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Foreword

The current issue of the Journal of Economic Development, Environment and People offers the readers interesting topics and aims at raising awareness on the real challenges of today: economic development and environment and the fragile imbalance between them.

The first article examines the possibility of adapting economic development to climate change, considering that climate change is the most complex challenge humankind has had to face in recent times. With each successive generation, redressing the imbalance will be more difficult. The economic activity is a major anthropogenic factor in the current environmental turmoil.

Economic growth draws attention to the growing international economic, political and ecological interdependence in terms of its ecological outcome.

The future economic growth on the planet is becoming a global problem.

Countries from different areas on the Earth are concerned about the consequences of climate change. In Netherlands, for example, the Dutch Meteorological Institute has conducted a study on the consequences of climate change on the country. Four different scenarios regarding the rise in temperature and their consequences have been developed, making predictions on the effects of climate change on nature, agriculture and even on the society, as a whole. None of these scenarios are optimistic, the reality is dramatic.

Human behavior patterns related to nature are constantly driven by the willingness to change the environment; over the centuries, people have become more destructive in their search for more and richer resources, everyday comfort has prevailed against the future generation's welfare. Today, the consequences are obvious, the main challenge being to find solutions to support sustainable growth. Some scholars suggest that society should "revise" its ethic of responsibility related to the nature future.

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More practical approaches indicate that it is more suitable to develop a targeted strategy addressing only acute problems, as energy management, in a "sustainable" way. The new concept - sustainable energy management - means a new radical approach of the entire chain: energy generation, transmission and consumption. Living in high populated urban areas becomes more and more difficult and it requires new urban structures and/or new approaches of urban regeneration to make the living spaces friendlier to people and nature.

Words, words…. political correct discourses… Do we see any real changes in the human destructive behavior?

Some of the articles published in the current Issue tend to describe the reality of the economic growth – environment relation; others suggest solutions or address the ethical issues.

The debate is far to be ended. Stay tuned, read, comment or even express your own concerns, ideas and solutions!

Manuela Epure, Professor PhD
Editor en-chief

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Consequences of Climate Change for agriculture and nature in the Netherlands

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Abstract

After the publication of the IPCC reports on climate change, the Dutch Meteorological Institute of the Netherlands (KNMI) conducted a study on the consequences of climate change for the Netherlands. Four different scenarios regarding the rise in temperature and their consequences have been developed. Other institutes have elaborated more on these scenarios, making predictions on the effects of climate change on nature and agriculture for the Netherlands. Overall conclusions are that climate change will have dramatic consequences for nature, agriculture and Dutch society in general, being so exposed to rising sea levels. Depending on the scenario, consequences have various gradients of impacts and effects. In general, it is estimated that winters will be softer and wetter, and that summers will be hotter and drier with intermittent torrential rains that can have dire consequences for agriculture and nature. Growing seasons will start earlier and will last longer which could lead to mismatches in species interaction. Species of various kinds will suffer the effects of climate change and will disappear from the Netherlands altogether, either through extinction or by moving away north. Other warmth loving species from the south of the Netherlands will move upwards towards the country leading to possible threats to indigenous species.

Keywords: Agriculture, climate change, climate scenarios, landscape, nature, the Netherlands

JEL Codes: Q10, Q54, N54

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1. Introduction

In recent years the Netherlands has been confronted by the effects of climate change. Temperatures and amounts of precipitation have risen considerably. What exactly the consequences will be is still subject of research and debate but some trends are already visible. Climate change will affect many parts of society. This paper will explore the effects for agriculture and nature. A description of the historical development of the Dutch landscape and nature will be given first, further expanded by an overview of other aspects of environmental degradation that affect the current landscape and nature in the Netherlands. This is important in order to understand the context on which climate change will have its effect.

The paper will then describe the changes in temperature and precipitation observed followed by a description of four scenarios developed by the Dutch Meteorological Institute which make projections of future temperatures and amounts of precipitation. Next, the effects of climate change on agriculture and nature will be discussed. Lastly, the paper will end with conclusions.

This paper is the result of a literature review and for the study a variety of documents of mostly Dutch institutes and authors was conducted. All sources, but one, were in the Dutch language. For this paper the author has translated the found sources into the English language.

2. Historical development of landscape and nature in the Netherlands

2.1. Landscape and nature throughout the centuries

The landscape in the Netherlands has been greatly affected by the choices made in the past. Probably nowhere in the world had humans so much effect on the landscape and nature (Londo, 1997). The landscape is managed in order to combine multiple functions like urbanization, agriculture, industry, recreation and nature, which is required in such a densely populated country. There is truth in saying that the Dutch –at least partly- created their country. However, one of the best kept secrets of the Netherlands is that the Dutch themselves are responsible that a large part of their country lies below sea level. This part of the study will show how these changes came about and what their effects are. It will set the context on which climate change happens. Later in the study, these effects will be elaborated on.

Before settlements, the country's landscape consisted for 70% out of peat (Roos et al., 2004) and ancient forests. Peat is the remains of plants which accumulated over time. The wet conditions of the Dutch landscape assured that the peat was not exposed to oxygen and could therefore mineralize. Early settlers started to clear the forest and excavate the peat, converting the land into agricultural land. Trees were cut in order to create space for cattle. Water was drained away. The peat was exposed to oxygen and mineralized, creating fertile farmland. Farmland was used until the land was exhausted, to be replaced with other converted land. This is how over the centuries, peat and forests were converted into agricultural lands (Londo, 1997).

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The consequence of this was that land subsided due to compaction of soil. More water needed to be pumped out in order to keep the land suitable for agriculture. This at first did not pose a problem since the land was still well above sea level but from the 10th century onwards the population of the Netherlands rose steadily and more land needed to be converted to agricultural land and this land needed to be kept dry. Elaborate systems of ditches and canals were constructed to lead the water away to the rivers and eventually to the sea. This process lasted for centuries leading to the vicious circle of pumping water out in order to convert peat into farmland and to continue pumping in order to keep that farmland not submerged with water. With the introduction of windmills this process really took off. This led to the famous Dutch landscape with her characteristic ditches, canals and dikes which created so called polders: pieces of reclaimed land protected by dikes converted into agricultural land (Beekman et al., 2010)

Another development that took place during the centuries was protecting the ever decreasing level of land against floods. Floods came predominately from the sea but also from the rivers. Dunes were raised and strengthened along the coastline, dikes were build along rivers and elaborate systems of canals and waterways pumped water from ditches to canals, rivers and eventually to the sea. Nevertheless, this did not prevent floods from occurring and in 1953 a large flood took place in the South West of the country killing 1,835 people and causing massive damage. This tragedy led to the formation of the so-called Delta plan which conducted projects to further strengthen the coastline and build dams and dikes in the South West. The Dutch thought once again that they were safe but then the threat came from another direction: the rivers. During the 90s of the last century, excess melt and rain water from the rivers threatened to flood large parts of the eastern part of the country. Subsequent summers were too dry and weakened the dikes made out of peat material. Dikes were too weak and needed to be strengthened. However, it seemed that building higher and stronger dikes were not the solution. It was decided to expand the capacity of the river to handle large amounts of water by giving the rivers space to 'breathe' that is, the rivers were given a chance to deal with excess water by converting neighboring land into floodplains. Rivers were allowed to flood these lands in order to get the pressure off.

2.2. Effects of the changing landscape on nature

The mentioned interventions in the Dutch landscape of course had consequences for nature. Primeval forests in the Netherlands disappeared altogether and apart from some areas, no large forests remain. Those remained are a mix of leafed and coniferous forests with introduced tree species like the Scottish pine. Animal species that found habitat in these forests also disappeared. Examples are wolf, bear and red deer.

Currently, the Netherlands counts many different types landscapes each with its own particular kind of vegetation and corresponding fauna. Unique are the salt water landscapes and heath with their ecosystems. Some of these ecosystems also disappeared although initiatives to restore them are currently being conducted.

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The largest effects on nature come from agriculture and urbanization. Agriculture converted natural land into land used for monoculture crops or livestock. After WWII, agriculture in the Netherlands really took off when a system that converted many small plots of land into big pieces was introduced. The characteristic borders between plots of lands consisting out of hedges disappeared altogether or were replaced with barbed wire for convenience. This led to a loss of not only landscape beauty but also to a loss of biodiversity because habitats and corridors were lost.

The irony is that in the past 70% of the country was covered with peat and forests containing many ecosystems and offering habitat to many species, nowadays 70% of the country is covered with grassy meadows often used for monoculture agriculture leading to loss of habitat and biodiversity. Overall it can be concluded that the Dutch landscape has changed dramatically over the centuries due to agriculture, industry and urbanization. The effects on nature have also been quite dramatic with loss of biodiversity and habitat. Numerous aspects linked to historical and economic development are contributing factors to the state of nature in the Netherlands. These are: subsidence of land, acidification due to SO2 emissions, eutrophication, pollution and landscape fragmentation. Two factors are linked to the climate change:

Rising sea level and increasing rain and melt water in the rivers due to climate change;

Periods of droughts alternated with excessive torrential rain

They will be elaborated in this study. It is within the above pictured context that climate change will affect species chances of survival and abilities to adapt to climate change.

Before awareness of the effects of climate change arose, the Netherlands already started dealing with the other causes of environmental damage and damage to nature. Like many other countries it signed the LRTAP convention to reduce emissions of SO2 and other acidifying gasses. Other agreements governing pollution were also signed. Agriculture had to limit the use of fertilizers and the unrestrained spreading over the land of manure. However, agriculture has a strong political pillar making change a difficult and slow process.

2.3. Restoring nature

A multitude of nature restoration projects have been conducted over the years combating the effects of acidification, eutrophication and dehydration. That often involves removing top layers of soil which over time had accumulated too many nutrients leading to dominance of nutrient loving species, often grasses. Other projects involve restoring and widening natural meandering water flows that were previously made straight to accommodate agriculture. Meandering increases the holding capacity of these water bodies. This leads to a multitude of different aquatic and embankment habitats and ecosystems accommodating many species of insects, fish and other water creatures, creating corridors between separated ecosystems and habitats. As much as possible in these projects, the historic situation as it once was is being restored. This often has various success rates. Restoring natural areas requires careful planning, careful observation and a great deal of luck with local conditions and weather (Bouwman et al., 2011).

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In order to preserve and increase nature and biodiversity, a series of ecological networks were developed with robust connections between them resulting in the country's Ecological Main Structure (EHS), see Annex IV. Farmers were often appointed as 'stewards of nature' and compensated for the use of their land or for not moving their fields' too early thereby allowing birds on their lands to have nests. Subsequent governments had invested millions of Euro in the EHS and the structure is estimated to be half way. Unfortunately, the new government of the Netherlands has put a stop on the structure possible under pressure from the agricultural lobby and against the directives for habitats of the Europeans Union. The EHS which served as an example for the EU's Natura2000 ecological networks is now under pressure and the plans to stop investing in it will most likely collide with the EU.

3. Climate change in the Netherlands

3.1. Temperature and precipitation changes in the Netherlands

The average temperature in the world has risen with 0.4 to 0.7 o C since 1900 (MNP book). Compared, the average temperature in the Netherlands has risen with 1.7 o C since 1900 and the precipitation increased with 18% (Vonk et al., 2010). This is due to changes in wind and weather conditions over the Atlantic Ocean caused by climate change.

The last 20 years the temperature in the Netherlands has risen with 0.7 o C (Roos et. al., 2004) and the temperatures in the years 2006 and 2007 were just as high as those measured at the end of the 20th century in the middle of France (Vonk et al., 2010). The first decade of the 21st century has been the warmest since measurements of temperature began (Vonk et al., 2010) and the summer of 2010 was the warmest ever measured. The warming of the Netherlands is noticeable in all seasons but not equally spread out over all seasons. In general there is an increase in the number of warm extremes and a decrease in the number of cold extremes.

The water temperatures also rose. In fens the water temperature rose quite dramatically over the last 20 years by almost 2 o C. The water temperature in the river Rhine in the last century rose with 3 o C of which 2 o C were accountable by the discharge of cooling water from power plants. Sea water temperature rose with 1 o C (Lenderink et al., 2008 in Vonk et al., 2010). Temperature at the bottom of the North Sea rose 1.5 o C, as measured at the end of the 1980s (Hiddink & Ter Hostede, 2008 in Vonk et al, 2010).

In the period 1906 – 2005 the average amount of precipitation has risen with 18% in the Netherlands, especially in winter (+26%), spring (+21%) and autumn (+26%). The amount barely changed in summer (KNMI, 2006 in Vonk et al., 2010). The increase is attributed to changes in wind patterns along the coast and by the warming of sea water. Especially coastal areas have become wetter (KNMI, 2008 in Vonk et al, 2010). The frequency and intensity of torrential rain have increased, especially in winter time. Just as with average precipitation, extreme precipitation has increased especially in coastal areas.

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3.2. Climate change scenarios

Following the reports of the IPCC on climate change and the measured national changes in temperature and precipitation, the Dutch Meteorological Institute developed four different climate scenarios for the Netherlands.

These scenarios make projections of the possible effects of global climate change on temperature, precipitation, wind and other climatic conditions for the Netherlands. Projections were made for the year 2050 and 2100.

The climate in the Netherlands is very much determined by the global climate and by the western winds coming from the Atlantic Ocean (KNMI, 2009).

Overall, all scenarios project the following effects for the Netherlands:1

The temperature will continue to rise;

Sea level will continue to rise

Winters will be more moderate and wetter;

Summers will be drier leading to periods of drought;

The calculated change in wind will be small compared to the natural fluctuations;

Sporadic but heavy torrential rains in summer.

The severity of the effects of climate change is determined by the relative rise in temperature. In the most modest scenario the global temperature for the year 2050 rises with 1oC compared to 1990, in the worst scenario the temperature rises with 2 o C. For the year 2100 temperature increments of respectively 2 and 4 oC compared with 1990 are expected for the “best” and “worst” case scenarios. The meteorological institute calculated for all scenarios what the highest, lowest and average temperature and amounts of precipitation per season will be. In all scenarios the temperatures will go up. The number of days with precipitation will increase in winter and also the amount of rain will increase. In summer the number of days with precipitation will decrease while at the same time evapotranspiration will increase leading to droughts. This will be alternated with heavy torrential rains leading to floods and potential failed harvests.

Finally, the Institute also projected the sea level rise under each scenarios for the years of 2050 and 2100. For 2050 this will be respectively 15-25 cm and 20-35 cm for the best and worst case scenario, while for 2100 this will be 35-60 cm and 40-85 cm2.

Based on the studies of the IPCC and the Dutch Meteorological Institute, other studies to the effects of climate change were conducted. These studies along with economic and demographic developments led to projections for society as a whole. This report will only deal with the consequences for agriculture and

[1] www.knmi.nl/klimaatscenarios/

[2] dito

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nature. However, choices made regarding other societal functions can also have effects on agriculture and nature. These choices are not taken into account in this report.

4. Effects of climate change

4.1. Agriculture

In 2008 a study to the effects of climate change for agriculture and nature was conducted by Alterra, the research Institute of Wageningen University. The main effects for agriculture that are to be expected are:

- Changing temperature patterns and rising average temperature
- Changing precipitation patterns and amounts of precipitation
- Rising sea level and associated relative land subsidence leading to rewetting of land due to rising groundwater level (see figure 1)
- Rising sea level and associated salinization of soils
- Rising CO2 concentrations

(Blom et. al., 2008)

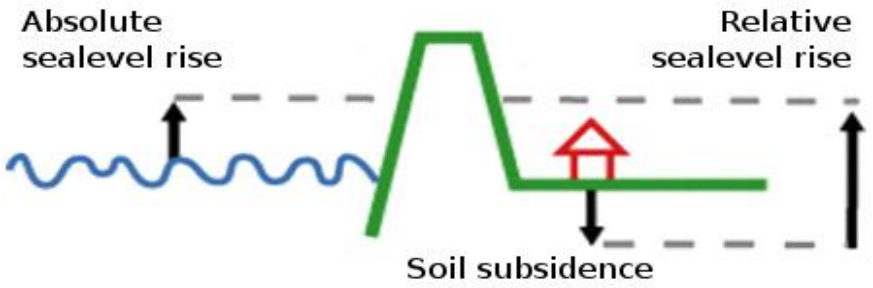

Fig.1: Relation between absolute sea level rise, relative sea level rise and soil subsidence due to soil compaction[3]

The starting point was the overview of the crop distribution in the Netherlands based on which the consequences of the climate change are envisaged, see Annex I.

The Alterra researchers distinguished two types of climate change: structural and incidental. They concluded that the structural climate change in general will have a relatively limited effect on agriculture. Because winters will become more moderate, the growing season will start earlier and last longer leading to an increase in productivity. However due to the moderate winters, pests and diseases will have more

[3] www.knmi.nl/klimaatscenarios/

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chances for survival and become a threat for the next season. Also the climatic conditions will be favorable for un-indigenous weeds (Blom et al., 2008).

The Dutch Meteorological Institute predicts that increased CO2 levels will contribute to a faster and more abundant growth of crops. However, reduced summer rains coupled with evapotranspiration of crops and vegetation in summer due to higher temperatures will lead to dehydration and droughts (de Bilt, 2008).

The incidental effects on agriculture of climate change will be more dramatic than the structural ones. Examples of incidental effects are heat waves and floods. Increased winter rains coupled with increased melt water coming from the rivers and rising salty groundwater can potentially be a threat to crops. This depends on the crop, the growing stage of the crop, the ambient temperature and the dispersion potentials of diseases and plagues. Salinization for instance is damaging for potatoes but beneficial for sugar beets because the salt increases the sugar content in beets (Blom et. al., 2008). The overall sensitivity of agricultural crops in the Netherlands to the consequences of climate change is showed in Annex II. Annex III shows the sensitivity of agricultural crops for the various effects of climate change: Salinization, rewetting, droughts, diseases/plagues, and extreme conditions (Blom et. al., 2008).

Table1: examples of the envisaged effects of climate change are listed

Salinization	Climate change will lead to absolute sea level rise while the subsidence of soil due to soil compaction will add to relative sea level rise (see figure 1). Sea water will penetrate deeper into the groundwater moving inland, eventually surfacing into the top layers of soil creating brackish conditions. This saline seepage is damaging for certain crops like grasses, grains, orchards and potatoes. Like mentioned before, sugar beets will benefit from more saline groundwater but overall saline seepage is bad for agriculture (Blom et. al., 2008).
Drought	Drought can potentially lead to loss of agricultural production. One way to combat drought is to irrigate more which will put a strain of the local water reserves which will already be under threat due to other social demands on the water reserves. A solution to that is to bring in water from the lakes which however would have negative effects on nature since this is often water alien to the region. Another effect of droughts can be denitrification in the soil. This will change the ability of crops and vegetation to absorb nitrogen which important for growth.
Rewetting	Increased precipitation in winter and increased melt water coming from the rivers can lead to rewetting. Increased pressure from rivers can lead to seepage of water to top soil layers. Too much water can lead to the drowning and rotting of crops. It can also play a role in the leaching of nutrients and pesticides to the surface which would damage water quality. Rewetting also increases the chances on diseases and plagues. Fungi and bacteria can spread more easily. Soft winters can increase rates of survival of pests and increase resistance of pest to pesticides. This can lead to an increase of the number of predators in the next season. Positive effects of rewetting are decontamination of soil,

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	less compaction of peat, and the storage of water as buffers (Blom et. al., 2008).
Extreme conditions	Extreme weather conditions can lead to damage of agricultural crops. Physical damage by heat waves, torrential rains, strong winds, late frost and hailstorms can inflict severe damage to grains, vegetables and orchards (Blom et. al, 2008).

4.2. Nature

The effects of climate change on agriculture will also apply to nature. Salinization, droughts, rewetting and extreme weather conditions will also affect species of plants, vegetation and animal species which depend on them. Also there is a chance of increased diseases and plagues (Roos et al., 2004). The severity varies per specie, the stage of growth and other variables. The difference with damage to agricultural crops is that agriculture is much more within the domain of human control than is nature. Natural or half natural landscapes are far more complex and difficult to manage than cultural landscapes like agricultural landscapes.

Even more, the other aspects of environmental degradation (eutrophication, acidification, fragmentation, pollution, dehydration and subsidence of soil) will compound the effects of climate change on nature more than they do on agriculture. Especially the level of fragmentation of nature in the Netherlands will play an important role in the ability of species to deal with the effects of climate change. This following part elaborates the effects of climate change on nature given the current environmental conditions.

Physiological and phenological effects

Both temperature rise and increased concentrations of CO2 will have stimulating effects on the physiological processes concerning the growth and decomposition of plant and animal species. Vegetation could start to grow earlier and the season could last longer. However, every plant and animal species will react differently which is dependent on a combination of change in temperature, precipitation, weather patterns and risks.to.drought.

Within specie there is a dependence on location and niche. Although there is considerable uncertainty about the adaptability of species to climate change, the general trend is an advance in the growing and reproductive season. This can lead to a mismatch in food chains (Vos, C. et. al, 2007). Bird or other species that depend on the availability of fruits, seeds or insects can get into trouble when these food sources have already peaked and are no longer available. Migrating birds which depend on timed availability of food sources in different countries can be faced with shortages of food on their migrations (Roos et al., 2004)

Changes in a-biotic conditions

Higher concentrations of CO2 lead to more efficient water management and less evapotranspiration in vegetation. This in turn will lead to an increased mineralization of the soil, especially increased availability of

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nitrogen which will aid in the growth of vegetation. Next to this, an accelerated photosynthesis within some plants will increase biomass production which can have consequences for competitive relations between plant species. This will lead to a roughing of the undergrowth blocking other slow growing plant species. There will be drought and deterioration of water quality near brook and river systems, swamps, wet heath, fens and peat moor. The location of seepage zones can change and pressure of seepage in coastal areas will increase which can lead to the shifting of transition areas between fresh and salt water (Vos, C. et. al, 2007).

Changes in the water regime (currents, length and depth) can influence the habitats and reproductive chances of many species (Roos et al., 2004).

All these changes will have consequences for the functional relations between various species and will lead to shifts in species compositions and in compositions of ecosystems.

Geographical changes of ecosystems

Any change in climate in general will lead to a change in the geographical dispersion of species because the suitable habitats will shift along with the climate. Warmth loving species will move northwards and cold loving species already have been noticed to decrease at the southernmost tip of their living and dispersal habitats. Species preferring the cold will face difficulties to survive in the Netherlands, will be extinct of will move away north from the Netherlands.

Species that prefer warmth and heat will move to the Netherlands from the south and also within the Netherlands a shift of these species will take place (Blom et al., 2008). Species alien to the Netherlands can find habitat in the country and can upset competitive relations between species, overwhelming indigenous species which already have difficulty dealing with climate change and the other environmental problems.

Also, increased weather extremes will have effects on the occurrence, mortality rates and geographical displacements of species. This will have consequences for the reproduction and therefore survival of species (Vos, C. et. al, 2007). Also there is a risk of decreased genetic variation and the risk that species cannot keep up with the speed of climate change (Roos et al., 2004). Any hindering due to fragmentation and lack of migrating or dispersal corridors will compound to this problem (Bennett, 2003).

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Fig. 2. Four possible reactions of plants and animals to climate change (source: Roos et al., 2004):

Green = Stay, Red = Appearance, Blue = Disappearance, Yellow = Perish, Orange = Emergence of exotic species

5. Conclusions

Nature and the landscape in the Netherlands have changed dramatically over the centuries. Before settlements occurred in the Netherlands, the country was covered for 70% with peat and forests. Large scale deforestation and excavation of peat to make way for agriculture, urbanization, industry, infrastructure and for energy use turned the Netherlands into a fragmented cultural landscape where nature now only occupies 3% of total area of the country. The wide use of fertilizers and pesticides coupled with emissions of green house gasses, acid rain gasses and pollution caused by persistent organic pollutants to name a few, led to further environmental deterioration. It is under these conditions that agriculture and nature need to adapt to the effects of climate change.

The effects of climate change for the Netherlands will be a rise in temperature and precipitation throughout the year leading to milder and wetter winters and drier and hotter summers with incidental but heavy torrential rains. Overall, agriculture and nature will be confronted with a combination of salinization, rewetting, droughts, and extreme weather conditions. For agriculture it means that there are higher chances of failed harvests, damage to crops and risks of diseases and plagues. On the other hand growing seasons will be longer and productivity can increase. The agricultural sector needs to adapt to climate change by

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altering existing crops to make them more suitable for dry or wet conditions and make them more resistant to diseases and plagues.

Regarding nature, species have already started to move and rather sooner than later species will become extinct or will move out of the Netherlands altogether, while others will stay in the country but will move northwards. New species will move from the south into the country with yet unforeseen consequences for relations between species. Nature can be helped to adapt to climate change by improving mobility opportunities for species by connecting fragmented habitats and by creating migration and dispersion pathways.

The difficulty in a densely populated country like the Netherlands where different social functions compete for the same space is to find the right mix of measures to fight the effects of climate change which will benefit both nature and humans. Agriculture has done a lot of damage to nature and will in the future compete with nature when it comes to measures to adapt to climate change. For instance, droughts will affect agriculture and one solution is to bring in water from other areas which however will not be suitable for local nature. Nature and agriculture can however 'join' forces. Agricultural plagues and pests can be combated by restoring nature areas in and around agricultural areas. The insects living in these areas are natural predators to many agricultural pests. Restoring nature areas can help in retaining water reserves and fight erosion. Restored nature in agricultural areas can attract tourist and provide alternative incomes to farmers.

There is a need for stakeholders like farmers, nature conservationists and national and local governments to come together to combat the effects of climate change while preserving the quality of the landscape and nature.

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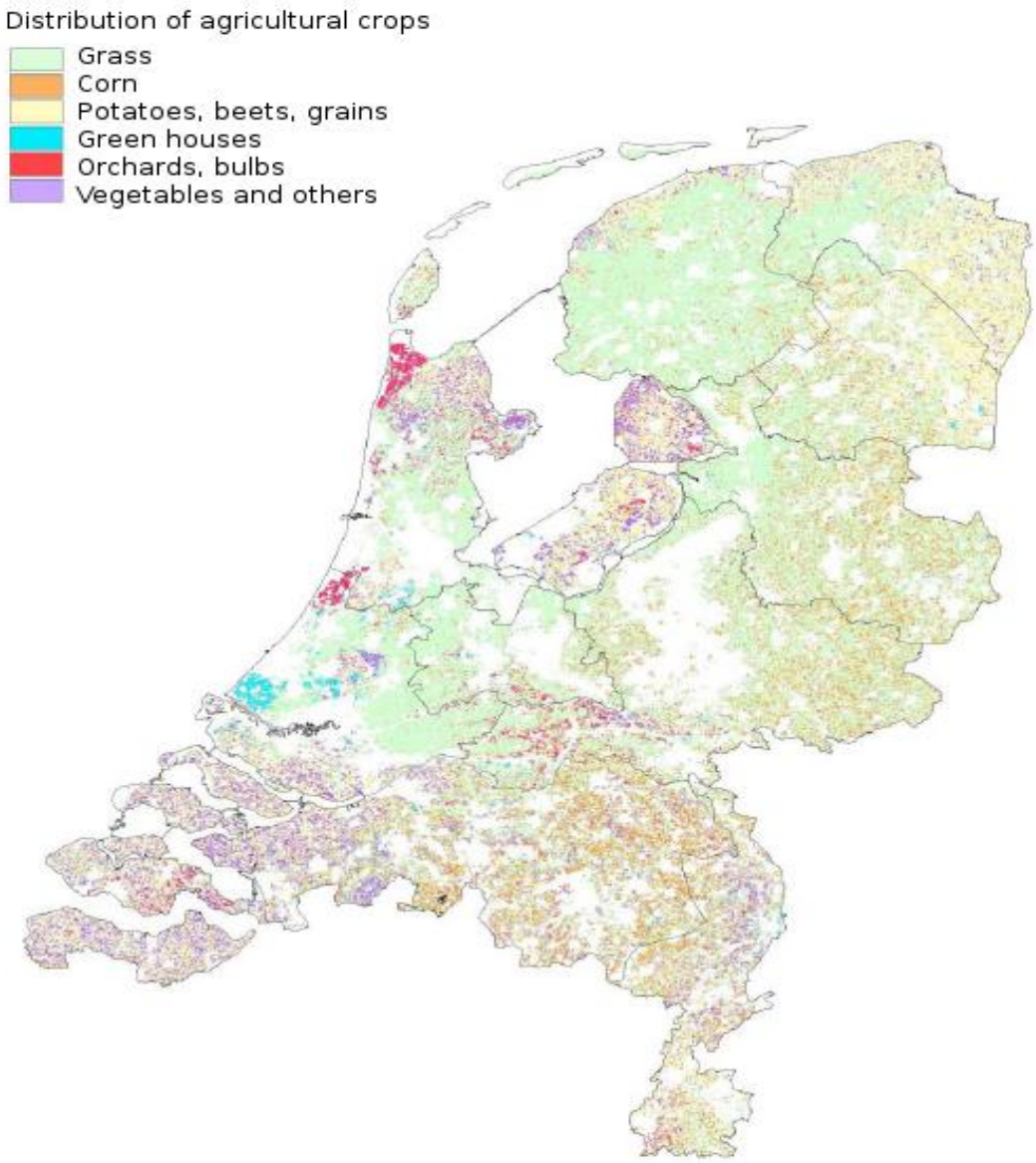
Annex I

Distribution of agricultural crops in the Netherlands (source: Alterra)



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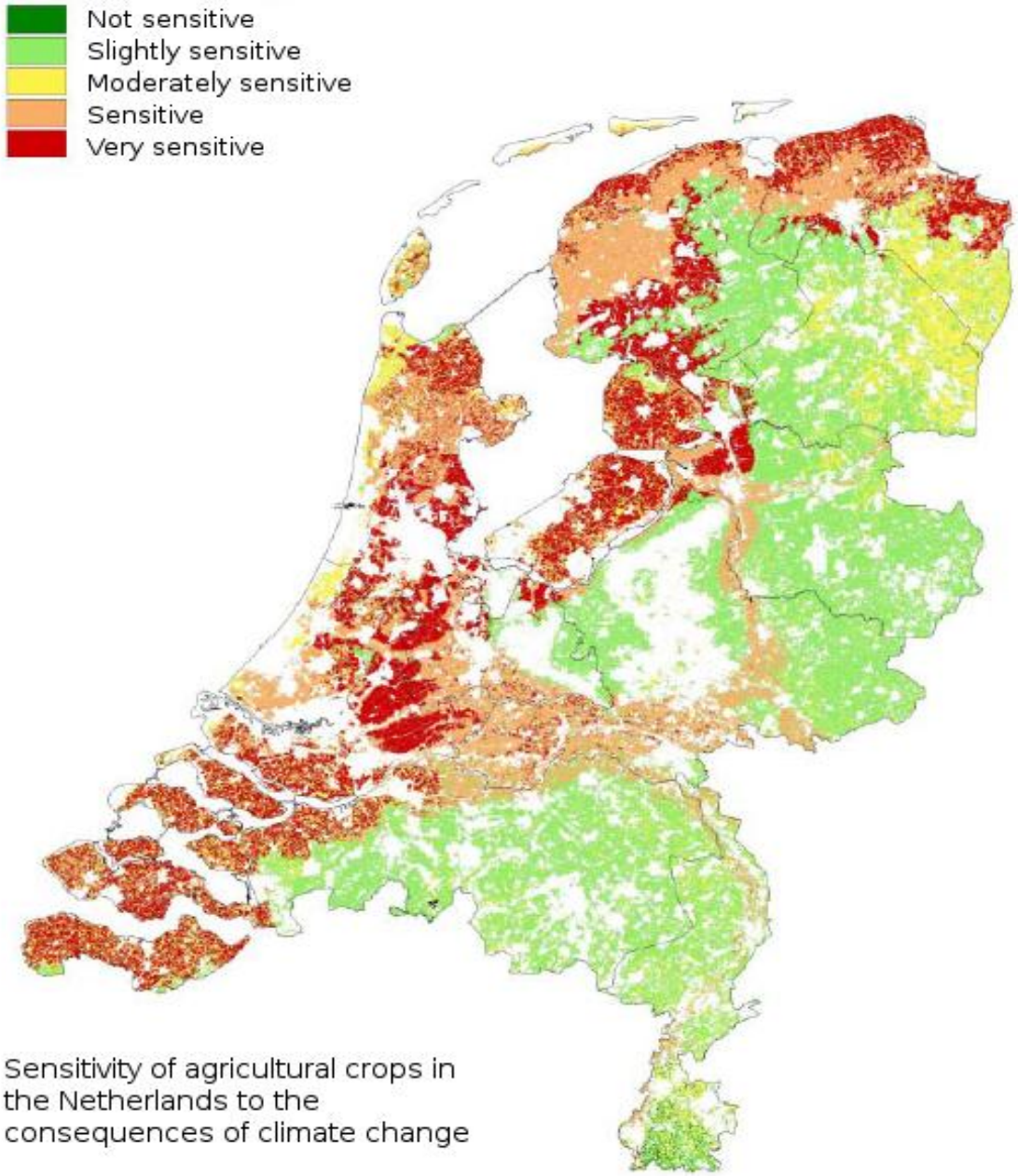
Annex II Sensitivity of agricultural crops in the Netherlands to the consequences of climate change



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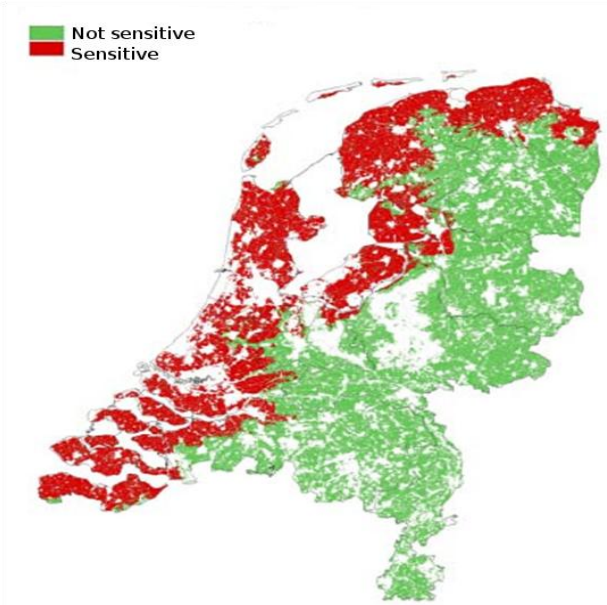
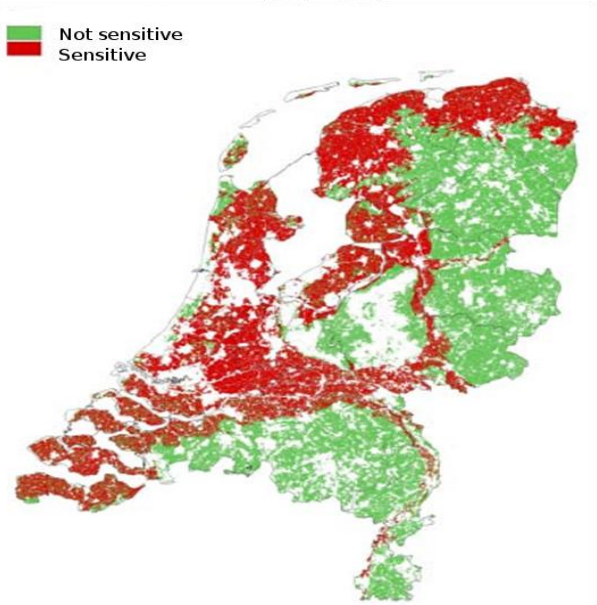
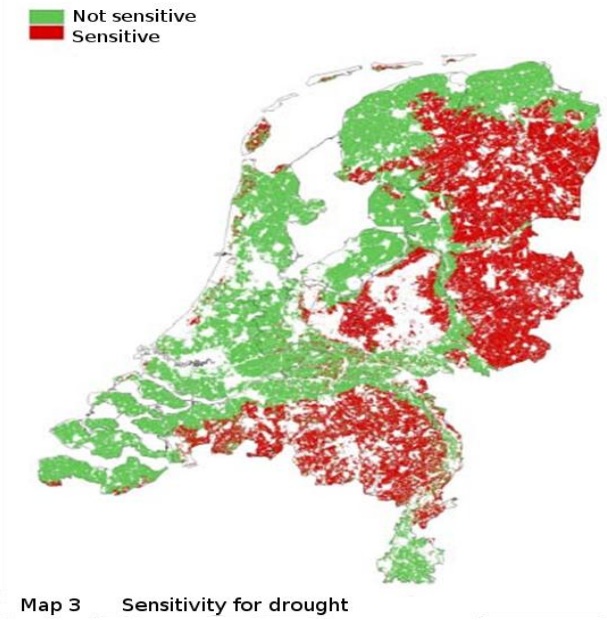
Annex III Sensitivity maps for extreme conditions



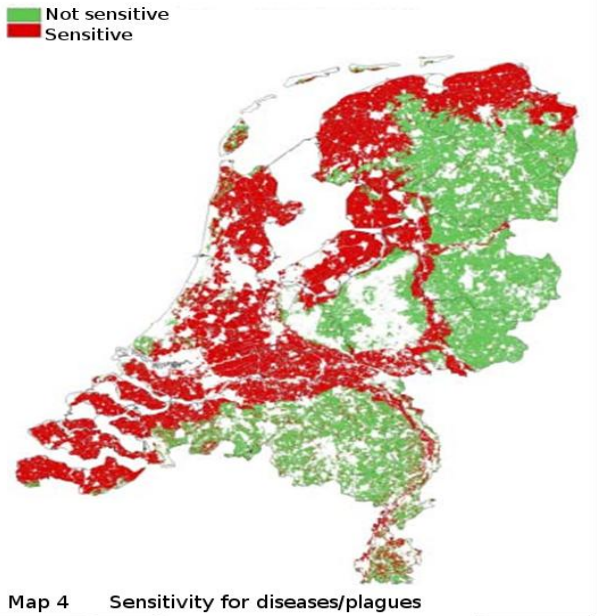
Map 1 Sensitivity for salinization



Map 2 Sensitivity for rewetting



Map 3 Sensitivity for drought



Map 4 Sensitivity for diseases/plagues

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Annex IV Ecological Main Structure (EHS) in the Netherlands

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Sustainable energy management - a prerequisite for the realization Kyoto Protocol

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Abstract

Energy management can be defined as the process of planning, directing, implementing and controlling the process of generation, transmission and energy consumption. Energy management is a kind of synthesis of phenomena and concepts of modern energy management (management), or the use of modern settings management in the energy sector. Furthermore, when outlining the basic settings for power management Modern management is based on the assumptions of sustainability and conservation of energy stability for present and future generations. Therefore, modern energy management can be seen as a kind of synthesis of three actuarial sciences: energy, sustainable development and management. Sustainable Energy Management is a unique new concept, idea and approach that require many changes in the traditional way of understanding and interpretation of energy management at all levels. Sustainable energy management concept cannot therefore be construed as an adopted and defined the concept, but must be constantly modified and adjusted in accordance with changes in the three areas that define it, and in accordance with the specific country or region where applicable. Accordingly, sustainable energy management can be defined as the process of energy management that is based on fundamental principles of sustainable development.

Keywords: energy, economics, management

JEL Codes: Q13, Q40, Q48, P48

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1. Introduction

Previous experience, theory and practice, clearly indicated the need to develop special mechanisms aimed at proper management of energy in all phases of its existence, at all levels in all time frames. The need for energy management has existed since ancient times in various forms, but it is only modern science and practice management, respecting the principles of sustainable development, provide an adequate framework for the implementation of the above mentioned problems. When designing the concept of sustainable energy management, it was necessary to proceed from the broadest framework that defines processes in this area, and relate primarily to two main factors that are important izuzeno, and that the size of the strategic issues that need to be addressed and assessed verme required to the proposed energy management strategy could be realized. Sustainable access to energy management and created just for these two characteristics that define it more and more powerful than a number of changes that are encountered in the history of mankind.

2. Concept of sustainable energy management

Energy management can be defined as the process of planning, directing, implementing and controlling the process of generation, transmission and energy consumption. Energy management is a kind of synthesis of phenomena and concepts of modern energy management (management), or the use of modern settings menažmenta in the energy sector. Furthermore, when outlining the basic settings for power management Modern management is based on the assumptions of sustainability and conservation of energy stability for present and future generations. Therefore, modern energy management can be seen as a kind of synthesis of three actuarial sciences: energy, sustainable development and management, which are interconnected and conditioned, as shown in Figure 1.

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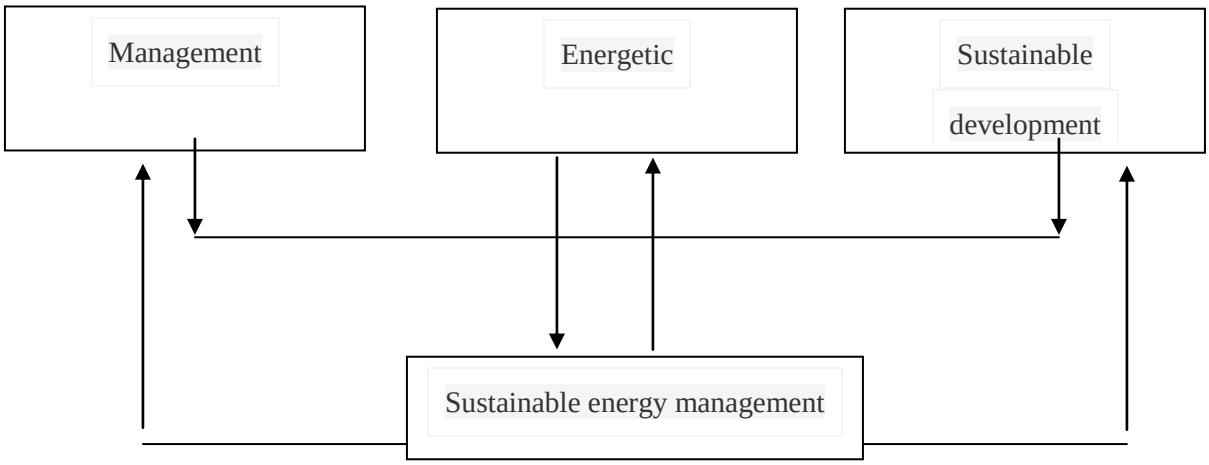

Fig. 1: The basic concept of sustainable energy management

Sustainable Energy Management is a unique new concept, idea and approach that require many changes in the traditional way of understanding and interpretation of energy management at all levels. Sustainable management of energy generated integrates many features of the environment. Sustainable energy management concept cannot therefore be construed as an adopted and defined the concept, but must be constantly modified and adjusted in accordance with changes in the three areas that define it, and in accordance with the specific country or region where applicable. Basically, the concept of sustainable energy defines the following parameters in the environment:

- Management and interpretation accepted theory, the existing experience, state regulations, navigation companies, the requirements of all stakeholders, level of education, awareness and commitment, and general orientation toward social responsibility;

- Energy. first of all legislation, existing energy resources, new energy resources, energy efficiency level, the level of technology development, production and consumption levels, system stability, connectivity with other systems, the degree of self-sufficiency:

- Sustainable development and acceptance of the concept at the state level, the ratification of the international agreement, the parameters of national sustainable development strategy, the list of priorities.

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Accordingly, sustainable energy management can be defined as the process of energy management that is based on fundamental principles of sustainable development. Sustainable energy management must therefore be regarded as a concept that greatly deviates from the traditional management mode, which has largely ignored the need of preserving, restoring and saving energy resources. Thus conceived, the concept of sustainable energy management is a major global change whose effects is felt throughout the world community, and imposes a need for major changes in the mode of behavior and thinking, responsible institutions, as well as each individual. Therefore, the concept of sustainable energy management can be seen as a challenge of modern mankind, which opens up possibilities for proposals and development of many solutions that will have long term consequences for the development of human society as a whole.

Because of all this is necessary, or the only possible main issues of sustainable energy management approach taking into account the known scientific settings, practices and taking into account the characteristics of the entity that initiates, accepts and implements energy management in a sustainable manner. In general, sustainable energy management involves the implementation of a number of different activities aimed at concrete goals of sustainable development into practice, production, transmission and energy consumption.

Traditionally measured from the point of social and economic development of the utmost importance is the implementation of those measures and activities that bring the most effective results in less time, but with the acknowledgment of the principle of sustainability, an imperative of time becomes less significant. Eligible activities are those that bring high-quality results regardless of the time needed to detect and measure the positive effects.

Given the complexity and globalism of modern business, and taking into account a number of problems and disagreements in terms of global trends and priorities for development, sustainable energy management cannot be defined through a series of stringent actions to be undertaken, but modern science and practice show that the activity in the field of strategic and operational management, and improving quality, and socially responsible behavior in general, became imperative when it comes to the realization of the concept of sustainable energy development in practice.

The problem is the theoretical "gap between current and desired state." With that in mind, it is necessary to implement appropriate changes and implement appropriate activities to a company or community lead to a sustainable energy business and therefore will solve the problems of this kind. Phases to more responsible energy business are the following:

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- Identification of problems (as a diagnostic activity), a specific phase for each company because each company is characterized by a number of differences and particularities in relation to other companies. If the management company set as the desired state of introduction of energy-sustainable business to a certain level (or completely), it should be in line with the objective to assess their own strengths and weaknesses defined. This is the stage set of company goals, which largely determines all other activities;

- Identification of development options, including prediction of activities that can be implemented to achieve the goals that are more energy-efficient dodnose business. While predictions of how that can achieve the set goals, each variant should be worked out in detail and realistic estimate. At this stage, a useful (but not critical) may experience companies in a similar situation;

- Choosing the most suitable variant leads to a set goal - energy responsibility. This phase involves making appropriate decisions (choice of several options offered) that determines the future course of action;

- Implementation of the chosen method to achieve the set objectives include a range of activities, requires the engagement of certain human resources, financial resources and time;

- Control and correction of deficiencies is a necessary activity that must be continuously carried out in order to timely correct the weaknesses and irregularities to which mainly comes from, no matter how many activities were planned in detail;

- Reaching the goal, which the company achieves a higher energy level of responsibility, which is certainly an appropriate way to inform all interested parties, especially consumers, owners and the community;

- Identification of (new) problem, thus returning to the beginning of activities and the company strives to improve its environmental activities on a suitable business to be continuous.

At all times relevant business service needs to monitor the situation in the region, which is primarily related to new requirements for energy-responsible business (which mostly come from consumers and legislators) and to initiate the previously mentioned activities. In all stages leading to the achievement of

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environmentally responsible businesses should be involved the whole management of the company, and if necessary, we can engage with the professionals.

Sustainable development itself is a kind of strategy of development of mankind which is restricted upon its particular, is subject to changes and adjustments. The effects of such development can be precisely measured at a certain point. But unlike traditional management, there is no strict orientation to reaching your goals. In fact, sustainable development is not defined in time and space, and involves constant improvement and improvement of, so it is not possible to reach a certain goal and then stop the implementation of sustainable development management process. Sustainable development is not a goal in itself, but a process that aims to continuously redefine and modify.

Thus defined the process of sustainable development makes it necessary for the application of certain traditional strategic management activities, enabling implementation and process control during the duration of which is practically unlimited. Sustainable energy management is not a very simply application of traditional methods of strategic management, but is their modification, which led to the development of a unique model of sustainable management that differs from the traditional and important measure questioned the justification of its implementation when it comes to sustainable management in the field of energy.

In order to design a strategy for sustainable energy development is above all necessary to set specific priorities for development. It is suggested five basic implementation of priority programs, which are diverse according to program content, but complementary from the standpoint of coordinating the operation and development of the whole energy system that is energy production sectors and the sectors of energy consumption and a gradual but consistent realization of the goals promoted in the future implementation of the proposed strategy.

- First-priority basic continuity of the technological modernization of existing power plants / systems / sources, in the sectors of oil, natural gas, coal with surface and underground mining, electric power sector, with manufacturing facilities: thermal, hydro and thermal power plant and transmission system or distribution systems, both the heat-district heating and industrial power plants.

- Second Priority-oriented rational use of energy quality and energy efficiency in production, distribution and use of energy by end users of energy services.

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- Third-specific priority use NRSE (new renewable energy sources) and new energy-efficient and environmentally friendly energy technologies and devices / equipment energy use.

- Fourth-optional priority for the emergency / urgent investment in new power sources, with new gas technologies (combined gas-steam power plants).

- The fifth-long term development and regional strategic priority, building new energy infrastructure facilities and electric power and heat sources within the energy sector, and capital-intensive energy infrastructure.

3. Future directions of sustainable energy management

Time dimension of the energy problem is particularly pronounced as huge especially by means of energy management, and consequences which consequently may occur. Meeting the demand for energy exists throughout the modern history of mankind. Over time they grew need emerged as new ways for faster and more efficient use of energy resources, but the situation at the end of the twentieth century led to the need for this trend of uncontrolled energy review, slow down and redefined in ways that would be consistent with the concept of sustainable development.

The future in the field of energy management is defined in a way that clearly distinguished commitment must slow down the exploitation of nonrenewable resources, that energy must be used efficiently and that all users have to adapt to the energy business and a new way of thinking.

These fundamental changes in the energy management are exceptionally complex, comprehensive, linked with a number of smaller and larger changes in all spheres of work and thinking. It is necessary to redefine the existing legislation, adopt appropriate strategies at global and national levels, adjusted for each business entity and individual consumers. Changes in energy management changes related to the global community as a whole, but also to every individual.

In addition to the time required to implement sustainable energy management strategies, in order to select the type of strategic implementation is necessary to consider the size and strategic problems. The energy problem is global, with an upward trend. It features a number of factors, which are primarily related to the increase in global energy demand, uneven distribution of energy resources, and expressed high degree of dependence modern man of his energy is available. Problems with the power lead to minor or major problems in economy, society, relations between countries and relations in the global community. It is expected that the scale of these problems in the future, perhaps larger and more complex battle. It is

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therefore quite correct to assume that the energy problem is one of the largest and most complex strategic problems facing our civilization.

Respect the time frame and estimate the size of the energy problem can be given to the proposal of possible ways to implement sustainable energy, as shown in Figure 2.

		Time for change implementation	
		Long	Short
The size of the strategic issues	Great	Sequentila intervention	Complex intervention
	Small	Evolutionary Intervention	Contorl intervention

Fig. 2: Types of possible implementation strategies for sustainable energy management

When a company is faced with small problems (small energy consumers) a period of time that it is available is not long enough, the implementation strategy will include a gradual or evolutionary (incremental) changes. If you have problems the company faces a small but a short time for which it is necessary to solve the resulting problem, which usually occurs in cases where the adopted new regulations that sharply define the changes in energy consumption, the activities carried out management (management action) directly to places where the problems began.

In cases where the company is a large manufacturer or a consumer of energy, should be especially careful to approach the selection of ways to implement sustainable energy strategies. Depending on how much time the organization has to solve the problem, there are two possible strategies. If the company is available a long time and emerging issues are large, it is sequential intervention or action in stages. However, if they are problems that cannot wait, apply a complex intervention and the management company must be fit (synchronized) changes in all parts of the enterprise.

In the sphere of energy problems may be that they have more or less potential impact on the situation in enterprises or a country as a whole, which largely depends on the resources which the country has and the way in which energy is being spent. Sustainable Development Strategy defines the energy problems in

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general as an area for which the essential need to solve a very long time, which is longer than the length of life for present generations and in addition there is a clearly defined position that the energy problems will never be able to fully resolve. The energy problem will be the constant companion of mankind for an indefinite period of the future.

A selected strategy for sustainable energy management is a highly complex process subject to the action of many influences. On the other hand, despite the clear front delimited proposed models for energy management, it is often not possible to select and implement a strategy without intermediate changes and adjustments. In addition, changes in the energy sphere are very numerous and diverse, and their impact on the sustainable management of energy is often associated with a host of economic and political change. Because of this, there are difficulties in trying to in some way to clearly define sustainable energy management. Every possible definition can be proposed redefined and vary depending on many factors.

4. Acknowledgements

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5. Conclusion

In line with these priorities, the implementation of which will let the achievement of sustainable energy systems in the world, it is necessary to access the implementation of local, national programs that will be defined in line with the new strategic approach to energy management. The traditional approach to strategic management is not fully acceptable for sustainable management.

The actual planning process should be concrete actions (implementation strategies) and planning decisions are only an intermediate stage of the planning process. Through the implementation of the strategy, the company implemented the ideas of concrete achievements. In the process of formulating strategy came to the forefront of entrepreneurship and visionary qualities of leaders, while in the process of implementation is important that the skills of human resources with the help realize those goals. Modern business is characterized by continuous change. Magnitude of the problem caused by change and speed needed to solve the problem, determine the complexity and speed of implementation strategies. Depending on the size of the company and the division of management style there are several approaches to

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implementing the strategy. Each of the approaches has advantages and disadvantages, and the task of strategic management is that, depending on the size changes caused by implementation of selected strategies and other conditions, creates a flow of implementing the strategy.

Implementation of strategic orientation is not a single process but a process that involves the provision and allocation of resources, creation of organizational, procedural, and other motivational conditions and making a series of individual plans for undertaking and coordinating activities for the realization of these goals. Implementing the strategy involves a complex process of creating conditions and integration activities to be realized the expected results. For the proper management of activities it is necessary to specify the responsibility and authority, to identify tasks and budget and allocate them to the carriers through a system of coordination and overall management of the implementation process. In this case, emphasis is placed on global issues affecting the implementation of the strategy. The major issues are concerning to the creation of appropriate organizational structures and business culture of the company, transforming the long-term objectives in the current levels of performance, management and implementation activities of the process control and audit strategy.

Sustainable energy management is an extremely complex process, both in phase and Preparation of planning and in implementation phase.

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Sustainable urban structures to challenge climate change

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Abstract

Public spaces within the city in all their form of different types - streets, boulevards, squares, plazas, market places, green areas - are the backbone of cities. Over the centuries buildings defined the shape and quality of public spaces, valorising them in various ways.

The post-modern development of urban form generated a great number of "urban spaces", where there is no longer correspondence between architectural forms and social and political messages: shopping malls and theme parks, inner public spaces, strip developments etc. Urban sprawl accompanied by loss of agricultural/rural land and its impact on the environment are serious concerns for most cities over Europe. To strike the right balance between inner city regeneration, under-use of urban land in the old abandoned sites and the ecological benefits that accompany the new private business initiatives in suburban areas, is one of the major challenges confronting cities in Europe.

The paper will analyze the complex relations between architecture and public space, in an attempt to understand how traditional urban structures, public and green spaces, squares and streets, could provide orientation for quality-oriented regeneration. Case in point is Bucharest - capital city of Romania - where aggressive intervention in the urban structure during the 1980s disrupted the fabric of the city. The investigation is oriented towards fundamental questions such as: how to secure and preserve sites that serve as initial points in upgrading processes, how to balance private investment criteria and the quality interests of the urban communities.

The major aim is to provide a support for decision making in restoring the fundamental role of public urban space in shaping urban form and supporting community life.

Keywords: public space, urban structure, regeneration, urban policy

JEL Codes: Q54

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1. Introduction

As early as the 1960s Jane Jacobs commented on the complexity of cities "Cities happen to be problems in organized complexity…Cities …do not exhibit one problem in organized complexity which if understood explains all…..The variables are many…they are interrelated in an organic whole". [1, p.446].

Urban structures of the 21st century were shaped by an historical evolution process, influenced by geographical structures, political and cultural environments. For some decades now urban planners are concerned in promoting sustainable urban development, addressing a wide range of issues. Several approaches emerged, among which environmental issues took a leading place (green design, ecodesign), along with their implications on health, quality of life and on the society at large.

Among the latest challenges is climate change that in fact goes beyond environment protection, involving most economic, social, cultural aspects of urban life.

Yet, urban structures are *resilient*. Mitigating the effects of climate change requires a long-term strategic approach. To achieve sustainability under foreseeable new conditions design professionals should develop innovative and creative solutions that would address all the dimensions of sustainability in the urban environment.

This paper will investigate one of such approaches carried out by young architects-to-be. It addresses a priority issue of urban re-modeling of Bucharest: to enhance the importance of the river Dambovitza cutting through the city, widening water surfaces and increasing green areas, for the ultimate benefit of the quality of life of the inhabitants.

2. The Context

Bucharest is criss-crossed by two main rivers: Dambovitza which cuts northwest to south east, through its centre, and Colentina, which develops over a series of lakes in the northern part of the city.

Seasonal flooding of the city and sanitation needs prompted in the 1980s the administration to proceed to taming its course by having its bed covered in prefabricated concrete slabs. The river bed was enlarged twice the original size, thus getting shallower; the sewage mains of the city were placed under it.

Several bridges over the river were demolished, breaking connections between the banks and briskly interrupting several important historical roads. Pedestrian walkways along the river were reduced in their dimensions. Unfortunately the former rich, almost wild vegetation was replaced by scarce trees. No attempts to form a bankside promenade along the river or platforms for any kind of sailing or bathing facilities were planned or encouraged. The river lost its appeal, and its architectonic vocabulary discourages its being lived or integrated within the city. Nowadays isolated by the most trafficked street in Bucharest running both ways along it, it provides no natural solace for the city dweller.

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Fig.:.Above, the river in the late 1970s (rezistentaurbana.blogspot.com), and beneath, the river nowadays (personal archive)

And yet, despite its lack of planned social comfort and urban furnishing, Dambovitza's banks have been metabolized: on sunny days courageous fishermen lounge its concrete slopes, some even attempt swimming (although nowadays going for a splash in the monumental fountains is a more common and, to a certain extent, safer practice).

Fig.2: Dambovitza, eastern side (personal archive)

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In what concerns the new interventions though, the attitude of obstructing the relationship towards waterscapes still continues. Constructions of private capital limit themselves to the investor's area without taking into account the increased comfort a public space along the river would provide: the properties are usually fenced around. Moreover, the municipality does not get involved either: the river banks and lake sides remain unattended to, and no public infrastructure or furnishings are being considered. The following images portray the current situation in the northern part of Bucharest, along the Colentina River:

Fig.3: Pantelimon quarter (photo Vlad Nanca, bükreshblog.blogspot.com)

Fig.4:The Casamea residential villas (www.casamea.ro): no territorial intervention whatsoever upon integrating the river banks as public, common space for the neighborhood.

Fig.5: The (unintended) ironically entitled "Waterlily Lake" new housing ensemble in Chitila; fenced in (ansamblurirezidentiale.ro)

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To second the urban intervention upon Dambovitza, a massive accumulation lake, Lacul Morii, was created upon it, in the North West side of Bucharest, holding a 246 ha surface. The role of the lake was to withhold any exceeding Dambovitza water that might have turned into flood. Walled by a 7 km long and some 5 m high continuous artificial hill topped with a concrete passageway, with only a few piercing staircases reaching its top, it is unperceived from the street level. Once at the top though, the image is impressive- it seems the whole city has been transported at the seaside, since the dimensions of the lake are as huge as the surprise of finding it there.

Fig.6: Morii Lake, 2009 (personal archive)

Although in this case the original goal of constructing the lake included using it as sportive infrastructure, the intention was never carried out. Excepting brave fishermen clinging to the slopey concrete banks, neighboring inhabitants washing their carpets and stray dogs, the lake attracts no one, taking on to being residual, hidden.

Fig.7: Lake banks poached as public space: fishing, washing and drying out, jogging tracks marked by dilatation joints (metropotam.ro, listenoire.ro)

Since 2007, marketing scouts have been attempting to place the island of the Morii Lake among the hip venues, organizing the CokeLive concert series.

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Fig.8: Cokelive 2007

3. A new dimension and role for the river

Last summer we put up a workshop for Urban Scenarios in order to Dis-still Bucharest; we approached the search for solutions starting from what Bucharest offers us, turning its problems into advantages and departure points towards a sustainable, feasible and characteristic development for both the city and its users. We had 13 students participating, organized in five teams, each having chosen a keyword as theme. The aim of the workshop was the production of one manifesto for each theme; on one hand a manifesto gives a decisive character to the proposal, on the other hand it draws the public's, the city users' attention.

We are going to present you the work of two students who chose Water as their keyword; the curious inconspicuousness of the Dambovitza River inside the city being the challenge in the approach of their project.

After carrying out an analysis of functions along its banks and their scarce connection to the water front, a quite radical and strategic idea sprung out: dividing the banks according to traffic use. One bank would become pedestrian and open towards the river, allowing users to benefit from its presence, while the other bank would take in all private car traffic.

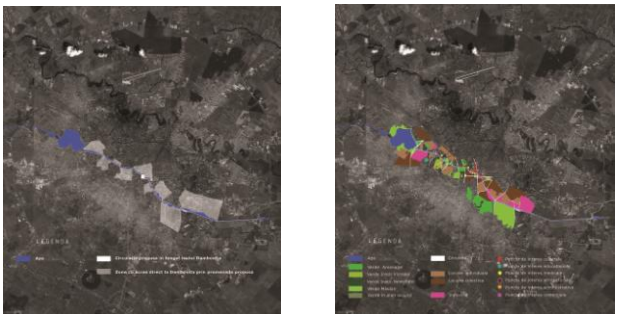

Fig. 9. Pedestrian and open towards the river and private car traffic.

The division follows the functions along the river: areas of public interest, cultural zones and residential neighbourhoods would be served only by public transportation and their banks would be topographically re-modeled in an organic, free manner, enabling the public to come into direct contact with the river. The other

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functions would benefit private car traffic and a more remote approach to the river side. The banks thus alternate in their use, but both integrate the river in the urban space and users' daily life.

Fig. 10: Banks thus alternate in their use

Their manifesto focuses on the Opera Plaza.

Fig. 11: Opera Plaza

4. Conclusions

The case study presented above is but an example of how can traditional urban structures provide orientation for a new type of development that would contribute to mitigating climate change in our cities.

A number of other priority issues may be dealt with, such as inner-city green areas, re-use of brown fields within the city. They are of great importance both for the quality of urban life and could contribute to mitigating climate change.

We believe that scientific exchange, knowledge transfer, complex cooperative actions between countries of our region would foster a pool of knowledge in the interest of sustainable development in

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South East Europe. We should tap on the creative potential of young professionals and students in finding solutions that would solve future problems, namely by:

- ✓ identifying priority areas of action
- ✓ devising new methods of understanding the context of urban design
- ✓ finding methods of testing and predicting the consequences of development proposals.

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Adapting of Economic Development to Climate Change

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Abstract

Climate change is the most complex challenge that humankind has had to face in recent times. With each successive generation, redressing the imbalance will be more difficult. Diverse and complex requirements of maintaining life on Earth, collectively called the environment, can be caused both by natural, geophysical factors, and anthropogenic or social factors.

There is a lot of evidence that the economic activity of mankind is a major anthropogenic factor in current turmoil of the environment on Earth. Since the middle of the nineteenth century, the anthropogenic impacts on the environment are becoming increasingly important, and undoubtedly dominate. Of all forms of economic activity the greatest impact have the activities related to energy production and use in various sectors. The link between environmental conditions and economic activities has become the subject of separate scientific disciplines that are dynamically developing in the second half of the twentieth century.

Economic growth of the economies, especially of developed countries, in seventies and eighties of the twentieth century, drew attention to the growing international economic, political and ecological interdependence, particulary in terms of its ecological outcome. The future economic growth of all countries on the planet is becoming a global problem.

In this context, more attention must be paid to the relationship between population, resources, and environmental outcomes on one side, and long-term sustainable economic development on the other side. In the recent time there have been noticeable the increasing number of problems that are becoming global: economic, social and energy problems, and contain ecological basis. Human decisions and activities are dependent on ethics and view of the world, and this view depends on the culture, tradition, achieved level of development and so on.

Therefore, it is necessary to adjust economic development to climate change, where a great importance plays cooperation between the public and private sector.

Keywords: Economic development, Climate change, Environment, Economic growth, Globalization.

JEL Codes: Q54, Q56, Q44, F4

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1. Introduction

"Missed opportunity never returns"[1]

There is almost no man in the world who has not heard for climate change and its meaning, at least in some extent. The point is the fact that gases generated in industrial production and greenhouse gas emissions, lead to increase of climate temperature on Earth which in the future can have catastrophic consequences. Nevertheless, the vast majority of people do little, or does nothing to change their habits in everyday life, even though they are a source of danger that threaten our climate changes.

One can not say that we are not aware of the occurrence of climate change. On the contrary, many books have been written related to climate change and their potential consequences. For at least twentyfive years or more, authors and others are expressing great concern about the warming of Earth's atmosphere, but without significant results. In recent years, the issue erupted in the foreground of discussions and debates and not only across countries but across the world. However, as humanity, we are just beginning to take necessary measures against the dangers which we face our next generation. However, global warming, due to its importance and because it is mainly related to the future, is the problem that is different from all others. It is a danger that seems abstract and elusive, despite the potential destructiveness of its consequences.

Politicians are becoming aware of the importance of this problem and the urgency to solve it and therefore, many countries have recently started to implement an ambitious policy on climate change. In recent years an important step was initiated: Most political leaders became aware of the risks that climate change means and the need to respond to them. It is only the first step-the introduction of the topic in the realm of politics and economics. The second step would have to mean that it becomes part of our institutions and everyday concerns of citizens, and in order to do that, much more needs to be done. The international community has been launched, at least in principle. In order to reduce worldwide emissions of greenhouse gases, the United Nations are organizing talks on limiting global warming. They started in Rio 1992, continued in Kyoto 1997 and after that in Bali in 2007. Discussions are still been held, but without significant and concrete results.

[1] Slović Dragoslav, *Epigrams*, Fineks, Belgrade, 2011.

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Emissions markets can function only with a fixed maximum price of carbon, and such decision, and its implementation in practice, is a matter of politics and economics. Crucial impact in reducing emissions of greenhouse gases will have the technological advances, but it has to be conducted with support from the government. The only existing large supranational Community, European Union, is highly dependent on decisions made by its member states, because EU has only limited authority over them.

The role of markets in mitigating climate change is more than simply controlling the emissions. Market forces, in many areas, can achieve what no one else can. In general, when the price of ecological goods can be determined without compromising other values, it should be done, because the competition will contribute to greater efficiency in every exchange of the goods. Environmental costs incurred as a result of economic processes, often lead to what economists call "independent external influences"- are not borne by those who caused them. Therefore, the objective of national policy should be to ensure that these costs, whenever possible, be an internal matter, namely the market's matter.

Countries which are the vanguards in creating policies and economics related to climate change, and developed countries need to be those, may face the problem of competition. Their economy may fall into difficulties, because they must be exposed to competitive goods, that somewhere else, where there are no environmental taxes and regulatory restrictions, can be produced more cheaply. A number of business units and groups have used this reason for the slow response to the initiative for the introduction of measures to mitigate climate change.

Finally, there is a number of important issues about the technology. Key importance, in solving the problem of climate change, are investments in renewable energy. But these sources will not occur spontaneously, or only under the influence of market forces. To withstand the competition of fossil fuels, they must have a financial support of the government, and government must protect these investments from the impact of inevitable changes in prices of oil and natural gas. Technological changes may be predicted only in a limited extent.

Creating a policy on climate change requires new ideas, and one of which refers to the *guarantee government*. "When it comes to climate change, countries must provide, facilitate, encourage and support the diversity of social groups that drive the development of such policies. But it can not be limited to providing, as it must to ensure achievement of concrete results-especially the progressive reduction

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of emissions. Government guarantee is a government that is able to achieve such results, on which may rely not only its citizens but also leaders of other countries."[2]

2. The Politics of Adjustments

Borrowed from evolutionary biology, the term "adjustment" is widely used in texts on climate change. In some ways it is misleading, because it means responding to the consequences of climate change when they occur. But just as it is the case in efforts to limit global warming, the adjustment has to come onward and it must have a preventive character.

For adjustment is said to be "exposed to ridicule and miserable cousin of emission reductions".[3] Among the supporters of environmental adjustments, debates were at one time a taboo in fear that they could adversely affect on efforts to mitigate climate changes. Undoubtedly, however, is that the times have changed. In Bali, the same discussions were held related to adjustments as much as reductions.

Problems related to adjustments to climate change are in some way even more complex than those relating to mitigation. Because, if we are to be prepared to adjust before the climate change really occurs, or while they are still at an early stage, we need to determine what will be the consequences of global warming in many areas in which they will affect. It is important to determine the activities of adjustment policies, because they can be helpful in determining the direction of our effort. There is a difference between the subsequent adjustments and adjustments to possible future developments. Adjustments to possible future developments are often referred to as proactive adjustments (PA).[4] As part of our present knowledge - and the available resources - PA should be at the heart of all our reflections about adjustments, although subsequent adjustments are certainly going to be necessary.

The essence of the PA is in diagnosis and the ensurance of sensitive areas and spots. Sensitive area is a risk- the risk of compromising some important activities, lifestyle or resources. Sensitivity is obviously the economic and social concept and it is not reffered only to the physical environment. When we talk about it, we must consider also its opposite side, resistance. Resistance is defined as the ability to adapt, the

[2] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, page 16.

[3] European Commision: *Adapting to Climate Change in Europe*, Commission of the European Communities, Brussels 2007.

[4] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, page 197.

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ability not only to non withdrawal to external changes and turns but also, whenever possible, activity and positive reaction to them. This may be characteristic of the physical environment, individuals or a group. The first case concerns the ability to withstand the environment created by changes of various kinds. It, for example, may take the form of retaining the existing embankments, or the timely construction of new ones, which serve as a defense against expected flooding. The second case relates to the individual's character traits - his ability to cope with adverse circumstances and to overcome them. As for the group, this trait refers to factors such as the ability of community members to work together, not divided and individually, and if necessary, modify and even reverse the current way of life. For example, small farmers who grow more crops will be more resilient than those who cultivate only one crop and depend on it.

Political and economic convergence are equally important for climate change adjustment policies as well as the way of their policy mitigatation - it will definitely affect how people will accept the proposed measures of all kinds. What is present all around is very limited effectiveness of policy of intimidation and provoking anxiety. The "polluter pays" principle is important as in the case of mitigation, both within individual countries and their mutual relationship. Rich countries must take much of the responsibility to adapt, at least when it comes to developing countries, just as they have to make efforts in limiting the development of global warming. Developing countries are much more vulnerable to the effects of climate change from the industrial developed countries, partly because many of them are in areas with unstable climate, and partly from the reason that they do not have the resources which are to be provided and ensured by already developed countries.

As in the case of the mitigation of climate change, but also in the making of policy and its implementation, the leading role must have the government. In order to support the process of adjustments, the government must encourage innovation and creativity in various fields of business and society. Involvement of citizens is required, and the rights and obligations must be allocated to different levels of management. A significant political problem is the fact that the financing of adjustment projects will inevitably be competitive investments necessary to mitigate climate change.

What the country needs to do in terms of adapting will depend to a large extent on its climate and geographical position. The U.S. has one of the most unstable climates in the world, extreme forms of its expression will become more stronger and more frequent. In countries with moderate climates such as Northern European countries, climate change may initially have some positive consequences.

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The first task in the adjustment policies for each country is to make a thorough review of vulnerabilities on the local and national level. Adjustments can contribute to innovations in the same way as mitigation strategies. At least a part of such changes would be beneficial per se, regardless of climatic events-such as greater efforts in savings of water, improved weather forecasting systems and planting crops resistant enough to succeed in adverse conditions.[5]

Adjustments are bringing us back to the question of planning, because it implies systematic thinking in advance. It should be understood not only as the search for vulnerabilities and its repair, but also as a result of the research of indirect potential mitigation strategies.

3. Emissions Market

The creation of emissions markets was made in Kyoto, but, like all forms of policies on climate change, it was influenced and affected by political and economic interests. The European Commission had initially planned to impose tax on emissions in all member states within its programs related to climate change. This has failed from a known cause-it can not overcome the opposing views of member states in relation to taxation.

Creating a market which would restrict environmental pollution, originates from the United States, where, at first, such markets were relatively successfully used to control emissions of sulfur dioxide.[6] These emissions, which come from coal-fired power plants, were the main cause of "acid rains". But, instead of just reducing the quantity of sulfur dioxide, the creation of market with authorizations for its emissions has been made. The original proposal by Robert Stavins, the main author of the plan, consisted of authorizations which are than sold at auction shows to creators of emissions and thus establish their market value. But, it has been blocked in the Congress. Its adoption would mean that companies, whose products are subject of the consumption, had to pay large sum of money for such authorizations, which would be poured in the treasury of the federal government.[7] Despite the shortcomings, the plan, in practice, led to a significant reduction in emissions, and with much less total cost than the industry representatives argued, who opposed the plan. The resulting market forces have contributed to the rapid creation of effective technological innovations in key industrial areas.

[5] Prins Gwyn, Raynor Steve, *The Wrong Trousers*, James Martin Institute, Oxford 2007, page 33-34.

[6] See: MacKenzie Donald, *Making Things the Same*, School of Social and Political Studies, Edinburgh 2008; and article „Constructing Emissions Markets“ in the book *Material Markets*, Oxford University Press, Oxford 2009, chapter 7.

[7] Ellerman Denny et al., *Markets for Clean Air*, Cambridge University Press, Cambridge 2000.

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The preliminary plan for a possible international emissions market was made in Kyoto. It was agreed that industrialized countries can sell to each other "emissions reduction units", and that they can trade with developing countries and also that it can be take into account in terms of achieving their emission reduction quotas. EU system for emissions trading began operating in early 2005. It included about half the CO_2 emissions in the EU-ones from the continuous production of energy, especially electricity, and from some countries with high energy consumption. It is not related to other gases that cause greenhouse effect. The goal was the creation of an open market with a single price for carbon emissions. However, a system that was introduced, was giving member states the right to determine their own national emissions quotas. The consequence of previously mentioned was oversized authorizations, because it was in the interest of all member states to provide themselves as much as possible favorable terms or at least some maneuver possibilities.

The European Commission stated that Phase 1 of the EU system for trading gas emissions was "phase of getting the experience" and that it will find a way to implement stronger market capitalization, in the process of market development. In order to prepare for phase 2, the national authorizing programs will be much more strict than it was reviewed before. More than 60% of authorizations will be sold at auction and it will, in addition to CO_2, include other gases that cause greenhouse effect.[8] The Commission intends, after 2012, to include in the system maritime transport and forestry. Unlike most of the voluntary emissions markets, it is based on authorizations rather than on projects-in other words, it is mutually determined by market capitalization.

When it comes to cash flow, in the period 2003-2008, market emissions are progressing rapidly. Data from Directorate for funding gas emission reduction of the World Bank, suggested that under such projects in 2008, enabled the exchange in the value of 337 metric tons of carbon dioxide, more than double compared to the previous year, in which was recorded an increase of that trade by 40%, in comparison to year before. Will this tendency maintain under unfavorable conditions of global economic situation, which means less confidence in the markets, is a matter of assumption. Markets for gas emissions trading will certainly exist, although at this point, it can not be said how much emissions trading system-which is by far the most important one-in its modified form, will be effective.

As past experience, with the system for trading gas emissions shows, it will not be easy to estimate their contribution in restriction of these emissions, even though this limitation is their primary reason

[8] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, page 239.

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for existence. The leading author of Stern's review, recently proposed a "new global deal on climate change."[9] Stern wants to contribute to negotiations on global agreement for the period after 2012, with the intention of reducing the concentration of gases causing the greenhouse effect, to 450 and 500 ppm CO_2e. Given the already existing amount of these gases in the atmosphere, he says, that goal is very difficult to achieve, and no large country or group of countries, should lag behind in achieving the required reduction in emissions. "Each country must fulfill its obligations ... When you determine the basic parameters, governments around the world must commit to implement real concerted measures."[10]

Gas emissions trading will enable achievement of global goals in the most efficient and economical way, but the markets will have to be carefully planned and used in practice, because wrong measures can lead to their activities in the wrong direction, false incentives and increasing of protectionism. Stern predicts that by 2020, worldwide, will exist a system of market capitalization and gas emission trading that would include all industrial countries and wealthier developing countries.

The financial crisis shows that the international markets must operate more efficiently in the economic terms, and it takes time.

4. Tax Emissions

Systems of taxation will have an important role in stimulating innovation and, to some extent, in their guiding. Taxes are one of the main tools of governmental policy and in efforts to reduce emissions, they will certainly be of great importance. In the discussion of those who support emissions trading, and those who prefer its taxation, we consider the latter option is more appropriate, although the two strategies can be applied simultaneously.

There are two types of taxes which has the immediate cause of greenhouse gases: those whose funds are, in part or in whole, used to protect the environment, and those, whose aim is to comply people's behavior with the objectives regarding climate change. For example, taxes whose funds are invested in the development of renewable technologies can be included in the first category. Other taxes can serve as an incentive or as a punishment.

[9] Stern Nicholas, „*Key Elements of a Global Deal on Climate Change*", 2008. Available on LSE web site.

[10] Ibid., page 10

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From an economic point of view, the purpose of taxing emissions is elimination of external influences, when it comes to environmental protection, to determine how much they really cost, including future generations. As in many other policy areas related to climate change, it is easy to present the principle, but it is often difficult to implement it in practice. For example, the cost of food production in the modern agriculture, which uses artificial fertilizers and pesticides do not include their adverse effects on arable land. They also do not include any emissions produced by transportation of food to all parts of the world. It is not easy to find the right price, and that goes for many other areas, having in mind the complexity of modern manufacturing processes. These taxes should contribute to energy conservation and use of innovations at the beginning of the production cycle and thus to reduce the need for subsequent interventions and recycling. Concerning the de novo emissions, tax should be capable of being trade for. In other words, citizens should have the opportunity to exchange tax in other areas. Such strategy can sometimes lead to "double win"- to limit pollution and at the same time benefits of other types. [11]

The widespread assertion is that, to the possible extent, taxation should include the "bad" (source emissions), not "good" (such as employees, in the form of income tax).[12] This is in accordance with the "polluter pays" principle. However, it should be noted, that this is not black and white situation, as one might think, because we want to tax and to contribute to the active engagement of "good" source emissions in solving the problem of climate change-such as investment in renewable technologies. Taxation of "bad" means that they will rapidly replace the "good" ones, to the extent that taxation can contribute to social and economic changes, hence the revenues from these sources will inevitably decline, even if taxation take the form of tax incentives. Therefore, we must bear in mind the overall tax system, because everywhere will need to be introduced compensatory changes.

In many countries it has been thoroughly discussed about the possibilities of immediate tax exchange. Thus, an analysis in the United States showed an exchange tax of fifteen dollars per metric ton of greenhouse gases to reduce the federal income tax on earnings of employees on first 3,660 dollars of earnings of employees.[13]

How potentially regressive impact of taxing emissions raises concerns of many, it should be considered some of the proposed strategies for its counteract. In a survey conducted in the UK, Rowntree

[11] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, page 182.

[12] Ibid., page 183

[13] Metcalf Gilbert, *A Green Employment Tax Swap*, The Brokkings Institution, Washington 2007.

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Foundation analyzed four areas in which these taxes have been introduced or are seriously considering of introducing them.[14] These were the areas of energy and water supply, transport and waste in households. The purpose of the analysis was the consideration of ways in which the negative impact of taxes on the poorer segments of the population could be neutralized.

The survey confirmed that, if general terms and conditions remain unchanged, environmental taxes in these areas would have a significant negative impact on poorer households. Population with low incomes, tends to conserve energy, maybe even to the detriment of their own health, especially when it comes to heating.[15]

All proposed strategies are complexed, which means that it is not easy to achieve the ambitious goal of harmonization of taxation of emissions and simplicity in use of taxation, while protecting the poor. It seems that so far no country has engaged in an extensive review of taxation effects of greenhouse gas emissions, and it is certainly necessary because virtually all the individual taxes have only indirect effects.

But unlike taxes on emissions, they do not make the income tax for the government, but instead create new large costs that must be covered and thereby contribute to inflation; in addition, changes in oil and natural gas prices can not be reliably predicted. There is also the danger that it can lead to the return to the use of coal. This means that tax emissions are surely needed, but developments in world energy markets will inevitably affect the areas in which it will be needed and how much, as well as how much will be in the form of incentives rather than punishment.

5. Limitation of Emissions

Limiting emissions has supporters and opponents. Those who support it are attracted to its apparent simplicity, the general character and radicality. To each citizen it would be designated the amount of annual emissions in the energy consumption in households and to travel, including travel by plane. This amount would be the same for all adults, and somewhat less for children. Its respect would be a liability. Here, the crucial role has the government, because it would not only determine the level of quotas, but would also control their use.

Allowed amount of emissions of gases each year would be reduced to a predetermined percentage, in accordance with the realization of national goals to reduce these emissions. Individuals whose lifestyle involves small emissions could sell their surplus of emission at market prices to those whose power consumption means more emissions. In principle, this might include the companies and organizations,

[14] Ekins Paul, Dresner Simon, *Green Taxes and Charges*, Rowntree Foundation, York 2004.

[15] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, page 185.

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not just individuals. Allowed emission amount would be divided into carbon units. Anyone would get "smart" card to the annual allowable amount of emissions which would make redundant many of the specific government programs to encourage savings and people could decide themselves how to use their quotas.

Three different versions are suggested-exchangeable energy quotas, quotas exchangeable for households and personal carbon quotas. The proposer of the first is David Fleming.[16] It would also relate to the organizations (including government) and individuals. The upper limit of emissions would be determined in accordance with the objectives of reducing emissions at the country level. The plan would include in the oil, natural gas, electricity and coal. Individuals would be able to sell their units immediately upon their acquisition, and, if necessary, to re-buy them in the market.

Roberts and Thumin[17] emphasized that the introduction of restrictions on emissions will directly make it easier for people to change their behavior. It is possible that it will motivate them to action, but it will not be provided to them. Limiting emissions can not, therefore, be a substitute for other measures necessary to curb emissions of gases that produce greenhouse gases. Roberts and Thumin have done what they believed to be missing – they gave a detailed analysis of the arguments for and against this approaches.

Suggestions to limit emissions of these gases is not possible to test with the pilot survey. The main reason for this is for that to function, the program had to be forcibly put into practice. Roberts and Thumin do not perform any strong conclusions, but based on their observations, there is the standpoint that the limitation of emissions is impractical and unworkable. When this whole idea is carefully considered, its apparent advantages disappear.

6. Conclusion

None of the approaches that is based mainly on the deprivation will not succeed. We must create a positive model of low carbon future that will, in addition, be consistent with the current everyday life of common man. Such model does not currently exist and we need to find it. There has to be a vision emerged from the political, social and economic contemplation. It can not be utopia, but it will have features of utopian ideals which should be pursued. It is necessary to achieve a mix of idealism and persistence. For

[16] Fleming David, *Energy and the Common Purpose*, Lean Economy Conncetion, London, 2006.

[17] Roberts Simon, Thumin Joshua, *A Rough Guide to Individual Carbon Trading*, Centre for Sustainable Energy, London 2006, page 3.

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example, lifestyle changes that contribute to the reduction of greenhouse gas emissions will directly affect the economy. If they are due to create greater employment opportunities, than currently available, they will have a direct and pragmatic value.

To achieve these goals it will be necessary to establish vigorous management of companies, NGOs and citizens, who will also need to create new forms of joint action and cooperation and, where the situation requires so, to fully use modern communication network. Governments need to set themselves ambitious goals. For example, in finding new ideas and technologies can create competition that would include recognition and awards for outstanding achievements.

Some measures will have to be very harsh, many will be unpopular and will trigger to resistance. On the path of reforms often stand powerful interests and they must reach a compromise. The attitude of many authors is that even very severe restrictions, if they are properly approached, can create new possibilities and in practice it almost always happens. In response to climate change and ensuring energy security, we can expect a large number of technological innovations and should do our best to encourage this processes. Without such innovation is not possible to imagine the end of our dependence on oil, natural gas and coal which are the main sources of environmental pollution. The transition to renewable energy sources is essential and must be very extensive. But research shows that the penetration process of technological change in the overall economy and society could take years. For the problems we face there are no quick solutions - what is forthcoming, is hard work, and even with significant breakthroughs that we accomplish and that we really need.

But the reward is exceptional. Ahead of us is a completely different world, if we can find the way to it. The world in which not only that climate change is curbed, but where there is no more oil domination in world politics.

Finally, we could finish with some selected proposals by Anthony Giddens, in his book The Politics of Climate Change, which are extensively used in research of this paper:[18]

1. Strive for political and economic convergence, whenever possible, and do it actively. It is important to create the vanguard of entrepreneurs, that will draw the maximum benefit from the economic benefits of professionally guided environmental policy. Fear and anxiety are not always effective motivators, especially when the risks are abstract and threats are distant. In addition, the risks of climate change, how the public perceives them, are just one of many concerns.

[18] Giddens Anthony, *The Politics of Climate Change*, Polity Press Ltd, Cambridge, 2009, pages 1-22.

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2. Try to introduce care about climate change in the daily lives of people, although it is very hard to do so. Sometimes the best way is indirect. The public would likely respond rather to the initiative to save energy, than to the warnings of the dangers of climate change. It should not discuss much about goals. What is important at this point is how to determine policy on climate change. Setting goals can serve as an excuse for inaction, rather than the other way around. Taxation of emissions is a good thing, but those taxes must not be introduced individually. It is necessary to make a complete review of the tax system.
3. To establish accurate procedures for assessing long-term nature of risk, because the policy in terms of climate change, involves complex measures. We must create a future where the majority of energy needs to be supplied from renewable energy sources. It will be a truly far-reaching transition, with an abundance of complex social and economic consequences. Intensive and constantly cooperation with other countries, regions and cities in the broader global network. Adding to its politics some utopian thinking, since in any scenario, we are going towards a society that will ultimately be quite different from today's. We have to take a chance.

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Ethic of responsibility and the future of nature

Miso Kulic, PhD

Abstract.
The question of science is the one that concerns the very foundations of our reality and, in addition to that, it is a question that deals not only with our natural reality, with what was once called the "natural nature", but also with social and technological reality produced by science itself, which for a long time now is our second nature. Science has become not only the instrument by which we try to understand the reality of nature, through the process of creating reality, forming and transforming nature, it has become the reality in which we live itself, and without which, as it seems, we could hardly go on living. However, even though science as an instrument for understanding reality has become the reality which we have produced ourselves, we are still, paradoxically enough, far from answering the essential question: What is science?
Since the question of science is at the same time the one of the production of reality, it is obvious that the question "what is science?" does not amount to a self-evident question asked by a scientist regarding his scientific field. It is not only a question concerning the nature of scientific knowledge, or of scientific methods of scientific results achieved. What is at stake here is the insight concerning social and political usage of science, that the reality, which is produced by the sciences, reveals to us even in the forms of its deification, manipulation, ideologization and virtualization. Is persevering in its science-Enlightenment paradigm of human emancipation or does it, on the wave of critical self-reflection spanning all the way through the 20th century, more and more question, as Paul Feyerabend (Against Method) does, the extent of constraints imposed on free thought which it produces itself? Of course, the other side of the questioning itself belongs here too: scientific progress can be evaluated regardless of its consequences, of the dangerous threats it poses to our future: nuclear annihilation, ecological pollution or climate changes which endanger the survival of the living world?

Keywords: question of science, social and technological reality, scientific progress

JEL Codes: I31, I20

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1. Introduction

Question about science[1] is the question of the very foundations of our reality and in addition to that, it is an issue that concerns not only the natural reality, "natural nature" as it once was called, but also social, technical and technological reality that is produced by the science itself and which has already been our second nature for a long time. Science has become not only the instrument by which we understand the reality of nature, but producing a reality, shaping and transforming nature – it has now become the reality in which we live, and without which, it seems, it is more than difficult that we might live. However, although science as an instrument for understanding reality has become the reality that we have produced ourselves, we are still, paradoxically, far from essential answer to the question: what is science?

Since the question of science is at the same time the question about the production of reality, it is immediately shown that the question: what is science is not just about an implied question asked by scientists about their own science, therefore, it is not only a question concerning the nature of scientific knowledge, scientific methods or achieved scientific results, but there is also an insight on the social, political usage of science which is shown by the reality produced by science in the forms of its deification, manipulation, ideologization or virtualization. Is science still persisting in its Enlightenment paradigm of liberation of human, or is it, on a wave of critical self-reflection of science that is spanning through the entire twentieth century, more and more asking, as Paul Feyerabend is (Paul Feyerabend, Against Method), about the extent of suppressing free thought that is produced precisely by it, the modern science. Of course, the other side of the question also belongs here: whether the progress of science can be considered outside of its consequences, the dangerous threats of the future: nuclear annihilation, environmental pollution, or climate changes which endanger the survival of the living world?

It is clear that in the question of science any fragmentary or regional understanding of science is exceeded as something that in its special object is never related to the totality, but only in one particular region of reality that special science researches, precisely because the question of science became the

[1] This text was created as the result of working on the scientific project of the Ministry of Science of the Republic of Serbia on the topic: Research of the climate changes and its impact on the environment – monitoring the impact, adaptation and mitigation, no.43007

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question of the whole life reality. The totality of reality has become almost the same as a scientific reality, because the totality of scientific reality appears as a true whole that understands the diversity of life in its unity. Therefore the idea of the unity of science and of interdisciplinary cooperation of special sciences is identical as the notion of a unique reality in its related environmental diversity.

2. Our study

This is the point where the question arises: is the ability to prevent natural disasters produced by a man – as seen in the dramatically altered climate - falls into the realm of finding an appropriate scientific and technological response, or the solution is, perhaps, in the fundamental change of irrational economic principle which is expressed in the insatiable aspirations for profit? However, it is at first sight noted that this dilemma presupposes such mutually connection between science and economics of the modern world, which, because of that is not a real dilemma, since it has become well-known that the essence of progress is raised into the principle which measures its own vitality only by faster and faster beats of profits. Thereby, science and its values are seen as the identity to this economic rhythm of the beats of the profit, in other words, the value became the same as the profit. Science is, without any doubt, subordinated to the economic interests of the society, to the system of value that comes from this interest, and although the question of science in this context is one more complex problem, it is safe to say that the process which is at work today witnesses to the completely changed relation of the powerful layers of modern society according to proclaimed universal right of the human to dispose with scientific results which are obtained.

For decades, scientific discoveries are no longer taking place where they have traditionally always happened: within universities, but within the institutes and laboratories of powerful financial corporations. Universities, despite their declarative definition, are less scientific and educational institutions as they were centuries since its creation, but are only areas for gaining education, but without a real and full involvement of teachers and students in the process of scientific work. It is true that there are arguments that consider that the implicit modern monopoly on science is the one which has a basis in real social relations. That is to say, the arguments used to defend this position of monopoly of the scientific research are always the one that is referring to the need of the safety of the society. However, as long as it in some respects was plausible argument, it should be said that even one thing of real life is not remained - from agriculture to nuclear power - which would not have entered into the question the safety of the society. Therefore indication to this type of security threat, may also be in the function of hiding strong totalitarian, profit-motivated economic tendencies of the modern democratic society, the same company that Herbert Marcuse described as "pleasant, well established, sensible, democratic lack of freedom" (Herbert Marcuse, One

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Dimensional Man). The problem becomes even further complicated when the egoism of the richest and the most powerful social class appears as a collective egoism. Even clearer, when it receives its global contours.

Because of that it is not difficult to establish today that the collective economic egoism, which is especially manifested in the question of the control of the use of natural resources, as the collective reduction of morality, since the question of global responsibilities cannot be seen beyond their own egoistic need of making profit. That is the reason why the universal moral principles are accepted only if they coincide to the own egoistic principle of increasing wealth and power. This fact precisely requires the question today: has the science, except being an "instrument of social progress", the right to, regardless of economic and political interests of society, put the issue about own autonomous ethical principles? Is for the ethics of responsibility of the modern world necessary to establish the demand about the necessity of thinking of possible consequences of scientific acknowledgements, or the ethical responsibility is left to the economic and political sphere, particularly to the area that sets itself up as a place of general judgments about ethics or lack of ethics of an act? Is not science and scientific acknowledgement too often presented in ideological terms only as "disinterested," "objective," "value-neutral", therefore something which shouldn't been wondered about the moral consequences of its knowledge? That is the reason why the dominant ideological belief of the twentieth century is managed to be established: that the ethical issue in science is beyond of its scientific discoveries, in other words beyond its "objective" research subject. In fact, it is about the ideological belief that the ethics can be found only in the appliance of scientific knowledge, and hence the ethic is out of science, since the appliance is out of its reach.

Therefore, it seems, the ethical discourse still need to recover and take into consideration the issues that were raised in front of the scientists when their work made the atomic bomb the part of our reality. Perhaps, therefore, of greatest importance is to re-enable the call to that inner sense of moral responsibility of the scientists that is so deeply, human and in responsible manner presented in the letter of Albert Einstein to the U.S. President Theodore Roosevelt, and in which Roosevelt was warned of the danger of appliance and abuse of the atomic bombs.

But today, the issue of climate changes is the one that could call into the question the very existence of life on the planet even more dramatically than the one the atomic bomb creators had. The usage of nuclear weapons can be controlled, and therefore its usage can be considered as something regional, because it does not necessarily and globally endanger the humanity. In distinction to, climate disturbance threatens the essence of nature, the substance on which the entire life of the planet is grounded on, so the climate change is the direct effect of industry created way of human life. If the science is tacit on or minimizes the cataclysmic consequences of climate changes, which is happened very often under pressure from the side of the large corporations, then the responsibility is not only in economic and political sphere. The ethic of

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responsibility is also the autonomous responsibility of the science for the future of nature as the future of the living world, including, of course, humankind. A part of environmental history can be used as illustration, which took place from the 30s of the twentieth century.

That is to say, if the question of nuclear waste, acid rains, toxic substances, or automobile exhaust gases something that could and can be solved regionally, the problems of climate changes are those which can be solved only on global level. For example, researchers like Clive Ponting (Clive Ponting, A New Green History of the World) noted that the reduction in the ozone layer, despite of numerous interstate and regional agreements, initially perceived a complete failure. This is an example in which a regionally problem has become global, but that could be partially solved on regional level. The problem that arose from the ozone layer, artificial chemicals, chlorofluorocarbons (CFC) presented the greatest problem, because, as Ponting quoted: one atom of chlorine is able to destroy one hundred thousand ozone molecules. Sprays, gases from refrigerators or air conditioners that used CFC, at the same time were becoming more and more cheaper in industrial production, and the consequence is giddily increase of CFC. The real problem arose when it is found that CFC does not decompose, and that all amounts of CFC that have ever been produced still persist in the atmosphere. CFC destroys the ozone layer which, in turn, by omission of ultraviolet radiation stimulates the appearance of skin cancer, cataracts, slows down the photosynthesis among plants, and destroys phytoplankton in the oceans which are the basis of nutrition of all living organisms in the sea. Clive Ponting recalls that numerous environmental organizations demanded an immediate ban on the usage of CFC, but that the powerful companies prevented that with the help of high-ranking officials, who have cynically claimed, as Secretary of Environment and State Planning of the United States did, "that the use of protective agents against the sun, hats and sunglasses, has more sense than to harm such an important American industry." However, international action was productive and very quickly found a replacement for CFC, but whole mankind will have to suffer from the hazardous consequences of such economic egoism and existential irrationalism through the whole next century. Therefore, the question that Clive Ponting predicated in his study sounds reasonable: are the modern societies environmentally sustainable? Whether, therefore, the ethics of responsibility in its demand for the future of nature as the future of humanity is also a requirement for different principles of social life? And the Science also?

Hans Jonas (Das Prinzip Verantwortung) was among the first who signified that the new ethics presupposes the natural world also, and that unlike the traditional one which was related only to human relationships, this new ethics must be also included into ecology. Insofar new ethics is based on the principle of accountability which is conceived completely differently from the principles of responsibilities of the traditional ethics. The ethics of responsibility is in fact one different attitude to the existence of the science

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and technology, because it notes that the subordination of nature, which is imagined as happiness to people, led whole mankind to the edge of threat, if not to the edge of disaster of its own being. Therefore, this ethic of responsibility is at the same time the ethics of fear, according to the opinion of Hans Jonas, "only if we can predict the possibilities of human destruction, we will be able to reach to that idea of a man who should be saved from this." Therefore Jonas intercedes on the responsibility of the scientists, but at the same time he does not see a solution out of scientific and technological rationality, without which we can not solve problems which, otherwise, without them would not exist.

On the other hand, Herbert Marcuse believes that the rationality of the social system itself is problematic. Modern society transforms nature in technological manner and in that way it changes the basis of dominance, because the former personal dependence on a master replaces by the dependence on "objective order of things", i.e. on economic laws, markets, etc... Scientific organizations and the division of labor increased productivity in all areas of human life, but although the result is a higher standard of living, as one undoubted value, the price is paid by establishing of a new model of the human mind and behavior. In the name of such a high standard, the most destructive and the most oppressed parts of entrepreneurship were justified by subtle methods, and in this way the scientific and technical rationality and manipulation were combined to and shaped into the new forms of social control. Therefore, Marcuse asks himself, whether a man can be satisfied by the explanation that the unscientific outcome is the result of specific social application of the science? Indeed, it is not difficult to agree with Marcuse that the principle of scientific rationality produces irrationality, hence, that the unscientific principle of rationality of a man is applied against the man.

Although Marcuse does not have an answer on a specific form of a truly humane society, which is certainly not a defect, his critical blade is substantially opposite to that of Hans Jonas, because it is based on the critique of assumptions of possible solutions that indicates Jonas. For Jonas, the fear of the disastrous consequences of the transformation and exploitation of the nature is something that can possibly stop us. Certainly, it would be too harsh to say that Jonas thought that ethics of fear is the solution to the problem, because the fear in his philosophy of nature is something that just should face us to the consequences. Therefore, Jonas' valuable considerations are basically only the one that brings us near to the understanding that scientific-technological rationality faces the human with the fact that every advance in science is at the same time the one that has global consequences for the whole of life. Liability concerns not only the human but also totality world of life.

On the other hand, Marcuse believes that modern society is irrational precisely because its economic growth depends on the repression of the real possibilities for pacification, or – which is the other side of the same coin – because it maintains its peace by constant threat of war. Marcuse in his studies of the ideology

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of the developed industrial society does not have a dilemma that the threat of nuclear catastrophe, that could destroy humanity, the one that serves to the preservation of the forces which perpetuate this danger. Developed industrial society becomes richer, bigger and better by perpetuating this danger, and thus the production of fear emerges as the one that encourages business and general progress. Fear for safety enables that political needs of a layer of society become individual needs. So fear is not only the ability to prevent trouble, but it could be the one that hides the real trouble. By this it is ensured that also these irrational foundations of social relations appear unproblematic.

Marcuse was the first who brought the cause of danger in clear connection with the way one society is organized, and so his theoretical assumptions of his consideration from the 60s of the twentieth century are almost identical to modern criticism according to which threat of global warming is seen as a delusion. Manipulation of saving the planet from climate changes, as critics believe, is supported and produced by HAARP, by the weapon that is capable of changing climate, produces earthquakes and destroys wildlife. So global warming associated with melting is nothing but an instrument for the production of global proportion fear. Hence, these critics consider that the global warming does not exist, but was designed only as a place for successful business and it is in fact only a plan of powerful bankers and industrialists to govern and exploit, primarily, the Third World countries.

However, if it is about global manipulation and not climate changes which are the result of irresponsible human relation to the nature - the question of profit still remains as an irrational economic relation that leads to apocalyptic events. The global threat is both and global and dangerous.

In this sense, climate changes, for the first time in history, face us to the possibility of global catastrophe. Global warming perhaps is no longer only an instrument of pacification, the production of fear in the function of profits and stability of the system, but it is the reality that faces humanity with the fact of the collective egoism of the rich countries and increasing inequalities among people. Rich countries have greater possibility than the poor countries to face the consequences of climate changes because the biggest resources of water and energy belong to them. Therefore, the future defined by global warming may lead to the appearance of environmental refugees, and thus to the conditions under which environmental refugees can be accepted or not. Ecological enslavement can quickly become our reality. UN Intergovernmental Panel on Climate Change IPCC (Intergovernmental Panel on Climate Change) and its reports on reduction of agricultural yields and the disappearance of many species are directly linked to the increase temperature. Some IPCC reports are particularly dramatic, because they indicate to the real possibility that the effects of global warming will especially befall the world of denominated inequalities. On the other hand, the solution

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in reducing the current concentration of carbon dioxide, methane and nitrous oxide in the atmosphere could help, but the richest countries do not accept it. All hope is laid in the invention of new technology. However, there is no new technology, and if appeared it had to be the one that would not bring into question the principles of economic growth, as the Australian Prime Minister explained roughly.

3. Conclusions

All this shows that the economic and principles of social organization in general are based on the irrational pursuit of gaining profit by those who in the future, even though it would be found the new technology that would alleviate adverse climate changes, will not keep the humanity away from the dangers of global catastrophe. Moreover, global warming could lead to the disintegration of existing social systems and return the humanity to the natural struggle for survival. Another possibility is that the global threat which climate changes are carrying rapidly makes what history so far has never succeeded - to unite on the organic basis humanity and to lay the foundations of one more righteous society.

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The Value of Decentralisations in Wastewater Management: Gauteng Province Case Study, South Africa

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Abstract

In a semi-arid water scarce country like South Africa, the efficient use of limited water resources and measures to extend the service value of these resources is a prerequisite for achieving sustainable development.

The conventional supply-sided management approach to water supply causes increased wastewater generation with accompanied increased pollution loads requiring higher levels of mitigation environmental pollution. Where disposal of wastewater treatment effluent takes place in rivers and natural water bodies, the lack of adequate natural compensating capacity of such water bodies typically result in severe ecological damage of the aquatic environment. With a shift of emphasis to a sustainable demand side management approach (as opposed to a supply side one), the avoidance of water wastage and high wastewater generation represents both resource conservation and environmental protection friendly approaches and contribute to overall sustainability. The integrated nature of water supply and wastewater management systems require an approach that considers these systems holistically. A new paradigm for water management is therefore needed to ensure that the issues of waste disposal and pollution are dealt with in a sustainable manner taking into account the emerging objectives of modern society for resource conservation and environmental protection.

A balance therefore has to be found between the uses of additional fresh water resources as a means of satisfying en ever increasing water demand on the one hand and alternative unconventional resource exploration and employment, without the risk of depletion of natural available fresh water resource flow, irreversible harm to the environment and social and economic constraints.

This paper explores wastewater and grey water reuse as unconventional resources in a qualitative manner within this balancing equation. It further proposes a methodology for deriving monetary indicator values for wastewater reuse by internalizing negative environmental impacts. This is achieved through application of Lagrangian

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optimization of the treatment plant production function (output distance function) for deriving marginal prices of contaminant removal and resulting avoided pollution.

Keywords: Water resource protection, Sustainable wastewater management, Centralized wastewater management, Decentralized wastewater management, Production (output distance) function, environmental benefits valuing

JEL Codes: Q25, Q28, Q53, Q56

1. Introduction

In a semi-arid water scarce country like South Africa, the efficient use of the limited water resources and measures to extend the service value of these resources is a pre-requisite for achieving sustainable development. Constant pressure exists to explore new resources to meet the ever increasing demand posed by growth in population. Urban areas being centres of high economic activity not only attract new industries because of viable financial prospects and readily available resources, but also large numbers of people hoping to secure a better future.

From the UN population projections (2009) given in Figure 1 it is evident that the world urban population has moved beyond the 50% mark since 2007 (equal urban and rural populations) and is expected to reach nearly 60% by 2030. Furthermore, for developed countries the urban populations will approximately be 75% by 2010 and 80% by 2030, while for developing countries, the urban population is expected to be around 45% in 2010 and reach 55% by 2030. For the continent of Africa the population residing in urban areas is expected to reach 50% by 2030.

Based on the population data mentioned, the rate of urbanization in developing countries in the next decade or two is expected to be about twice that of developed countries. This surge of growth in city populations will result in urban areas becoming demand nodes where ever increasing water supply and wastewater management will become a major challenge. This will apply increased pressure, not only on infrastructure necessary for provision of water, but also on finite fresh water resources and the available natural resource flow relied on.

Furthermore, not only will the increased population place a large burden on resources, but the high rate of urbanization and accompanying population growth would result in increased urban sprawl and slum development phenomena which make the provision of water and sanitary services extremely difficult and costly. The United Nation MDG progress report (United Nations 2010), emphasizes that since 2000 the portion of urban inhabitants of the developing world living in slums have declined from 39 to 33% in 2010. Even though some 200 million slum dwellers gained by obtaining access to a reasonable level of services and improved housing, in absolute terms the population living in slums has actually increased due to eradication measures being insufficient to offset the growth of more slum settlements. It is estimated that in 2010 slum inhabitants accounted for 830 million people compared to 760 million in the year 2000.

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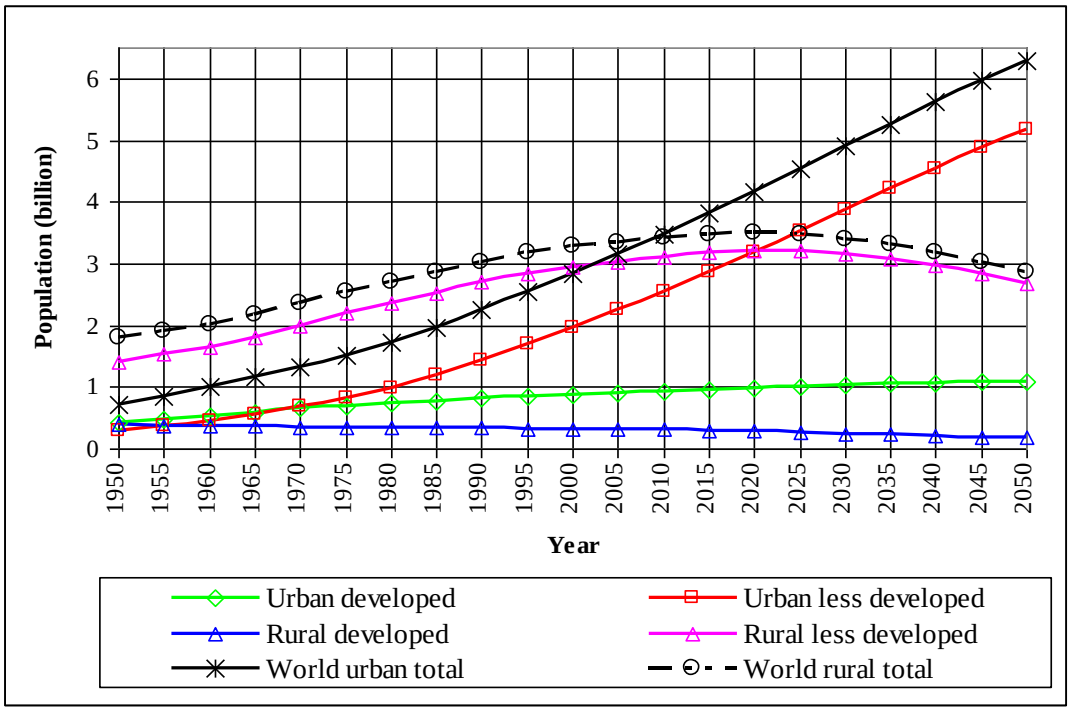

Fig. 1: Contributions of urban and rural populations for developed and less developed (or developing countries) (UN 2009)

Slum sections of urban communities in need of infrastructure will grow unless the provision of services and housing is either heavily subsidized by grants obtained from the international community and organizations. It is clear that the financial burden of the growing cities to render adequate essential services to all would simply become much more difficult. Under conditions of ever dwindling financial resources available to cities for the purpose of achieving the United Nations MDG and specifically the Goal 7 of a 50% reduction in people without safe water and appropriate sanitation by 2015, would become very difficult if not unlikely to achieve.

This further emphasizes the urgency for a new water management approach and innovate ideas of options of technology to meet such goals. In essence what is needed is a paradigm shift from the conventional supply-sided water management approach.

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2. Background

The conventional supply-sided water supply management approach causes increased wastewater generation with accompanied increased pollution loads requiring higher levels of mitigation of environmental pollution. Where disposal of wastewater treatment effluent takes place in rivers and natural water bodies, the lack of adequate natural compensating capacity of such water bodies typically result in severe ecological damage of the aquatic environment. With a shift of emphasis to a sustainable demand sided management approach (as opposed to a supply sided one), the avoided water wastage and reduction of high volumes of wastewater generation represents both resource conservation and environmental protection benefits that contribute to overall sustainability. The integrated nature of water supply and wastewater management systems requires an approach that considers these systems holistically and linked with all elemental cycles closed within the given spatial and time frames with an objective to achieve "zero waste" scenarios as close as possible. Through a different and innovative new way of thinking (i.e. wastewater considered as valuable resource opposed to waste product) and proper related public health and social educational programmes, the paradigm shift required could obtain momentum with due consideration in water resource planning and management in the future.

The segmented approach of conventional water management with a mainly supply-side approach is under pressure. While having to meet growing need of water and sanitation services the conventional approach is not able to efficiently manage the reducing water resources and minimise both negative impacts on the environment and deterioration of the quality of life of urban inhabitants.

Although the effects on public health with these end-of-pipe systems have been very good, the sustainability of this approach continues to be questioned (Gijzen 1998). The use of large quantities of high quality water to convey concentrated human waste to centralized treatment facilities located on the outlying borders of cities and beyond makes resource management very difficult and limit fresh water resource conservation. For water scare countries this state of affairs is particularly not desirable or feasible from a sustainability point of view.

Sustainable water management will only be realized if both the waste minimization (reduced water consumption) and wastewater reuse concept are applied in an integrated way (Gijzen 1998). The need for a new approach is a result of the need to further protect the environment from pollution and to ensure that a high ecological diversity is maintained while at the same time natural resources are conserved by optimal use (Lettinga et al., 2001). Lettinga et al. also point out that the high cost of current conventional centralized systems is beyond the economic means of most developing countries. Countries with an average per capita GNP less than US $ 1000 (1994 cost base), lack the resources to construct centralized systems and also cannot afford to maintain them. Furthermore, such systems have to be rebuild after 50 to 70 years at escalated increased expense which makes such systems even more unaffordable for developing countries.

A new paradigm for water management is needed to ensure that the issues of waste disposal and pollution are dealt with in a sustainable manner taking into account the emerging objectives of modern society for resource conservation and environmental protection. A balance therefore has to be found

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between the use of additional fresh water resources as a means of satisfying an ever increasing water demand on the one hand and alternative unconventional resource exploration and employment, without the risk of depletion of the natural available fresh water resource flow, irreversible harm to the environment and social and economic constraints.

2.1. Wastewater management systems in sustainable wastewater management

Two distinct types of wastewater management systems can be distinguished, namely centralized and decentralized systems. Centralised systems for wastewater treatment are considered by many in the water sector as the best practice for most communities because of the high level of reliability, established management framework and economies of scale giving an apparent (but not necessarily real) advantage of least cost per capita. Within the context of material flows, the centralized wastewater management system is an open ended loop system and is nowadays considered as being unsustainable in light of the high resource intensity (energy, inefficient use of water) and very little if any useful by-products recovery contained in wastewaters (Lettinga et al., 2001).

More recently the decentralised wastewater management approach is receiving renewed interest towards finding more affordable solutions and its prevention focus aimed at both resource protection and recovery and purposed redirection of water and nutrient cycles are facilitated at varying scale, such as from household to cluster or community levels. In addition, decentralised systems could be a more appropriate alternative to provide for tendency of sprawl development in cities towards the outer city fringes (Reynders et al., 2010).

The necessary technologies for treatment of wastewater to any existing regulatory standard (even to drinking water quality if needed) are available for the complete wastewater continuum system scale (Rocky Mountain Institute 2004). Technology is therefore not the constraint for seeking an optimal solution, but rather the needs of society and the water resources availability. Despite the fact that the technology may be available if it is unaffordable it cannot be considered to be sustainable.

With increased level of decentralized wastewater management onsite based resource recovery becomes more favourable and feasible, while at high centralized management scenarios offsite resource recovery through surface water reclamation are typical, groundwater recharge could potentially ensure optimal resource utilization (Reynders, 2011).

2.2. Wastewater as unconventional resources

The rationale and drivers for wastewater reuse as a non-conventional resource to supplement finite fresh water resources according to UNEP/GEC (2004) are: 1) optimal use (finite fresh water resources emphasizes the need of multiple use); 2) matching application and quality (ensures effective and efficient use of fresh water resources); 3) proximity (urban environment wastewater provides a readily available resource); 4) dependability (virtual constant wastewater generation even under drought conditions); 5) versatility (technology proven and tested for any required treatment levels); 6) safety (track record of no

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adverse health impacts ensured by appropriate quality monitoring); 7) water resource competing demands (mitigates food security increased agricultural demands); 8) fiscal responsibility (recognition of economic and environmental benefits); 9) public interest (increasing public awareness of negative environmental impacts of fresh resource overuse); 10) environmental and economic impacts of traditional resource approaches avoided (reservoir facilities and dams); 11) proven success track record (growth in successful number of reuse projects globally); 12) real cost of fresh water supplies (growing implementation of pricing structures being actual cost based); 13) more stringent water quality standards (increased cost makes direct reuse an economically viable alternative); 14) necessity and opportunity (suitable intervention under conditions of droughts, water shortages, etc.).

Wastewater effluent adequately treated could be used for urban uses (landscape, fire fighting etc) groundwater recharge, environmental enhancement, industrial and agricultural purposes. Potable urban use could be considered provided more advanced tertiary treatment processes are introduced.

The use of nutrients contained in wastewater would reduce the exploitation of a scarce phosphorus mineral resource as well as the high energy use for its mining and the nitrogen fixation process required for artificial fertilizer production and a vast array of negative environmental impacts of such production processes could also be avoided (Gijzen 2001).

Chemical energy present in wastewater in the form of carbonaceous matter with its decomposition has an inherent potential for energy generation. Appropriate technologies for extracting energy from wastewater, amongst others, are: 1) anaerobic digestion; 2) biofixation (plants, algae), and; 3) microbial fuel cells. Burton et al. (2009) pointed out that ease of separation of the energy from the wastewater is crucial to the feasibility of the process employed for energy recovery, i.e. biogas which separates naturally from wastewater while bioethanol requires energy intensive distillation for its recovery.

2.3. Intrinsic value recovery pathways - Reclamation, Reuse and Recycling

Wastewater reclamation, recycling and reuse are significant components of the hydrologic cycle in urban, industrial and agriculture areas as demonstrated in Figure 2. The quantity transferred via each pathway depends on the watershed characteristics, climatic and geo-hydrologic factors, degree of water use for various applications and degree of reclamation, reuse and recycling.

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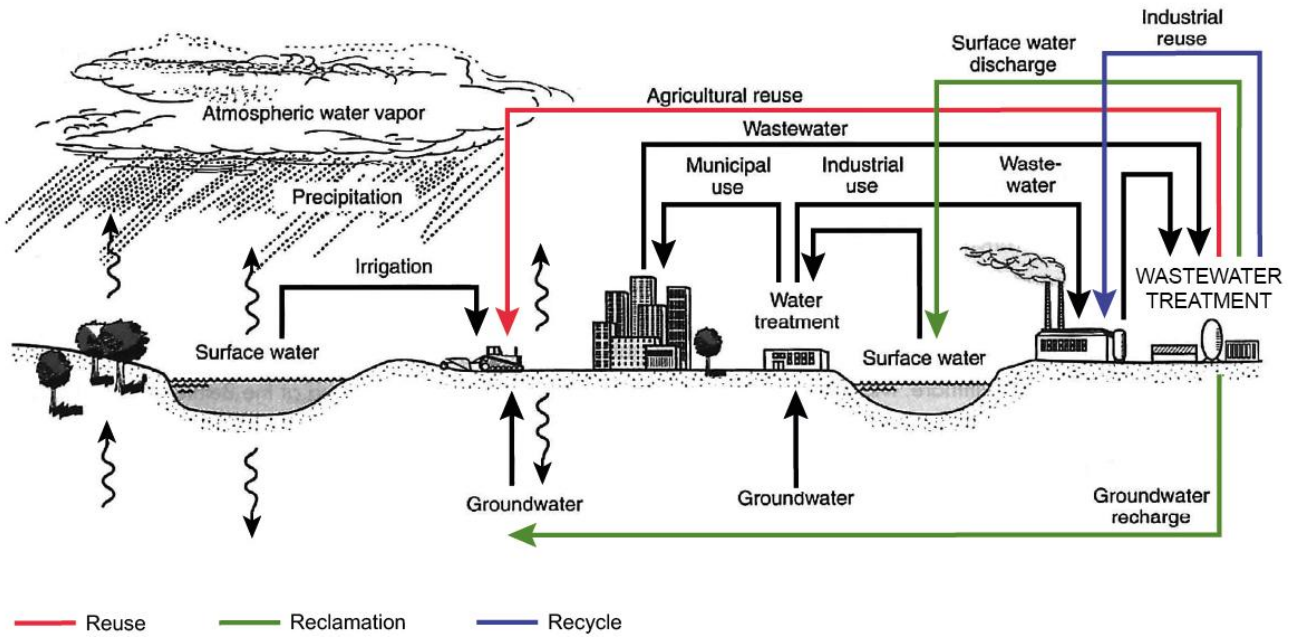

Fig. 2: Hydrologic cycle and the major intrinsic value recovery pathways (Reynders, 2011)

Various applications of wastewater reuse are possible and the reuse categories and examples thereof are given in Table 1.

Table 1: Wastewater reuses categories and application examples (UNEP/GEC, 2004)

Category of reuse	Examples of applications
Urban use	
Unrestricted	Landscape irrigation of parks, playgrounds, school yards, golf courses, cemeteries, residential green belts, snow melting
Restricted	Irrigation of areas with infrequent and controlled access
Other	Fire protection, disaster preparedness, construction

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Agricultural Food crops Non-food crops and crops consumed after processing	 Irrigation for crops grown for human consumption Irrigation for fodder, fibre, flowers, seed crops, pastures, commercial nurseries, sod farms
Recreational use Unrestricted Restricted	 No limitation on body contact: lakes and ponds used for swimming, snowmaking Fishing, boating and other non-contact recreational activities
Environmental enhancement	Artificial wetlands creation, natural wetland enhancement and stream flow
Groundwater recharge	Groundwater replenishment for potable water, salt water intrusion control, subsidence control
Industrial reuse	Cooling system water, process water, boiler feed water, toilets, laundry, construction wash-down water, air conditioning
Residential use	Cleaning, laundry, toilet, air conditioning
Potable reuse	Blending with municipal water supply, pipe to pipe supply

Despite the fact that technologies are available for adequate treatment to potable use quality and even higher than required standards, the concept of drinking wastewater still does not have wide public support. According to Dolnicar and Shafer (2009), there are several factors combined that hinder recycled water uptake for potable use. These include inadequate distribution infrastructure for supply (which applies to any reuse application as such), existing highly subsidized and comparatively low cost potable water resources, and a low level of community awareness of the limitations of freshwater resources, particularly in urban areas.

Grey water (all domestic/commercial wastewater excluding human excreta) reuse has great potential for fresh water resource conservation at household and public level environments (Dixon et al., 1999). As the total grey water fraction of combined domestic sewage is estimated to be around 75 % by volume, from a fresh water conservation point of view approximately 30% to nearly 40% of the total household water consumption could be saved by reuse for flushing toilets and garden watering (Eriksson et al. 2002, Al-

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Jayyousi 2003, Li et al., 2009). In the case of public environments (such as offices and shopping malls) the proportion used for toilet flushing is as high as 48 to 63% (Lazarova et al., 2003). The problem in such cases is the limited availability of grey water of such uses and most likely will require supplementation from potable water supplies for toilet flushing application of grey water. When limited volumes of grey water are available, reuse of the larger available wastewater flow would be more appropriate for achieving fresh water resource conservation.

With such applications only the "light grey water" fraction is used, excluding the "dark grey water" from kitchens (sinks and dishwashers) and laundry purposes. Kitchen (scullery) wastewater contains food wastes that would putrefy and cause bad odour and biological film build-up in reuse systems blocking pipes. Kitchen grey water accounts for about 5 to 12% of average household consumption and its omission from the grey water reuse source is therefore not significant (Christova-Boal et al., 1996, Li et al., 2009).

With regard to irrigational reuse, grey water provide only minor nutrient value, as the major fraction of nutrients is present in human excreta consisting of faeces plus urine.

Schemes or trails of grey water reuse for toilet flushing occurs mainly at household level (Australia, Canada, France, Germany and the UK) with instances of office buildings (Japan). Also instances of treated wastewater reuse for toilet flushing occurs such as in the USA, UK, Canada and Japan (Lazarova et al., 2003). There are a number of problems related to the reuse of untreated grey wastewater. There is a risk of spreading diseases when water is reused for e.g. toilet flushing or irrigation. Spreading of pathogenic micro-organisms in the water in the form of aerosols generated as the toilets are flushed allow spreading and both inhaling and hand to mouth contact are dangerous (Eriksson et al. 2002).

Although social support does exist for reuse, there are reservations of its applications, in particular where direct personal contact and ingestion is concerned. According to the WHO (2006), the question of public acceptance of grey water reuse is less problematic compared to wastewater reuse. This is attributed to users being in contact with grey water at source (bath, shower and basin) and generally being considered by them as not being harmful and that no religious edicts prohibit its reuse.

If the treated final effluent could be perceived as being 'used water' rather than sewage or wastewater, it would go a long way towards fostering a different public and political perception of this potentially useful resource. A pioneer of the Namibian wastewater reuse project for potable use said: "water should not be judged by its history but by its quality" (Haarhoff, van der Merwe 1996). This is surely to be of fundamental importance when the issue of acceptance not for potable reuse alone but all applications of reuse is being dealt with by society.

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3. Methodology for valuing intrinsic wastewater resource recovery

The best way of effectively reducing the water footprint of any given nation is by reduction of water withdrawals through implementation of reuse and multiple water use. As alluded to previously, wastewaters should be seen as valuable resources which have intrinsic value for society and such value can and should be recovered. While issues of sustainability of wastewater management act as a main driver for intrinsic value recovery, this will only happen in practice if economic value of such recovery is possible and the conditions under which such recovery will be justifiable are clearly outlined, not only from a sustainability point of view but also in terms of economic parameters. What in fact is needed is a methodology for assessment of the economic evaluation of the intrinsic value recovery potential from wastewater for required feasibility analyses at wastewater treatment plant and wastewater management system levels.

For objective economic comparison and decision-making, both in the public and private domain, the value of water resources has to be based on an objective market related price. The major challenge in obtaining this is that water resources are generally considered a public good, are not traded in private markets nor subjected to the market price mechanism although a trend in this direction is well documented in the literature. The result is that water resources are considered to be of low market value and exploited (Birol et al., 2006). A further challenge is to account for the resource scarcity value (in terms of both quantity and quality) in addition to resource extraction costs. If scarcity is not recognized, high resource use, wastage and pollution of water resources are likely to be the end result.

In addition, factors also contributing to this value distortion of water resources, amongst others, are government subsidization and the practice of not accrediting polluting industries with environmental protection externality benefits achieved by them. To correct the value distortion of the water resources mentioned, all benefits obtained by use of water resources need to be captured in a total resource valuation.

The methods developed for determining environmental resource values are adequately covered in the literature. (Rocky Mountain Institute 2004, Birol et al., 2006). Among the group known as “indirect valuation” methods, the “production function” approach through analysis of a parameterized distance function was selected as basis of analysis of resource valuation. The “distance-function” approach, as opposed to a conventional production function one, was favoured because: 1) it allows modeling the joint production of multiple outputs; 2) aggregation of outputs or inputs are not required for deriving shadow price; 3) no assumptions of production process behaviour such as cost-minimization or profit-maximization have to be made for deriving shadow prices, and; 4) it allows for shadow price derivation based on the Shephard (1970) duality theory (Färe et al. 1993, O’Donnell, Coelli 2005).

The established methodology of using frontier functions to analyze production efficiency, known as Data Envelopment Analysis (DEA), was used in the analysis Farrell (1957). By exploring derivatives along the mentioned frontier of technology, shadow prices that support such technology are derived (Färe et al., 1993).

To employ the concept of production function valuing used in the industrial sector for pollution control and wastewater treatment situations, analogies are drawn between the desirable and undesirable outputs in

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the two respective situations or "production processes". The wastewater treated effluent is considered analogous to a desirable production output of an industry, while contaminants removed for ensuring effluent quality are considered as undesirable outputs.

It should be noted that each particular situation is unique and requires a careful application of the analogy principle so as to ensure adequate problem formulation. With the appropriate application of the analogy principle a relevant problem formulation can be obtained for the thorough economic analysis of the different wastewater management system scenarios.

The distance function approach can be employed for both wastewater treatment level and wastewater management system level analyses for the same sewage catchment area (Reynders, 2011) and are illustrated in Figure 3. Provided the necessary data is available, distance function valuing can also be used for the analysis of a fully decentralised wastewater treatment system with each household operating their own "wastewater treatment facility". The result of such analyses can be used for comparison purposes of wastewater management of a particular, but using a virtual single centralized wastewater treatment plant as a replacement for all the individual decentralized system plants. The method can be extended to the comparative analysis of any set of scenarios of the wastewater management system composition (individual, cluster and block, central and regional plants). Such a scenario analysis can then be used to evaluate the net economic effects of utilizing different system configurations and technology options (Figure 4). Theoretically one could also begin to ask questions regarding the economic effects of choices between reclamation, reuse and recycle or a combination thereof and analyze the economic performance differences between surface and ground water reclamation strategies.

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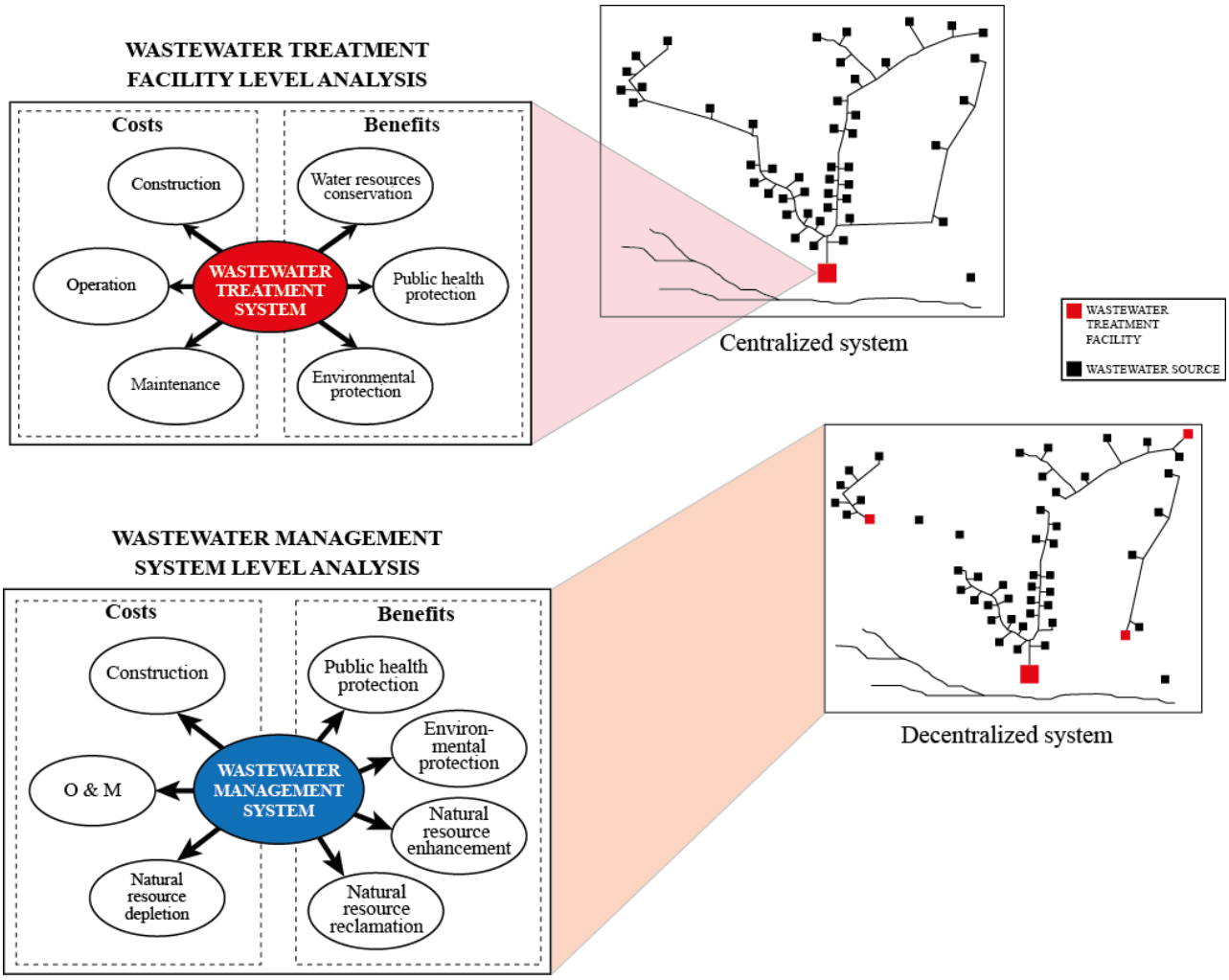

Fig. 3: Illustration of wastewater treatment level and wastewater management system level analysis (Reynders. 2011)

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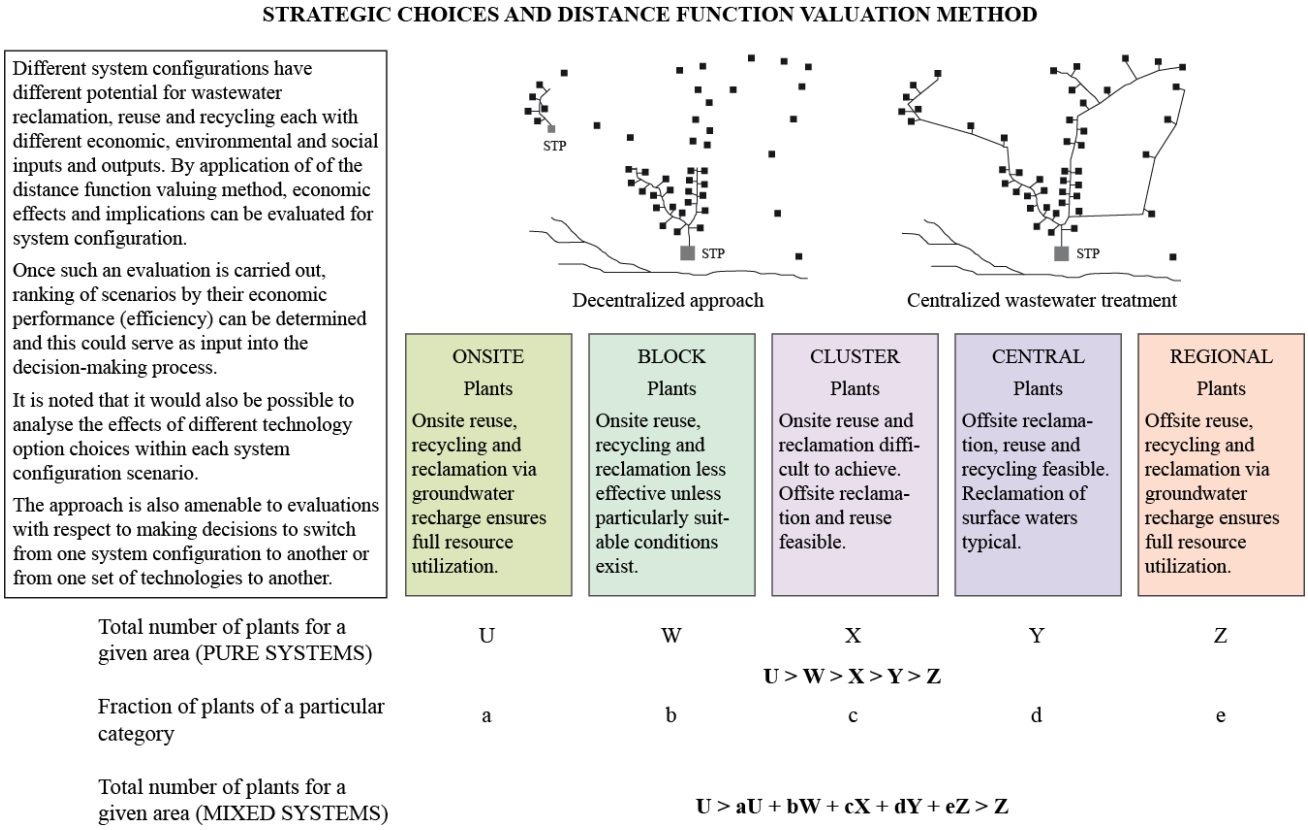

Fig. 4: Strategic choices and distance function method application in wastewater management continuum (Reynders 2011)

4. Case study: Wastewater reuse beneficiation at wastewater treatment facility level

The indirect distance function approach was employed to jointly quantify and internalize environmental, public health and water resource conservation benefits of avoided pollution in the economic cost-benefit analysis of nine wastewater treatment facilities located in Gauteng Province South Africa. Inclusiveness of environmental, resource conservation and public health benefits here are due to these being fully achieved as a result of complete effluent reclamation and fully sewered wastewater catchments with final effluent disinfection.

The sequence of steps followed for environmental benefits valuing and subsequent economic analysis is outlined in Figure 5 and the analysis results obtained are given in Tables 2 to 6 and Figure 6 respectively.

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Table 2: Output distance function optimal parameters

Output distance function - optimal parameter values							
Parameter	**Value**	**Parameter**	**Value**	**Parameter**	**Value**	**Parameter**	**Value**
α_0	-7.20E-03	γ_{22}	4.14E-03	γ_{54}	-1.05E-02	β_{11}	1.76E-03
α_1	2.24E-01	γ_{23}	-2.04E-02	γ_{55}	-9.51E-03	β_{12}	-2.07E-01
α_2	1.76E-01	γ_{24}	-4.30E-03	α_{11}	4.85E-03	β_{13}	-8.39E-02
α_3	1.82E-01	γ_{25}	-1.27E-02	α_{12}	1.33E-02	β_{14}	3.16E-01
α_4	2.13E-01	γ_{31}	1.59E-02	α_{13}	3.63E-02	β_{15}	-4.79E-03
α_5	2.06E-01	γ_{32}	-1.36E-02	α_{14}	-3.88E-02	β_{22}	3.44E-02
β_1	-8.59E-02	γ_{33}	3.14E-03	α_{15}	-1.56E-02	β_{23}	1.79E-01
β_2	-4.63E-02	γ_{34}	-6.16E-03	α_{22}	-1.36E-02	β_{24}	-2.14E-01
β_3	-4.94E-02	γ_{35}	6.52E-04	α_{23}	-1.65E-02	β_{25}	8.16E-02
β_4	-8.53E-02	γ_{41}	-4.55E-02	α_{24}	9.21E-03	β_{33}	2.12E-02
β_5	-5.27E-02	γ_{42}	-2.59E-03	α_{25}	7.59E-03	β_{34}	-1.13E-01
γ_{11}	3.69E-02	γ_{43}	7.32E-04	α_{33}	-3.08E-02	β_{35}	-1.95E-02
γ_{12}	-4.01E-03	γ_{44}	2.44E-02	α_{34}	1.22E-02	β_{44}	4.57E-03
γ_{13}	-4.12E-03	γ_{45}	2.30E-02	α_{35}	-1.19E-03	β_{45}	1.55E-02
γ_{14}	-1.41E-02	γ_{51}	1.22E-02	α_{44}	1.26E-02	β_{55}	-7.39E-02
γ_{15}	-1.46E-02	γ_{52}	3.59E-03	α_{45}	4.86E-03		
γ_{21}	3.32E-02	γ_{53}	4.18E-03	α_{55}	4.34E-03		

Table 3: WWTP output distance function values and shadow prices

WWTP's	**Output distance function values**	**Shadow prices - undesirable outputs** (ZAR/kg) (assumed desirable output objective price = ZAR 1/m^3)			
		COD	**SS**	**N**	**P**
Plant 1	0.999999218	-0.03	-0.09	-2.49	-6.57
Plant 2	0.999999252	-0.05	-0.14	-1.38	-7.87
Plant 3	0.999999269	-0.07	-0.11	-2.38	-8.98
Plant 4	0.999998613	-0.11	-0.29	-6.27	-21.19
Plant 5	0.999999898	-0.05	-0.22	-3.72	-13.57
Plant 6	0.999998548	-0.06	-0.18	-5.35	-21.94
Plant 7	0.999999347	-0.05	-0.19	-1.94	-8.96
Plant 8	0.999999152	-0.08	-0.33	-3.59	-16.67
Plant 9	0.999999565	-0.09	-0.29	-2.01	-7.58

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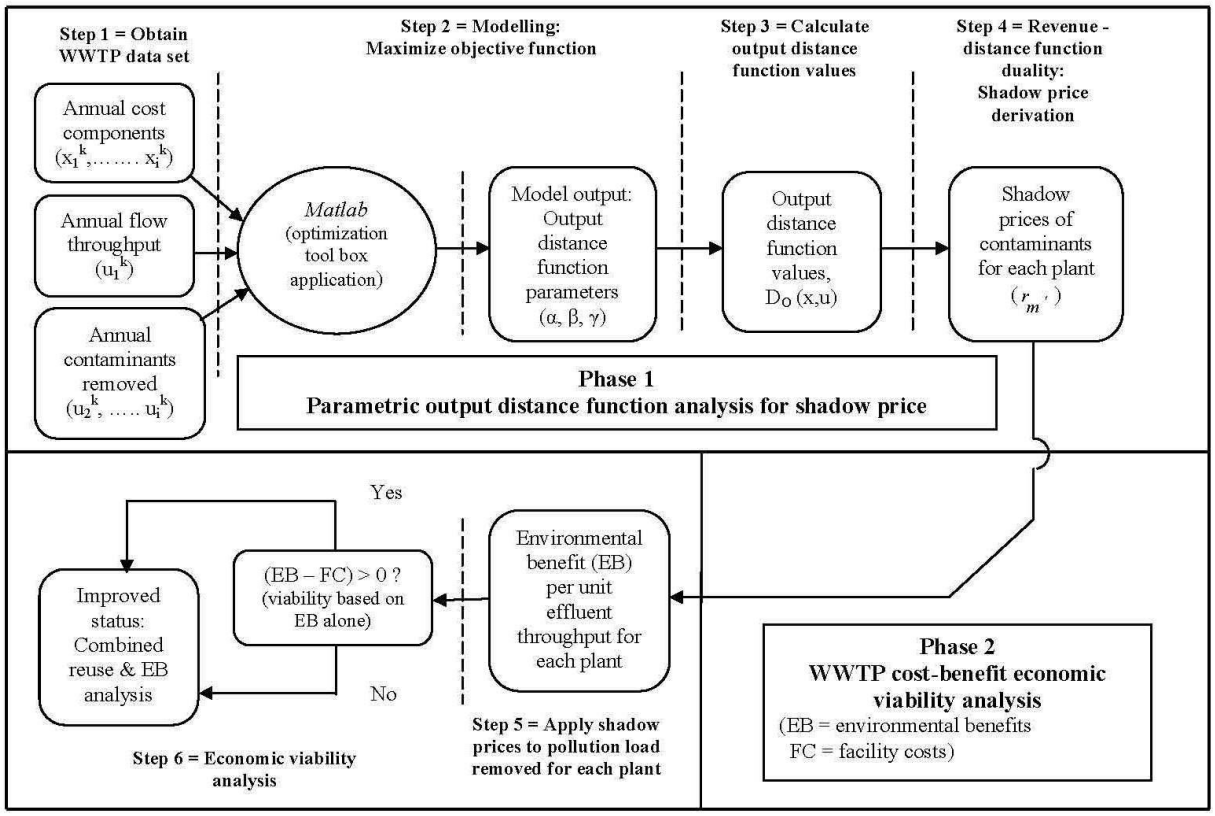

Fig. 5: Step sequence for environmental benefits valuing and cost-benefit analysis

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Table 4: Distance function valuing of environmental benefits of plants in ZAR/m3

WWTP's	Annual effluent throughput (m^3)	Environmental benefits (EB) in ZAR /m^3 and % contribution (Based on absolute price of treated effluent = ZAR 1/m^3)				
		COD	SS	N	P	Total
Plant 1	256,780	0.033213	0.044440	0.047800	0.043152	0.168605
		(19.70%)	(26.36%)	(28.35%)	(25.59%)	
Plant 2	31,636,780	0.057322	0.072197	0.040873	0.047951	0.218344
		(26.25%)	(33.07%)	(18.18%)	(21.96%)	
Plant 3	21,407,700	0.066401	0.093532	0.027689	0.038258	0.225879
		(29.40%)	(41.41%)	(12.26%)	(16.94%)	
Plant 4	14,800,440	0.041862	0.028328	0.050086	0.029494	0.149770
		(27.95%)	(18.91%)	(33.44%)	(19.69%)	
Plant 5	4,090,020	0.028168	0.034316	0.058967	0.047021	0.168472
		(16.72%)	(20.37%)	(35.00%)	(27.91%)	
Plant 6	5,822,860	0.017740	0.019697	0.082755	0.065910	0.186101
		(9.53%)	(10.58%)	(44.47%)	(35.42%)	
Plant 7	10,289,230	0.039136	0.052232	0.055795	0.054111	0.201275
		(19.44%)	(25.95%)	(27.72%)	(26.88%)	
Plant 8	46,491,640	0.040559	0.060207	0.044934	0.043854	0.189554
		(21,40%)	(31.76%)	(23.71%)	(23.14%)	
Plant 9	67,914,570	0.059233	0.068017	0.027204	0.026198	0.180652
		(32.79%)	(37.65%)	(15.06%)	(14.50%)	

Table 5: Contaminant load removed per unit throughput of WWTP's

WWTP's	Contaminants load removed (kg/m^3)			
	COD	SS	N	P
Plant 1	1.062	0.507	0.019	0.007
Plant 2	1.177	0.498	0.030	0.006
Plant 3	0.925	0.831	0.012	0.004
Plant 4	0.395	0.098	0.008	0.001
Plant 5	0.587	0.159	0.016	0.003
Plant 6	0.288	0.107	0.015	0.003
Plant 7	0.841	0.275	0.029	0.006
Plant 8	0.536	0.182	0.013	0.003
Plant 9	0.647	0.232	0.014	0.003

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Table 6: Value ranking of plant suitability for nutrient recovery with agricultural reuse

Agriculture reuse value ranking (potential for nutrient recovery)		Nutrient (N and P) contribution to plant total environmental benefits (%)
Ranking	Plant ID no.	
1	6	79.89
2	5	62.91
3	7	54.60
4	1	53.94
5	4	53.13
6	8	46.85
7	2	40.14
8	9	29.56
9	3	29.20

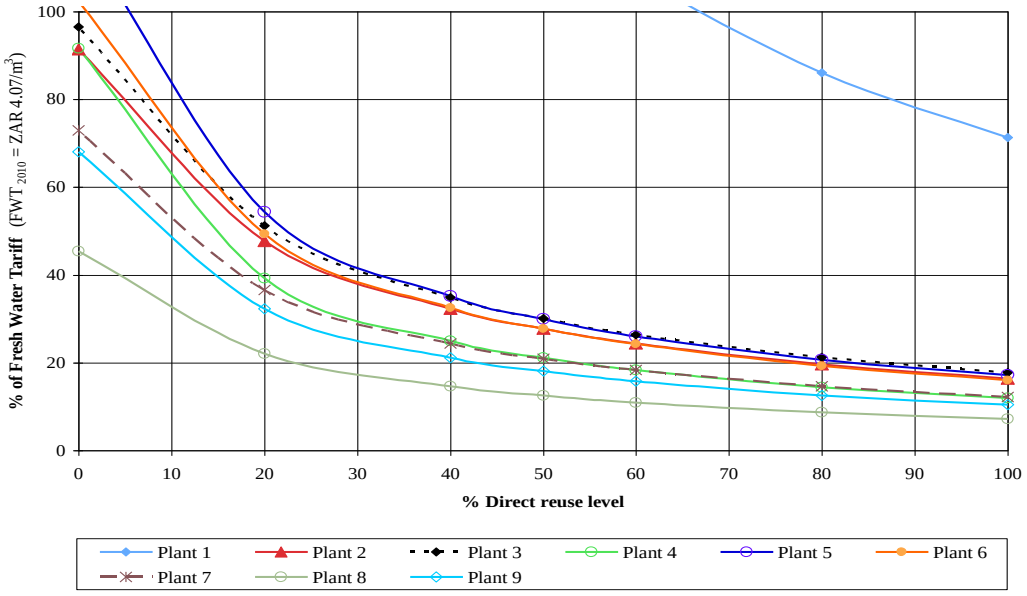

Fig.6: Plant cost-benefit breakeven tariffs as % of current bulk fresh water tariff

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5. Conclusions

The economic viability analysis results illustrated in Figure 6 reveals the following:

Plant no's 1 and 7 require reuse levels of approximately 70 and 10% of effluent for economic viability at 100% of fresh water tariff level.

The rest of the plants are economically viable based on internalized environmental benefits alone (i.e. no reuse required) at 100% of fresh water tariff level.

Generally (except Plant no. 1) for a reclamation or reuse level below roughly 20%, the reuse tariff required for economic viability increases quite rapidly as reuse level decreases. For reuse of around 20 to about 50%, the required reuse tariff flattens out and steadily declines for higher levels of reuse, confirming the fact that lower reuse tariff are possible in the event of higher reuse levels. The water reuse tariff obtained applies to plant level alone and need further adjustment for any conveyance system supply costs involved. For economic viability, this is likely to require higher treated effluent tariffs and reuse levels compared to those excluding conveyance costs.

It is clear from the contaminant shadow price data (Table 3) that the shadow price (in ZAR/kg) of phosphorus (P) is consistently highest for all plants, followed by nitrogen (N), suspended solids (SS) and organics (COD) the lowest. However, the opposite trend exists for contaminant load removed (in kg/m3) for all plants, i.e. P being the lowest, followed by N, SS and COD the highest (Table 5). This inverse trend between contaminant shadow price (ZAR/kg) and its load removed (kg/m3) for the entire plants analyzed, i.e. high contaminant shadow price corresponding to a low contaminant load removed and visa versa confirms the soundness of the algorithm used. This amounts to a relative high marginal cost (shadow price) having to be incurred for every additional unit of removal of contaminants with current low load removed and vice versa.

Since the environmental benefit of removal of a particular contaminant is equal to the mathematical product of plant throughput and shadow price, environmental benefits and load removed are also inversely related. Therefore, where a large environmental benefit occurs, a low removed load applies or high remaining fraction of such contaminant in the treated effluent is present and vice versa. A value ranking of suitability of treatment plant effluent for agricultural reuse (Table 6) was derived by considering fractional environmental benefit contributions of nutrients (N and P) for plants, i.e effluent from plants with highest nutrient environmental benefit contributions would be most suitable for agricultural reuse application.

Distance function valuing provides a methodology for evaluation of economic effects and implication together with corresponding economic efficiency rankings as input to strategic decision making, of: different wastewater management system configurations accompanied by their potential for wastewater reclamation, reuse and recycling.

The effects of different technology option choices within any system configuration.

Switching from one management system configuration to another or from one set of technology options to another.

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E.Wayne Nafziger - ECONOMIC DEVELOPMENT, 5TH Edition, Cambridge University Press, UK, 2012

Book review by Manuela Epure, Professor PhD

Interested readers can take a look inside of the book at:

http://books.google.ro/books?id=bGxVzEdae7UC&printsec=frontcover&dq=Economic+Development,+Nafziger&source=bl&ots=qKaeX4KrqA&sig=2wpgv971Igh0DUJrcz4EH--TzXE&hl=ro&sa=X&ei=TGVlUJdGzdmyBv2_gdAI&ved

Economic development has been a challenging topic for a wide range of scholars. Nevertheless, poverty and unequal income distribution around the globe show us today the "ugly" truth: the rich countries become richer and the poor countries are struggling more than ever with poverty. Does it have to be a reason for this? Is Globalization to blame?

The book author starts by raising a quite pertinent question: How the other two-thirds live? Are we aware about the real "picture"? Economic development is the field of social sciences which analyses the causes of poverty and low income around the world and examines the progress made in elaborating strategies that could help people, regions and countries to achieve greater economic prosperity.

In order to make it crystal clear, the book starts by defining the concept of "economic development" that helps beginners understand the concept and provides the basis for a better understanding of the main issues developed in the core chapters of the book. Drawing the picture frame, the author is portraying the economic development from a historical perspective, being aware that one can predict the future only if they completely understand the past and the present. I confess that reading this chapter, I realize how many different approaches of economic development mankind has witnessed. I strongly recommend our readers to explore this particular chapter seeing the origins of modern economic growth, surfing the world leaders in gross domestic product per capita in the last 150 years and looking at the growth models and approaches in the recent history along with the economic development of Europe and Japan after World War II and, of course, a brief review on the recent economic growth in developing countries.

The author is paying a special attention to the economic development theories; one can compare theories in terms of specificity, looking also at the context in what each theory appeared and at its major critics. From the first two classical English models to their foremost critic Karl Marx, developed in the 19th century, going through Walter Rostow's model – written as an alternative to Marx's theory and vicious circle theory – focusing on LDC low savings rates, the factual presentation is catching and makes the people reflect on the concepts and theories' evolution.

If the first part of the book is exclusively theoretical, in the second, the author shows us the reality of poverty, malnutrition and income inequality stating that economic growth is the most important factor contributing to poverty reduction. Nevertheless, the lack of reliable information on the real situation at regional and global scales generates difficulties in the development of anti-poverty programs; the solution is to ensure minimal standards for data admissibility, such as: the database must be based on actual household surveys or census; it should cover all income, including non-wage income; the data should include local price information; the data must have a national coverage; they should be disaggregated to pinpoint poverty reduction programs; they should avoid lags between collection and publication and long term gaps between survey rounds; they must compare, across time, surveys and measures; the income concept and recipient unit must be constant.

In less developed countries (LDC), 3,3 billion people (58%) and 500 million poor people live in rural areas, the rural poor population representing 50 - 70% of 1$/day poverty in the LDCs. In late 1980's, for the first time in world history, most workforce is hired outside agriculture. Still, the agriculture is the most important component of the LDC economies, 60% of the labor force in the LDC is employed in agriculture, so the obvious conclusion the author suggests is that any approach to reduce poverty should emphasize rural development and income distribution, including increasing the productivity and income of the rural population.

After portraying the cruel reality in LDC, in the third part of the book the author is focusing on the factors of growth. He is analyzing the population / development interdependence, especially on how fertility affects labor force participation and development. Undoubtly, population can be seen as a key factor of development, thus it's important to examine the factors that affect the labor skills and discuss about entrepreneurship, as a production resource coordinating labor, capital, natural resources and technology.

For the JEDEP readers, I find particularly interesting chapter 13 – Is Economic Growth Sustainable? Natural resources and the Environment. Why? you may ask. It is just because it legitimates the editors' work to publish high quality articles examining the relationship between Economic Development, Environment and People. The chapter addresses the effects of climate shocks on the economic activity. For example, the author demonstrates that high temperatures in a given year reduce the growth rate of GDP per capita, only in poor countries. In this respect, the author believes that economists should be interested in impossibility theorems – namely US style consumption standard for a world of 7 billion people is impossible. Intending to give readers an accurate response to the question in the chapter title, the author defines sustainable development as the progress that meets the needs of the present without compromising the ability of the future generations to meet their own needs. The chapter analyses natural resources and the environment within LDCs and whether development is sustainable, given resource scarcity and environmental damage (see modern China's economic growth related to environmental damage).

Part 4 of the book is dedicated to macroeconomics and international economics of development and analyses monetary, fiscal and income policies and inflation. The governments of developed countries (DCs) use monetary and fiscal policies to achieve goals in terms of output, employment and price stability; meanwhile LDCs face greater limitations in achieving monetary and fiscal macroeconomic goals and the author explains, in a comparative manner, how these mechanisms are working.

At the end of the book, in Part 5, the author proposes Five Development Strategies that are addressing key regions of the world. The transition to liberalization and economic reform is a quite suitable strategy for Eastern Europe, the Former Soviet Union and China while Stabilisation and Adjustment and Reform seem more suitable for other countries.

The study of economic development should become a long run “journey”, going on established “theoretical” paths but looking around to different landscapes, identifying what is representative for each region you cross and also noticing the influential factors that could affect and even stop you from going further. It is supposed to be not the “journey” of one generation, we shouldn’t think only to our own needs but also to the next generations.

I strongly recommend the book to economists, social scientists, and students and of course politicians and policy makers if we really want to understand the world where we live in. I promised myself to come back regularly and to study different parts of the book just because I haven’t succeeded in going deeply into the logic and diversity of the author’s idea.

Enjoy it! It is worth it!

Manuela Epure, Professor PhD

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