 Estimates

National University of Water Management and Nature Resources Use had defined in research on “Climatic optimal strategy of management and development of natural-irrigation complexes as natural-technogenic systems” that it is possible to improve existing poor situation of irrigation by 20% to 50%. (Національний університет водного господарства та природокористування, 2008) This reduction however requires initiation of national programme and funding.

6.2.9.7 Discussion and AIS relevance

Higher decrease of water consumption is encouraged, but attention should be paid on keeping the agricultural yields at least at the same levels. This could be monitored by values of such indices as API, GDPI and SFI which are vulnerable to the decrease of agricultural products.

6.2.10 Demographic Dynamics Index (DDI)

6.2.10.1 Objective

In order to reflect the quantitative changes of the population situation, the Demographic Dynamics Index is used. It shows the ratio of births to the total number of births and deaths. The goal set by Resolution N 879 from 24.06.2006 by Cabinet Council of Ukraine (Cabinet Council of Ukraine, 2006) defines the aimed level of population recovery to the 52 mio inhabitants - the level of 1991.

6.2.10.2 PSR Relevance

DDI is a pressure index.

6.2.10.3 OECD Relevance

Socio-cultural issues.

6.2.10.4

6.2.10.5 Method of computation

$$DDI = \frac{BE}{BE + DE},$$

where:

DDI – Demographic Dynamics Index;

BE – Amount of birth cases for a given period;

DE – Amount of death cases for a given period.

6.2.10.6 Comments and limitations

The goal of national population recover is to reach the level of 1991 - 52 mio inhabitants. DDI values can lie in the range from 0 to 1. The values of $DDI < 0.5$ indicate a demographical crisis in the country, e.g. death rate exceeds birth rate, the value of 0.6 indicates that birth/death ratio is 1,43 resulting in population recover to 52 mio in 20 years under level of deaths of 2008.

- Critical zone: 0.0 ... 0.5
- Acceptable zone: 0.5 ... 0.6
- Optimal zone: 0.6 ... 1.0

The proportion of rural population in Ukraine stays constant at the level 0.32, so the DDI representatively reflects the dynamics for rural population.

6.2.10.7 Process of obtaining data

Raw data are available from annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.10.8 Data availability

Available data represent annual statistical information for the period of 1990 – 2008. The statistic date can be found in Table XIII in Annex.

6.2.10.9 Discussion and AIS relevance

Demographic dynamic is very important issue for Ukraine. At 1991, when Ukraine became independent, the national population counted at the level of 52 millions, nowadays this number decreased to the level of 46 millions accompanied by the population aging. The trends and forecasts (Food and Agriculture Organization of the United Nations - Database, 2009) tells that in the next 20-25 years Ukrainian population will continue to decrease if complex stimulation of birth dynamic and further improvement of mortality rates will not be introduced.

6.2.10.10 Visualization of calculated values

In the following figure 26, the calculated DDI index values based on available data are presented. From the graph one can observe continuous negative trend with some improvements during last couple of years. Ukraine experiences demographic crisis - this could be confirmed by the fact that Ukrainian population had reduced from 52 mio inhabitants by 8 mio, and presents one of the worst European situation. The situation should be taken as critical and measures for recovering the national population must be introduced.

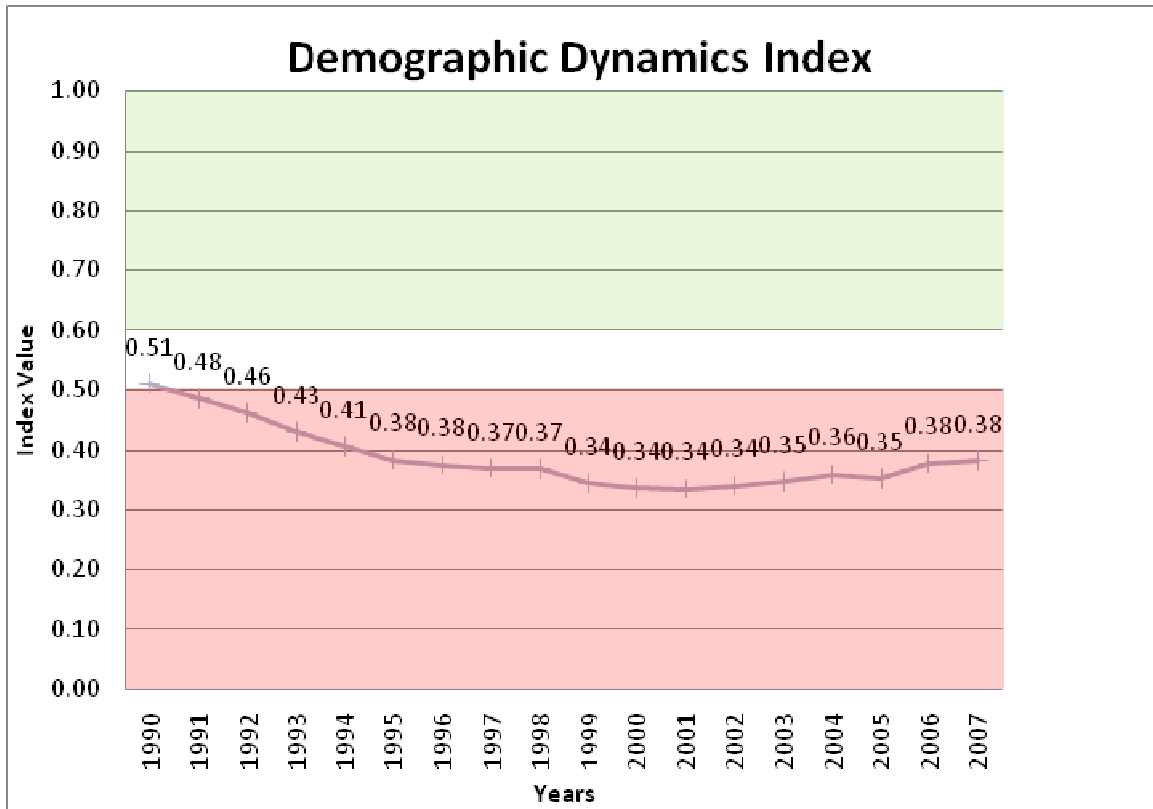


Figure 26. Demographic Dynamic Index (1990 - 2007)

6.2.11 Life Expectancy Index (LEI)

6.2.11.1 Objective

One of the main parameters for the estimation of the quality of life in the country is expectancy of life at birth.

6.2.11.2 PSR Relevance

LEI is a response - state index.

6.2.11.3 OECD Relevance

Socio-cultural issues.

6.2.11.4 Method of computation

$$LEI = \frac{LE_{\text{actual}} - LE_{\text{min}}}{LE_{\text{aimed}} - LE_{\text{min}}},$$

where:

LEI – Life Expectancy Index;

LE_{actual} – the actual average life expectancy at birth in the country;

LE_{min} – the minimal life expectancy at birth;

LE_{max} – the maximal life expectancy at birth.

6.2.11.5 Comments and limitations

LEI values lay in the range from 0 to 1, the higher the value, the higher the life expectancy at birth. The index aggregates the statistical data without differentiation by gender. The critical zone threshold of 0,4 corresponds to life expectancy at birth of 49 years, the optimal zone threshold of 0,8 corresponds to life expectancy at birth of 73 years, the index value 1 denotes the best case - 85 years .

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.8
- Optimal zone: 0.8 ... 1.0

6.2.11.6 Process of obtaining data

Raw data are available from annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.11.7 Data availability

The available data represent annual statistical information for the period of 1991 – 2006. The missing statistic data are extrapolated using linear regression. Data is presented in Table XIV in Annex

6.2.11.8 **Estimates**

According to the United Nations Development Programme (Human Development and Climate Change 2007/2008, p. 356):

- the minimal life expectancy at birth is set to 25 years, as defined by UNDP 2007;
- the maximal life expectancy at birth is set to 85 years (estimated world average value for 2050) as defined by UNDP 2007.

6.2.11.9 **Discussion and AIS relevance**

The life expectancy is key social factor for both rural and urban area. The importance for improving the life expectancy and living conditions in rural area is even more important since the statistic values for rural sector is lower, than in urban area, and the problem of population aging is also – an important issue for Ukrainian village (Institute for Demography and Social Studies of the NAS of Ukraine, 2007).

6.2.11.10 Visualization of calculated values

In the following figure 27, the calculated LEI index values based on available data are presented. From the graph one can observe continuous stable trend with some worsening of the life expectancy during 1993 - 1996. Afterwards situation is not changing since 1997.

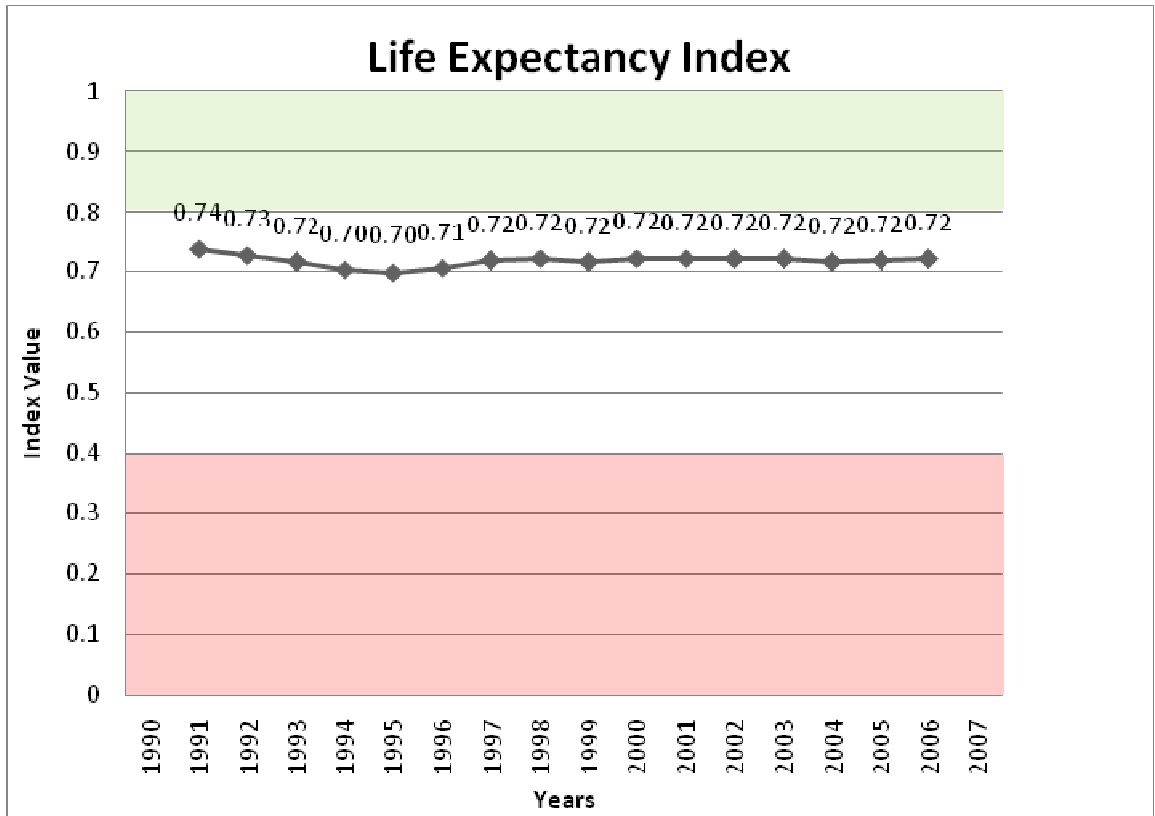


Figure 27. Life Expectancy Index (1991 - 2006)

6.2.12 Hospital Sufficiency Index (HSI)

6.2.12.1 Objective

Provision of the population with medical care facilities is an important parameter of the health development of the nation. The Hospital Sufficiency Index represents normalized coverage of the population by stationary places in hospitals (beds).

6.2.12.2 PSR Relevance

HSI is a state index.

6.2.12.3 OECD Relevance

Socio-cultural issues.

6.2.12.4 Method of computation

$$HSI = \frac{HP_{\text{actual}} - HP_{\text{min}}}{HP_{\text{aimed}} - HP_{\text{min}}},$$

where:

HSI – Hospital Sufficiency Index;

HP_{actual} – the actual amount of stationary hospital places, per 10,000 of population;

HP_{min} – the least possible amount of stationary hospital places, per 10,000 of population;

HP_{aimed} – the amount of stationary hospital places, per 10,000 of population, that is targeted for achievement.

6.2.12.5 Comments and limitations

HSI values lies in the range from 0 to 1, the higher the value, the better the coverage of the population. The critical-acceptable zone threshold value 0,25 denotes the minimal amount of hospital beds availability within Europe (Georgia counted 33 beds per 10 000 inhabitants (World Health Organisation, 2009, p. 99)), the optimal zone threshold value 0,5 shows situation, when average European beds coverage is exceeded (63 beds per 10 000 inhabitants (World Health Organisation, 2009, p. 99))

- Critical zone: 0.0 ... 0.25
- Acceptable zone: 0.25 ... 0.5
- Optimal zone: 0.5 ... 1.0

6.2.12.6 Process of obtaining data

Raw data are available from annual reports and on the portal of the State Statistical Committee of Ukraine.

6.2.12.7 Data availability

The data can be found in Table XIX in Annex. The given data represent annual statistical information for the period from Ukraine's last year as a Soviet republic 1990 to 2008.

6.2.12.8 Estimates

The least possible amount of stationary hospital places, per 10,000 of population, is assumed to be zero: $HP_{\min} = 0$. E.g. there are no hospitals in the country.

The value is targeted to achieve the level of 132 beds per 10,000 citizens – the Ukrainian level of 1990.

6.2.12.9 Discussion and AIS relevance

Hospital beds are used to indicate the availability of inpatient services. There is no global norm for the density of hospital beds in relation to total population. In the European Region, there are 63 hospital beds per 10 000 population compared with 10 per 10 000 in the African Region. Statistics on hospital bed density are generally drawn from routine administrative records but in some settings only public sector beds are included (World Health Organisation, 2009).

6.2.12.10 Visualization of calculated values

In the following figure 28, the calculated HSI index values based on available data are presented. From the graph one can observe continuous negative trend with crucial dropdown during 1994 - 1998. Although the index values lie in optimal zone, and Ukraine counts one of the best hospital sufficiency in Europe, the conditions in hospitals could be improved by providing modern medical care equipment.

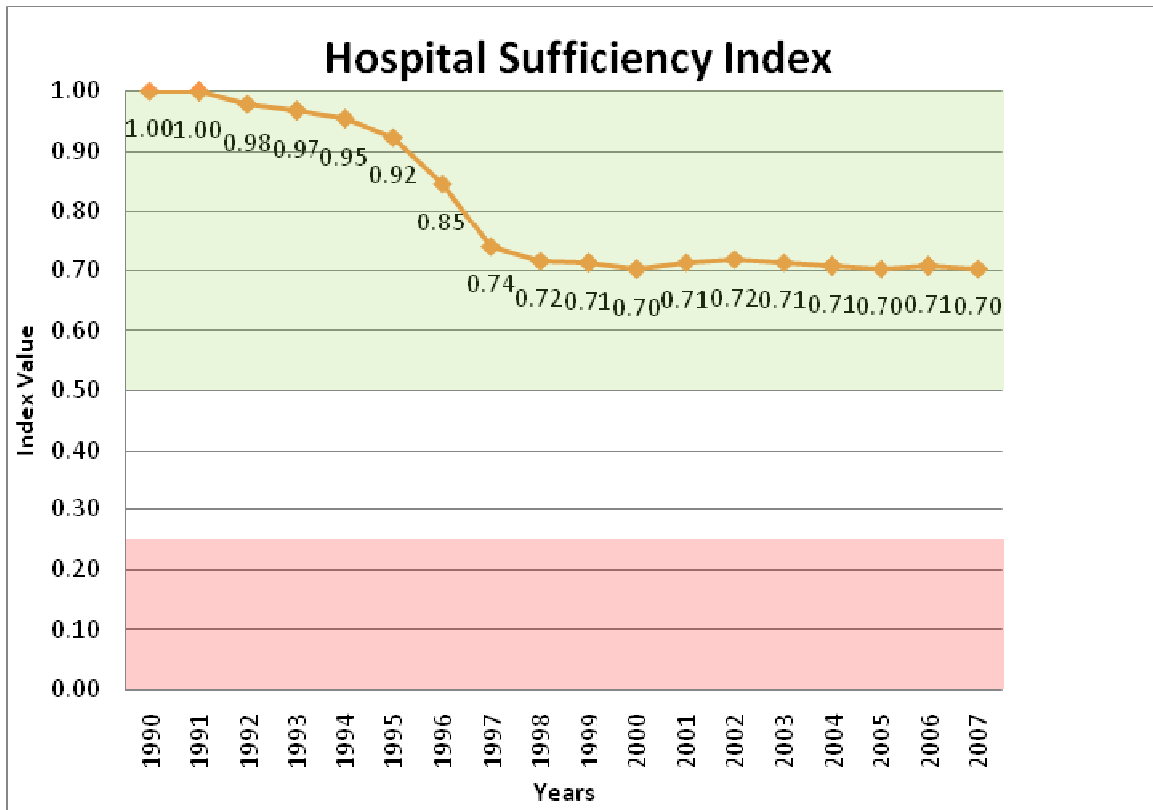


Figure 28. Hospital Sufficiency Index (1990-2007)

Based on the available statistical data gathered mainly from the Ukrainian State Statistic Committee and other listed sources, which could be also found in tables in Annex, and using the calculation methodology, which was described and explained in Chapters 6 and 6.1 and for each of twelve indices in relevant subchapters 6.2.1 – 6.2.12 the values of indices had been calculated and put in the table below. Due to the data lack, values for 10 time series were calculated and presented in the Table 5 “Calculated Indices for the period 1990-2007”. The values for SMFI and OAI are not complete due to the missing statistical data. Upon obtaining the additional information and data for the remaining two indices, detailed values can be recalculated, and the developed model will thus be elaborated and will provide more reliable interpretation. Data presented in Table 5 show summarized calculated values for the period from 1990 until 2007.

Table 5. Calculated Indices for the period 1990-2007

Years	Indices									
	GDPI	API	FSI	OAI	AGGEI	WWTI	SMFI	DDI	LEI	HSI
1990	0,583913	0,542353	0,795127	0,143763	0,5	0,731986	0,939394	0,510724	0,7179208	1,000000
1991	0,568422	0,519811	0,641271	0,152594	0,5382961	0,652605	0,444057	0,48497	0,7383333	0,997786
1992	0,550949	0,506338	0,686753	0,162391	0,5748754	0,679666	0,377267	0,461241	0,7278333	0,978598
1993	0,524776	0,508689	0,736009	0,172014	0,6039564	0,626106	0,320523	0,42911	0,7163333	0,966052
1994	0,48179	0,479185	0,56918	0,182318	0,655276	0,600003	0,272313	0,40549	0,7036667	0,954244
1995	0,461519	0,474108	0,62624	0,193061	0,6942627	0,601991	0,196212	0,383431	0,6988333	0,923247
1996	0,445272	0,458335	0,604105	0,204974	0,7524986	0,629954	0,115909	0,375593	0,706	0,845756
1997	0,441714	0,456213	0,627132	0,217701	0,7866903	0,608106	0,125	0,36982	0,718	0,739483
1998	0,4398	0,440119	0,531181	0,232111	0,8020127	0,595023	0,115152	0,36801	0,722	0,715867
1999	0,441034	0,429224	0,499644	0,247092	0,8178087	0,611085	0,095455	0,344913	0,7151667	0,712177
2000	0,452078	0,446066	0,558682	0,262366	0,8377682	0,648594	0,10303	0,336861	0,7221667	0,701107
2001	0,46838	0,463523	0,533349	0,277889	0,8266982	0,664015	0,110606	0,335383	0,722	0,712915
2002	0,478332	0,466445	0,559676	0,245762	0,8288639	0,659303	0,132576	0,341044	0,7206667	0,718081
2003	0,495119	0,449191	0,611094	0,358735	0,8515071	0,645342	0,14271	0,348041	0,7203333	0,712915
2004	0,515599	0,481337	0,600806	0,359432	0,8499482	0,603599	0,158612	0,359499	0,716	0,706273
2005	0,521321	0,483724	0,608008	0,362756	0,8530561	0,576552	0,176286	0,352703	0,7183333	0,702583
2006	0,534444	0,490264	0,566498	0,362924	0,8498002	0,535011	0,19593	0,377842	0,7208333	0,705535
2007	0,548222	0,48109	0,609612	0,374812	0,9451193	0,524679	0,217762	0,382567	0,7178916	0,702583

*The values of OAI (1990-2001), AGGEI (2007), SMFI (1991-1994; 2003-2007), LEI (1990, 2007) were obtained by exponential extrapolation

6.3 Top-level Indices

According to the results of methodological analysis, we define the following top-level indices.

6.3.1 Economic Development Index (EDI)

EDI is a summary measure of economic development. It can be used for measuring the achievements of the country in four dimensions:

- Gross domestic product index 6.2.1
- Agricultural production index 6.2.2
- Food sufficiency index 6.2.3
- Organic agriculture index 6.2.4

The Economic Development Index and its thresholds are calculated according to the methodology presented in sub-chapter 6.1.

The missing values for OAI had been obtained by exponential extrapolation

$$EDI = 1 - \sqrt[3]{\frac{1}{4}((1 - GDPI)^3 + (1 - API)^3 + (1 - FSI)^3 + (1 - OAI)^3)}$$

- Critical zone: 0.0 ... 0.4
- Acceptable zone: 0.4 ... 0.73
- Optimal zone: 0.73 ... 1.0

Figure 29 contains graphical representation of the EDI index for the years 1990-2007. The figure 29 illustrates EDI based on three available time series for GDPI, API, FSI and statistical and extrapolated data obtained for OAI.

6.3.1.1 Visualization of calculated values

Economic development index (Figure 29) reflects worsening of the situation in the first period of Ukrainian independence, which was caused by the industrial crisis and unstable processes in the post Soviet era. In the years 1994 - 1999 the index fallen to the critical zone. After 1999 the industrial and agricultural growth could be observed, which is confirmed by the increasing curve of the EDI, after introducing programme for organic agriculture in 2002, EDI curve's increase can be observed.

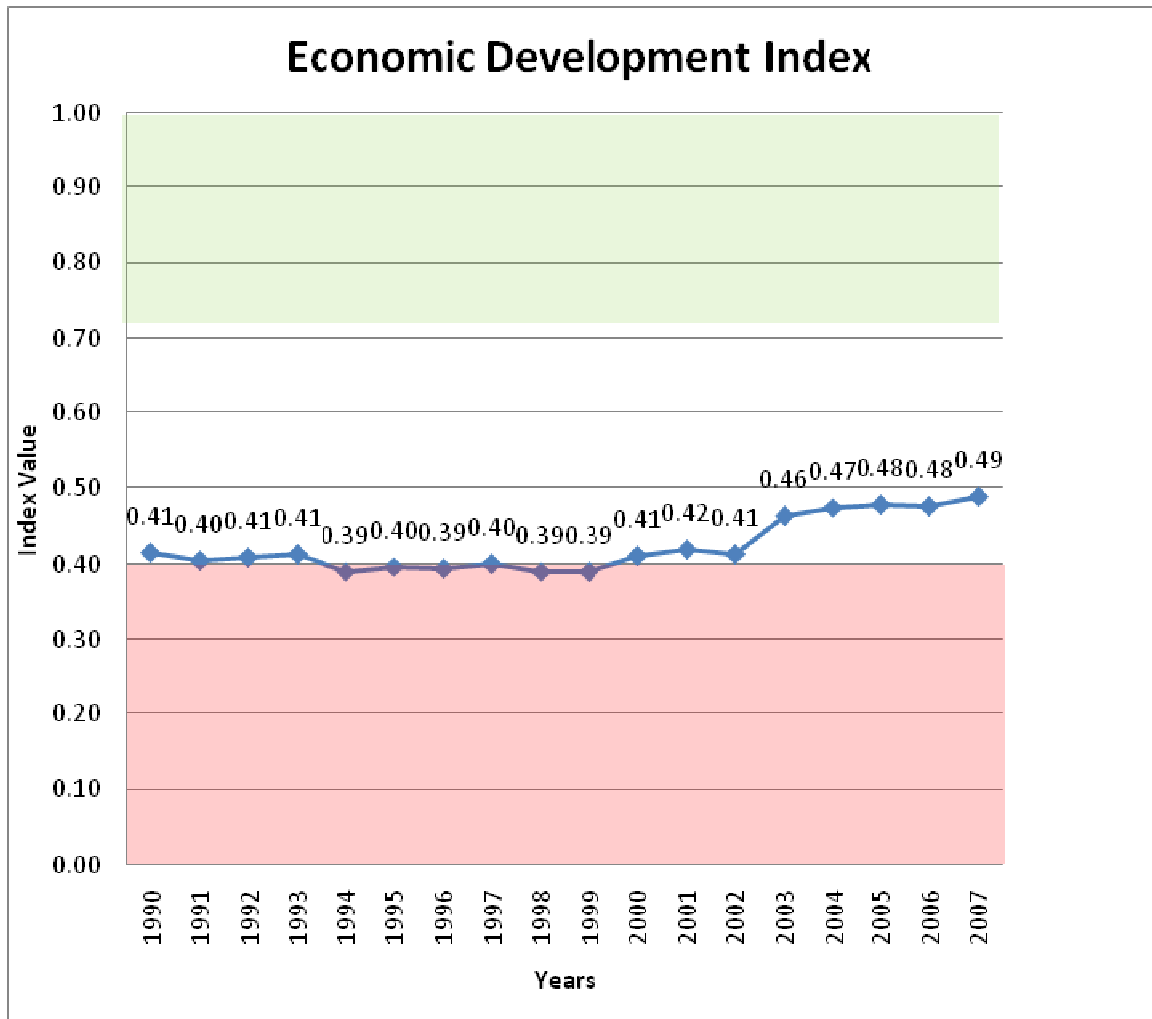


Figure 29. Economic Development Index (1990-2007)

6.3.2 Environmental Situation Index

ESI is a summary measure of environmental situation. It can be used for estimating the achievements of the country in the following dimensions.

- Greenhouse gas emissions from agricultural sources (AGGEI) 6.2.5
- Waste water treatment index (WWTI) 6.2.6
- Soil mineral fertilization index (SMFI) 6.2.7
- Pesticides usage index (PUI) 6.2.8
- Water consumption index (WCI) 6.2.9

The Economic Development Index and its thresholds are calculated according to the methodology presented in sub-chapter 6.1.

Due to the missing data for Pesticides usage index and Water consumption index these two indices are excluded from calculation. Upon condition of data availability they should be included in calculation.

The missing values for SMFI had been obtained by exponential interpolation

$$ESI = 1 - \sqrt[3]{\frac{1}{3}((1 - AGGEI)^3 + (1 - WWTI)^3 + (1 - SMFI)^3)}$$

- Critical zone: 0.0 ... 0.44
- Acceptable zone: 0.44 ... 0.73
- Optimal zone: 0.73 ... 1.0

6.3.2.1 Visualization of calculated values

Decreasing values of the Environmental situation index (Figure 30) in the 1990 – 1996 are explained by dramatic soil fertile substance depletion. Even crucial reduction of greenhouse gasses emissions as a result of industrial production's shortening caused by crisis could not push the index out critical zone. At the same time, positive effects of emissions reduction was also lowered by the worsening of waste water treatment. Since 1999 the index continues to grow, deviating in correlation with the current situation and loads, tending to the acceptable zone.

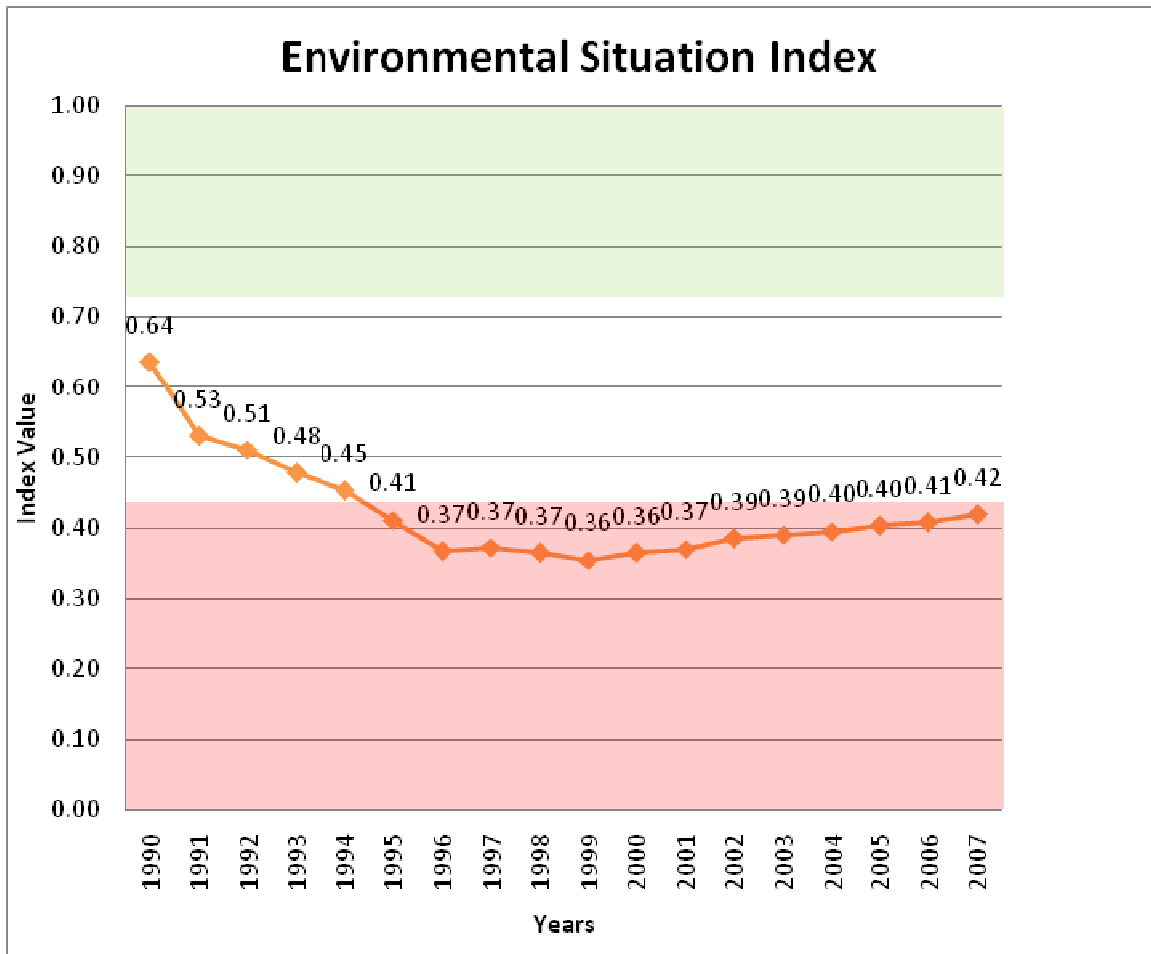


Figure 30. Environmental Situation Index (1990-2007)

6.3.3 Social Development Index

SDI is a summary measure of social development. It can be used for measuring the achievements of the country in four dimensions.

- Demographical dynamics index (DDI) 6.2.10
- Life expectancy index (LEI) 6.2.11
- Hospital sufficiency index (HSI) 6.2.12

The Social Development Index and its thresholds are calculated according to the methodology presented in sub-chapter 6.1.

$$SDI = 1 - \sqrt[3]{\frac{1}{3}((1 - DDI)^3 + (1 - LEI)^3 + (1 - HSI)^3)}$$

- Critical zone: 0.0 ... 0.41
- Acceptable zone: 0.41 ... 0.66
- Optimal zone: 0.66... 1.0

6.3.3.1 Visualization of calculated values

The Social Development Index curve (Figure 31) decrease in 1991-1999 can be explained by the lowering of life expectancy, demographic crisis caused by low birth rate, decreasing the hospital bed availability, particularly in rural areas. In the period from 2000 until 2003 the situation became more stable. Since 2004 the social sector has been steadily developing, from 2005 and until now, we can observe slow, but positive progress.

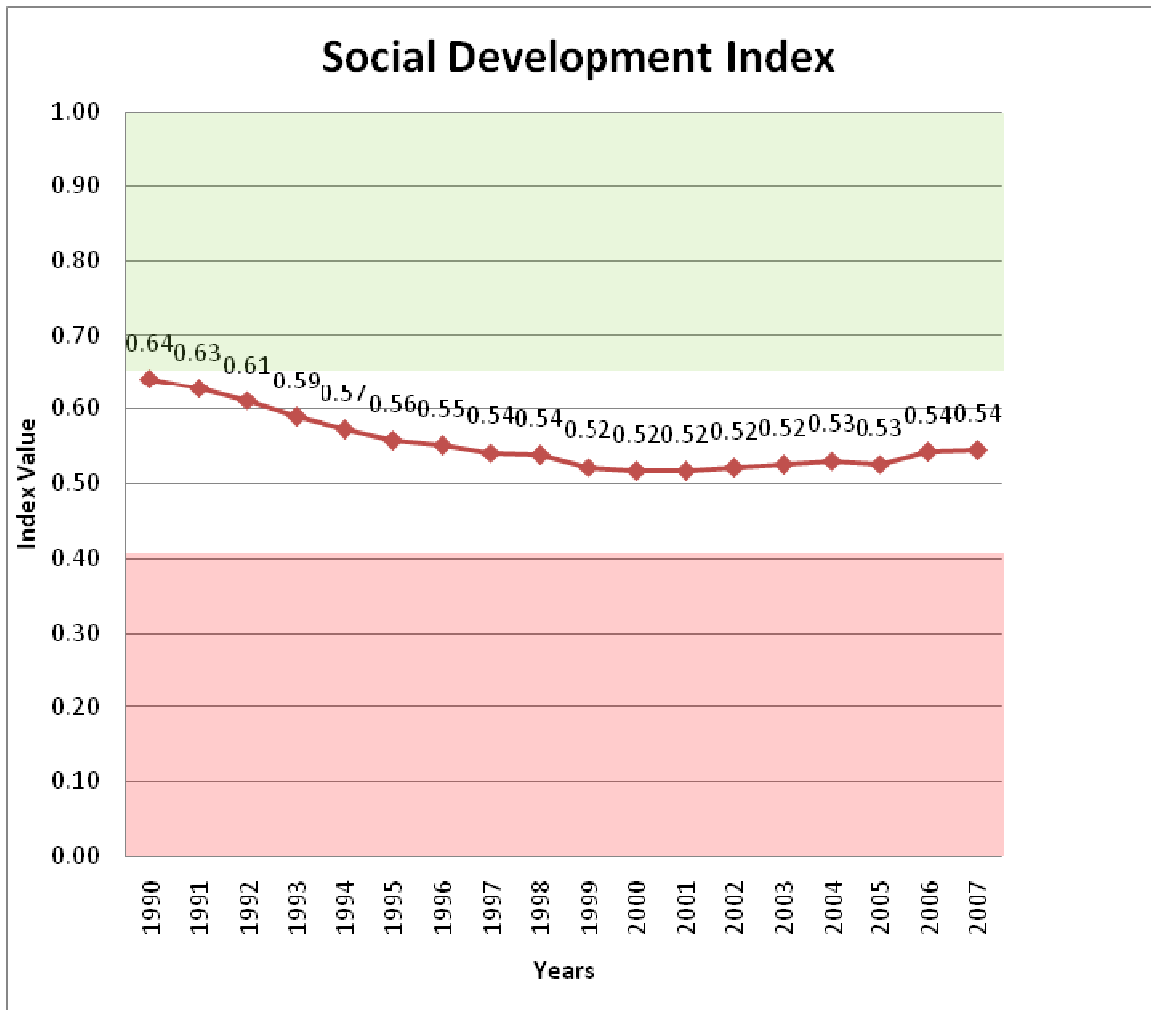


Figure 31. Social Development Index (1990-2007)

The described three top-level indices are calculated and represented in the table 6.

Table 6. Top-level indices, calculated for Ukraine (1990-2007)

Year	Top-level Indices		
	EDI	ESI	SDI
1990	0,414168	0,636177	0,640339
1991	0,404245	0,529646	0,627924
1992	0,408154	0,510811	0,611030
1993	0,412298	0,477435	0,588575
1994	0,390185	0,453263	0,571373
1995	0,396494	0,411665	0,556239
1996	0,393092	0,368127	0,550465
1997	0,399674	0,372904	0,540862
1998	0,390176	0,365321	0,537473
1999	0,388940	0,355009	0,521791
2000	0,409940	0,364675	0,516178
2001	0,419416	0,370975	0,516675
2002	0,413181	0,385175	0,520696
2003	0,463314	0,390896	0,524442
2004	0,474748	0,395919	0,530232
2005	0,478812	0,403104	0,525812
2006	0,476647	0,407570	0,542053
2007	0,488343	0,419714	0,544169

From Figure 32 we can observe the dynamics of indices describing the situation in Ukraine represented by the economic, environmental and social components. There are not thresholds on the graph, since it serves for the index dynamics overview.

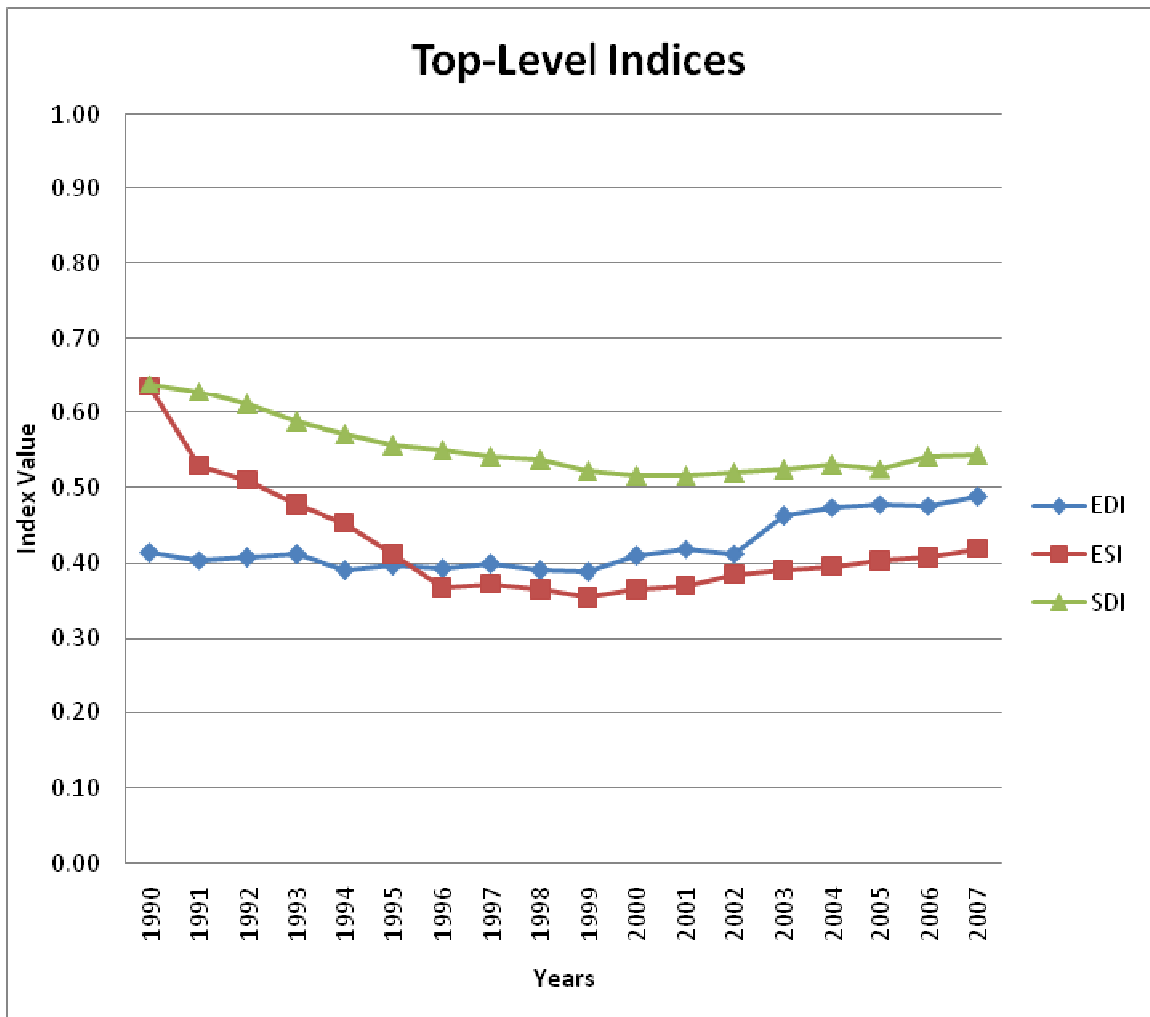


Figure 32. Dynamics of the top-level indices for Ukraine (1990-2007)

7 Conclusions and Recommendations

As it can be observed from the materials of this research, Ukraine as a state, since gaining independence in 1991, has been undergoing major transformations, social, economic and political. These transformations affected the Ukrainian society in a multitude of ways; they set into action the process of reformation of the state, industrial, agricultural, private and other sectors towards entering the global market in the capacity of a new, strong and independent partner.

Alongside substantial positive changes, the importance of which is not to be underestimated, the overall success of these actions proved to be rather limited, particularly with regards to reforms in the agro-industrial sector, which represents the focus of the given work.

Reasons for the many obvious strategic miscalculations are diverse. However, it is safe to say that the most distinctive of them is lack of flexibility, and above all competence, among ministry officials and regional decision-makers with regards to problems under their jurisdiction. They often do not have sufficient knowledge as to specific numbers, data and ways of assessing existing circumstances, which results into limited effectiveness of their – even well-intentioned – actions. Acknowledging this deficiency, the author has conducted a thorough analysis of both historic background and current conditions in Ukrainian AIS and has developed, based on the available experience and methodology of the OECD PSR approach, UNDP methodology and SEA, a set of indices that will help to provide analytical information for governmental and regional policy-makers as to the current state and changes in the conditions of environment in agriculture; help responsible ministers and other policy-makers to clearly understand the linkages between the causes and effects of the impact of agriculture and agricultural policy on the economic, environmental and social aspects, and guide their responses aimed at controlling and improving the existing situation; as well as contribute to monitoring and evaluation of the effectiveness of policies in promoting sustainable development for AIS.

This set of indices was based on (but not limited to) the so-called Driving Force-State-Response (DSR) framework developed by OECD, which takes into account the specific characteristics of agriculture and its relation to the environment, the consideration of agriculture in the broader context of sustainable development with the view of fostering sustainable development strategies and reaching a clearer understanding of the linkages between the economy, society and the environment, with major priorities being nutrient use, pesticide use, water use, land use and conservation, soil quality, water quality, greenhouse gases, biodiversity, wildlife habitats, landscape, farm management, farm financial resources, and socio-cultural issues.

In order to adapt the above-mentioned framework to specific conditions with regards to Ukrainian agriculture, the author has conducted a multilateral analysis of the current situation in Ukrainian AIS and identified the driving forces, pressures and causes of existing conditions. It was concluded that the main reasons, which caused continuous crisis in the Ukrainian AIS have been fallibility of the normative/legislative base for AIS development compiled in the mid-90s; slow rates of land and property relations reformation; ineffectiveness of collective property, bankruptcy of state sector farms due

to breach of state funding; wrong tax policy and crediting overpressure on agriculture producers; absence of land market and producers' rights to dispose their land at their own discretion; underestimation of theoretic and practice experience gained by other countries with economies in transition; disregard of necessity for positioning agriculture as one of the leading sectors of Ukrainian economy; and unattractiveness of investment climate in Ukraine, imperfection of tax system for foreign companies.

It is therefore recommended that, in order to meet escalating world food needs, sustainable intensification of agro-production is needed, with priority setting on the key areas of agricultural technology, institutional support, and policy making, at all levels from local to global, and shift from a focus on growth to a focus on social equity and environmental improvement. This fundamental change will require commitment to basing development programmes on a flexible approach that recognizes the complex and unpredictable process of dealing with agroecological systems, and with the individuals and communities that are directly involved in managing these systems.

An overview of crucial changes, which took place in Ukraine during transition period was given, and the guiding principles of Ukrainian agrarian reform were formulated. From the above-mentioned analysis, it can be concluded reformation of the AIS has led to the introduction of new legal and organizational forms of management in rural areas. It did not, however, solve all the problems standing in the way of improved agro-production, rural population's welfare and general sustainable development at Ukrainian farms.

It is clear that without the introduction of an agricultural growth strategy based on enhancing the efficiency of the AIS, the agricultural sector will continue to stagnate. At the same time, medium-term improvements in the quality of rural life are essential in order to give the agrarian reform the necessary credibility and political support.

The reform brought about a number of visible advantages, basic among which being demonopolization of agriculture, its orientation not only on home but also on foreign market; gradual formation of free land market, land-lease relations development; civilized infrastructure of agrarian market formation (including commodity exchanges, wholesale markets, agro-trade houses, fairs, trade enterprises, auctions, etc.); providing producers with a freedom of choice as for forms of property, production, realization, incomes distribution and just fees for their work; additional credits and investments in new technologies; and a more effective flexible state support of agriculture. Leasing and rent markets for agricultural lands reacted fast and began to adequately create a new kind of profit for rural population. Rental payments per annum for an average land parcel remain low, but provide the equivalent of about two and a half months wages for an agricultural worker. There are also signs that large farm enterprises, which still control most of the agricultural land in Ukraine through leases, are becoming more profitable and are responding more quickly to changes in market conditions as a result of optimized ownership structures.

However, the agrarian reform still has to be enhanced in terms of simultaneous implementation of an agricultural growth strategy and a rural development strategy. In this respect, key reform area must include trade policies (including free export), transport, storage, infrastructure of market information and agricultural statistics, institutional

framework for land market, access to finance and risk management instruments, research and vocational training of agricultural specialists and farm managers, as well as veterinary and food safety control system.

One of the major problems with the land reform and farm restructuring process thus far has been the slow pace of non-land asset distribution (e.g. machinery), which has resulted in concentration of the primary means of production in the hands of small groups of former collective farm insiders. In the short run this has had the effect of limiting the pool of potential land renters and placing downward pressure on land rental prices, which the government has regulated through a mandatory floor price. In the longer run it creates the risk of distorted wealth and power structures in rural areas that can result in a rapid concentration of land ownership, with negative social and economic consequences. One of the first priorities for the government over the next three to five years should be to complete the process of land parcel demarcation. In carrying out this task government policy will need to prevent rapid consolidation of land in the hands of a small number of individuals or over-fragmentation of farm operating units into sizes that are not viable.

The Department of reformation of the AIS is therefore to continuously create and improve a qualitatively new strategy and methods of agrarian land reform and further development of agriculture; take further measures aimed at increasing the level of profitability of agricultural production by means of creating and developing AIS advisory services and coordinating their work; provide the implementation of sustainable land use policy; and secure effective monitoring of the agrarian reform.

Apart from the mentioned reform, the Ministry of Agrarian Policy (MAP) of Ukraine has prepared an advanced draft of a national program for the 'Agro-industrial Sector and Development of Rural Areas' that is to run until 2015. The program entitled to make a significant contribution to increased sectoral competitiveness in the AIS and reduce rural/urban disparities, by enhancing rural development, enforcing competitiveness of Ukrainian agriculture, including quality and safety issues, and ensure better natural resource management and environmental sustainability by stimulating agriculture production growth and GDP; providing people with domestic food; demonopolizing and decentralizing the agrarian sector; developing the new infrastructure; creating more attractive conditions for foreign investors; forming the free land market and develop land-lease relations; matching Ukrainian agricultural products to European standards and quality requirements; increasing credits and investments in new technologies; providing producers with a freedom of choice; increasing state support of agriculture; raising agro-produce export; enhancing the quality of agro-produce; and stabilizing the AIS and make it insensitive to disturbances.

Apart from this, the concept for sustainable agriculture was elaborated and presented by the Ministry of Agrarian Policy of Ukraine in cooperation with the Ministry of Nature and Environmental Protection and the Ministry of Economic development and European Integration, in the framework of which it was decided that organic agriculture would be a perfect solution to current agricultural crisis, since it puts very low pressure on soils and environment, provides farmers with the possibility to avoid usage of harmful and as a rule expensive pesticides and fertilizers and in the end effect produce healthy, natural agricultural products not only valuable for Ukrainian population, but also in high demand at the European and world markets.

Despite all the good intentions, it has to be mentioned, however, that the development of organic production in Ukraine has been extremely slow and asymmetric in the past years owing to the general incompleteness of legal and normative basis and the government's inability to strictly define the state policy in the field of organic production, create necessary conditions for organic products' legal recognition and protection, form the national certification system, set relevant rules and standards. State support and stimulation system for organic farms development remains very scarce, and domination of export and underdevelopment of home market and consumption of certified organic products and organic food persists.

On top of this, only one or two types of organic raw agricultural products, corns and oil, are predominantly produced and exported, while production of other crops still stands on a very low level. Production of organic cattle is still non-existing. The processing industry for organic agriculture is not developed.

Finally, mostly large agricultural enterprises are involved in organic production; transition among small and medium enterprises is rather limited.

All the above-mentioned deficiencies of the state policy towards the development of organic agriculture are, however, easy to overcome, provided that the government pays them due attention. It has to be kept in mind that due to protracted economic crisis owing in particular to the lack of circulating assets on farms, the last decade of the 20th century saw considerable reduction in use of mineral fertilizers, pesticides and other chemicals, which slowed the decrease in soils quality and intensified their rehabilitation in terms of maintaining natural fertility, thus resulting in the emergence of large areas of arable land filled with ecologically clean black soils that are perfect for organic farming, should the MAP conduct a comprehensive research in order to identify them and offer their owners supportive measures, such as state subsidies, lower taxation of organic production, assistance in conversion to organic farming and carrying out respective certification.

Formation of sustainable internal market of organic and bio-products is essential. What it mainly requires is strengthening of the national system of organic guarantees, stimulating interest for such products and making "bio-label" trendy. Farmers' attention needs to be brought to potential advantages such as economic, social (e.g. health protection) and ecologic and to intensifying, by raising public awareness, the consumption of organic agricultural products. All this is only possible on the condition that the state act as a guarantor for those who decide to switch to organic farming by certifying their products and providing them with adequate product markets. Apart from this, legislation, standardization and certification systems must be aimed at setting up an international equivalent system of organic guarantees for export of bio-products from Ukraine.

Another field demanding urgent elaboration with regards to Ukrainian AIS is the implementation of SEA procedure, adapted to country-specific demands and taking into consideration the history of traditional decision-making and implementation processes that had been historically practised in Ukraine while it was part of the USSR, without referring to which understanding of the existing and possible obstacles that can block SEA procedures is not possible.

Analysis shows that prototype environmental assessment procedures existed in the USSR since the 1970s. Some of them included SEA elements, which were basically represented by planning rules and regulations (such as standards and procedures for conducting site investigation and obtaining necessary permits); expert review procedures (carried out by the special expert committees of appropriate ministries and acting as a co-ordination and control mechanism, which addressed environmental aspects of planned activities); and the system of environmental planning called “Territorial Integrated Schemes of Nature Protection” addressing environmental issues at a more general strategic level. In order to overcome these hindrances, in the mid-1980s, a system of State Environmental Expert Reviews was introduced, which aimed at expanding the range of environmental assessment procedures to the extent that would cover all environmentally significant activities at both project and strategic levels. The innovations, however, did not result in any considerable improvements, and the situation remained unchangeable until the early 1990s, when the so-called OVOS (Assessment of Environmental Impacts) based on outdated – and essentially ambiguous – pro-Soviet understanding of sustainability was implemented as a mandatory procedure for all project developers, followed by the system of Ecological Expertise (EE) representing a set of more dynamic and up-to-date regulatory measures and aiming at preparing the conclusions as to the conformity of the planned or the running activities to the norms and requirements of the legislation on environmental protection, rational use and recreation of natural resources, and provision of ecological safety. EE conclusions have the status of recommendation and are expected to be taken into consideration by State Ecological Expertise (SEE) in the process of decision making about further realization of the examined project.

The legal base for SEA procedures in Ukraine has not yet been developed in the national legislation system. A major hindrance in the way of introduction of such system lies in the challenge of stepping away from this long-lasting system and introducing something qualitatively new and appropriate for current conditions of the country’s development. It is needless to say that this process demands considerable financial and mental effort on the part of agrarian researchers and decision-makers. A much easier option is to resort to copying western countries’ environmental policies and trying to impose them in the Ukrainian setting, which to a large degree differs from that of the Western Europe. Combined with the fact that these newly introduced policies persistently continue to be based on old methodologies and standards and that the majority of governmental decision-makers in the field of environment are representatives of the “old school” lacking flexibility and not infrequently hostile to innovations, it becomes obvious that today’s environmental assessment in Ukraine is inconsistent and inappropriate for the existing conditions.

It is therefore crucial that a legislative basis specifically suitable for SEA in Ukraine be developed by the law-makers, where SEA will be introduced into the state legal system at all levels and where more representatives of the newly formed ecological NGOs – in other words, young, progressive professionals, whose philosophy and education have nothing to do with the Soviet system – will be given more authority.

Public participation should be introduced at the early stages of assessment. This will benefit both project developers and those carrying out the assessment, and enable the vast public to feel involved in the decision-making process at strategic level.

Four main levels of SEA implementation in Ukraine should include the ministerial level (the Ministry of Environment and Nature Protection of Ukraine) at which the elaboration of the legislative background and regulations for the SEA and the development of mechanism for SEA application in Ukrainian environmental policy shall be carried out; the level of local authorities, responsible for the creation of a specific department responsible for regulating transition to sustainable agriculture; the level of environmental NGOs that shall provide informational resources and services, as well as organize round tables, training courses on sustainable development and SEA, debates and other public participation activities; and the level of environmental faculties of Ukrainian universities that shall provide academic support in the form of special courses on SEA in Ukraine and research in other countries, ensure participation in projects connected with transition to sustainable development for students, and introduce extension part-time courses and seminars for administrative employees of the environmental branch aimed at raising their competence level.

All this will provide governmental departments and relevant agencies with both exhaustive information regarding the optimal strategies of SEA implementation and adequately skilled personnel for putting these strategies into action.

Also important is that Ukrainian environmental legislation be harmonized with that of the European Union. Since Ukraine strives to integrate into the EU, it would offer more opportunities for the implementation of international projects and ease the bureaucratic protractations.

The set of top level indices based upon three main categories of indices – economic, environmental and social – offered by the author is intended to provide analytical information for governmental and regional policy-makers as to the current state and changes in the conditions of environment in agriculture; help responsible ministers and other policy-makers to clearly understand the linkages between the causes and effects of the impact of agriculture and agricultural policy on the environment, and guide their responses aimed at controlling and improving the existing situation; and thus contribute to monitoring and evaluation of the effectiveness of policies in promoting sustainable development and agriculture.

With the help of combining OECD, PSR, HDI and SEA methodologies it became possible to aggregate three top-level indices (*Economic Development Index, Environmental Situation Index and Social Development Index*) offering a comprehensive picture of development of Ukrainian agricultural parameters since the launch of the agrarian reform. The resulting mathematical calculation methodology is intended as a guide for calculating both these and any other set of initial data, indicators and indices, should this be considered necessary by responsible bodies and decision-makers.

In light of the above-mentioned recommendations, present research aims at equipping decision-makers with both retrospective analysis of Ukrainian agricultural development and a critical review of current policies. The author shall file this research to the Ministry of Environment and Nature Protection of Ukraine, the Ministry of Agrarian Policy of Ukraine and shall distribute it among other interested government officials and representatives of ecologic NGOs. Hard copies of the work shall also be submitted to the libraries of Brandenburg University of Technology, Cottbus, the National Mining

University of Ukraine and the Agrarian University of Dniepropetrovsk, where they will be made available both internally, among students and teaching staff, and externally, to all interested parties and individuals.

Being based on the available government reports and official statistical data, which are at present incomplete and lacking integrity, the developed set of indices has its obvious limitations. It is planned, however, that with the elaboration of statistical databases and enhancement of state reporting system, it will soon be possible to complement the suggested model with additional initial data, in which case it will become more exhaustive and will thus gain additional credibility. This is regarded by the author as a future challenge and a potential for further research to be carried out in close cooperation with the responsible ministries.

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Annex. Statistical Data

**Table I: The number of the actual population (as of July 1, 2008)
(All-Ukrainian population census, 2008)**

	Total population	urban	rural
Ukraine	46221981	31592115	14629866
Autonomous Republic of Crimea	1967845	1238211	729634
Vinnitsia region	1665179	811620	853559
Volyn' region	1035935	531257	504678
Dnipropetrovsk region	3383816	2824061	559755
Donetsk region	4516627	4085107	431520
Zhytomyr region	1299401	745486	553915
Zakarpattia region	1241939	461035	780904
Zaporizhzhia region	1825744	1398963	426781
Ivano-Frankivsk region	1381265	593434	787831
Kyiv region	1732082	1048833	683249
Kirovohrad region	1033289	634485	398804
Luhans'k region	2342720	2027867	314853
L'viv region	2553567	1545076	1008491
Mykolaiv region	1198776	810088	388688
Odesa region	2391190	1588964	802226
Poltava region	1517797	917732	917732
Rivne region	1150790	547299	603491
Sumy region	1190002	794108	395894
Ternopil' region	1095612	473796	621816
Kharkiv region	2784042	2218997	565045
Kherson region	1102991	673568	429423
Khmel'nyts'kyi region	1345454	722034	623420
Cherkasy region	1309825	728319	581506
Chernivtsi region	583513	375285	528146
Chernihiv region	1128277	695105	433172
The city of Kyiv	2745006	2745006	none
Sevastopol' (city council)	379379	356379	23000

Table II: Gross domestic product (1990-2007)

(State Statistics Committee of Ukraine, 2009b)

Year	At current prices		Volume indices			Deflators	At prices of 2008*
	gross domestic product	gross domestic product per capita	gross domestic product	gross domestic product per capita	gross domestic product	gross domestic product	gross domestic product per capita
	bln KRB	ths KRB	percent of the previous year		percent of 1990	percent of the previous year	UAH
1	2	3	4	5	6	7	8
1990	167	3					24799.3
1991	299	6	91.3	91.1	91.3	196.2	22601.1
1992	5033	97	90.1	89.8	82.3	1866.0	20354.6
1993	148273	2842	85.8	85.7	70.6	3435.4	17400.4
1994	1203769	23184	77.1	77.4	54.4	1053.5	13449.5
1995	5451642	105793	87.8	88.5	47.8	515.5	11911.4
	mio. UAH	UAH	percent of the previous year		percent of 1990	percent of the previous year	
1996	81519	1595	90.0	90.7	43.0	166.2	10806.5
1997	93365	1842	97.0	97.8	41.7	118.1	10578.6
1998	102593	2040	98.1	98.8	40.9	112.1	10457.9
1999	130442	2614	99.8	100.6	40.8	127.3	10535.6
2000	170070	3436	105.9	106.7	43.2	123.1	11256.3
2001	204190	4195	109.2	111.1	47.2	109.9	12411.2
2002	225810	4685	105.2	106.3	49.7	105.1	13173.7
2003	267344	5591	109.6	110.5	54.4	108.0	14567.7
2004	345113	7273	112.1	113.0	61.0	115.1	16469.5
2005	441452	9372	102.7	103.5	62.7	124.5	17044.0
2006	544153	11630	107.3	108.1	67.3	114.8	18438.2
2007	720731	15496	107.9	108.6	72.6	122.7	20024.7

* The values were calculated on the basis of gross domestic product per capita (column 2) and Deflators (column 7). After the monetary reform of 1996, the Karbovantsy were replaced by Ukrainian Hryvnya (100,000 KRB = 1 UAH).

Table III: Greenhouse Gasses Emissions (1990-2006)

(United Nations, 2006, pp. 5, 104), (Bereznitskaya, M.V., Butrim, O.V., Panchenko, G.G., Pirozhenko, Y.V., Habatyk, A.P., 2008, pp. 5, 101)

Year	Total GHG emissions (equivalent of mln t. CO₂)	GHG emissions from agricultural sources (equivalent of mln t. CO₂)
1990	925.38	101.355
1991	809.18	93.592
1992	712.6	86.177
1993	640.81	80.282
1994	575.15	69.879
1995	521.17	61.976
1996	472.75	50.171
1997	451.46	43.24
1998	410.08	40.134
1999	408.05	36.932
2000	395.1	32.886
2001	398.97	35.13
2002	400.5	34.691
2003	416.03	30.101
2004	413.42	30.417
2005	425.67	29.787
2006	443.18	30.447

Table IV. Sown area of main agricultural crops (ths of ha) (1990-2008)
 (State Statistics Committee of Ukraine, 2009d)

	grain and leguminous crops	sugar beet (factory)	sunflower	potatoes	vegetables grown in the open	fodder crops
1990	14583	1607	1636	1429	456	11999
1991	14671	1558	1601	1533	477	11555
1992	13903	1498	1641	1702	500	11707
1993	14305	1530	1637	1552	474	11287
1994	13527	1485	1784	1532	457	11881
1995	14152	1475	2020	1532	503	10898
1996	13248	1359	2107	1547	476	11026
1997	15051	1104	2065	1579	480	9720
1998	13718	1017	2531	1513	459	9236
1999	13154	1022	2889	1552	497	8653
2000	13646	856	2943	1629	538	7063
2001	15586	970	2502	1604	490	6375
2002	15448	897	2834	1590	479	5858
2003	12495	773	4001	1585	480	5074
2004	15434	732	3521	1556	476	4243
2005	15005	652	3743	1514	465	3738
2006	14515	815	3964	1464	469	3277
2007	15115	610	3604	1453	451	3028
2008	15636	380	4306	1413	458	2752

Table V. Production of main agricultural crops (ths of tons) (1990-2008)
 (State Statistics Committee of Ukraine, 2009d)

	grain and leguminous crops (in weight after the cleaning)	sugar beet (factory)	sunflower seeds (in weight after the cleaning)	potatoes	vegetables	fruits and berries
1990	51009	44264	2571	16732	6666	2902
1991	38674	36168	2311	14550	5932	1537
1992	38537	28783	2127	20277	5310	2122
1993	45623	33717	2075	21009	6055	2798
1994	35497	28138	1569	16102	5142	1153
1995	33930	29650	2860	14729	5880	1897
1996	24571	23009	2123	18410	5070	1924
1997	35472	17663	2308	16701	5168	2793
1998	26471	15523	2266	15405	5492	1178
1999	24581	14064	2794	12723	5324	766
2000	24459	13199	3457	19838	5821	1453
2001	39706	15575	2251	17344	5907	1106
2002	38804	14452	3271	16619	5827	1211
2003	20234	13392	4254	18453	6538	1697
2004	41809	16600	3050	20755	6964	1635
2005	38016	15468	4706	19462	7295	1690
2006	34258	22421	5324	19467	8058	1114
2007	29295	16978	4174	19102	6835	1470
2008	53290	13438	6526	19545	7965	1504

Table VI. Yield of main agricultural crops (centners per ha of the harvested area) (1990-2008)
(State Statistics Committee of Ukraine, 2009d)

	Yield of main agricultural crops, centners per hectare of the harvested area					
	grain and leguminous crops (in weight after the cleaning)	sugar beet (factory)	sunflower seeds (in weight after the cleaning)	potatoes	vegetables	fruits and berries
1990	35.1	276	15.8	117	149	42.7
1991	26.5	234	14.6	95	128	23.0
1992	27.9	194	13.0	119	110	32.2
1993	32.1	222	12.7	137	130	43.2
1994	26.8	192	9.1	105	115	18.0
1995	24.3	205	14.2	96	120	29.8
1996	19.6	183	10.5	119	112	30.6
1997	24.5	176	11.5	106	114	44.5
1998	20.8	174	9.3	102	123	28.6
1999	19.7	156	10.0	82	111	19.2
2000	19.4	177	12.2	122	112	38.4
2001	27.1	183	9.4	108	123	30.5
2002	27.3	189	12.0	104	124	36.5
2003	18.2	201	11.2	116	139	56.0
2004	28.3	238	8.9	133	149	58.1
2005	26.0	248	12.8	128	157	63.7
2006	24.1	285	13.6	133	171	45.0
2007	21.8	294	12.2	131	152	61.7
2008	34.6	356	15.3	139	174	64.4

Table VII. Number of livestock and poultry (ths of heads) (1990-2008)
 (State Statistics Committee of Ukraine, 2009e)

	cattle		pigs	sheep and goats	poultry, mln. of heads
	total	including cows			
1990	25194.8	8527.6	19946.7	9003.1	255.1
1991	24623.4	8378.2	19426.9	8418.7	246.1
1992	23727.6	8262.6	17838.7	7829.1	243.1
1993	22456.8	8057.2	16174.9	7236.6	214.6
1994	21607.3	8077.7	15298.0	6862.6	190.5
1995	19624.3	7818.3	13945.5	5574.5	164.9
1996	17557.3	7531.3	13144.4	4098.6	149.7
1997	15313.2	6971.9	11235.6	3047.1	129.4
1998	12758.5	6264.8	9478.7	2361.8	123.3
1999	11721.6	5840.8	10083.4	2026.0	129.5
2000	10626.5	5431.0	10072.9	1884.7	126.1
2001	9423.7	4958.3	7652.3	1875.0	123.7
2002	9421.1	4918.1	8369.5	1965.0	136.8
2003	9108.4	4715.6	9203.7	1984.4	147.4
2004	7712.1	4283.5	7321.5	1858.8	142.4
2005	6902.9	3926.0	6466.1	1754.5	152.8
2006	6514.1	3635.1	7052.8	1629.5	162.0
2007	6175.4	3346.7	8055.0	1617.2	166.5
2008	5490.9	3095.9	7019.9	1678.6	169.3

Table VIII. Production of animal products (1990-2007)
(State Statistics Committee of Ukraine, 2009e)

	meat of all kinds (in slaughter weight), ths of tons	milk, mio. of tons	eggs, mio. of pieces	wool, ths of tons
1990	4357.8	24508.3	16286.7	29804
1991	4029.1	22408.6	15187.8	26646
1992	3400.9	19113.7	13496.0	23080
1993	2814.5	18376.5	11793.8	21101
1994	2677.4	18137.5	10153.7	19281
1995	2293.7	17274.3	9403.5	13926
1996	2112.7	15821.2	8763.3	9318
1997	1874.9	13767.6	8242.4	6679
1998	1706.4	13752.7	8301.4	4557
1999	1695.3	13362.2	8739.7	3759
2000	1662.8	12657.9	8808.6	3400
2001	1517.4	13444.2	9668.2	3266
2002	1647.9	14142.4	11309.3	3392
2003	1724.7	13661.4	11477.1	3353
2004	1599.6	13709.5	11955.0	3202
2005	1597.0	13714.4	13045.9	3195
2006	1723.2	13286.9	14234.6	3277
2007	1911.7	12262.1	14062.5	3449

Table IX. Indices of agricultural production, in % of previous year (1990 – 2007)
(State Statistics Committee of Ukraine, 2009f)

	Agricultural land area, ths of ha	Indices of agricultural production, in % of previous year									Agricultural Production, at prices of 1996, mio UAH *	Agricultural Production per capita of rural population, at prices of 2008, UAH**
		all types of farms			including agricultural enterprises			households				
		gross production	of which crop production	of which animal production	gross production	of which crop production	of which animal production	gross production	of which crop production	of which animal production		
1990	42030.3	...	...	...	...	...	...	...	...	...		19332.81
1991	41973.4	86.8	82.9	90.1	82.5	78.3	86.6	96.5	96.5	96.5		16890.47
1992	41929.5	91.7	101.4	84.3	82.6	88.0	77.9	109.5	133.9	95.0		15580.52
1993	41890.4	101.5	111.5	92.1	97.6	109.2	86.1	107.1	115.3	100.3		15801.59
1994	41861.6	83.5	76.5	91.3	79.3	74.2	85.7	89.1	80.0	97.8		13241.22
1995	41852.9	96.4	103.5	89.7	91.0	97.8	83.6	102.8	111.5	95.9	31634	12844.54
1996	41839.7	90.5	91.2	89.8	78.8	79.4	78.2	102.9	105.9	100.1	28642	11686.25
1997	41854.3	98.2	107.1	88.5	95.3	113.4	71.8	100.7	101.2	100.1	28112	11538.62
1998	41826.5	90.4	81.9	101.6	84.1	76.1	100.5	95.1	88.0	102.1	25359.6	10477.96
1999	41829.5	93.1	89.5	97.1	90.8	91.5	89.7	94.7	87.8	100.7	23602	9815.86
2000	41827.0	109.8	123.2	96.4	95.0	104.4	80.1	119.3	140.7	103.5	25907	10858.06
2001	41817.0	110.2	112.6	107.0	120.4	125.0	110.9	104.9	104.1	105.7		12055.26
2002	41800.4	101.2	98.0	105.3	98.3	92.7	111.2	102.9	102.5	103.2		12268.13
2003	41788.5	89.0	85.4	93.5	74.8	67.5	89.0	97.1	98.9	95.3		11063.24
2004	41763.8	119.7	135.4	102.0	140.4	162.5	108.1	110.7	121.4	99.8		13413.07
2005	41722.2	100.1	97.0	104.7	102.7	96.0	117.5	98.6	97.7	99.7		13606.28
2006	41675.9	102.5	101.7	103.6	109.5	106.8	114.4	98.5	98.3	98.6		14150.00
2007	41650.0	93.5	90.5	97.7	95.8	89.0	107.1	92.1	91.6	92.7		13393.26

* (Ivanuh, R.A., Dusanovs'kyi, S.L., Bilan, E.M., 2003, p. 120)

** The calculated values are based on: agricultural production, at prices of 1996 (column 12), indices of agricultural production (column 3), deflators (Table II, column 7), rural population of Ukraine (Table XIII, column 4)

Table X. Profitability of agricultural production, % (1990-2007)
(State Statistics Committee of Ukraine, 2009f)

	agricultural production	including												
		crop production	of which					animal production	of which					
grain	sunflower seeds		sugar beet (factory)	potatoes	vegetables grown in the open	beef and veal ¹	pork ¹		mutton and goat ¹	meat of poultry ¹	milk	eggs		
1990	42.6	98.3	275.1	236.5	29.5	27.2	27.6	22.2	20.6	20.7	2.3	17.0	32.2	27.3
1991	56.2	114.6	166.2	307.6	59.9	150.4	60.3	33.9	43.9	36.0	29.3	2.6	21.7	47.1
1992	118.9	206.5	346.0	541.6	142.9	233.8	72.8	76.1	131.2	95.4	119.0	32.0	39.6	67.8
1993	116.2	214.6	361.1	505.6	143.5	68.6	39.4	56.7	88.0	67.0	84.7	13.4	42.0	75.1
1994	57.8	123.2	214.1	224.1	66.0	112.1	106.8	15.7	29.8	31.0	28.9	-2.3	-5.2	55.0
1995	13.6	55.5	85.6	170.9	31.2	34.3	12.8	-16.5	-19.8	-16.7	-31.9	-18.4	-23.2	36.5
1996	-11.7	29.7	64.6	53.0	3.8	6.4	-26.5	-39.7	-43.1	-42.1	-51.8	-32.8	-44.0	-2.4
1997	-24.1	14.5	37.5	19.4	-10.4	-24.1	-37.4	-54.3	-61.5	-57.4	-58.8	-44.9	-53.7	-5.5
1998	-29.5	-3.3	1.9	22.0	-12.0	-18.6	-25.2	-49.9	-59.3	-47.4	-59.4	-43.4	-46.7	-1.3
1999	-22.1	8.0	12.0	54.5	-14.8	-12.5	-12.8	-46.6	-57.9	-51.0	-57.0	-45.5	-36.6	-0.7
2000	-1.0	30.8	64.8	52.2	6.1	14.0	-1.7	-33.8	-42.3	-44.3	-46.4	-33.2	-6.0	10.6
2001	18.3	35.8	43.3	68.7	1.5	11.4	-0.8	-6.6	-21.4	-7.2	-24.9	-1.7	-0.8	25.1
2002	4.9	22.3	19.3	77.9	-8.6	24.2	8.9	-19.8	-40.5	-16.9	-26.7	-1.1	-13.8	14.6
2003	12.6	41.7	45.8	64.3	6.2	33.5	30.9	-18.8	-44.3	-33.0	-37.8	11.0	9.9	18.5
2004	8.1	20.3	20.1	45.2	-0.8	-0.7	-5.0	-11.3	-33.8	-14.4	-44.3	3.8	-0.4	15.2
2005	6.8	7.9	3.1	24.3	4.8	17.8	16.1	5.0	-25.0	14.9	-32.1	24.9	12.2	23.5
2006	2.8	11.3	7.4	20.7	11.1	56.2	14.8	-11.0	-38.4	-9.2	-34.3	12.1	-3.7	-6.8
2007	15.6	32.7	28.7	75.9	-11.1	24.7	14.1	-13.4	-41.0	-27.6	-46.4	-19.0	13.8	9.1

¹ Sale of livestock and poultry for meat excluding their processing on the own production facilities.

Table XI. Average sale prices for agricultural products sold by agricultural enterprises (except small), UAH per 1 ton (1996-2008)¹
(State Statistics Committee of Ukraine, 2009f)

	grain and leguminous crops	sunflower seeds	sugar beet	potatoes	vegetables		livestock and poultry (in live weight)	milk and dairy products	eggs, per thsd. of pieces
					total	total			
1996	168.4	265.2	64.6	274.3	326.4	-	973.4	191.5	114.6
1997	176.1	246.4	69.8	245.0	352.1	-	1040.4	239.5	122.6
1998	154.2	321.0	68.2	273.2	333.0	-	1496.0	284.1	124.9
1999	200.4	507.6	79.2	492.4	447.8	1440.7	1767.3	360.4	141.9
2000	443.8	522.6	121.5	517.1	572.1	1871.2	2358.0	536.4	191.7
2001	381.3	783.2	139.1	449.8	748.9	2250.3	4175.5	603.7	210.0
2002	312.5	843.7	128.1	555.8	864.8	2314.3	3644.0	541.0	168.1
2003	535.1	856.5	140.3	623.3	1012.7	2524.3	3480.7	696.9	193.2
2004	453.1	1150.6	135.7	530.4	1225.0	2986.4	5092.7	835.3	238.3
2005	417.8	978.2	177.0	685.2	1462.1	3392.2	6909.9	1126.9	251.8
2006	515.2	939.1	186.0	1070.3	1547.4	3607.7	6307.7	1070.2	192.7
2007	833.5	1899.4	157.6	1032.0	1995.4	4382.6	6466.5	1660.6	274.4
2008	778.6	1367.3	218.9	1154.3	2059.9	5506.3	10184.3	2065.1	377.4

¹ Without VAT, transportation dispatching and overhead expenses, but including subsidies and additional payments.

Table XII. Grain and wheat supply/demand balances in Ukraine (mio. tons, 2003/04 – 2007/08)
 (State Statistics Committee of Ukraine, 2009g)

Year	Grains, total					Wheat				
	03/04	04/05	05/06	06/07	07/08	03/04	04/05	05/06	06/07	07/08
Opening stocks	2.03	1.34	2.47	2.70	2.75	1.43	0.93	1.29	1.98	1.90
Crop	20.32	37.96	36.82	34.40	28.20	4.25	16.53	17.91	13.81	13.70
Imports	3.73	0.16	0.19	0.19	0.23	3.40	0.005	0.01	0.01	0.025
Supply	26.07	39.46	39.47	37.29	31.18	9.08	17.46	19.21	15.80	15.62
Exports	2.89	11.28	13.24	9.79	3.33	0.05	4.33	6.48	3.30	1.00
Demand	24.73	36.99	36.77	34.54	27.01	8.15	16.18	17.23	13.90	12.35
Closing stocks	1.34	2.47	2.70	2.75	4.17	0.93	1.29	1.98	1.90	3.27
Stocks/demand (%)	5.4	6.7	7.4	8.0	15.4	11.4	8.0	11.5	13.6	26.5

Table XIII. Population of Ukraine (1990 - 2009)
 (State Statistics Committee of Ukraine, 2009h)

	Total present population			Total resident population			Birth / Death statistics	
	total, thsd.	of which		total, thsd.	of which		Births, thsd.	Deaths, thsd.
		urban	rural		males	females		
1990	51838.5	34869.2	16969.3	51556.5	23826.2	27730.3	657,2	629,6
1991	51944.4	35085.2	16859.2	51623.5	23886.5	27737.0	630,8	669,9
1992	52056.6	35296.9	16759.7	51708.2	23949.4	27758.8	596,8	697,1
1993	52244.1	35471.0	16773.1	51870.4	24046.3	27824.1	557,5	741,7
1994	52114.4	35400.7	16713.7	51715.4	23981.1	27734.3	521,5	764,6
1995	51728.4	35118.8	16609.6	51300.4	23792.3	27508.1	492,9	792,6
1996	51297.1	34767.9	16529.2	50874.1	23591.6	27282.5	467,2	776,7
1997	50818.4	34387.5	16430.9	50400.0	23366.2	27033.8	442,6	754,2
1998	50370.8	34048.2	16322.6	49973.5	23163.5	26810.0	419,2	719,9
1999	49918.1	33702.1	16216.0	49544.8	22963.4	26581.4	389,2	739,2
2000	49429.8	33338.6	16091.2	49115.0	22754.7	26360.3	385,1	758,1
2001	48923.2	32951.7	15971.5	48663.6	22530.4	26133.2	376,4	745,9
2002	48457.1	32574.4	15882.7	48240.9	22316.3	25924.6	390,7	754,9
2003	48003.5	32328.4	15675.1	47823.1	22112.5	25710.6	408,6	765,4
2004	47622.4	32146.4	15476.0	47442.1	21926.8	25515.3	427,3	761,3
2005	47280.8	32009.3	15271.5	47100.5	21754.0	25346.5	426,1	782
2006	46929.5	31877.7	15051.8	46749.2	21574.7	25174.5	460,4	758,1
2007	46646.0	31777.4	14868.6	46465.7	21434.7	25031.0	472,7	762,9
2008	46372.7	31668.8	14703.9	46192.3	21297.7	24894.6	510,6	754,5
2009	46143.7	31587.2	14556.5	45963.4	21185.0	24778.4	630,8	669,9

**Table XIV. Life expectancy at birth
(State Statistics Committee of Ukraine, 2009h)**

Period for which data are presented (years) average life expectancy at birth	Life expectancy at birth, years	of which:	
		males	females
1991-1992	69.30	64.20	74.18
1992-1993	68.67	63.50	73.70
1993-1994	67.98	62.78	73.15
1994-1995	67.22	61.82	72.72
1995-1996	66.93	61.40	72.65
1996-1997	67.36	61.91	72.95
1997-1998	68.08	62.74	73.50
1998-1999	68.32	62.95	73.74
1999-2000	67.91	62.44	73.55
2000-2001	68.33	62.77	74.08
2001-2002	68.32	62.70	74.13
2002-2003	68.24	62.64	74.06
2003-2004	68.22	62.60	74.05
2004-2005	67.96	62.23	73.97
2005-2006	68.10	62.38	74.06
2006-2007	68.25	62.51	74.22
2007-2008	68.27	62.51	74.28

**Table XV. Water consumption parameters in Ukraine
(Food and Agriculture Organization of the United Nations - Database, 2009)**

		1988-1992	1993-1997	1998-2002	2003-2007
Ukraine	Cultivated area (arable land + permanent crops) (1000 ha)	34456(1992)	34081(1997)	33457(2002)	33333(2007)
	Average precipitation in depth (mm/yr)	565(1992)	565(1997)	565(2002)	565(2007)
	Agricultural water withdrawal (10⁹ m³/yr)			19.7(2000)	
	Area equipped for irrigation: total (1000 ha)			730,1 (2002)	731,4 (2003)

**Table XVI. Total area under organic agriculture and number of certified organic farms in Ukraine (2002-2008)
(Organic Federation of Ukraine, 2010)**

Year	2002	2003	2004	2005	2006	2007	2008
Area, hectares	164449	239542	240000	241980	242034	249872	269984
Number of organic farms	31	69	70	72	80	92	118

Table XVII. Area under arable lands and permanent crops in Ukraine.
(Food and Agriculture Organization of the United Nations - Database, 2009)

Year	Area under arable lands and permanent crops, 1000 ha
1992	34456.00
1993	34417.00
1994	34357.00
1995	34329.00
1996	34211.00
1997	34081.00
1998	33821.00
1999	33615.00
2000	33496.00
2001	33461.00
2002	33457.00
2003	33387.00
2004	33386.00
2005	33353.00
2006	33345.00
2007	33333.00
2008	34456.00

Table XVIII. Waste water discharge in Ukraine (1990 - 2008)
(State Statistics Committee of Ukraine, 2009i)

Year	Water discharge, mio m ³ / year			purified
	contaminated			
	total	Of which with partial treatment*	of which without purification	
1990	3199	2729	470	3318
1991	4291	3590	701	2532
1992	4008	3057	951	3207
1993	4652	3456	1196	2611
1994	4873	3820	1053	2075
1995	4652	3740	912	1936
1996	4109	3129	980	2304
1997	4233	3470	763	1798
1998	4228	3415	813	1644
1999	3920	3172	748	1743
2000	3313	2555	758	2100
2001	3008	2262	746	2188
2002	2920	2138	782	2111
2003	2948	2144	804	1946
2004	3326	2568	758	1492
2005	3444	2548	896	1315
2006	3891	2464	1427	1304
2007	3854	2348	1506	1245
2008	2728	3590	616	1357

*The values are obtained as difference of total contaminated discharge and discharge without purification

Table XIX. Health care establishments (1990 - 2008)
(State Statistics Committee of Ukraine, 2009j)

Year	Total medical institutions, thsd.	Beds		Total out-patient facilities, thsd.	Capacity of out-patient facilities, thsd. of visits per shift	
		total, thsd.	per 10,000 population		total	per 10,000 population
1990	3,9	700	135,5	6,9	895	173,1
1991	3,9	700	135,2	7,0	922	178,0
1992	3,9	689	132,6	7,1	939	180,5
1993	3,9	679	130,9	7,2	952	183,5
1994	3,9	665	129,3	7,2	959	186,4
1995	3,9	639	125,1	7,2	966	189,0
1996	3,7	580	114,6	7,1	960	189,7
1997	3,4	503	100,2	7,1	964	191,9
1998	3,3	483	97,0	7,2	966	193,7
1999	3,3	477	96,5	7,3	973	196,6
2000	3,3	466	95,0	7,4	973	198,4
2001	3,2	466	96,6	7,4	980	203,4
2002	3,1	465	97,3	7,4	980	205,0
2003	3,0	458	96,6	7,6	981	206,8
2004	2,9	451	95,7	7,7	987	209,6
2005	2,9	445	95,2	7,8	990	211,7
2006 ¹	2,9	444	95,6	7,9	998	214,8
2007	2,8	440	95,2	8,0	992	214,7
2008	2,9	437	95,1	8,8	987	214,8

Table XX. Fertilizer use intensity in Ukraine in 1990-2002
(Food and Agriculture Organisation of the United Nations, 2005)

Year	1990	1995	1996	1997	1998	1999	2000	2001	2002
Kg/ha	124	25,9	15,3	16,5	15,2	12,6	13,6	14,6	17,5